

Designation of Critical Habitat for the Rio Grande Silvery Minnow

Final Environmental Impact Statement



**U.S. Fish and Wildlife Service
Region 2**

February 2003

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Acronyms and Abbreviations

AMAFA	Albuquerque Metropolitan Area Flood Control Authority
BA	Biological assessment
BIA	Bureau of Indian Affairs, U.S. Department of the Interior
BO	Biological Opinion
bluntnose shiner	Pecos bluntnose shiner
BLM	Bureau of Land Management, U.S. Department of the Interior
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CID	Carlsbad Irrigation District
Corps	U.S. Army Corps of Engineers
CWA	Clean Water Act, also known as the Federal Water Pollution Control Act
DEIS	Draft environmental impact statement
EA	Economic analysis under Endangered Species Act
EIS	Environmental impact statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act, 16 USC sections 1531-1544
ESA Work Group	Middle Rio Grande Endangered Species Act Collaborative Program
flycatcher	Southwestern willow flycatcher
FR	Federal Register
FSID	Fort Sumner Irrigation District
IBWC	International Boundary and Water Commission, United States and Mexico
LPVRWP	Lower Pecos Valley Regional Water Plan
LFCC	Low Flow Conveyance Channel
MRG	Middle Rio Grande
MRGCD	Middle Rio Grande Conservancy District
MSA	Metropolitan Statistical Area
NEPA	National Environmental Policy Act, 42 USC sections 4321-4370d
NMDGF	New Mexico Department of Game and Fish
NMHPD	New Mexico Historic Preservation Division
NMISC	New Mexico Interstate Stream Commission
NPDES	National Pollution Discharge Elimination System
NPS	National Park Service
NWR	National Wildlife Refuge
OSE	Office of the State Engineer, State of New Mexico
OSM	Office of Surface Mining Reclamation and Enforcement
PMA	Pueblo Management Areas
Reclamation	Bureau of Reclamation, U.S. Department of the Interior
RGWSR	Rio Grande Wild and Scenic River
RPA	Reasonable and prudent alternative under the ESA (<i>see</i> glossary)
RPM	Reasonable and prudent measures under the ESA (<i>see</i> glossary)
Service	U.S. Fish and Wildlife Service, U.S. Department of the Interior

silvery minnow	Rio Grande silvery minnow (<i>Hybognathus aramus</i>)
SSCFCA	Southern Sandoval County Arroyo Flood Control Authority
TMDL	Total maximum daily load
TPW	Texas Parks and Wildlife, State of Texas
TNRCC	Texas Natural Resources and Conservation Commission
URGWOP	Upper Rio Grande Water Operations
USC	United States Code
USIBWC	International Boundary and Water Commission, U.S. Section
WMA	Waterfowl Management Area

Final Environmental Impact Statement
Designation of Critical Habitat for the Rio Grande Silvery Minnow

Lead agency: United States Department of the Interior, Fish and Wildlife Service

Cooperating agencies: U.S. Army Corps of Engineers; U.S. Department of the Interior, Bureau of Indian Affairs

States and counties where the proposed action is located: New Mexico: Bernalillo, Sandoval, Socorro, and Valencia Counties;

Abstract: This Final Environmental Impact Statement (FEIS) examines the impact on the environment of the designation of critical habitat for the Rio Grande silvery minnow (*Hybognathus amarus*), an aquatic species listed as endangered under the Endangered Species Act (ESA). The silvery minnow was historically one of the most abundant and widespread fishes in the Rio Grande Basin, occurring from Espanola, New Mexico to the Gulf of Mexico. It was also found in the Pecos River from Santa Rosa, New Mexico downstream to the confluence of the Pecos with the Rio Grande in Texas. The minnow now occurs only in the Rio Grande in New Mexico, from Cochiti Dam downstream to Elephant Butte reservoir, five percent of its former range. Most of the minnows are found in the reach of the Rio Grande from San Acacia Diversion Dam to Elephant Butte, in Socorro County.

Once a species is listed under the ESA, federal agencies must consult with the Fish and Wildlife Service and ensure that actions they authorize, fund or carry out do not jeopardize the species continued existence. Once critical habitat is designated, federal agencies must also consult to ensure that actions they authorize, fund or carry out do not adversely modify designated habitat. The ESA requires the Service to designate critical habitat for endangered species to the maximum extent prudent. Critical habitat includes occupied and unoccupied areas “essential to the conservation of the species,” and “conservation” is defined as actions necessary to bring the species to the point where it can be delisted.

The Service proposes to designate as critical habitat for the minnow the currently occupied reaches of the Rio Grande in New Mexico, referred to as the Middle Rio Grande. The proposed designation extends from Cochiti Dam, Sandoval County, downstream to the utility line crossing the Rio Grande at UTM 13–311474E, 3719722 N, just east of the Bosque Well demarcated on USGS Paraje Well 7.5 minute quadrangle (1980), Socorro County, New Mexico. The critical habitat designation defines the lateral extent (width) as those areas bounded by existing levees or, in areas without levees, 91.4 meters (300 feet) of riparian zone adjacent to each side of the bankfull stage of the middle Rio Grande. We have also excluded areas within the middle Rio Grande where we believe adequate special management is in place. The Pueblo lands of Santo Domingo, Santa Ana, Sandia, and Isleta within this area are not included in the proposed designation. These four Pueblos have submitted special management plans that will provide adequate protections for the silvery minnow within the boundaries of their land.

Impacts of this alternative include an increased scope of consultations, which will be expanded to include effects of actions on critical habitat, as well as some changes to the actions to avoid adverse modification. It is likely that efforts will be made to increase the flow in the Rio Grande in areas that now experience drying events, and that this acquisition of water could impact agricultural communities. While a voluntary water market is important to maintaining silvery minnow habitat, the secondary impacts on the communities could be substantial. Efforts to minimize drying events, combined with river restoration activities for the minnow, will impact favorably on riverine and riparian ecosystems but, depending on the reduction in irrigated cropland, could reduce forage for the migratory bird population.

This FEIS also analyzes the impacts of four other alternatives: (1) Designation the entire Middle Rio Grande; (2) Designating the Middle Rio Grande, except for the Cochiti reach, the northern reach of the Middle Rio Grande and one that has undergone major changes since Cochiti Dam went online in 1975; (3) Designating the Middle Rio Grande except the San Acacia reach, the southern reach on the Middle Rio Grande and one that experiences significant drying during parts of the year; (4) Designating the Middle Rio Grande as well as two extended reaches within the minnow's historical range, the Pecos River from Sumner Dam to Brantley Reservoir in NM and the Rio Grande in Big Bend NP and the Rio Grande Wild and Scenic River in Texas.. A no action alternative is also analyzed.

Public Comment: Public comments on the FEIS are welcome and will be accepted through March 21, 2003. A Record of Decision will then be issued. Comments should be directed to: Joy Nicholopoulos, Field Supervisor, New Mexico Ecological Services Field Office, U.S. Fish and Wildlife Service, 2105 Osuna Blvd., NE, Albuquerque, NM 87113.

H. Dale Hall
Acting Regional Director

Approved: _____
Date: _____

Executive Summary

I. Background

The ESA defines critical habitat as (1) the specific areas occupied by the species in which are found those physical or biological features that are essential to the conservation of the species and which may require special management considerations or protection, and (2) specific areas outside the geographical areas occupied by the species which the Service determines are essential for the conservation of the species. (16 USC sec. 1532(5)). “Conservation of the species” refers to the use of all methods and procedures which are necessary to bring a species to the point at which the measures provided under the Act are no longer necessary (16 USC sec. 1532(3)).

When designating critical habitat for a species, the Service must also consider the economic and other relevant impacts of specifying a particular area as critical habitat and may exclude an area if the benefits of exclusion outweigh the benefits of inclusion. An area may not be excluded, however, if the Service determines, based on the best scientific and commercial data available, that the failure to designate the area as critical habitat will result in the extinction of the species (16 USC sec. 1533(b)(2)). This Final Environmental Impact Statement (FEIS) examines the environmental impacts associated with designation of critical habitat for the endangered Rio Grande silvery minnow.

II. Purpose and Need

The purpose of the action is to designate critical habitat for the Rio Grande silvery minnow. The Rio Grande silvery minnow was listed in 1994 as endangered under the Federal Endangered Species Act of 1973 as amended (ESA) (59 FR 36988). Section 4(a)(3) of the ESA requires that the Service, to the maximum extent prudent and determinable, designate critical habitat at the time a species is listed as endangered or threatened. Service regulations (50 CFR 424.12(a)(2)) state that critical habitat is not determinable if information sufficient to perform required analyses of the impacts of the designation is lacking, or if the biological needs of the species are not sufficiently well known to permit identification of an area as critical habitat. At the time it listed the silvery minnow, the Service found that critical habitat was not determinable because there was insufficient information to perform the required analyses of the impacts of the designation (59 FR 36988).

Critical habitat was first designated for the silvery minnow under the ESA in July 1999 (64 FR 36274). A number of parties brought suit against the Secretary of the Interior (Secretary) challenging the designation. On November 21, 2000, the United States District Court for the District of New Mexico, in Middle Rio Grande Conservancy District v. Babbitt, Civ. Nos. 99-870, 99-872, 99-1445M/RLP (Consolidated) set aside the July 9, 1999, critical habitat designation and ordered the Service to issue both an EIS under the National Environmental Policy Act (NEPA) and a new proposed rule designating critical habitat for the silvery minnow. This FEIS has been prepared on the redesignation, pursuant to the Court’s order.

III. Alternative Development

Public Involvement

On April 5, 2001, we mailed approximately 500 pre-proposal notification letters to the six Middle Rio Grande Indian Pueblos (Cochiti, Santo Domingo, San Felipe, Santa Ana, Sandia, and Isleta), various governmental agencies, interested individuals, and the New Mexico Congressional delegation. The letter informed them of our intent to prepare an EIS for the proposed designation of critical habitat for the silvery minnow and announced public scoping meetings pursuant to NEPA. On April 17, 23, 24, and 27, 2001, we held public scoping meetings in Albuquerque, and Carlsbad, New Mexico, and Fort Stockton, Texas, and Socorro, New Mexico, respectively. We solicited oral and written comments and input. We were particularly interested in obtaining additional information on the status of the species or information concerning threats to the species. The comment period closed June 5, 2001. We received approximately 40 comments during the EIS scoping process. During April 2001, we contracted with Industrial Economics Incorporated for an economic analysis and the Institute of Public Law at the University of New Mexico School of Law for an EIS on the proposed critical habitat designation.

Following the closing of the scoping comment period, we outlined possible alternatives for the EIS. We held a meeting on September 12, 2001, to solicit input on the possible alternatives from the Rio Grande silveryMinnow Recovery Team (Recovery Team) and other invited participants including individuals from the Carlsbad Irrigation District, Fort Sumner Irrigation District, the States of New Mexico and Texas, and potentially affected Pueblos and Tribes. Following this meeting, we sent letters to the Recovery Team and other invited participants, including Tribal entities, and resource agencies in New Mexico and Texas, to solicit any additional information—particularly biological, cultural, social, or economic data—that may be pertinent to the economic analysis or EIS. We received 10 comments from our requests for additional information. The information provided in the comment letters was fully considered in developing the alternatives that were analyzed in the DEIS, which contained the proposed rule as our preferred alternative. The comments were made part of the administrative record, for this NEPA analysis.

Development of Alternatives

When designating critical habitat for a species under the ESA, the Service identifies areas that are essential for the conservation of the species. Areas that are essential to the conservation of the species are areas needed to bring the species to the point that the protections of the ESA are no longer necessary (16 USC sec. 1532(3)). In other words, the Service must consider areas that are essential for the species not just to survive but also to recover and be removed from the list of endangered and threatened species.

An area that is occupied by the species at the time of listing may be included in critical habitat designation if the area contains the physical and biological features that are essential to the conservation of the species and if that area requires special management considerations or protection. Specific areas outside the geographical area occupied by the species may also be designated as critical habitat if the

Service determines that such areas are essential for the conservation of the species (16 USC sec. 1532(5)). Designation is based on the best scientific and commercial data available, after taking into consideration the economic and any other relevant impacts of specifying any particular area as critical habitat. Areas may be excluded from designation if it is determined that the benefits of exclusion outweigh the benefits of including the area, provided the exclusion will not result in the extinction of the species. The ESA precludes designation of the entire geographical area which can be occupied by the species except under circumstances to be determined by the Secretary (16 USC sec. 1532(5)(C)).

The selection of alternatives for critical habitat designation for the silvery minnow was based to a substantial extent on the Rio Grande Silvery Minnow Recovery Plan, approved by the Regional Director for Region 2 of the Service on July 8, 1999 (Service 1999). The Recovery Plan was prepared by the Rio Grande Silvery Minnow Recovery Team, which includes Federal, State, local, tribal, university, and non-profit representatives. The goals of the Recovery Plan are to stabilize and enhance populations of silvery minnow and its habitat in the Middle Rio Grande Valley, and to reestablish the minnow in other areas of its historic range (Service 1999).

In deciding on the alternatives to be studied, the Service considered the presence of physical and biological features essential to survival and recovery. These physical and biological features are known in the regulations implementing the ESA as “primary constituent elements” (50 CFR 424.12). Such requirements include, but are not limited to, space for individual and population growth, and for normal behavior; food, water, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, or rearing of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distribution of a species. Known primary constituent elements are to be included in the final rule designating critical habitat (50 CFR 424.12)

The primary constituent elements the Service proposes for the silvery minnow are:

1. A hydrologic regime that provides sufficient flowing water with low to moderate currents capable of forming and maintaining a diversity of aquatic habitats, such as, but not limited to: backwaters (a body of water connected to the main channel, but with no appreciable flow), shallow side channels, pools (that portion of the river that is deep with relatively little velocity compared to the rest of the channel), eddies (a pool with water moving opposite to that in the river channel), and runs (flowing water in the river channel without obstructions) of varying depth and velocity which are necessary for each of the particular silvery minnow life-history stages (e.g., the silvery minnow requires habitat with sufficient flows from early spring (March) to early summer (June) to trigger spawning, flows in the summer (June) and fall (October) that do not increase prolonged periods of low or no flow; and a relatively constant winter flow (November to February)) in appropriate seasons;
2. The presence of eddies created by debris piles, pools, or backwaters, or other refuge habitat (e.g., connected oxbows or braided channels) within unimpounded stretches of flowing water of sufficient length (i.e., river miles) that provide a variation of habitats with a wide range of depth and velocities;

3. Substrates of predominantly sand or silt; and
4. Water of sufficient quality to maintain natural, daily, and seasonally variable water temperatures in the approximate range of greater than 1°C (35°F) and less than 30°C (85°F) and reduce degraded water quality conditions (decreased dissolved oxygen, increased p.H., etc.).

In selecting the alternative designations of critical habitat to be studied in the DEIS, the Service considered the comments received in the previous rulemaking on critical habitat designation, the comments received during scoping for the current rulemaking, comments and suggestions of the Recovery Team, and the expertise and experience of the Service and other parties interested in silvery minnow survival and recovery efforts.

The primary goals of the silvery minnow Recovery Plan are to: 1) stabilize and enhance populations of the silvery minnow and its habitat in the middle Rio Grande valley; and 2) reestablish the silvery minnow in at least three other areas of its historic range (Service 1999). The Service believes that the second recovery goal can be achieved by using the authorities under section 10(j) of the Act. Consequently, the Service developed a conservation strategy that they believe is consistent with the species' Recovery Plan. The conservation strategy is to reestablish the silvery minnow, under section 10(j) of the Act, within areas of its historic ranges possibly including the river reach in the middle Pecos River, the river reach in the lower Rio Grande, and other unoccupied areas. Any future recovery efforts, including repatriation of the species to areas of its historic range must be conducted in accordance with NEPA and the Act. An overview of the process to establish an experimental population under section 10(j) of the Act is described below.

Section 10(j) of the Act enables the Service to designate certain populations of federally listed species that are released into the wild as "experimental." The circumstances under which this designation can be applied are: 1) the population is geographically separate from non-experimental populations of the same species (e.g., the population is reintroduced outside the species' current range but within its probable historic range); and 2) the Service determines that the release will further the conservation of the species. Section 10(j) is designed to increase the flexibility in managing an experimental population by allowing the Service to treat the population as threatened, regardless of the species' status elsewhere in its range. Threatened status allows more discretion in developing and implementing management programs and special regulations for a population and allows the Service to develop any regulations they consider necessary to provide for the conservation of a threatened species. In situations where there are experimental populations, certain section 9 prohibitions (i.e., harm, harass, capture) that apply to threatened species may no longer apply, and a special rule can be developed that contains the prohibitions and exceptions necessary and appropriate to conserve that species. This flexibility allows the Service to manage the experimental population in a manner that will ensure that current and future land, water, or air uses and activities should not be restricted and the population can be managed for recovery purposes.

The Service considered the draft and final economic analysis and the draft EIS, including comments received on the drafts, when conducting a final evaluation under section 4(b)(2) of the ESA to determine whether the benefits of excluding any portion of the area proposed for designation outweighed the benefits of specifying the area as part of critical habitat (16 USC 1533(b)(2); 250 CFR 424.19). The Service will also considered management plans that were submitted for approval; see the discussion of management plans at end of this chapter.

Alternatives Considered in Detail

Alternative A: No Action

As required by NEPA, a No Action alternative is included in this EIS. The No Action Alternative is defined as a decision to forgo the designation of critical habitat for the Rio Grande silvery minnow. This alternative serves to delineate the existing environment and conditions that are anticipated to result from the listing of the species, without designation of critical habitat.

It is not clear that the Service could, under the law, adopt the No Action Alternative. The ESA requires that the Service (1) designate critical habitat at the time that it lists a species as endangered or threatened to the maximum extent prudent or determinable or (2) if designation is not determinable, to designate critical habitat within one year thereafter, based on such data as may be available at the time, to the maximum extent prudent (16 USC sec. 1533(a)(6)(C)). Moreover, this FEIS has been prepared on the redesignation, pursuant United States District Court for the District of New Mexico, in Middle Rio Grande Conservancy District v. Babbitt, Civ. Nos. 99-870, 99-872, 99-1445M/RLP (Consolidated) that ordered the Service to issue both an EIS and a redesignation of critical habitat for the silvery minnow.

Alternative B: The Middle Rio Grande from Cochiti Dam to Elephant Butte Dam, and the lower Jemez River

This alternative would designate as critical habitat, the last remaining portion of the occupied range in the Middle Rio Grande (Cochiti Dam to Elephant Butte Dam) in New Mexico. This alternative considers the Middle Rio Grande from immediately downstream of Cochiti Reservoir to the Elephant Butte Reservoir Dam, including the Jemez River, a tributary of the Rio Grande, from Jemez Canyon Reservoir to its confluence with the Rio Grande in New Mexico. The proposed critical habitat designation defines the lateral extent (width) as those areas bounded by existing levees. In areas without levees, the lateral extent of critical habitat is proposed to be defined as 91.4 meters (300 feet) of riparian zone adjacent to each side of the river. Lands located within these boundaries which are not considered critical habitat and are excluded by definition include: developed flood control facilities, existing paved roads, bridges, parking lots, dikes, levees, diversion structures, railroad tracks, railroad trestles, water diversion and irrigation canals outside of natural stream channels, the low flow conveyance channel, active gravel pits, cultivated agricultural land, and residential, commercial, and industrial developments. (Service 2003).

Sub-Alternative B-2: Exclusion of Areas With Special Management Plans (Preferred Alternative)

Under Sub-alternative B-2, the silvery minnow critical habitat designation in the Rio Grande would extend from Cochiti Dam downstream to the utility line crossing the Rio Grande, a permanent identified landmark in Socorro County, NM. The designation also includes the tributary Jemez River from Jemez Canyon Dam in NM to the upstream boundary of Santa Ana Pueblo. Under this sub-alternative, the Pueblo lands of Santo Domingo, Santa Ana, Sandia, and Isleta within this area are excluded from the critical habitat designation in accordance with section 4(b)(2) of the ESA. Except for these areas, the final remaining portion of the silvery minnow's occupied range in the middle Rio Grande in NM is being designated as critical habitat. The critical habitat designation defines the lateral extent (width) as those areas bounded by existing levees or, in areas without levees, 300 feet (ft) (91.4 meters (m)) of riparian zone adjacent to each side of the bankfull stage of the middle Rio Grande. As described in Alternative B, lands located within these boundaries which are not considered critical habitat and are excluded by definition include: developed flood control facilities, existing paved roads, bridges, parking lots, dikes, levees, diversion structures, railroad tracks, railroad trestles, water diversion and irrigation canals outside of natural stream channels, the low flow conveyance channel, active gravel pits, cultivated agricultural land, and residential, commercial, and industrial developments. (Service 2003).

Alternative C: The Middle Rio Grande, Excluding of the Cochiti Reach

This alternative is the same designation described in Alternative B except that the Cochiti reach, as defined in Alternative B, would be excluded from the designation. Instead of beginning just below Cochiti Dam on the Middle Rio Grande, the northern boundary of critical habitat would be the Angostura Diversion Dam on the Rio Grande and Jemez Canyon Dam on the Jemez River. The lateral extent of critical habitat would be the same as in Alternative B, and would include those areas bounded by existing levees. In areas without levees the lateral extent of critical habitat is defined as 91.4 meters (300 feet) of riparian zone adjacent to each side of the river. Lands located within these boundaries which are not considered critical habitat and are excluded by definition include: developed flood control facilities, existing paved roads, bridges, parking lots, dikes, levees, diversion structures, railroad tracks, railroad trestles, water diversion and irrigation canals outside of natural stream channels, the low flow conveyance channel, active gravel pits, cultivated agricultural land, and residential, commercial, and industrial developments. (Service 2003).

Alternative D: The Middle Rio Grande, Excluding the San Acacia Reach

This alternative is the same as Alternative B except that the reach from San Acacia Diversion Dam to Elephant Butte Dam would be excluded from the designation. This alternative would exclude many of the segments of the Middle Rio Grande that have experienced intermittency in recent years. The lateral extent of critical habitat would be the same as in Alternative B, and would include those areas bounded by existing levees. In areas without levees the lateral extent of critical habitat is defined as 91.4 meters (300 feet) of riparian zone adjacent to each side of the river. Lands located within these boundaries which are not considered critical habitat and are excluded by

definition include: developed flood control facilities, existing paved roads, bridges, parking lots, dikes, levees, diversion structures, railroad tracks, railroad trestles, water diversion and irrigation canals outside of natural stream channels, the low flow conveyance channel, active gravel pits, cultivated agricultural land, and residential, commercial, and industrial developments. (Service 2003).

Alternative E: Designation of Selected Reaches of the Middle Rio Grande, Lower Rio Grande, and Middle Pecos River

This alternative would designate as critical habitat: 1) the Middle Rio Grande as described in Alternative B; 2) a river reach in the lower Rio Grande in Big Bend National Park downstream of the park boundary to the Terrell/Val Verde County line, Texas; and 3) a river reach in the middle Pecos River, New Mexico, from Sumner Dam to Brantley Dam in De Baca, Chaves, and Eddy Counties, New Mexico. The lateral extent (width) of critical habitat would include those areas bounded by existing levees. In areas without levees, the lateral extent of critical habitat is defined as 91.4 meters (300 feet) of riparian zone adjacent to each side of these reaches of river, with the exception of proposed critical habitat in the lower Rio Grande. Since critical habitat cannot be designated outside the United States' jurisdiction (50 CFR 424.12), the Service would propose that the lateral width of critical habitat designation in this stream reach extend from the U.S./Mexico International Boundary (delineated as the middle of the deepest channel) to the edge of the 91.4-meter (300-foot) lateral width (see discussion above) on the United States' side. Lands located within these boundaries which are not considered critical habitat and are excluded by definition include: developed flood control facilities, existing paved roads, bridges, parking lots, dikes, levees, diversion structures, railroad tracks, railroad trestles, water diversion and irrigation canals outside of natural stream channels, the low flow conveyance channel, active gravel pits, cultivated agricultural land, and residential, commercial, and industrial developments. (Service 2003).

IV. Impacts Analysis

This FEIS and, in particular, the analysis of impacts, poses a set of unusual if not unique challenges. Environmental impacts that may be attributable to critical habitat designation may be attributable at the same time to the fact that a species is listed under the Endangered Species Act (ESA), the fact that Federal agencies may be required to take conservation measures because of such listing, or the fact that other federally listed species with similar habitat needs or geographic locations may also require conservation measures.

The Tenth Circuit U.S. Court of Appeals, in a case involving critical habitat designation for the southwestern willow flycatcher, concluded that: "Congress intended that the Service conduct a full analysis of all of the economic impacts of a critical habitat designation, regardless of whether those impacts are attributable co-extensively to other causes." New Mexico Cattle Growers Ass'n v. U.S. Fish and Wildlife Service, 248 F.3d 1277 (10th Cir. 2001). Although the Tenth Circuit's opinion was addressed to economic analyses under the ESA, the Service has concluded that the same approach should be taken in this FEIS under NEPA.

In keeping with the Tenth Circuit's opinion, the Service's analysis of impacts of critical habitat designation for the silvery minnow has been expanded to include an assessment of the possible impacts of ESA section 7(a)(2), in addition to the impacts associated with the re-designation of critical habitat. At the same time, however, it remains true that this analysis—as its title indicates—was necessitated by designation of critical habitat alone; Federal listing under the ESA itself is not subject to NEPA analysis. Thus, the Service has also tried to identify and analyze, to the greatest extent possible, those impacts that would result solely from critical habitat designation.

It is important to emphasize that the requirements placed upon this analysis—namely, to assess the impacts of designation even if such impacts are “attributable co-extensively to other causes”—may result in some of its findings being misunderstood or misinterpreted. Not all of the impacts identified in Chapter 4 are or would be a direct consequence of critical habitat designation. The Rio Grande silvery minnow was listed as endangered in 1994, and this fact has influenced management actions on the Middle Rio Grande ever since. Changes in river management in New Mexico have also been influenced by the presence of two other federally listed species: the southwestern willow flycatcher and (on the Pecos River) the Pecos bluntnose shiner. To avoid confusion it should be kept in mind, and this will be pointed out periodically, that impacts arising from critical habitat designation can be difficult to separate from impacts arising due to listing alone. The following tables provide a summary of the potential impacts associated with each alternative analyzed in the FEIS.

Summary of Potential Impacts Associated with Each Alternative

TABLE S-1		Summary of Alternatives—Areas and Entities Affected by Critical Habitat Designation									Sources of Combined Section 7 Impacts	
		Total Miles	Total River Miles	Lateral Extent	Miles Occupied Habitat	Miles Unocc. Habitat	# of Reaches	Miles on Pueblo Land	Pueblos Affected	Counties Affected	Silvery Minnow	Other
A	MRG	0	0	0	0	0	0	0	None	None	• Listing	• Listing of flycatcher
	LRG	0	0	0	0	0	0	0	None	None	None	None
	Pecos	0	0	0	0	0	0	0	None	None	None	• Listing of shiner • CH for shiner • Listing of flycatcher
B	MRG	212	Approx. 180	To levees, or 300 ft.	Approx. 180	Approx. 34 (reservoir)	5	45	Cochiti S. Domingo S. Felipe S. Ana Sandia Isleta	Sandoval Bernalillo Valencia Socorro	• Listing • Critical Habitat Desig.	• Listing of flycatcher
B-2	MRG	157	Approx. 132	To levees, or 300 ft.	Approx. 132	0	5	15	Cochiti S. Felipe	Sandoval Bernalillo Valencia Socorro	• Listing • Critical Habitat Desig.	• Listing of flycatcher
C	MRG	191	Approx 159	300 ft.	Approx. 159	Approx. 34 (reservoir)	4	25	S. Ana Sandia Isleta	Sandoval Bernalillo Valencia Socorro	• Listing • Critical Habitat Desig.	• Listing of flycatcher

TABLE S-1 cont.		Summary of Alternatives—Areas and Entities Affected by Critical Habitat Designation									Sources of Combined Section 7 Impacts	
		Total Miles	Total River Miles	Latera l Extent	Miles Occupied Habitat	Miles Unocc. Habitat	# of Reaches	Miles on Pueblo Land	Pueblos Affected	Counties Affected	Silvery Minnow	Other
D	MRG	120	120	300 ft.	120	0	4	45	Cochiti, S. Domingo S. Felipe S. Ana Sandia Isleta	Sandoval Bernalillo Valencia Socorro	<ul style="list-style-type: none"> • Listing • Critical Habitat Desig. 	<ul style="list-style-type: none"> • Listing of flycatcher
	MRG	212	Approx. 180	To levees, or 300 ft.	Approx. 180	Approx. 34 (reservoir)	5	45	Cochiti S. Domingo S. Felipe S. Ana Sandia Isleta	Sandoval Bernalillo Valencia Socorro	<ul style="list-style-type: none"> • Listing • Critical Habitat Desig. 	<ul style="list-style-type: none"> • Listing of flycatcher
	LRG	236	236	300 ft.	0	236	1	0	None	Brewster Terrell	<ul style="list-style-type: none"> • Critical Habitat Desig. 	None
	Pecos	223	Approx. 210	300 ft.	0	223	1	0	None	De Baca Chaves Eddy	<ul style="list-style-type: none"> • Critical Habitat Desig. 	<ul style="list-style-type: none"> • Listing of shiner • CH for shiner • Listing of flycatcher

TABLE S-2		Impacts on Federal Agency Consultations			
		Expected baseline¹ consultation costs, 20 yrs.	Expected above baseline consultation costs, 20 yrs.	Expected baseline project modification costs, 20 yrs.	Expected above baseline project modification costs, 20 yrs.
A	MRG	\$835,300 (low) \$2,135,500 (high)	0	\$14.0 million (low) \$23.4 million (high)	0
	LRG	N/A, no baseline for minnow.	0	N/A, no baseline for minnow.	0
	Pecos	N/A, no baseline for minnow.	0	N/A, no baseline for minnow.	0
B	MRG	Same as in Alternative A (No Action), jeopardy consults continue	\$1,052,200 (low) \$2,662,500 (high)	Same as in Alternative A (No Action), jeopardy consults continue	\$4.5 million (low) \$8.1 million (high)
B-2		Same as in Alternative A (No Action), jeopardy consults continue	N/A - Expected to be lower than Alternative B due to a reduction in the area designated	Same as in Alternative A (No Action), jeopardy consults continue	N/A - Expected to be lower than Alternative B due to a reduction in the area designated
C	MRG	Same as Alt. A (No Action), jeopardy consults continue in non-designated reach.	\$832,600 (low) \$2,083,700 (high)	Same as Alt. A (No Action), jeopardy consults continue in non-designated reach.	\$3.5 million (low) \$6.4 million (high)

¹On the MRG, a historical baseline exists for consultations since 1994 regarding the silvery minnow and proposed or designated critical habitat for that species. “Baseline level” means consultations continuing at the annual rate established since 1994. “Above baseline” means additional consultations arising due to the new designation of critical habitat. On the LRG (Big Bend reach) and the Pecos, no such baseline for silvery minnow consultations exists.

TABLE S-2 cont.		Impacts on Federal Agency Consultations			
		Expected baseline² consultation costs, 20 yrs.	Expected above baseline consultation costs, 20 yrs.	Expected baseline project modification costs, 20 yrs.	Expected above baseline project modification costs, 20 yrs.
D	MRG	Same as Alt. A (No Action), jeopardy consults continue in non-designated reach.	\$792,800 (low) \$2,018,400 (high)	Same as Alt. A (No Action), jeopardy consults continue in non-designated reach.	\$2.7 million (low) \$4.3 million (high)
E	MRG	Same as in Alternative A (No Action), jeopardy consults continue	Same as Alternative B	Same as Alt. A (No Action), jeopardy consults continue in non-designated reach.	Same as Alternative B
	LRG	N/A, no baseline for minnow.	\$461,600 (low) \$569,000 (high)	N/A, no baseline for minnow.	\$3.6 million (low) \$7.8 million (high)
	Pecos	N/A, no baseline for minnow.	\$773,400 (low) \$2,048,400 (high)	N/A, no baseline for minnow.	\$11.6 million (low) \$19.4 million (high)

²On the MRG, a historical baseline exists for consultations since 1994 regarding the silvery minnow and proposed or designated critical habitat for that species. “Baseline level” means consultations continuing at the annual rate established since 1994. “Above baseline” means additional consultations arising due to the new designation of critical habitat. On the LRG (Big Bend reach) and the Pecos, no such baseline for silvery minnow consultations exists.

TABLE S-3		Impacts on Water Resources				
				Supplemental Water for Target Flows		
		Water Operations	Water Rights and Use	Estimated Need/Year <u>95%</u> ³ 50%	Total Water Rights Cost <u>95%</u> 50%	Possible sources of supplemental water
A	MRG	<u>Listing:</u> It is expected that changes in river management and water operations such as those outlined in the Service's 2001 Programmatic Biological Opinion will be continued. This includes operations of storage, diversion, and flood control facilities. <u>Designation:</u> Will not occur; no additional impacts.	<u>Listing:</u> Water rights may be transferred or leased, to provide supplemental flows and other conservation measures such as those outlined in the Service's 2001 Programmatic Biological Opinion. Federal management agencies, MRGCD, and ISC will continue to work in close coordination to ensure both adequate stream flows of the minnow and fulfillment of Rio Grande Compact obligations. <u>Designation:</u> Will not occur; no additional impacts.	40,427 ac-ft 5,635 ac-ft	\$205 million \$28.6 million	<ul style="list-style-type: none"> San Juan-Chama water, if available for lease. Native Rio Grande water, if available for sale or lease, or in a compact credit situation and stored in upstream reservoirs.
	LRG	No effect.	No effect.	0	0	N/A
	Pecos	No effect. Water operations would continue to be affected by the bluntnose shiner.	No effect. Water rights and use would continue to be affected by efforts to provide supplemental flows for the bluntnose shiner.	0	0	N/A

³95% = Annual supply of water sufficient to meet flow targets for the Middle Rio Grande set forth in the Service's 2001 Biological Opinion, and/or to supply 50 cfs at Acme gage on the Pecos River, 95 years out of 100, based on historical flow data. 50% = Annual supply to meet targets 50 years out of 100. Quantities and costs of existing supplemental water provided for the Pecos bluntnose shiner are not considered. (Industrial Economics 2003.)

TABLE S-3 cont.		Impacts on Water Resources				
		Water Operations	Water Rights and Use	Supplemental Water for Target Flows		Possible sources of supplemental water
				Estimated Need/Year <u>95%</u> ⁴ 50%	Total Water Rights Cost <u>95%</u> 50%	
B	MRG	<p><u>Listing with Designation</u>: Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically</u>: Additional consultation requirements and possible project modifications on flood control projects, and possibly other activities in the river floodplain.</p>	<p><u>Listing with Designation</u>: Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically</u>: Added focus on conservation of aquatic and riparian habitat may stimulate restoration efforts and potentially increase net depletions.</p>	<p><u>40,427 ac-ft</u> 5,635 ac-ft</p>	<p><u>\$205 million</u> \$28.6 million</p>	<ul style="list-style-type: none"> • San Juan-Chama water, if available for lease. • Native Rio Grande water, if available for sale or lease, or in a compact credit situation and stored in upstream reservoirs.

⁴95% = Annual supply of water sufficient to meet flow targets for the Middle Rio Grande set forth in the Service's 2001 Biological Opinion, and/or to supply 50 cfs at Acme gage on the Pecos River, 95 years out of 100, based on historical flow data. 50% = Annual supply to meet targets 50 years out of 100. Quantities and costs of existing supplemental water provided for the Pecos bluntnose shiner are not considered. (Industrial Economics 2003.)

TABLE S-3 cont.		Impacts on Water Resources				
		Water Operations	Water Rights and Use	Supplemental Water for Target Flows		Possible sources of supplemental water
				Estimated Need/Year <u>95%</u> ⁵ 50%	Total Water Rights Cost <u>95%</u> 50%	
B-2	MRG	<p><u>Listing with Designation</u>: Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically</u>: Additional consultation requirements and possible project modifications may be reduced from those anticipated under Alternative B due to a reduction in the area designated.</p>	<p><u>Listing with Designation</u>: Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically</u>: Added focus on conservation of aquatic and riparian habitat may stimulate restoration efforts and potentially increase net depletions.</p>	N/A Expected to be equal to or less than the supplemental water estimates for Alternative B	N/A Expected to be equal to or less than the supplemental water estimates for Alternative B	<ul style="list-style-type: none"> San Juan-Chama water, if available for lease. Native Rio Grande water, if available for sale or lease, or in a compact credit situation and stored in upstream reservoirs.

⁵95% = Annual supply of water sufficient to meet flow targets for the Middle Rio Grande set forth in the Service's 2001 Biological Opinion, and/or to supply 50 cfs at Acme gage on the Pecos River, 95 years out of 100, based on historical flow data. 50% = Annual supply to meet targets 50 years out of 100. Quantities and costs of existing supplemental water provided for the Pecos bluntnose shiner are not considered. (Industrial Economics 2003.)

TABLE S-3 cont.		Impacts on Water Resources				
		Water Operations	Water Rights and Use	Supplemental Water for Target Flows		Possible sources of supplemental water
				Estimated Need/Year <u>95%</u> ⁶ 50%	Total Water Rights Cost <u>95%</u> 50%	
C	MRG	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> Possible added consultations and project modifications as described in Alt. B, but not pertaining to projects within and only affecting the Cochiti reach.</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> Added focus on conservation of aquatic and riparian habitat may stimulate restoration efforts and potentially increase net depletions. Restoration activities would proceed in the Cochiti reach, but possibly at a reduced rate than under Alternative B.</p>	<p><u>40,427 ac-ft</u> 5,635 ac-ft</p>	<p><u>\$205 million</u> \$28.6 million</p>	As described for Alt. A (No Action).

⁶95% = Annual supply of water sufficient to meet flow targets for the Middle Rio Grande set forth in the Service's 2001 Biological Opinion, and/or to supply 50 cfs at Acme gage on the Pecos River, 95 years out of 100, based on historical flow data. 50% = Annual supply to meet targets 50 years out of 100. Quantities and costs of existing supplemental water provided for the Pecos bluntnose shiner are not considered. (Industrial Economics 2003.)

TABLE S-3 cont.		Impacts on Water Resources				
		Water Operations	Water Rights and Use	Supplemental Water for Target Flows		Possible sources of supplemental water
				Estimated Need/Year <u>95%</u> ⁷ 50%	Total Water Rights Cost <u>95%</u> 50%	
D	MRG	<p><u>Listing with Designation</u>: Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically</u>: Possible added consultations and project modifications as described in Alt. B, but not pertaining to projects within and only affecting the San Acacia reach.</p>	<p><u>Listing with Designation</u>: Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically</u>: Added focus on conservation of aquatic and riparian habitat may stimulate restoration efforts and potentially increase net depletions. Restoration activities would proceed in the San Acacia reach, but possibly at a reduced rate than under Alternative B.</p>	<p><u>40,427 ac-ft</u> 5,635 ac-ft</p>	<p><u>\$205 million</u> \$28.6 million</p>	<p>As described for Alt. A (No Action).</p>

⁷95% = Annual supply of water sufficient to meet flow targets for the Middle Rio Grande set forth in the Service's 2001 Biological Opinion, and/or to supply 50 cfs at Acme gage on the Pecos River, 95 years out of 100, based on historical flow data. 50% = Annual supply to meet targets 50 years out of 100. Quantities and costs of existing supplemental water provided for the Pecos bluntnose shiner are not considered. (Industrial Economics 2003.)

TABLE S-3 cont.		Impacts on Water Resources				
		Water Operations	Water Rights and Use	Supplemental Water for Target Flows		Possible sources of supplemental water
				Estimated Need/Year <u>95%</u> ⁸ 50%	Total Water Rights Cost <u>95%</u> 50%	
E	MRG	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> Additional consultation requirements and possible project modifications on flood control projects, and possibly other activities in the river floodplain.</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> Added focus on conservation of aquatic and riparian habitat may stimulate restoration efforts and potentially increase net depletions.</p>	40,427 ac-ft 5,635 ac-ft	\$205 million \$28.6 million	As described for Alt. A (No Action).
	LRG	Should the need arise, consultation would be required for USIBWC boundary maintenance activities.	No transfer of rights or change in existing use is anticipated.	0	0	N/A
	Pecos	Likely continuation and augmentation of existing modified water operations as instituted to conserve and avoid jeopardy to the bluntnose shiner. Possible increase in supplemental flows to maintain suitable conditions for the minnow.	Any management plan to increase supplemental flows due to designation would result in an additional need to acquire or lease water rights. This would add to already significant cumulative impacts arising from Pecos River Compact obligations.	24,263 ac-ft 16,431 ac-ft	\$47.3 million \$28.6 million	Surface and groundwater rights, if available for lease or purchase.

⁸95% = Annual supply of water sufficient to meet flow targets for the Middle Rio Grande set forth in the Service's 2001 Biological Opinion, and/or to supply 50 cfs at Acme gage on the Pecos River, 95 years out of 100, based on historical flow data. 50% = Annual supply to meet targets 50 years out of 100. Quantities and costs of existing supplemental water provided for the Pecos bluntnose shiner are not considered. (Industrial Economics 2003.)

TABLE S-4		Biological Impacts of silvery minnow listing and critical habitat designation		
		Vegetation	Silvery Minnow	Fish and Wildlife
A	MRG	<p><u>Listing:</u> Native vegetation may benefit from agency actions undertaken to conserve or avoid jeopardy to the minnow, including implementation of a more natural hydrological regime and habitat restoration including saltcedar eradication.</p> <p><u>Designation:</u> Will not occur; no additional benefits.</p>	<p><u>Listing:</u> Under the ESA, the minnow may benefit from conservation actions that may be implemented under section 7(a)(1), regulatory protections afforded by the section 7(a)(2) jeopardy standard, and the section 9 take prohibition. Significant benefits include the actions spelled out as an RPA in the Service's recent Programmatic Biological Opinion (Service 2001b). The minnow will likely continue to benefit from the acquisition of supplemental water to maintain target flows, pumping of water from the LFCC, rescue and relocation efforts undertaken by the Service, and habitat restoration activities undertaken by Federal agencies.</p> <p><u>Designation:</u> Will not occur; no additional benefits. An opportunity to identify and focus additional management attention on habitat features considered essential to the conservation of the species will be lost.</p>	<p><u>Listing:</u> Native fish species will continue to benefit from improved hydrological regime and river channel restoration activities undertaken to benefit the minnow. Riparian-zone species including endangered southwestern willow flycatcher benefit from habitat restoration. Migratory cranes and waterfowl may be adversely impacted if loss of agricultural production affects winter food base.</p> <p><u>Designation:</u> Will not occur; no additional benefits.</p>
	LRG	No effect.	Potential habitat for reintroduction would receive no extra protection.	No effect.
	Pecos	No effect.	Potential habitat for reintroduction would receive no extra protection.	No effect.

TABLE S-4		Biological Impacts of silvery minnow listing and critical habitat designation		
		Vegetation	Silvery Minnow	Fish and Wildlife
B	MRG	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> In all reaches native vegetation may benefit from additional protections to the river floodplain within 300' of the river channel.</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> In all reaches the minnow will benefit from any additional protections to physical and biological features present in the reach and considered essential to the conservation of the species. The minnow will benefit from increased conservation attention focused on the river channel and 300' of adjacent floodplain.</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> In all reaches native fish may benefit from any additional protections to the river channel and water quality provided by designation. Various riparian-zone species including flycatcher may benefit from added floodplain protection.</p>
	MRG	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> In designated critical habitat native vegetation may benefit from additional protections to the river floodplain within 300' of the river channel. In Pueblo Management Areas (PMAs), vegetation may benefit from protections provided by the special management plan</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> In all reaches, including the excluded PMAs, the minnow will benefit from any additional protections to physical and biological features present in the reach and considered essential to the conservation of the species. The minnow will benefit from increased conservation attention focused on the river channel and 300' of adjacent floodplain. These additional protections to the river channel and adjacent floodplain should be provided by the special management plans that have been established for the PMAs that are excluded under this sub-alternative.</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> In all reaches native fish may benefit from any additional protections to the river channel and water quality provided by designation or the special management plans. Various riparian-zone species including flycatcher may benefit from added floodplain protection provided by the designation and special management plans.</p>

TABLE S-4 cont.		Biological Impacts of silvery minnow listing and critical habitat designation		
		Vegetation	Silvery Minnow	Fish and Wildlife
C	MRG	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> South of Angostura Diversion Dam, native vegetation may benefit from additional protections to the river floodplain within 300' of the river channel. These benefits will not be present in the Cochiti reach.</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> South of Angostura Diversion Dam, the minnow will benefit from any additional protections to physical and biological features present in the reach and considered essential to the conservation of the species. The minnow will benefit from increased conservation attention focused on the river channel and 300' of adjacent floodplain. These additional protections and benefits will not be present in the Cochiti reach.</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> South of Angostura Diversion Dam native fish will benefit from any additional protections to the river channel provided by designation. Various riparian-zone species including flycatcher may benefit from added floodplain protection. These benefits will not be present in the Cochiti reach.</p>
		<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> North of San Acacia Diversion Dam, native vegetation may benefit from additional protections to the river floodplain within 300' of the river channel. These benefits will not be present in the San Acacia reach.</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> North of San Acacia Diversion Dam, the minnow will benefit from any additional protections to physical and biological features present in the reach and considered essential to the conservation of the species. The minnow will benefit from increased conservation attention focused on the river channel and 300' of adjacent floodplain. These additional protections and benefits will not be present in the San Acacia reach.</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> North of San Acacia Diversion Dam native fish will benefit from any additional protections to the river channel and water quality provided by designation. Various riparian-zone species including flycatcher may benefit from added floodplain protection. These benefits will not be present in the San Acacia reach.</p>

TABLE S-4 cont.		Biological Impacts of silvery minnow listing and critical habitat designation		
		Vegetation	Silvery Minnow	Fish and Wildlife
E	MRG	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> In all reaches native vegetation may benefit from additional protections to the river floodplain within 300' of the river channel.</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> In all reaches the minnow will benefit from any additional protections to physical and biological features present in the reach and considered essential to the conservation of the species. The minnow will benefit from increased conservation attention focused on the river channel and 300' of adjacent floodplain.</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> In all reaches native fish may benefit from any additional protections to the river channel and water quality provided by designation. Various riparian-zone species including flycatcher may benefit from added floodplain protection.</p>
	LRG	No effect.	No direct impacts, but potential habitat for reintroduction would receive extra protection.	No effect.
	Pecos	Native vegetation may benefit if additional habitat restoration is carried out as a result of designation.	Potential habitat for reintroduction would receive extra protection.	Native fish species may benefit if additional management attention is devoted to conserving and/or improving aquatic habitat as a result of designation. Riparian-zone species may benefit from added protections or habitat restoration in the river floodplain.

TABLE S-5 95% ⁹ 50% (target flow scenarios)		Land Use and Economic Impacts of Acquiring Water to Maintain Target Flows (Data from Final Economic Analysis. Impacts Under Alternatives B, B-2,C, and D are identical)								
		Lost agricultural production--alfalfa acres	Percent regional alfalfa acreage lost	Percent state alf. acreage lost	Value of foregone agricultural production	Effect on regional economic output	Percent of regional economic output lost	Jobs Lost	Percent effect on regional employment	Other industries affected
A	MRG	9,094 (95%) 1,266 (50%)	(4 counties) 26.7% 3.7%	3.1% .4 %	\$5.98 million \$.83 million	\$8.39 million \$1.17 million	.026% .0036%	362 51	.081% .011%	real estate, wholes ale trade, agricultural services, doctors and dentists, eating and drinking, hospitals.
	LRG	0	0	0	0	0	0	0	0	0
	Pecos	None for minnow; target flows for shiner not considered.	None due to minnow.	None due to minnow.	None due to minnow.	None due to minnow.	None due to minnow.	None due to minnow.	None due to minnow.	None due to minnow.
B, B-2, C, D,	MRG	9,094 (95%) 1,266 (50%)	(4 counties) 26.7% 3.7%	3.1% .4 %	\$5.98 million \$.83 million	\$8.39 million \$1.17 million	.026% .0036%	362 51	.081% .011%	real estate, wholes ale trade, agricultural services, doctors and dentists, eating and drinking, hospitals.

⁹95% = Cost of obtaining water sufficient to meet flow targets set forth in the Service's 2001 Biological Opinion 95 years out of 100, based on historical flow data. 50% = Cost of meeting targets 50 years out of 100. (Industrial Economics 2003.)

TABLE S-5 cont. <u>95%</u> ¹⁰ 50% (target flow scenarios)		Land Use and Economic Impacts of Acquiring Water to Maintain Target Flows (Data from Final Economic Analysis. Impacts Under Alternatives B, C, and D are identical)								
		Lost agricultural production-- alfalfa acres	Percent regional alfalfa acreage lost	Percent state alf. acreage lost	Value of foregone agricultural production	Effect on regional economic output	Percent of regional economic output lost	Jobs Lost	Percent effect on regional employment	Other industries affected
E	MRG	<u>9,094</u> (95%) 1,266 (50%)	(4 counties) <u>26.7%</u> 3.7%	<u>3.1%</u> .4 %	<u>\$5.98 million</u> \$.83 million	<u>\$8.39 million</u> \$1.17 million	<u>.026%</u> .0036%	<u>362</u> 51	<u>.081%</u> .011%	real estate, wholesale trade, agricultural services, doctors and dentists, eating and drinking, hospitals.
	LRG	0	0	0	0	0	0	0	0	0
	Pecos	<u>5,839</u> 3,921	(3 counties) <u>6.2%</u> 4.2%	<u>2.0%</u> 1.3%	<u>\$4.21 million</u> \$2.83 million	<u>\$6.24 million</u> \$4.19 million	<u>.012%</u> .008%	<u>158</u> 106	<u>.28%</u> .19%	agricultural services real estate, wholesale trade, petroleum refining, facility maintenance and repair.

¹⁰95% = Cost of obtaining water sufficient to meet flow targets set forth in the Service's 2001 Biological Opinion 95 years out of 100, based on historical flow data. 50% = Cost of meeting targets 50 years out of 100. (Industrial Economics 2003.)

TABLE S-6		Indian Trust Resources	Environmental Justice	Cultural Resources	Recreation
A	MRG	<p><u>Listing</u>: Should have no effect on Federal Indian water rights. Nothing in the current biological opinion issued by the Service should affect or impair Indian Pueblo and Tribal trust resources on the Middle Rio Grande.</p> <p><u>Designation</u>: Will not occur; no additional impacts.</p>	<p><u>Listing</u>: Possible disproportionate impacts on minority and low income communities, particularly in Socorro County, stemming from supplemental water acquisition.</p> <p><u>Designation</u>: Will not occur; no additional impacts.</p>	<p><u>Listing</u>: Possible limited negative impacts stemming from changes in water operations and river channel management on historical and archeological sites. Insufficient information to assess possible impacts to sacred sites on Pueblo lands. Either no impact or possible positive impact on Pueblo use of Rio Grande water for ceremonial purposes.</p> <p><u>Designation</u>: Will not occur; no additional impacts.</p>	<p><u>Listing</u>: Possible loss of fishing or boating opportunities stemming from reservoir draw downs to maintain target flows. Possible loss of hunting or wildlife viewing opportunities if migratory waterfowl are negatively affected by water operations for maintaining target flows. Possible increase in recreation and wildlife viewing opportunities in the Rio Grande bosque due to habitat restoration.</p> <p><u>Designation</u>: Will not occur; no additional impacts.</p>
	LRG	No effect.	No effect.	No effect.	No effect.
	Pecos	No effect.	No effect.	No effect.	No effect.
B	MRG	<p><u>Listing with Designation</u>: Same as Alternative A (No Action).</p> <p><u>Designation Specifically</u>: Should have no effect on Federal Indian water rights. Some Middle Rio Grande Pueblos may benefit if designation leads to greater Federal support for Tribal habitat restoration activities, or focuses more management attention on the need to maintain water flow and quality on Pueblo lands.</p>	<p><u>Listing with Designation</u>: Same as Alternative A (No Action).</p> <p><u>Designation Specifically</u>: No additional environmental justice concerns.</p>	<p><u>Listing with Designation</u>: Same as Alternative A (No Action).</p> <p><u>Designation Specifically</u>: Possible benefits stemming from additional consultation requirement for actions in the river floodplain. However, additional consultation requirements may place an additional burden on Pueblo related consultations.</p>	<p><u>Listing with Designation</u>: Same as Alternative A (No Action).</p> <p><u>Designation Specifically</u>: Possible benefits stemming from additional focus on habitat conservation and restoration in the river floodplain. However, additional consultation requirements may place an additional burden on Pueblo related consultations.</p>

TABLE S-6 cont.		Indian Trust Resources	Environmental Justice	Cultural Resources	Recreation
B-2	MRG	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> Should have no effect on Federal Indian water rights. Exclusion of the PMAs located on Pueblo lands (Pueblos of Santo Domingo, Santa Ana, Sandia, and Isleta) may have the positive effect of assuring these four Pueblos that they have the relative freedom to manage their own river and riparian restoration efforts.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> No additional environmental justice concerns.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> Additional burden stemming from increased consultation requirements would be reduced for the Pueblo lands considered to be PMAs.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> Additional burden stemming from increased consultation requirements would be reduced for the Pueblo lands considered to be PMAs.</p>
C	MRG	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> No adverse impacts. Possible benefits stemming from increased Federal support for Tribal habitat conservation activities will not be present in the Cochiti reach.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> No additional environmental justice concerns.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> South of Angostura Diversion Dam, possible benefits stemming from additional consultation requirement for actions in the river floodplain. These benefits will not be present in the Cochiti reach.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> South of Angostura Diversion Dam, possible benefits stemming from additional focus on habitat conservation and restoration in the river floodplain. These benefits will not be present in the Cochiti reach.</p>

TABLE S-6 cont.		Indian Trust Resources	Environmental Justice	Cultural Resources	Recreation
D	MRG	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> Same as Alt. B, Indian Trust Resources unaffected by the exclusion of San Acacia reach.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> No additional environmental justice concerns.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> North of San Acacia Diversion Dam, possible benefits stemming from additional consultation requirement for actions in the river floodplain. These benefits will not be present in the San Acacia reach.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> North of San Acacia Diversion Dam, possible benefits stemming from additional focus on habitat conservation and restoration in the river floodplain. These benefits will not be present in the San Acacia reach.</p>
	MRG	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> Should have no effect on Federal Indian water rights. Some Middle Rio Grande Pueblos may benefit if designation leads to greater Federal support for Tribal habitat restoration activities, or focuses more management attention on the need to maintain water flow and quality on Pueblo lands.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> No additional environmental justice concerns.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> Possible benefits stemming from additional consultation requirement for actions in the river floodplain.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> Possible benefits stemming from additional focus on habitat conservation and restoration in the river floodplain.</p>
	LRG	No Indian trust issues identified.	No environmental justice issues identified.	No impacts.	No adverse impacts.
	Pecos	No Indian trust issues identified.	If future actions are taken to provide supplemental water for the silvery minnow, there may be disproportionate economic impacts on low income communities, particularly in De Baca County.	No adverse impacts.	Possible increase in recreation and wildlife viewing opportunities due to habitat protection and restoration in the river floodplain. If designation leads to future changes in water operations, possible negative impacts on recreational use of reservoirs and some loss of hunting opportunities.

Chapter 1. Purpose and Need for Action

Introduction

This Final Environmental Impact Statement (FEIS) examines the environmental impacts associated with designation of critical habitat for the endangered Rio Grande silvery minnow (silvery minnow) (see *Appendix D* for a list of scientific names). The silvery minnow was historically one of the most abundant and widespread fishes in the Rio Grande Basin, occurring from Española, New Mexico to the Gulf of Mexico. It was also found in the Pecos River, a major tributary of the Rio Grande, from Santa Rosa, New Mexico downstream to the confluence of the Pecos with the Rio Grande in Texas. The silvery minnow now occurs only in the Rio Grande in New Mexico, from Cochiti Dam downstream to the headwaters of Elephant Butte Reservoir, an area which is approximately five percent of its known historical range (see Figure 1-1). The Silvery minnow was listed in 1994 as endangered under the Federal Endangered Species Act of 1973 as amended (ESA) (59 FR 36988).

Critical habitat was first designated for the silvery minnow under the ESA in July 1999 (64 FR 36274). A number of parties brought suit against the Secretary of the Interior (Secretary) challenging the designation. On November 21, 2000, the United States District Court for the District of New Mexico, in Middle Rio Grande Conservancy District v. Babbitt, Civ. Nos. 99-870, 99-872, 99-1445M/RLP (Consolidated) set aside the July 9, 1999, critical habitat designation and ordered the Service to issue both an EIS under the National Environmental Policy Act (NEPA) and re-designate critical habitat for the silvery minnow. A draft EIS (DEIS) and this FEIS have been prepared on the redesignation, pursuant to the Court's order.

Purpose of the Action

The purpose of the action is to redesignate critical habitat for the Rio Grande silvery minnow, a species listed as endangered under the ESA. Section 4 of the ESA requires that the U.S. Fish and Wildlife Service (Service) designate critical habitat for endangered and threatened species to the maximum extent prudent (16 USC sec. 1533(b)).

The ESA defines critical habitat as (1) the specific areas occupied by the species in which are found those physical or biological features that are essential to the conservation of the species and which may require special management considerations or protection, and (2) specific areas outside the geographical areas occupied by the species which the Service determines are essential for the conservation of the species. (16 USC sec. 1532(5)). "Conservation of the species" refers to the use of all methods and procedures which are necessary to bring a species to the point at which the measures provided under the ESA are no longer necessary (16 USC sec. 1532(3)).

The process of designating critical habitat for the silvery minnow does not end with the identification of areas essential to the conservation of the species. The Service must also consider the economic and other relevant impacts of specifying a particular area as critical habitat and may exclude an area if the benefits of exclusion outweigh the benefits of inclusion. An area may not be excluded, however, if the Service determines, based on the best scientific and commercial data available, that the failure to designate the area as critical habitat will result in the extinction of the species (16 USC sec. 1533(b)(2)).

Need for the Action

Critical habitat designation may identify areas that are essential to the conservation of the Silvery minnow, that is, areas which are essential to the survival and recovery of the species. The silvery minnow now occupies only about five percent of its known historical range (Service 2001b). Population declines have occurred largely over the past century, in association with the rise of modern river management practices on the Rio Grande and the Pecos River. Throughout much of its range, decline of the silvery minnow has been attributed to modification of the flow regime and channel drying because of impoundments, water diversion for agriculture, stream channelization, and perhaps both interactions with non-native fish and decreasing water quality (Bestgen and Platania 1991; Service 1999;).

Population monitoring data indicates that the silvery minnow has continued to decline since its listing as endangered in 1994 (Dudley and Platania 2002). During 1999, over 95 percent of the silvery minnows captured occurred in the southern portion of the Middle Rio Grande in New Mexico, in the area between San Acacia Diversion Dam and Elephant Butte Reservoir (Service 2001b). This severe restriction in the species' range has made the minnow vulnerable to a single catastrophic event, such as a prolonged period of low or no flow (i.e., the loss of all surface water).

Designation of critical habitat may focus attention on the conservation needs of the silvery minnow. Designation identifies areas that are essential to the conservation of the minnow, regardless of whether they are currently occupied by the species. Critical habitat helps alert the public, and land and water management agencies to the importance of an area to the species' survival and recovery. Federal agencies are required to consult with the Service regarding actions they carry out, fund, or authorize that may have an adverse impact within designated critical habitat. Within areas occupied by the species, critical habitat designation also identifies areas that may require special management or protection.

Designating critical habitat does not, in itself, lead to the survival or recovery of the species. Critical habitat receives specific protections only through section 7 of the ESA, which requires that Federal agencies consult with the Service and ensure that actions that they authorize, fund or carry out do not destroy or adversely modify critical habitat (16 USC 1536(a)(2)). Nevertheless, by identifying areas essential to the conservation of the species, and

by requiring consultation, designation provides an opportunity for Federal agencies and their public and private partners to protect needed habitat.

The Service first designated critical habitat for the silvery minnow on July 6, 1999 (64 FR 36274). A number of parties challenged the Service's designation in court. On November 21, 2000, the United States District Court for the District of New Mexico, in Middle Rio Grande Conservancy District v. Babbitt, Civ. Nos. 99-870, 99-872, and 99-1445M/RLP (Consolidated), set aside the July 9, 1999 critical habitat designation and ordered the Service to issue both an EIS and a new proposed rule designating critical habitat within 120 days. A proposed rule, draft economic analysis, DEIS, final rule, final economic analysis, and this FEIS are being issued pursuant to that order.

Background

Rio Grande Silvery Minnow

The silvery minnow is one of seven species in the genus *Hybognathus* found in the United States (Pflieger 1980). It is a stout silvery minnow with moderately small eyes and a small, slightly oblique mouth. Adults may reach 3.5 inches in total length (Sublette et al. 1990). Its dorsal fin is distinctly pointed with the front of it located slightly closer to the tip of the snout than to the base of the tail. The fish is silver with emerald reflections. Its belly is silvery white; fins are plain; and barbels (or barbs) are absent (Sublette et al. 1990).

The species was historically one of the most abundant and widespread fishes in the Rio Grande Basin, occurring from Española, New Mexico, to the Gulf of Mexico. It was also found in the Pecos River, a major tributary of the Rio Grande, from Santa Rosa, New Mexico, downstream to its confluence with the Rio Grande in Texas (Pflieger 1980). The silvery minnow is now completely extirpated from the Pecos River and from the Rio Grande downstream of Elephant Butte Reservoir to the Gulf of Mexico (Bestgen and Platania 1991).

Decline of the species in the Middle Rio Grande¹ probably began in 1916 when the gates of Elephant Butte Dam were closed. Construction of Elephant Butte signaled the beginning of an era of dam construction on the main stem of the Rio Grande that resulted in the construction of five major dams within the silvery minnow's habitat (Shupe and Williams 1988). These dams allowed manipulation and diversion of the flow of the river. Often this manipulation resulted in the temporary drying of reaches of river, and the elimination of all fish. Diversion dams on the

¹For purposes of interstate compacts and formal river operation protocols, the Rio Grande is divided into the Upper Rio Grande, which extends from the river's headwaters in Colorado south through New Mexico to Fort Quitman, Texas, and the Lower Rio Grande, which extends south from Fort Quitman to the Gulf of Mexico. The phrase "Middle Rio Grande," as used in popular parlance, means loosely the middle of the Upper Rio Grande. As used in this FEIS, the phrase refers to the Rio Grande between Cochiti Dam and Elephant Butte Dam, in New Mexico.

Middle Rio Grande created barriers to upstream fish movement, dividing the river into a series of separate reaches. Concurrent with dam construction was an increase in the abundance of non-native fish, including species stocked into the reservoirs created by the dams (Sublette *et al.* 1990). Once established, these species often completely replaced the native fish fauna (Propst *et al.* 1987; Propst 1999).

Historically, the Middle Rio Grande was home to four other small native minnows--the speckled chub, the Rio Grande shiner, the phantom shiner, and the Rio Grande bluntnose shiner, (see *Appendix D* for a list of scientific names)--that are now either extinct or extirpated (Platania 1991). The silvery minnow is the only native minnow surviving today in the Middle Rio Grande.

The silvery minnow prefers shallow, slow-moving waters with a sand and silt substrate. Such habitat is generally associated with an aggrading and braided river that includes sidebars, oxbows, and backwaters (Bestgen and Platania 1991; Platania 1991). However, physical modifications to the Rio Grande over the last century, including the construction of dams and levees, and channelization of the main stem, have altered or eliminated much of this kind of habitat throughout the silvery minnow's historic range. Channelization projects have straightened and shortened mainstem river reaches, increased the velocity of the current, and altered riparian vegetation, instream cover, and substrate composition (Reclamation and Corps 2001b).

Although the silvery minnow is a hardy fish, capable of withstanding many of the natural stresses of the desert aquatic environment, the large majority of the individual silvery minnows live only one year (Bestgen and Platania 1991). Thus, a healthy annual spawn is key to the survival of the species. The spring runoff coincides with and may trigger the silvery minnow's spawn, and the eggs produced drift downstream in the water column (Smith 1999a; Platania and Dudley 2001). In the Middle Rio Grande, diversion dams allow for the in-channel passage of some eggs and larvae downstream, but prevent minnows from subsequently being able to move back upstream as runoff waters recede. During the irrigation season (March 1 to October 31), silvery minnows often become stranded in diversion channels, where they are unlikely to survive (Smith 1999a; Lang and Altenbach 1993). Diversion dams with unscreened intake canals may also trap silvery minnow fry and buoyant eggs (Smith 1998; 1999a).

It is believed that historically, the silvery minnow was able to withstand periods of drought primarily by retreating to pools and backwater refugia. Stretches of river that became completely dewatered during drying events were repopulated when flow conditions improved, both by the movement of minnows from areas that maintained sufficient flowing water and by the drift of eggs from upstream populations (Service 1999). When the present-day Middle Rio Grande dries and dams prevent upstream movement, the silvery minnow can become trapped in dewatered reaches and die. Complete mortality of silvery minnows was documented in specific isolated pools on the Middle Rio Grande during river intermittency in both 1996 and 1997 (Smith and Hoagstrom 1997, Smith 1999b). Studies documented 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 the fish community within isolated pools. For example, isolated pools found during drying events typically only lasted for 48 hours (Smith 1999b). Those pools that persisted longer lost greater than 81 percent of their estimated surface area and greater than 26 percent maximum depth within 48 hours. Moreover, disconnected pools receive no surface inflow, and depending on their location, size, and duration of the drying event, will usually result in the death of all fish (Platania 1993b). When no river flow occurs for a period of several days or longer, complete mortality of silvery minnows can be expected in isolated pools.

This becomes particularly significant for the silvery minnow below the San Acacia Diversion Dam on the Middle Rio Grande, where the majority of silvery minnows have been collected. In the river reaches north of the dam, return flows from irrigation and other diversions are routed back into the main stem of the river, which assures a fairly consistent flow in many areas. Downstream of San Acacia Diversion Dam, however, return flows continue largely in off-river conveyance channels (with a few exceptions at Brown's Arroyo and the 10-mile outfall of the Low Flow Conveyance Channel (LFCC)) until they enter Elephant Butte Reservoir. Furthermore, because the river is an aggrading system below San Acacia (i.e., the river bottom is rising due to sedimentation), the bed of the river is now perched above the bed of the 75-mile LFCC, which runs immediately adjacent and parallel to the river. Because of this physical configuration, waters in the main stem of the river are drained from the river bed into the LFCC.

Decision to List the Rio Grande Silvery Minnow as Endangered

The Rio Grande silvery minnow was included in the Service's Annual Notice of Review (56 FR 58804; November 21, 1991) as a Category 1 candidate species. At that time, a Category 1 candidate species was one for which substantial information was available on biological vulnerability and threats to support a proposal to list it as an endangered or threatened species. On March 1, 1993, the Service proposed to list the Silvery minnow as an endangered species, with critical habitat (58 FR 11821). After a review of the comments received in response to the proposed rule, the Service published the final rule to list the Silvery minnow as endangered on July 20, 1994 (59 FR 36988). Critical habitat was not designated at the time. Section 4(a)(3) of the ESA requires that the Secretary, to the maximum extent prudent and determinable, designate critical habitat at the time a species is listed as endangered or threatened. The Service's regulations (50 CFR 424.12(a)(2)) state that critical habitat is not determinable if information sufficient to perform required analyses of the impacts of the designation is lacking or if the biological needs of the species are not sufficiently well known to permit identification of an area as critical habitat. At the time the silvery minnow was listed, we found that critical habitat was not determinable because there was insufficient information to perform the required analyses of the impacts of the designation.

Original Designation of Critical Habitat

At the time of listing, the Service found that critical habitat was not determinable for the silvery minnow because there was insufficient information to perform the required analyses of the impacts of the designation (59 FR 36988).

In September 1994, the Service contracted for a draft economic analysis of the critical habitat proposed in 1993. Shortly thereafter, the Service held a meeting with representatives from the U.S. Bureau of Reclamation (Reclamation) and U.S. Army Corps of Engineers (Corps), the two Federal agencies with significant activities within the range of the silvery minnow and the proposed critical habitat. Representatives of other Federal, tribal, state, and local governments and agencies were also invited to attend.

The Service later notified the public that, because of the Congressional moratorium and funding rescission on final listing actions and designations of critical habitat imposed by Public Law 104-6 in April 1995, no work would be conducted on the economic analysis or on the final decision concerning critical habitat. However, the Service solicited comments from the public and agencies on the economic analysis for use when such work resumed. When the moratorium was lifted in the spring of 1996, the Service faced a national backlog of 243 proposed listings. To address the workload, the Service published a Listing Priority Guidance, which prioritized listing actions and identified the designation of critical habitat as the lowest priority on which to expend limited funding and staff resources (61 FR 24722).

On February 22, 1999, in Forest Guardians v. Babbitt, Civ. No. 97- 0453 JC/DIS, the United States District Court for the District of New Mexico ordered the Service to publish a final determination with regard to critical habitat for the Silvery minnow within 30 days of the order. The deadline was later extended by the court to June 23, 1999 (120 days). On July 6, 1999, the Service published a final rule (64 FR 36274) designating critical habitat the stretch of the Middle Rio Grande from Cochiti Dam south to the San Marcial Railroad Bridge, a distance of 163 miles, as critical habitat for the silvery minnow.

Several parties--including the Middle Rio Grande Conservancy District; the New Mexico State Engineer, the New Mexico Interstate Stream Commission, the New Mexico Attorney General, Forest Guardians, Defenders of Wildlife, and the Southwest Environmental Center--filed suit objecting to the designation. On November 21, 2000, the U.S. District Court for the District of New Mexico ordered the Service to issue within 120 days both an EIS and a new proposed rule designating critical habitat under the ESA. On April 25, 2001, the Court issued an order denying the Service an extension of time and instructing the agency to continue to work on a formal designation with the urgency the work deserves.

Present Proceedings to Prepare an EIS and Redesignate Critical Habitat

Overview of the Scoping Process

The Service announced its notice of intent to prepare an EIS and gave notice of public scoping meetings in the Federal Register on April 5, 2001 (66 FR 18107). The Service mailed almost 500 letters to individuals, agencies, and organizations to inform them of the scoping process. Notices of meetings were placed in several newspapers of general circulation in New Mexico and Texas. The Federal Register notice, letters, and newspaper notices also invited the public to submit written comments and asked that those comments be submitted by June 4, 2001.

Public scoping meetings were held on April 17, 2001, in Albuquerque, on April 23, 2001, in Carlsbad, New Mexico and on April 24, 2001, in Fort Stockton, Texas. A meeting was also held on April 30, 2001 in Socorro, New Mexico. A total of one hundred and thirty five people attended these meetings, with some people attending more than one meeting. Over thirty people made oral comments at the meetings and thirty written comments were submitted, including comments from five of the six Indian Pueblos that are located in the Middle Rio Grande Valley.

During the scoping process that took place in April, May, and early June, 2001, members of the public submitted comments on possible alternatives for the designation and raised a number of issues. The Service's New Mexico Ecological Services Field Office in Albuquerque, took these questions, comments, and suggestions into consideration as it developed alternatives for the designation of critical habitat for the silvery minnow and identified potential impacts of the different alternatives for study in the EIS.

At a meeting of the Silvery minnow Recovery Team (Team) on September 12, 2001, the Service and EIS contractor personnel briefed the Team on the status of the EIS and discussed possible alternatives for designation. Because of the nature of the topic and the historical range of the minnow, members of the Rio Grande Fishes Recovery Team, the six Indian Pueblos on the Middle Rio Grande, and irrigation districts on the Pecos were invited to the meeting. The meeting took place at the offices of U.S. Fish and Wildlife's Service's New Mexico Ecological Services Field Office in Albuquerque, New Mexico. Fourteen individuals from outside the Service and EIS contractor staff attended. The Service distributed summaries of the September 12 discussion, and invited comments and suggestions on alternative designations and the submission of information on possible biological, cultural, social, and economic impacts. The Service received 10 letters in response to this request for information.

In our continuing efforts as the lead the Federal agency for compliance with NEPA (40 CFR 1501.5; 40 CFR 1501.6), we requested the expert review of the preliminary predecisional draft EIS and preliminary predecisional draft economic analysis from our cooperating agencies or from others agencies that had jurisdiction by law or special expertise on matters relating to the conservation of the silvery minnow. This list of agencies included: the U.S. Bureau of Reclamation, U.S. Bureau of Indian Affairs, National Park Service, U.S. Army Corps of

Engineers, New Mexico Department of Game and Fish, Texas Parks and Wildlife Department, New Mexico Interstate Stream Engineer, Chaves County, New Mexico, and the Middle Rio Grande Conservancy District.

In preparing the DEIS and FEIS, comments received by the Service during the comment period on the previous proposed rule (58 FR 11821) for designation of critical habitat were reviewed. The Service and EIS contractor also reviewed the scoping reports for the Upper Rio Grande Water Operations Review and EIS, and public comments on the Environmental Assessment for Reclamation's Supplemental Water Program. These are documents that were prepared regarding actions which directly or indirectly involve consideration of the status of the silvery minnow in the reaches of the Rio Grande that it currently occupies.

Some of the issues raised during scoping pertained to the development of the rule rather than to the analysis of impacts. It was suggested, for example, that the proposed rule identify with specificity the primary constituent elements. The scope and nature of the primary constituents are identified and discussed in the proposed rule to designate critical habitat for the silvery minnow.

A number of comments made during scoping pertained to the impacts on and concerns of particular parties. Most of these were rephrased into broader issues and are stated below.

Issues Raised During Scoping

The following issues and concerns, identified during the scoping process, are considered in this FEIS:

General Considerations

Scope of the EIS. Commentors reminded the Service that direct, indirect, and cumulative impacts of critical habitat designation should be evaluated. An appendix of available data sources for the silvery minnow should be provided.

"Baseline" approach to economic impacts. Commentors reminded the Service that the Tenth Circuit, in New Mexico Cattle Growers Ass'n v. U.S. Fish and Wildlife Service, 248 F.3d 1277 (10th Cir. 2001), held that the economic analysis required by the ESA must be an analysis of all the economic impacts of a designation, regardless of whether those impacts are attributable co-extensively to other causes.

Selection of alternatives. Commentors stated that the identification of alternatives and the scope of EIS review should: 1) comport with relevant court orders regarding designation of critical habitat for the silvery minnow; 2) reflect other recent interpretations of the ESA by the Federal courts; and 3) recognize the hydrologic realities of the Middle Rio Grande, and the State of New Mexico's responsibilities regarding river waters.

Range of alternatives. Commentors stated that the alternatives within the Service's discretion fall between a *de minimus* designation (i.e., designed to prevent extinction) and the designation necessary for the conservation of the minnow. The Service may eliminate from detailed study a significant number of alternatives falling outside of these bounds.

Consultation with Indian Pueblos. The Service should abide by Secretarial Order 3206 when preparing the EIS, and should consult with the Pueblos regarding any activities that may affect Pueblo trust resources. The EIS should ensure that the Pueblos do not bear the burden for conservation of the silvery minnow, and should emphasize regulation of non-Indian activities for the necessary conservation measures.

Silvery Minnow

Reintroduction. Some commentors asked the Service to state in the EIS whether it intends to augment any existing populations of silvery minnow or reintroduce the silvery minnow into critical habitat, and to analyze the effect of such actions on Pueblo and other lands.

Recruitment. Some commentors stated that more information about the habitat requirements for successful hatching and recruitment of silvery minnows is needed. Studies should be conducted to define critical habitat features and ecological interactions for increasing recruitment.

Species interactions on the Middle Rio Grande. Some commentors asked that an analysis of fish competition and predation in the Middle Rio Grande be conducted to determine possible threats to the silvery minnow.

Historic Flows of the Rio Grande. Some commentors stated that temporary interruption of surface flow in the Rio Grande is a natural and historical occurrence, and that this indicates that the minnow is adapted to periodic drying of the river.

Compatibility with Pecos bluntnose shiner. Some commentors stated that the Service needs to establish whether the reintroduction of the silvery minnow in the Pecos River would interfere with recovery and conservation of the Pecos bluntnose shiner.

Interaction with plains minnow. Some commentors noted that there are difficulties in distinguishing the silvery minnow from its relative, the plains minnow. The RGSM Recovery Plan identifies hybridization as a possible cause for the silvery minnow's demise in the Pecos River. Others believe that until the interaction between the silvery minnow and other minnows is understood, it is not feasible to reintroduce the silvery minnow into the Pecos River.

Non-traditional habitats. Some commentors stated that the Service needs to consider whether sufficient sampling of non-traditional habitats (e.g., irrigation canals, conveyance

channels, small tributaries, reservoirs) has been conducted to rule them out as potential minnow habitat.

Alternatives

No action alternative. Some commentors raised the question of whether a “No Action” alternative is realistic, given the legal requirement that the Service designate critical habitat for listed species.

Unoccupied reaches. Some commentors thought that designation of any river reach outside the occupied areas was not justified. Others thought it was important to designate unoccupied areas within the historical range for recovery purposes.

Middle Rio Grande exclusions. As an alternative to the first (1999) proposed designation of the Middle Rio Grande, the Service should consider excluding specific reaches in which the conditions for favorable minnow habitat do not exist.

Pueblo Indian lands. The Service should not designate critical habitat on Pueblo lands. The Service must recognize Pueblo sovereignty. Independent Pueblo management plans to conserve the silvery minnow may substitute for designation on Pueblo lands.

Length of river. The length of river needed by the silvery minnow to carry out its life cycle (longitudinal connectivity) needs to be considered in the development of alternatives.

Width of corridor. Some commentors stated that the floodplain on either side of the river channel should be included, citing research that shows that the silvery minnow needs periodic flooding of the floodplain. The 100-year floodplain was suggested.

Relocation or captive rearing. The Service should consider trapping and relocation or captive rearing operations as alternatives to designation on the Middle Rio Grande.

Rio Grande in Texas. Some commentors were opposed to designation of critical habitat in Texas. Some stated that there is no biological basis for reintroducing the silvery minnow in the Rio Grande in Texas, given that the reach has not been occupied for over forty years and may not be viable habitat. Commentors also stated that reintroduction in Texas would result in severe economic consequences for both agricultural and municipal water users and deleterious impacts on international water delivery obligations.

Pecos River in New Mexico. Some commentors were opposed to designation of critical habitat on the Pecos River in New Mexico. Some stated that the present biotic, flow, and habitat conditions in the Pecos River make it unsuitable for the silvery minnow. Any consideration of this river as either critical habitat or a site for establishment of additional populations must address these factors.

Pecos River in Texas. Designating critical habitat on the Pecos River in New Mexico could affect water rights on the Pecos in Texas. A substantial portion of the economy of the area depends on the availability of water.

Impacts

Compact obligations. Some commentors stated that designation may adversely impact the State of New Mexico's ability to comply with the Rio Grande Compact and the Pecos River Compact, and the Federal government's ability to comply with international treaties.

International obligations. Under the Convention of May 21, 1906, the U.S. has an obligation to deliver 60,000 acre-feet of Rio Grande water to Mexico annually. A shortfall in deliveries is permissible only during years of extreme drought. Some commentors also noted that any efforts to reestablish the silvery minnow within the international border reach of the Rio Grande would require an international agreement with Mexico.

Indian trust resources. The prior and paramount nature of Tribal water rights must be recognized. The Service must consider impacts of designation on Tribal water rights. The EIS should address any effects that designation of critical habitat would have on Tribal lands, and on Tribal uses of water for farming, economic development, ceremonial purposes, or other activities. Some Pueblo commentors ask that in the analysis of impacts, each Pueblo be considered its own separate economic unit.

Source of supplemental water. The Service should state whether the government plans to purchase or lease water rights to maintain flows for the silvery minnow. The EIS should include discussion of where, how, and from whom water will be obtained.

Growth and water scarcity. In analyzing the effects of designation, the Service must consider the scarcity of water in the Rio Grande Basin, and the increasing demand likely to result from continued urban growth in the region.

Agriculture. Many commentors stated that designation of critical habitat will result in the loss of irrigation water to farmers. The impacts on agricultural production for each designated reach and/or each separate county should be evaluated. This should include impacts on domestic livestock using irrigated pastures.

Economic valuation. Some commentors stated that the previous economic analysis assigned virtually no value to local irrigated agriculture. The real economic cost of gross value production should be used in the economic analysis, including the purchase and/or sale of labor, seed, fertilizer, fuels, vehicles, etc.

Private lands and parties. Some commentors stated that the EIS should discuss how critical habitat designation could affect private lands and private parties, directly or indirectly.

For example, some believe that restrictions on the actions of Federal agencies will affect non-Federal actors because water passes through Federal reservoirs. The Service must state how landowners whose property becomes part of critical habitat will be compensated.

Flood control. The Service must consider the impacts of designation of critical habitat on all flood control and levee maintenance activities carried out by Federal agencies. Noting that ninety percent of the town of Socorro is below the floodplain, some commentors asked whether critical habitat designation would affect the building or maintenance of a levee system to protect the town.

Flow regimes. Some commentors stated that supplemental flows in the Rio Grande will result in increased water velocities. The Service should address the impacts of higher velocities, particularly regarding the drift distance of silvery minnow eggs and the effects of faster flows on aquatic habitat.

Water quality. Concern was expressed about the impact of treated wastewater and raw sewage entering the Rio Grande. Another commentor pointed out typical farming practices do not degrade return flows to the Rio Grande.

Removing the plains minnow. The Service should state whether it is considering elimination of the plains minnow from the Pecos. If so, it should describe what methods would be used to eradicate the species, how thorough the removal process would be, and how it would be monitored. The EIS should address potential impacts to the Pecos River biotic community as a result of removing the species.

Noxious and invasive species. The impacts of the designation on programs to control noxious weeds and invasive plant species such as saltcedar should be evaluated. The Service should determine the impacts of saltcedar, and of saltcedar removal programs, on the minnow and its habitat. If designation requires that removal programs be curtailed, the Service should consider the impacts of such a requirement on other endangered, threatened, and candidate species.

Wildlife habitat. If the Service requires that supplemental water be obtained and kept in the Rio Grande to benefit the silvery minnow, habitat for migratory birds, resident species of mammals, insects, and plants dependent on shallow ground water sustained by irrigation would be impacted. If the Service uses water from Bosque del Apache National Wildlife Refuge to secure flows, production of winter forage for migratory cranes and waterfowl may be reduced.

Cultural concerns. The EIS should consider the impact of the proposed designation on the Pueblo Indian culture, religion, and spirituality.

Communities on the Pecos. Commentors noted that there is already a problem with water deliveries on the Pecos River. Some stated that reintroducing another endangered fish

would present even more difficulties for the agricultural economies of the affected counties in New Mexico and Texas. Also, restrictions would impact the cities' and counties' exercise of their water rights and their community development plans, resulting in adverse economic impacts.

Retiring irrigated land. An existing study, "Economic Effects of Irrigated Land Retirement in the Pecos River Basin," should be reviewed for the EIS and proposed rule.

Supplementing surface water supplies. The Service should consider the pumping of groundwater to maintain surface flows. Some commentors suggested that the Service consider developing artesian wells near Grandfalls and Imperial, Texas, to supplement water in the Pecos River for the minnow.

Farming way of life. The Service should consider in the EIS how designation may impact rural agricultural communities, and farming as a way of life.

Recreational values. The value of open space, trails, and recreational activities such as fishing should be considered.

Overview of the Comment Period for the DEIS

In the June 6, 2002, proposed rule and DEIS, we requested all interested parties to submit comments or information concerning the designation of critical habitat for the silvery minnow (67 FR 39206). During the comment period, we held public hearings in Socorro and Albuquerque on June 25, and 26, 2002, respectively. We published newspaper notices inviting public comment and announcing the public hearings in the following newspapers in New Mexico: Albuquerque Journal, Albuquerque Tribune, Socorro Defensor Chieftain, Sante Fe New Mexican, Las Cruces Sun. Transcripts of these hearings are available for inspection. The comment period originally scheduled to close on September 4, was extended until October 2, 2002 (67 FR 57783). We contacted all appropriate State and Federal agencies, Tribes, county governments, scientific organizations, and other interested parties and invited them to comment. On June 6, 2002, we hosted a teleconference to provide a short presentation and answer questions by reporters on all aspects of the proposed critical habitat designation, the draft economic analysis, and DEIS. We also provided notification of these documents through email, telephone calls, letters, and news releases faxed and/or mailed to affected elected officials, media outlets, local jurisdictions, Tribes, and interest groups. We also published all of the associated documents on our Region 2 Internet site following their release on June 6, 2002.

We solicited five independent experts who are familiar with this species to peer review the proposed critical habitat designation. Only one of the peer reviewers submitted comments, and these supported the proposed designation. We also received a total of 34 oral and 54 written comments. Of those oral comments, 10 supported critical habitat designation and 24 were opposed to designation. Of the written comments, 17 supported critical habitat designation, 22

were opposed to designation, and 15 were neutral or provided additional information. We reviewed all comments received for substantive issues and new data regarding critical habitat and the silvery minnow. We addressed and considered all comments received during the comment periods and public hearing testimony. Comments of a similar nature were grouped into issues and responses were provided. The comments and responses can be found in Appendix G.

Permits Required for Implementation

No permits are required for critical habitat designation. Designation takes place through a rulemaking process under the Administrative Procedures Act and the ESA. If the Service decides in the future to reintroduce the Silvery minnow into currently unoccupied reaches of the Rio Grande or the Pecos, it would likely do so through future rulemaking procedures. For example, the Service could establish an experimental population, under section 10(j) of the ESA, in currently unoccupied reaches of the Rio Grande or the Pecos, but first they must issue a proposed regulation and receive public comment on the proposal prior to publishing a final regulation. In addition, the Service would need to comply with NEPA.

Related Environmental Planning

Several other environmental planning initiatives that relate to ESA protections on the Rio Grande and the Pecos Rivers are pending. Two planning efforts on the Rio Grande are the Middle Rio Grande Endangered Species Act Collaborative Program (ESA Work Group) and the Upper Rio Grande Basin Water Operations (URGWOP) Review. As part of the URGWOP Review, a series of public meetings were held in 2002 regarding a draft environmental impact statement being prepared by Reclamation, the Corps, and the New Mexico Interstate Stream Commission (NMISC) on Rio Grande water operations from southern Colorado to Fort Quitman, Texas. One major initiative on the Pecos in New Mexico is the Pecos Water Operations Review and Environmental Impact Statement. These and other planning efforts are described further in Chapter 3, *Affected Environment*.

Chapter 2. Alternatives Including the Proposed Action

Development of Alternatives

When designating critical habitat for a species under the ESA, the Service identifies areas that are essential for the conservation of the species. Areas that are essential to the conservation of the species are areas needed to bring the species to the point that the protections of the ESA are no longer necessary (16 USC sec. 1532(3)). In other words, the Service must consider areas that are essential for the species not just to survive but also to recover and be removed from the list of endangered and threatened species.

An area that is occupied by the species at the time of listing may be included in critical habitat designation if the area contains the physical and biological features that are essential to the conservation of the species and if that area requires special management considerations or protection. Specific areas outside the geographical area occupied by the species may also be designated as critical habitat if the Service determines that such areas are essential for the conservation of the species (16 USC sec. 1532(5)). Designation is based on the best scientific and commercial data available, after taking into consideration the economic and any other relevant impacts of specifying any particular area as critical habitat. Areas may be excluded from designation if it is determined that the benefits of exclusion outweigh the benefits of including the area, provided the exclusion will not result in the extinction of the species. The ESA precludes designation of the entire geographical area which can be occupied by the species except under circumstances to be determined by the Secretary (16 USC sec. 1532(5)(C)).

The selection of alternatives for critical habitat designation for the silvery minnow was based to a substantial extent on the Rio Grande Silvery Minnow Recovery Plan, approved by the Regional Director for Region 2 of the Service on July 8, 1999 (Service 1999). The Recovery Plan was prepared by the Rio Grande Silvery Minnow Recovery Team, which includes Federal, State, local, tribal, university, and non-profit representatives. The goals of the Recovery Plan are to stabilize and enhance populations of silvery minnow and its habitat in the Middle Rio Grande Valley, and to reestablish the silvery minnow in other areas of its historic range (Service 1999).

In deciding on the alternatives to be studied, the Service considered the presence of physical and biological features essential to survival and recovery. These physical and biological features are known in the regulations implementing the ESA as “primary constituent elements” (50 CFR 424.12). Such requirements include, but are not limited to, space for individual and population growth, and for normal behavior; food, water, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, or rearing of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distribution of a species. Known primary constituent elements are to be included in the final rule designating critical habitat (50 CFR 424.12)

The primary constituent elements the Service proposes for the silvery minnow are:

1. A hydrologic regime that provides sufficient flowing water with low to moderate currents capable of forming and maintaining a diversity of aquatic habitats, such as, but not limited to: backwaters (a body of water connected to the main channel, but with no appreciable flow), shallow side channels, pools (that portion of the river that is deep with relatively little velocity compared to the rest of the channel), eddies (a pool with water moving opposite to that in the river channel), and runs (flowing water in the river channel without obstructions) of varying depth and velocity which are necessary for each of the particular silvery minnow life-history stages (e.g., the silvery minnow requires habitat with sufficient flows from early spring (March) to early summer (June) to trigger spawning, flows in the summer (June) and fall (October) that do not increase prolonged periods of low or no flow; and a relatively constant winter flow (November to February)) in appropriate seasons;
2. The presence of eddies created by debris piles, pools, or backwaters, or other refuge habitat (e.g., connected oxbows or braided channels) within unimpounded stretches of flowing water of sufficient length (i.e., river miles) that provide a variation of habitats with a wide range of depth and velocities;
3. Substrates of predominantly sand or silt; and
4. Water of sufficient quality to maintain natural, daily, and seasonally variable water temperatures in the approximate range of greater than 1°C (35°F) and less than 30°C (85°F) and reduce degraded water quality conditions (decreased dissolved oxygen, increased p.H., etc.).

In selecting the alternative designations of critical habitat to be studied in this FEIS, the Service considered the comments received in the previous rulemaking on critical habitat designation, the comments received during scoping for the current rulemaking, comments and suggestions of the Recovery Team, and the expertise and experience of the Service and other parties interested in silvery minnow survival and recovery efforts.

The primary goals of the silvery minnow Recovery Plan are to: 1) stabilize and enhance populations of the silvery minnow and its habitat in the middle Rio Grande valley; and 2) reestablish the silvery minnow in at least three other areas of its historic range (Service 1999). The Service believes that the second recovery goal can be achieved by using the authorities under section 10(j) of the ESA. Consequently, the Service developed a conservation strategy that they believe is consistent with the species' Recovery Plan. The conservation strategy is to reestablish the silvery minnow, under section 10(j) of the ESA, within areas of its historic ranges possibly including the river reach in the middle Pecos River, the river reach in the lower Rio Grande, and other unoccupied areas. Any future recovery efforts, including repatriation of the species to areas of its historic range must be conducted in accordance with NEPA and the ESA.

An overview of the process to establish an experimental population under section 10(j) of the ESA is described below.

Section 10(j) of the ESA enables the Service to designate certain populations of federally listed species that are released into the wild as "experimental." The circumstances under which this designation can be applied are: 1) the population is geographically separate from non-experimental populations of the same species (e.g., the population is reintroduced outside the species' current range but within its probable historic range); and 2) the Service determines that the release will further the conservation of the species. Section 10(j) is designed to increase the flexibility in managing an experimental population by allowing the Service to treat the population as threatened, regardless of the species' status elsewhere in its range. Threatened status allows more discretion in developing and implementing management programs and special regulations for a population and allows the Service to develop any regulations they consider necessary to provide for the conservation of a threatened species. In situations where there are experimental populations, certain section 9 prohibitions (i.e., harm, harass, capture) that apply to threatened species may no longer apply, and a special rule can be developed that contains the prohibitions and exceptions necessary and appropriate to conserve that species. This flexibility allows the Service to manage the experimental population in a manner that will ensure that current and future land, water, or air uses and activities should not be restricted and the population can be managed for recovery purposes.

Section 10(j) of the ESA requires that when an experimental population is designated, the Secretary determines whether that population is either essential or nonessential to the continued existence of the species, based on the best available information. Nonessential experimental populations located outside National Wildlife Refuge System or National Park System lands are treated, for the purposes of section 7 of the ESA, as if they are proposed for listing. Thus, for nonessential experimental populations, only two provisions of section 7 would apply outside National Wildlife Refuge System and National Park System lands: section 7(a)(1), which requires all Federal agencies to use their authorities to conserve listed species; and section 7(a)(4), which requires Federal agencies to informally confer with the Service on actions that are likely to jeopardize the continued existence of a proposed species. Section 7(a)(2) of the ESA, which requires Federal agencies to ensure that their activities are not likely to jeopardize the continued existence of a listed species, would not apply except on National Wildlife Refuge System and National Park System lands. Experimental populations determined to be "essential" to the survival of the species would remain subject to the consultation provisions of section 7(a)(2) of the ESA.

In order to establish an experimental population the Service must issue a proposed regulation and receive public comment on the proposal prior to publishing a final regulation. In addition, the Service would need to comply with NEPA. Also, their regulations require that, to the extent practicable, a regulation issued under section 10(j) of the ESA, represents an agreement between the Service, the affected State and Federal agencies, and persons holding any

interest in land that may be affected by the establishment of the experimental population (see 50 CFR §17.81 (d)).

The areas selected as alternatives have been evaluated for economic and other impacts. The Service considered the draft and final economic analysis, and the DEIS, including comments received on the drafts, when conducting a final evaluation under section 4(b)(2) of the ESA to determine whether the benefits of excluding any portion of the area proposed for designation outweigh the benefits of specifying the area as part of critical habitat (16 USC 1533(b)(2); 50 CFR 424.19). The Service also considered any management plans that were submitted during the comment period on the proposed designation; see the discussion of management plans below. As described in the final rule for the designation of critical habitat, we have altered our preferred alternative to reflect our evaluation under section 4(b)(2). A new sub-alternative (Sub-alternative B-2), described below, has been developed as a revision to the preferred alternative. Sub-alternative B-2 is different from Alternative B in that it excludes lands from the designation under section 4(b)(2) of the ESA.

The Service is required by the ESA to designate critical habitat by regulation (i.e., rule) (16 USC sec. 1533(a)(3)). No less than 90 days before the effective date of the rule, the Service must publish a general notice and the complete text of the proposed rule in the Federal Register (16 USC sec. 1533(b)(5)). In this instance, the proposed rule was published at the same time that the notice of availability of the DEIS was published. The Service sent copies of the proposed rule to the state agency in each state in which the species was believed to occur historically, and to each county in which the species is currently believed to occur, and invited the comment of the agency or county. In addition, notice was given to appropriate professional scientific organizations and a summary of the proposed rule was published in a newspaper of general circulation in each area of the United States in which the species is believed to occur. Hearings were held on the proposed rule for the designation of critical habitat in June 2002 (Service 2002).

The Secretary of the Interior is required to publish the final rule designating critical habitat to the maximum extent prudent, based on such data as may be available (16 USC sec. 1533(b)(6)(C)). The publication in the Federal Register is to include a summary on which the rule is based and the relationship of the data to the rule. The summary must also, to the maximum extent practicable, include a brief description and evaluation of the activities (whether public or private) which, in the opinion, of the Secretary, if undertaken may adversely modify such habitat, or may be affected by the designation (16 USC sec. 1533 (b)(8)).

Once a proposed rule to designate critical habitat is published, Federal agencies are required to *confer* with the Service on actions which are likely to result in the destruction or adverse modification of critical habitat (16 USC sec. 1536(a)(4)). Once critical habitat is designated, Federal agencies must *consult* with the Service and ensure that any action they authorize, fund, or carry out is not likely to result in the destruction or adverse modification of critical habitat. This requirement is in addition to the Federal agencies' obligation to ensure that

the actions they authorize, fund, or carry out do not jeopardize the continued existence of the species (16 USC sec. 1536(a)(2)).

The procedural requirements for conference or consultation are imposed by the ESA and the regulations found in Title 50, Part 402 of the Code of Federal Regulations. The Service has also developed an Endangered Species Consultation Handbook, adopted in March 1998, to assist Service employees in conducting consultations under the ESA. The procedures for consultations are described in the beginning of Chapter 4 of this EIS.

Consideration of Management Plans

Section 4(b)(2) allows the Service to exclude areas from critical habitat designation if the benefits of such exclusion outweigh the benefits of specifying such areas as critical habitat, unless exclusion would result in the extinction of the species. If excluding an area from a critical habitat designation will provide substantial conservation benefits, and at the same time including the area fails to confer a counter-balancing benefit to the species, then the benefits of excluding the area from critical habitat outweigh the benefits of including it.

The Service has analyzed the benefits of including the Pueblos of Santa Domingo, Santa Ana, Sandia, and Isleta as part of the critical habitat designation and the benefits of excluding these areas, and determined that the benefits of exclusion outweigh those of inclusion. A major factor in the analysis described below is that, even if excluded, these river reaches owned and managed by the Pueblos will nonetheless receive special management and protection through the special management plans, which were submitted by these Pueblos during the open comment period for the proposed rule. Under these management plans, the silvery minnow will benefit from monitoring, restoration, enhancement, and survey efforts. The Service has also determined that exclusion would not result in the extinction of the species. A summary of the four Tribal management plans can be found in Appendix F.

Benefits of Inclusion

There are few additional benefits of including the Pueblos of Santa Domingo, Santa Ana, Sandia, and Isleta in this critical habitat designation beyond what will be achieved through the implementation of their management plans. The principal benefit of any designated critical habitat is that activities in and affecting such habitat require consultation under section 7 of the Act. Such consultation would ensure that adequate protection is provided to avoid destruction or adverse modification of critical habitat. If adequate protection can be provided in another manner, the benefits of including any area in critical habitat are minimal. The economic analysis found that the Bureau of Indian Affairs (BIA) has no consultation history for the silvery minnow (i.e., no consultations have been conducted since the species was listed). However, the economic analysis found that, consultations may occur in the future for water trades or voluntary leasing that would benefit the silvery minnow. The economic analysis estimated 6 informal consultations may occur over the next 20 years, resulting from these beneficial water trades, but

that no formal consultations were likely. These consultations would occur regardless of whether critical habitat is designated, because the species occupies these four areas. Section 7 consultation under the jeopardy standards will still be required for activities affecting the silvery minnow. Beyond these informal consultations, we do not expect any additional consultations.

Although we believe the likelihood of additional consultations is small, consultation requirements under section 7 of the ESA would be triggered as a result of the funding or permitting processes administered by the Federal agency involved. The benefit of critical habitat designation would ensure that any actions funded by or permits given by a Federal agency would not likely destroy or adversely modify any critical habitat. Without critical habitat, projects would still trigger consultation requirements under the ESA because the silvery minnow is currently present in the middle Rio Grande. Given that no consultations have occurred with the BIA or the Pueblos since the silvery minnow was listed as endangered in 1994 and the overall low likelihood of Federal projects being proposed in these areas, the Service believes there is almost no regulatory benefit of a critical habitat designation in this area. Consequently, the designation of critical habitat in these areas would provide minimal, if any, regulatory benefit to the species.

Another possible benefit is that the designation of critical habitat can serve to educate the public regarding the potential conservation value of an area, and this may focus and contribute to conservation efforts by other parties by clearly delineating areas of high conservation value for certain species. Any information about the silvery minnow and its habitat that reaches a wide audience, including other parties engaged in conservation activities, would be considered valuable. However, the Pueblos are already working with the Service to address the habitat needs of the species. Further, these areas were included in the proposed designation, which itself has reached a wide audience, and has thus provided information to the broader public about the conservation value of these areas. Thus, the educational benefits that might follow critical habitat designation, such as providing information to the BIA, Reclamation, or Pueblos on areas that are important for the long-term survival and conservation of the species, have already been provided by proposing these areas as critical habitat. Alternatively, the same or greater educational benefits will be provided to these lands if they are excluded from the designation, because the management plans provide for conservation benefits above any that would be provided by designating critical habitat. For example, the educational aspects are likely greater for these areas if they are not included in the designation because the Pueblos will continue to work cooperatively toward the conservation of the silvery minnow, which will include continuing, initiating, and completing scientific studies (see discussion below). For these reasons, then, we believe that designation of critical habitat would have few, if any, additional benefits beyond those that will result from continued consultation under the jeopardy standard.

Benefits of Exclusion

The benefits of excluding the Pueblos of Santa Domingo, Santa Ana, Sandia, and Isleta from designated critical habitat are more significant. The proposed critical habitat designation

included 29.5 mi (47.5 km) of river through these areas. We believe that not designating critical habitat on these areas would have substantial benefits including: (1) the furtherance of our Federal Trust obligations and our deference to the Pueblos of Santa Domingo, Santa Ana, Sandia, and Isleta to develop and implement Tribal conservation and natural resource management plans for their lands and resources within the Rio Grande ecosystem, which includes the silvery minnow and its habitat; (2) the establishment and maintenance of effective working relationships to promote the conservation of the silvery minnow and its habitat; (3) the allowance for continued meaningful collaboration and cooperation in scientific studies to learn more about the life history and habitat requirements of the species; and (4) providing conservation benefits to the Rio Grande ecosystem and the silvery minnow and its habitat that might not otherwise occur.

As detailed above, we met with Pueblos and Tribes to discuss how each might be affected by the designation of critical habitat. During the open comment period, we established effective working relationships with the Pueblos of Santa Domingo, Santa Ana, Sandia, and Isleta. As part of our relationship, we provided technical assistance to each of these four Pueblos to develop voluntary measures to conserve the silvery minnow and its habitat on their lands. These voluntary measures are contained within special management plans that each of these Pueblos submitted during the open comment period (see discussion above). These actions were conducted in accordance with Secretarial Order 3206, “American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act” (June 5, 1997); the President's memorandum of April 29, 1994, “Government-to-Government Relations with Native American Tribal Governments” (59 FR 22951); Executive Order 13175; and the relevant provision of the Departmental Manual of the Department of the Interior (512 DM 2). We believe that these Pueblos should be the governmental entities to manage and promote the conservation of the silvery minnow on their lands. During our meetings with each of these Pueblos, we recognized and endorsed their fundamental right to provide for resource management activities, including those relating to the Rio Grande ecosystem. Much of our discussions centered on providing technical assistance to the Pueblos to develop, continue, or expand natural resource programs such that the designation of critical habitat for the silvery minnow would likely be unnecessary.

We find that other conservation benefits could be provided to the Rio Grande ecosystem and the silvery minnow and its habitat by excluding the Pueblos of Santa Domingo, Santa Ana, Sandia, and Isleta from the designation. For example, as part of maintaining an effective working relationship with each Pueblo, conservation benefits, including silvery minnow augmentation, population and habitat monitoring, silvery minnow research, habitat restoration, and the development of water leases may be possible. In fact, during our discussions with each of the Pueblos, we were informed that critical habitat would be viewed as an intrusion on their sovereign abilities to manage natural resources in accordance with their own policies, customs, and laws. To this end, we found that each Pueblo would prefer to work with us on a Government-to-Government basis. For these reasons, we believe that our working relationships with the Pueblos of Santa Domingo, Santa Ana, Sandia, and Isleta would be maintained if they

are excluded from the designation of critical for the silvery minnow. We view this as a substantial benefit.

Proactive voluntary conservation efforts are necessary to promote the recovery of the silvery minnow (Service 1999). Consideration of this issue is especially important in areas where the status of the species is uncertain or unknown. Recovery of the silvery minnow will require access to all areas of the middle Rio Grande and permission for monitoring and other efforts (e.g., augmentation of the existing population, water leasing, etc). Because we have not had permission from the Pueblos within the Cochiti reach, surveys to determine the status of the silvery minnow have not been conducted since the mid-1990s (Platania 1995; Hoagstrom and Brooks 2000). Pueblo cooperation is essential to obtain permission for these monitoring activities. As described above, the Santo Domingo intends to coordinate with us to survey for silvery minnows or habitat, to conduct water quality sampling, to develop water quality standards, and to devise relocation or augmentation protocols. Santa Ana Pueblo will continue to actively coordinate with us to implement a variety of voluntary conservation programs to augment the silvery minnow population within its lands and intends to continue its existing natural resource management programs that currently provide special management considerations or protections for the silvery minnow. Sandia Pueblo intends to enhance and restore the species' habitat through bosque restoration efforts, water quality monitoring, fire prevention activities, wetland enhancements, and natural pond restoration. Finally, Isleta Pueblo intends to protect, conserve, and promote the management of the silvery minnow and its associated habitat including population monitoring, habitat protection, habitat restoration, and continued water quality standards. Consequently, we view each of the special management plans as a starting point for cooperative and productive relationships that have the potential to provide additional substantive conservation benefits to the silvery minnow and its habitat. The additional benefits would be less likely if critical habitat was designated because the Pueblos view critical habitat as an intrusion on their ability to manage their own lands and trust resources.

The special management plans and comments submitted by each of the Pueblos documents that meaningful collaborative and cooperative scientific studies will begin or continue within their lands. These commitments demonstrate the willingness of each of the Pueblos to work cooperatively with us toward landscape-scale conservation efforts that will benefit the silvery minnow. Each of the Pueblos has committed to several ongoing or future management, restoration, enhancement, and survey activities that would not occur as a result of critical habitat designation. The Pueblos of Sandia and Isleta are currently participating in a water quality study with the Service. Santo Domingo Pueblo indicated that, among other activities, it will attempt to secure funding to implement silvery minnow and habitat inventories, water quality sampling, and the development of water quality standards. Santa Ana indicated that water quality data, stream geomorphology assessments, and aquatic and vegetation studies will continue. Therefore, the Service believes that the results of these or other similar studies will be used to develop and promote long-term strategies that will protect and conserve the silvery minnow and its habitat within the Pueblo lands of Santa Domingo, Santa Ana, Sandia,

and Isleta. The benefits of excluding these areas from critical habitat will encourage the continued cooperation and development of data-sharing protocols and scientific studies as part of implementing the special management plans. If these areas were designated as critical habitat, we believe it is unlikely that much of this information would be available to us.

In addition to management actions described above to address the conservation needs of the silvery minnow, we discussed with each of the Pueblos possible future amendments to the special management plans to include voluntary conservation efforts for other listed species and their habitat (e.g., southwestern willow flycatcher). All of the Pueblos indicated their willingness to work cooperatively with us to benefit other listed species. However, these future voluntarily management actions will likely be contingent upon whether lands on these four Pueblos are designated as critical habitat for the silvery minnow. Thus, a benefit of excluding these lands would be future voluntary conservation efforts that would benefit other listed species.

In summary, the benefits of including the Pueblos of Santa Domingo, Santa Ana, Sandia, and Isleta in critical habitat are small, and are limited to minor educational benefits. The benefits of excluding these areas from being designated as critical habitat for silvery minnow are more significant, and include encouraging the continued development and implementation of the special management measures such as monitoring, survey, enhancement, and restoration activities that are planned for the future or are currently being implemented. These programs will allow the Pueblos to manage their natural resources to benefit the Rio Grande ecosystem and silvery minnow, without the perception of Federal Government intrusion. This philosophy is also consistent with our published policies on Native American natural resource management. The exclusion of these areas will likely also provide additional benefits to the species that would not otherwise be available to encourage and maintain cooperative working relationships. We find that the benefits of excluding these areas from critical habitat designation outweigh the benefits of including these areas.

As noted above, the Service may exclude areas from the critical habitat designation only if it is determined, “based on the best scientific and commercial data available, that the failure to designate such area as critical habitat will result in the extinction of the species concerned.” Here, we have determined that exclusion of the Pueblo lands of Santo Domingo, Santa Ana, Sandia, and Isleta from the critical habitat designation will not result in the extinction of the silvery minnow. First, activities on these areas that may affect the silvery minnow will still require consultation under section 7 of the Act. Section 7(a)(2) of the ESA requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of listed species. Therefore, even without critical habitat designation on these lands, activities that occur on these lands cannot jeopardize the continued existence of the silvery minnow. Second, each of the Pueblos have committed to protecting and managing according to their special management plans and natural resource management objectives. In short, the Pueblos have committed to greater conservation measures on these areas than would be available through the designation of critical habitat. With these natural resource measures,

we have concluded that this exclusion from critical habitat will not result in the extinction of the silvery minnow. Accordingly, we have determined that the Pueblo lands of Santa Domingo, Santa Ana, Sandia, and Isleta should be excluded under subsection 4(b)(2) of the ESA because the benefits of exclusion outweigh the benefits of inclusion and will not cause the extinction of the species. For this reason, we are excluding from this critical habitat designation the Pueblo lands of Santa Domingo, Santa Ana, Sandia, and Isleta.

Alternative A – No Action

Description of the Alternative

The No Action Alternative is defined as a decision to forgo the designation of critical habitat for the silvery minnow. This alternative serves to delineate the existing environment and conditions that are anticipated to result from the listing of the species, without designation of critical habitat.

It is not clear that the Service could, under the law, adopt the No Action Alternative. The ESA requires that the Service (1) designate critical habitat at the time that it lists a species as endangered or threatened to the maximum extent prudent or determinable or (2) if designation is not determinable, to designate critical habitat within one year thereafter, based on such data as may be available at the time, to the maximum extent prudent (16 USC sec. 1533(a)(6)(C)). Moreover, this FEIS has been prepared on the redesignation, pursuant United States District Court for the District of New Mexico, in Middle Rio Grande Conservancy District v. Babbitt, Civ. Nos. 99-870, 99-872, 99-1445M/RLP (Consolidated) that ordered the Service to issue both an EIS and a new proposed rule designating critical habitat for the silvery minnow.

Actions Associated with the Alternative

Under the No Action Alternative, no critical habitat would be designated for the silvery minnow. The minnow would remain listed as endangered but without critical habitat designated, and Federal agencies would continue, in consultation with the Service, to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of the species.

Alternative B – The Middle Rio Grande from Cochiti Dam to Elephant Butte Dam, and the lower Jemez River

Description of the Alternative

This alternative, would designate as critical habitat, the last remaining portion of the occupied range of the silvery minnow, located in the Middle Rio Grande (Cochiti Dam to

Elephant Butte Dam) in New Mexico. The proposed critical habitat designation defines the lateral extent (width) as those areas bounded by existing levees. In areas without levees, the lateral extent of critical habitat is proposed to be defined as 91.4 meters (300 feet) of riparian zone adjacent to each side of the river.

This alternative considers the Middle Rio Grande from immediately downstream of Cochiti Reservoir to Elephant Butte Dam, including the Jemez River, a tributary of the Rio Grande, from Jemez Canyon Reservoir to its confluence with the Rio Grande in New Mexico. The stream reaches in the middle Rio Grande proposed for designation include the following:

a. Jemez Canyon Reach – 8 kilometers (5 miles) of the Jemez River immediately downstream of Jemez Canyon Reservoir to the confluence with the Rio Grande.

b. Cochiti Reach – 34 kilometers (21 miles) of the Rio Grande immediately downstream of Cochiti Reservoir to the Angostura Diversion Dam.

c. Angostura Reach – 61 kilometers (38 miles) of the Rio Grande immediately downstream of the Angostura Diversion Dam to the Isleta Diversion Dam.

d. Isleta Reach – 90 kilometers (56 mi) of the Rio Grande immediately downstream of the Isleta Diversion Dam to the San Acacia Diversion Dam.

e. San Acacia Reach – 147 kilometers (92 mi) of river immediately downstream of the San Acacia Diversion Dam to the Elephant Butte Reservoir Dam. The Service selected Elephant Butte Reservoir Dam as the boundary of the proposed critical habitat because it is easily identifiable. Nevertheless, the Service believes that the area inundated by the reservoir does not provide the physical or biological features essential to the conservation of the species and should be specifically excluded by definition from proposed critical habitat. The reservoir is defined in the proposed rule as that part of the body of water impounded by the dam where the storage waters are lentic (relatively still waters) and not part of the lotic (flowing water) river channel.

Proposed critical habitat includes the stream channels within the identified stream reaches and the areas within these reaches that are within the existing levees or, if no levees are present, then within a lateral distance of 91.4 m (300 ft) on each side of the bankfull width, which is the point at which water begins to leave the channel and move into the floodplain (Service 2002). Lands located within these boundaries which are not considered critical habitat and are excluded by definition include: developed flood control facilities, existing paved roads, bridges, parking lots, dikes, levees, diversion structures, railroad tracks, railroad trestles, water diversion and irrigation canals outside of natural stream channels, the low flow conveyance channel, active gravel pits, cultivated agricultural land, and residential, commercial, and industrial developments. (Service 2003).

General Locations of Critical Habitat for the Rio Grande Silvery Minnow under Alternative B

Middle Rio Grande Reaches



10 0 10 20 Miles

 Critical Habitat under Alternative B
 Not Included in Alternative B



Use Constraints: This map is intended to be used as a guide to the general areas being considered for Rio Grande silvery minnow critical habitat. Included in the designation would be a riparian zone that runs up to 300 feet on each side of the river. Lines portraying possible critical habitat have been made thicker for presentation purposes only.



Actions Associated with the Alternative

The immediate action associated with Alternative B is the issuance of a final rule identifying the major primary constituent elements and designating the areas described in this section as critical habitat for the silvery minnow. The designation then triggers the provision of the ESA that requires Federal agencies to consult with the Service and insure that any actions they authorize, fund, or carry out do not result in the destruction or adverse modification of the designated habitat.

Consultation will have to be conducted on any ongoing or proposed actions that have not considered critical habitat for the silvery minnow. For example, on the Middle Rio Grande reaches in New Mexico, consultations on ongoing actions that addressed jeopardy but not adverse modification would have to be reinitiated to consider critical habitat.

Section 4(b)(2) of the ESA requires the Service to base critical habitat designations on the best scientific and commercial data available, after taking into consideration the economic and any other relevant impact of specifying any particular area as critical habitat. The Service may exclude areas from a critical habitat designation when the benefits of exclusion outweigh the benefits of designation, provided the exclusion will not result in the extinction of the species. As part of this alternative, the Service has conducted a preliminary analysis of the river reach in the middle Pecos River, New Mexico, from Sumner Dam to Brantley Dam in De Baca, Chaves, and Eddy Counties, New Mexico; and the river reach in the lower Rio Grande in Big Bend National Park downstream of the National Park boundary to the Terrell/Val Verde County line, Texas. The Service believes that the benefits of excluding these areas from the designation of critical habitat outweigh the benefits of including them. Therefore, we are not proposing these areas as critical habitat.

Sub-Alternative B-2 – Exclusion of Four Pueblo Lands in the Middle Rio Grande (Preferred Alternative)

Description of the Sub-alternative

Based on our review of public comments received on the proposed rule for designation, the draft economic analysis, and the DEIS, and a re-evaluation of lands proposed as critical habitat, the Service has determined that changes to the proposed rule and the preferred alternative (Alternative B) presented in the DEIS were necessary. These changes are reflected in the final rule for the designation of critical habitat and are described in this sub-alternative. This alternative is not a new alternative, but rather a subset or “sub-alternative” of Alternative B. Instead of merely revising Alternative B to reflect the information received, the Service opted to develop this sub-alternative, and provide the reviewer with an opportunity to compare the revised proposal for the designation of critical habitat with the proposal put forth in the DEIS. This sub-alternative excludes areas that are proposed as critical habitat in Alternative B. These

exclusions were based on the Service's analysis under section 4(b)(2) of the ESA as described above. For those areas that will remain proposed for critical habitat, the lateral extent of the designation includes the stream channel and the areas within the existing levees or, if no levees are present, then within a lateral distance of 91.4 m (300 ft) on each side of the bankfull width. Bankfull width is defined as the point at which water begins to leave the channel and move into the floodplain (Service 2002). Lands located within these boundaries that are not considered critical habitat and are excluded by definition include: developed flood control facilities, existing paved roads, bridges, parking lots, dikes, levees, diversion structures, railroad tracks, railroad trestles, water diversion and irrigation canals outside of natural stream channels, the low flow conveyance channel, active gravel pits, cultivated agricultural land, and residential, commercial, and industrial developments. (Service 2003). The area covered by this sub-alternative is different from Alternative B in two ways:

I. The Southern Boundary of Critical Habitat

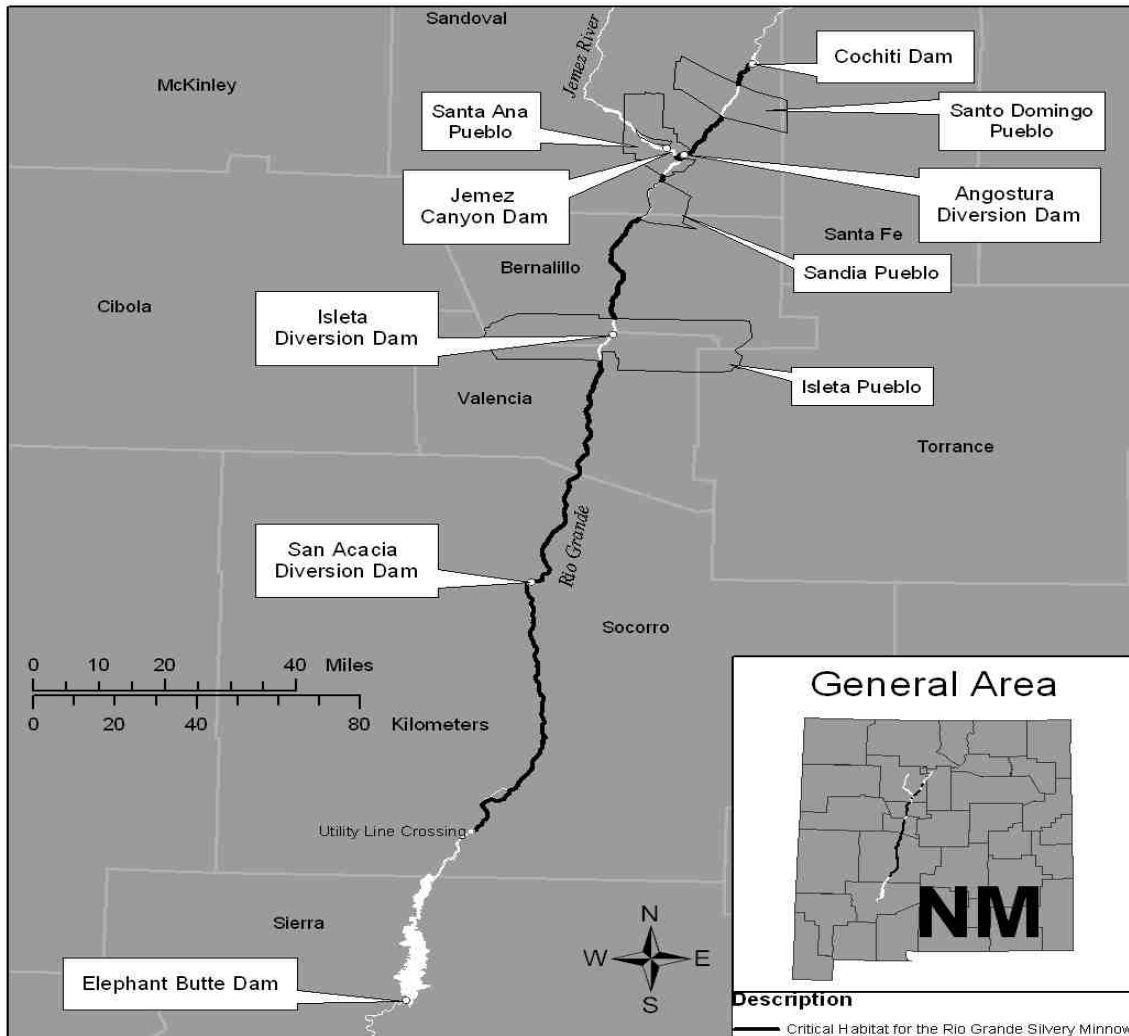
The southern boundary of critical habitat is the utility line crossing the Rio Grande at UTM 13–311474E, 3719722 N, just east of the Bosque Well demarcated on USGS Paraje Well 7.5 minute quadrangle (1980). This downstream boundary of critical habitat was selected because it is a permanent identified landmark that is found on a standard topographic map. The area below this boundary (i.e., from the utility line downstream to Elephant Butte Reservoir Dam) has the potential to be inundated by the reservoir and may not provide those physical or biological features essential to the conservation of the species and is therefore not included in the designation of critical habitat.

During the open comment period, Reclamation provided GIS maps that identified the utility line crossing the Rio Grande at UTM 13–311474E, 3719722 N, just east of the Bosque Well demarcated on USGS Paraje Well 7.5 minute quadrangle (1980) (M. Porter, Reclamation, pers. comm., 2002). Consequently, we revised the boundary for the designation because we find that the area downstream of the utility line is not essential to the conservation of the silvery minnow and we believe that the boundary, as originally proposed, was confusing as evidenced by many commentors, including the Elephant Butte Irrigation District, the NMISC, and others.

We further reviewed existing information (Platania and Dudley 2001a) to determine if the area from the designated critical habitat boundary to the headwaters of Elephant Butte Reservoir is essential to the conservation of the silvery minnow. For example, the location for the silvery minnow spawning study (Platania and Dudley 2000, 2001a) is just downstream of the critical habitat boundary. The study location was selected to maximize the potential number of silvery minnow eggs collected by rescuing those eggs destined to drift into Elephant Butte Reservoir. Currently, if silvery minnow spawn in the area from the designated critical habitat boundary to the headwaters of Elephant Butte Reservoir, the floating eggs would enter the reservoir in just a few hours. Once the eggs and larvae enter the reservoir, they would be subjected to predation (Platania and Dudley 2001a). Consequently, the area from the designated critical habitat boundary to the headwaters of Elephant Butte Reservoir is not essential to the

General Locations of Critical Habitat for the Rio Grande Silvery Minnow Under Alternative B-2

Middle Rio Grande Reaches



The Pueblo lands of Santo Domingo, Santa Ana, Sandia, and Isleta are not designated critical habitat (see 'Regulation Promulgation' section of this rule for exact descriptions of boundaries of designated critical habitat).

DISCLAIMER

This map is a graphical representation of Rio Grande Silvery Minnow critical habitat and is provided for illustrative purposes only. The map and [GIS (vector and/or raster)] files used to create this map are not the definitive source for determining critical habitat boundaries. While the Service makes every effort to represent the critical habitat shown on this map as completely and accurately as possible (given existing time, resource, data and display constraints), the USFWS gives no warranty, expressed or implied, as to the accuracy, reliability, or completeness of these data.

conservation of the silvery minnow. Because of these reasons, we also believe that the exclusion of this area from the designated critical habitat will not lead to the extinction of the species. It should be noted that the Service in collaboration with other State and Federal agencies, rescues silvery minnow eggs in the lower San Acacia Reach for use in captive propagation and subsequent augmentation of the silvery minnow in the middle Rio Grande.

II. Exclusion of Lands owned by the Pueblos of Santo Domingo, Santa Ana, Sandia, and Isleta

During the open comment period, we worked with Pueblos to develop voluntary measures to conserve the silvery minnow on their lands. The Pueblos of Santo Domingo, Santa Ana, Sandia, and Isleta each completed special management plans for the silvery minnow and submitted them to us during the open comment period. The socio-economic impacts related to this sub-alternative may be different depending on the management plan and the entity. Excluding the Tribal lands in this designation of critical habitat for the silvery minnow will not affect the recovery and future delisting of the species. Whether or not a species has designated critical habitat, it is protected both from any actions resulting in an unlawful take and from Federal actions that could jeopardize the continued existence of the species.

Section 4(b)(2) allows the Service to exclude areas from critical habitat designation if the benefits of such exclusion outweigh the benefits of specifying such areas as critical habitat, unless exclusion would result in the extinction of the species. If excluding an area from a critical habitat designation will provide substantial conservation benefits, and at the same time including the area fails to confer a counter-balancing benefit to the species, then the benefits of excluding the area from critical habitat outweigh the benefits of including it.

The Service has analyzed the benefits of including the Pueblos of Santa Domingo, Santa Ana, Sandia, and Isleta as part of the critical habitat designation and the benefits of excluding these areas, and determined that the benefits of exclusion outweigh those of inclusion. A major factor in the analysis (described above) is that, even if excluded, these river reaches owned and managed by the four Pueblos (**Pueblo Management Areas**) will nonetheless receive special management and protection through the management plans, which were submitted by these Pueblos during the open comment period for the proposed rule. Under these management plans, the silvery minnow will benefit from monitoring, restoration, enhancement, and survey efforts within each Pueblo Management Area (PMA). The Service has also determined that exclusion would not result in the extinction of the species. A summary of the four Tribal management plans can be found in Appendix F.

Actions Associated with the Sub-alternative

As with Alternative B, the initial action associated with this sub-alternative is the adoption of a final rule designating critical habitat for the silvery minnow. Unlike Alternative B,

those areas with special management plans and areas south of the utility line crossing the Rio Grande, east of the Bosque Well would not be included as part of the critical habitat designation on the Middle Rio Grande. The designation triggers the provision of the ESA that requires Federal agencies to consult with the Service and insure that any actions they authorize, fund, or carry out do not result in the destruction or adverse modification of the designated habitat.

Federal agencies would have to consult with the Service on any actions in areas that have been excluded under section 4(b)(2) if the action may affect the continued existence of the species (the jeopardy standard). They would also have to consult if their actions in the excluded areas may directly or indirectly affect critical habitat designated in downstream reaches. They would not have to consult on the possibility of adverse modification in the excluded area itself.

Consultation will have to be conducted on any ongoing or proposed actions that have not considered the new designation of critical habitat for the silvery minnow. For example, on the Middle Rio Grande, in New Mexico, consultations on ongoing actions that addressed jeopardy but not adverse modification would have to be reinitiated to consider critical habitat if they are located in areas that are designated as critical habitat or could affect areas that are designated as critical habitat.

Alternative C – Exclusion of the Cochiti Reach

Description of the Alternative

This alternative is the same designation described in Alternative B except that the Cochiti reach, as defined in Alternative B, would be excluded from the designation. Instead of beginning just below Cochiti Dam on the Middle Rio Grande, the northern boundary of critical habitat would be the Angostura Diversion Dam on the Rio Grande and Jemez Canyon Dam on the Jemez River. The lateral extent of critical habitat would be the same as in Alternative B, and would include those areas bounded by existing levees. In areas without levees the lateral extent of critical habitat is defined as 91.4 meters (300 feet) of riparian zone adjacent to each side of the river. Lands located within these boundaries that are not considered critical habitat and are excluded by definition include: developed flood control facilities, existing paved roads, bridges, parking lots, dikes, levees, diversion structures, railroad tracks, railroad trestles, water diversion and irrigation canals outside of natural stream channels, the low flow conveyance channel, active gravel pits, cultivated agricultural land, and residential, commercial, and industrial developments. (Service 2003).

General Locations of Critical Habitat for the Rio Grande Silvery Minnow under Alternative C

Middle Rio Grande Reaches



 Critical Habitat Under Alternative C
 Not Included in Alternative C

10 0 10 20 Miles



Use Constraints: This map is intended to be used as a guide to the general areas being considered for Rio Grande silvery minnow critical habitat. Included in the designation would be a riparian zone that runs up to 300 feet on each side of the river. Lines portraying possible critical habitat have been made thicker for presentation purposes only.



Actions Associated with the Alternative

As with Alternative B, the initial action associated with this alternative is the adoption of a final rule designating critical habitat. Unlike Alternative B, the Cochiti reach would not be included as part of critical habitat in the Middle Rio Grande. The other four reaches—Jemez, Angostura, Isleta, and San Acacia would remain the same.

Federal agencies would have to consult with the Service on any actions in the Cochiti reach that may affect the continued existence of the species (the jeopardy standard). They would also have to consult if their actions in the Cochiti reach may directly or indirectly affect critical habitat designated in downstream reaches. They would not have to consult on the possibility of adverse modification in the Cochiti reach itself.

Consultation will have to be conducted on any ongoing or proposed actions, outside of the Cochiti Reach, that have not considered critical habitat for the silvery minnow. Consultations on ongoing actions that addressed jeopardy but not adverse modification would have to be reinitiated to consider critical habitat.

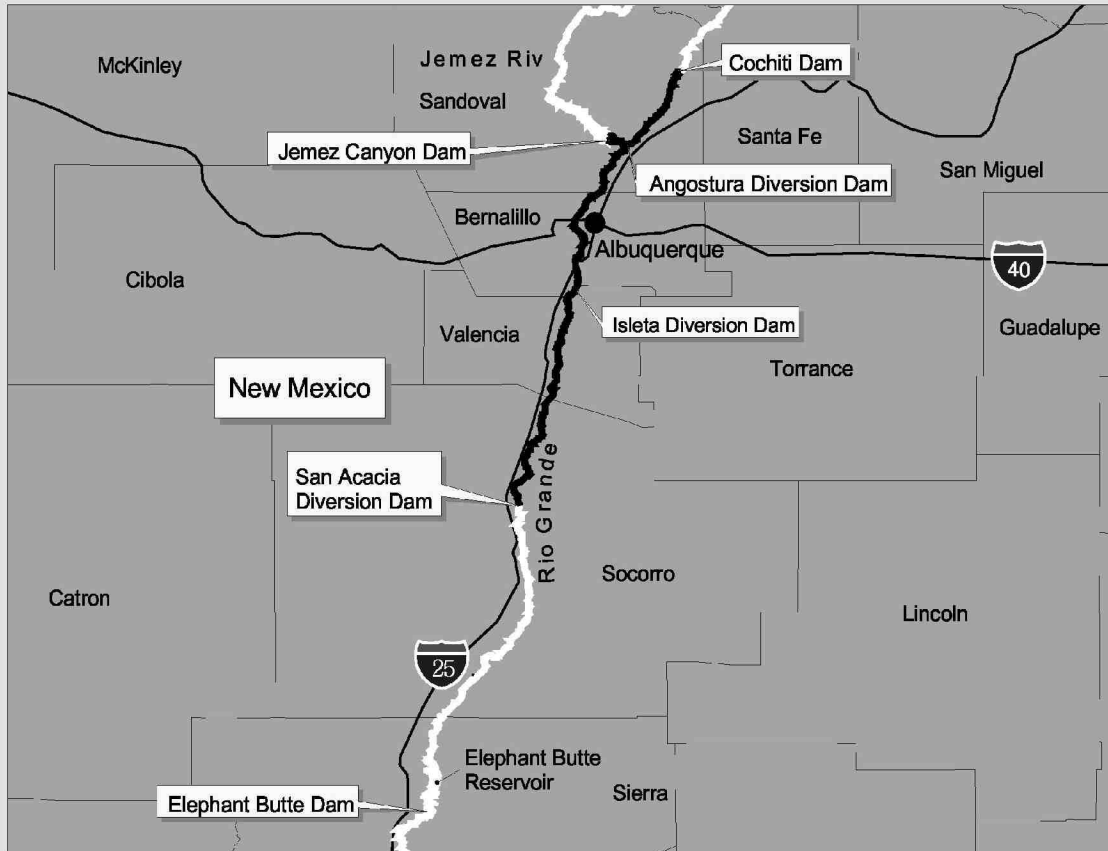
Alternative D – Exclusion of the San Acacia Reach

Description of the Alternative

This alternative is the same as Alternative B except that the reach from San Acacia Diversion Dam to Elephant Butte Dam. This alternative would exclude many of the segments of the Middle Rio Grande that have experienced intermittency in recent years. The lateral extent of critical habitat would be the same as in Alternative B, and would include those areas bounded by existing levees. In areas without levees the lateral extent of critical habitat is defined as 91.4 meters (300 feet) of riparian zone adjacent to each side of the river. Lands located within these boundaries that are not considered critical habitat and are excluded by definition include: developed flood control facilities, existing paved roads, bridges, parking lots, dikes, levees, diversion structures, railroad tracks, railroad trestles, water diversion and irrigation canals outside of natural stream channels, the low flow conveyance channel, active gravel pits, cultivated agricultural land, and residential, commercial, and industrial developments. (Service 2003).

General Locations of Critical Habitat for the Rio Grande Silvery Minnow under Alternative D

Middle Rio Grande Reaches



10 0 10 20 Miles

 **Critical Habitat under Alternative D**
 **Not Included in Alternative D**



Use Constraints: This map is intended to be used as a guide to the general areas being considered for Rio Grande silvery minnow critical habitat. Included in the designation would be a riparian zone that runs up to 300 feet on each side of the river. Lines portraying possible critical habitat have been made thicker for presentation purposes only.



Actions Associated with the Alternative

As with Alternative B, the initial action associated with the alternative is the adoption of a final rule designating critical habitat. Unlike in Alternative B, the San Acacia reach of the Middle Rio Grande would not be included in the final rule designating critical habitat. Federal agencies would only have to consult with the Service on actions in the San Acacia reach that may affect the continued existence of the species. Since the San Acacia reach is downstream from the reaches designated as critical habitat, it is unlikely that agency actions in the San Acacia reach would affect critical habitat upstream.

Consultation will have to be conducted on any ongoing or proposed actions, outside of the San Acacia Reach, that have not considered critical habitat for the silvery minnow. Consultations on ongoing actions that addressed jeopardy but not adverse modification would have to be reinitiated to consider critical habitat.

Alternative E –Designation of Selected Reaches of the Middle Rio Grande, Lower Rio Grande, and Middle Pecos River

Description of the Alternative

This alternative would designate as critical habitat: 1) the Middle Rio Grande as described in Alternative B; 2) a river reach in the lower Rio Grande in Big Bend National Park downstream of the park boundary to the Terrell/Val Verde County line, Texas; and 3) a river reach in the middle Pecos River, New Mexico, from Sumner Dam to Brantley Dam in De Baca, Chaves, and Eddy Counties, New Mexico. The lateral extent (width) of critical habitat would include those areas bounded by existing levees. In areas without levees, the lateral extent of critical habitat is defined as 91.4 meters (300 feet) of riparian zone adjacent to each side of these reaches of river, with the exception of proposed critical habitat in the lower Rio Grande. In the Lower Rio Grande critical habitat unit, the critical habitat would extend from the United States-Mexico boundary to the edge of the 300-foot lateral width on the United States' side. The international boundary is defined as the middle of the deepest channel of the river.

The three units included in this alternative are described as follows:

1. The middle Rio Grande from immediately downstream of Cochiti Reservoir to the Elephant Butte Reservoir Dam, including the Jemez River, a tributary of the Rio Grande, from Jemez Canyon Reservoir to its confluence with the Rio Grande in New Mexico. The Middle Rio Grande portion of this alternative is identical to Alternative B and includes the same stream reaches detailed above.

2. Lower Rio Grande Reach – 378 kilometers (236 miles) of river from the upstream boundary of Big Bend National Park (3.2 kilometers, or 2 miles, downstream of Lajitas, Texas) to the southern boundary of the Rio Grande Wild and Scenic River designation, which is at the

Terrell/Val Verde County line in Texas. The Service proposes that the critical habitat boundary in this stream include the river area from the United States/Mexico international boundary in the middle of the deepest channel to the edge of the 300-foot lateral width (see discussion below) on the United States' side.

3. Middle Pecos Reach – 359 kilometers (223 miles) of the Pecos River in New Mexico beginning immediately downstream of Sumner Dam to Brantley Reservoir Dam (but excluding the reservoir, as explained below).

Under this alternative, critical habitat includes the stream channels within the identified stream reaches and the areas within these reaches that are within the existing levees or, if no levees are present, then within a lateral distance of 91.4 meters (300 feet) on each side of the bankfull width, which is the point at which water begins to leave the channel and move into the floodplain (Service 2002). Lands located within these boundaries which are not considered critical habitat and are excluded by definition include: developed flood control facilities, existing paved roads, bridges, parking lots, dikes, levees, diversion structures, railroad tracks, railroad trestles, water diversion and irrigation canals outside of natural stream channels, the low flow conveyance channel, active gravel pits, cultivated agricultural land, and residential, commercial, and industrial developments. (Service 2003).

Actions Associated with the Alternative

The immediate action associated with Alternative E is the issuance of a final rule identifying the major primary constituent elements and designating the areas described in this section as critical habitat for the silvery minnow. The designation then triggers the provision of the ESA that requires Federal agencies to consult with the Service and insure that any actions they authorize, fund, or carry out do not result in the destruction or adverse modification of the designated habitat. Consultation will have to be conducted on any ongoing or future actions for which consultations have not considered critical habitat for the silvery minnow. For example, on the Middle Rio Grande reaches in New Mexico, consultations on ongoing actions that addressed jeopardy but not adverse modification would have to be reinitiated to consider critical habitat. On the Middle Pecos Reach in New Mexico, there have been consultations on Federal actions that may affect the Pecos bluntnose shiner or its critical habitat but consultation would have to be reinitiated to consider effects on critical habitat for the minnow. Few Federal actions affecting the river have taken place in the Lower Rio Grande Reach through Big Bend and the Rio Grande Wild and Scenic River, but consultations would be required on any Federal actions that may affect critical habitat.

General Locations of Critical Habitat for the Rio Grande Silvery Minnow under Alternative E



Critical Habitat under Alternative E
Not Included in Alternative E

- 1 = Middle Rio Grande Unit
- 2 = Lower Rio Grande Unit
- 3 = Middle Pecos River Unit



Use Constraints: This map is intended to be used as a guide to the general areas being considered for Rio Grande silvery minnow critical habitat. Included in the designation would be a riparian zone that runs up to 300 feet on each side of the river. Lines portraying possible critical habitat have been made thicker for presentation purposes only.



Alternatives Considered But Not Selected for Detailed Analysis

The following alternatives were considered but not selected for detailed analysis. Some of these alternatives contain areas that have little or no potential for being suitable for the silvery minnow while others need more study before they can be targeted for conservation efforts.

Entire Historical Range

The historical range of the silvery minnow includes the Rio Grande from Española, New Mexico, to the Gulf of Mexico, Texas, and the Pecos River from Santa Rosa, New Mexico, downstream to the confluence of the Pecos with the Rio Grande in Texas. The ESA precludes designation of the entire geographical area which can be occupied by the species except under circumstances to be determined by the Secretary (16 USC sec. 1532(5)(C)).

Certain areas within the species' historical range have been so altered that they are unlikely ever to be suitable habitat for the silvery minnow, as is more fully explained in the descriptions of various reaches below. Other areas within the species' historical range are areas that may become suitable at some point in the future but which may require significant restoration before they can become suitable habitat again. These areas could be considered in the future for critical habitat designation, or they could be considered for reintroduction of the species without designation of critical habitat. Designation of critical habitat may not include all of the habitat areas that may eventually be determined to be necessary for the recovery of the species. For these reasons, critical habitat designations do not signal that habitat outside the designation is unimportant or may not be required for recovery.

Specific Reaches

Reaches of the Rio Grande or the Pecos River which are not being considered alternatives for critical habitat designation are the following:

1. *Upstream of Cochiti Reservoir to the confluence of the Rio Chama and Rio Grande, New Mexico.* This reach is dominated by cool water, which is not considered suitable for the silvery minnow (Platania and Altenbach 1998). The majority of the reach is bounded by canyons, with substrate dominated by gravel, cobble, and boulder (Service 1999). The flow regime is also highly variable seasonally because of irrigation and other agricultural needs, and recreational and municipal uses. The river in this reach is highly manipulated by releases from El Vado and Abiquiu Reservoirs (J. Smith, Service, pers. comm. 2001). Silvery minnow populations may have been historically low in some areas in this reach (Bestgen and Platania 1991). Currently, the reach is dominated by cool or cold water species, which have almost completely replaced the native fish species (Service 1999).

2. *Downstream of Elephant Butte Dam to Caballo Dam, New Mexico.* This short 28-mile reach is highly channelized with widely variable flow regimes. Construction of Elephant Butte and Caballo Reservoirs in 1916 and 1938, respectively, severely altered the flows and habitat within the reach (Bestgen and Platania 1991), which is highly channelized to expedite water deliveries and very few native fish remain (Propst *et al.* 1987; International Boundary and Water Commission (IBWC) 2001a). The silvery minnow has not been documented within the reach since 1944 (Service 1999). The reach is subject to prolonged periods of low or no flow and there is no spring runoff spike (Service 1999). Altered flow regimes will continue to affect habitat quality in this reach, and the stream length is inadequate to ensure the survival of downstream drift of eggs and larvae and recruitment of adult silvery minnows (Platania and Altenbach 1998).

3. *Downstream of Caballo Dam, New Mexico, to American Diversion Dam, Texas.* This 110-mile reach has a highly regulated flow regime from releases of water stored in Caballo Reservoir. It is also highly channelized with winter flows near zero in the upper portions, and it does not contain suitable habitat for the silvery minnow (Service 1999; IBWC 2001a), which has not been reported in the reach since 1944 (Bestgen and Platania 1991, Service 1999). The reach is currently inhabited by many non-native fish species (IBWC 2001a).

4. *Downstream of American Diversion Dam to the upstream boundary of Big Bend National Park, Texas.* Portions of this reach are continually dewatered, especially between Fort Quitman and Presidio (Hubbs *et al.* 1977; U.S. Department of the Interior 1998); river flow is augmented downstream of Presidio by waters flowing from the Rio Conchos. The near continuous input of municipal waste has led to a deterioration of water quality, with corresponding changes to the assemblage of fish species in this reach (Hubbs *et al.* 1977; Bestgen and Platania 1988; IBWC 1994; El-Hage and Moulton 1998a). Flows consist of a blend of raw river water; treated municipal waste from El Paso, Texas, untreated municipal water from Juarez, Mexico, irrigation return flow, and the occasional floodwater (Texas Water Development Board 2001). Water temperatures can be elevated and oxygen levels decreased by the input of various pollutants, such as nitrogen or phosphorus (Texas Water Development Board 2001; IBWC 2001b). There are no current or museum records of silvery minnow from the reach (Service 1999). Because of dewatering upstream and degraded water quality, the Service believes this reach of river does not currently provide suitable habitat for the silvery minnow.

5. *Terrell/Val Verde County line, Texas to Amistad Dam, Texas.* This short reach is highly influenced by Amistad Reservoir at its terminus, which results, among other things, in the presence of non-native predators. It is believed that introduced fish played a role in the extirpation of silvery minnow in the reach (Bestgen and Platania 1991). Water quality is also a concern, particularly during low-flow conditions (Texas Water Development Board 2001; Texas Natural Resource Conservation Commission (TNRCC) 1996).

6. *Downstream of the Amistad Dam to Falcon Dam, Texas.* This 299-mile reach provides a continuous flow regime, with base flows ranging between 500 and 3,000 cfs (Service 1999). It is highly urbanized and has a number of instream barriers at Maverick, Eagle Pass, and Indio that would prevent movement of silvery minnow. Water quality is also a potential concern, particularly during low-flow conditions (Texas Water Development Board 2001; TNRCC 1996). This reach is heavily channelized, with little to no stream braiding, and in areas has inappropriate substrate (e.g., cobble). The fish community is dominated by warm water non-native predators (Platania 1990; Service 1999), and the silvery minnow has not been recorded in the reach since the 1950s (Service 1999).

7. *Downstream of Falcon Dam to the Gulf of Mexico, Texas.* The silvery minnow historically occupied this 275-mile reach of river (Service 1999). In fact, the location from which the species was originally described is Brownsville, Texas (Hubbs and Ortenburger 1929). However, the last collection of the silvery minnow occurred in 1961 just downstream of Falcon Reservoir (Bestgen and Platania 1991). The flow regime of the reach is highly influenced by releases from Falcon Reservoir, and most of the tributary inflow is controlled or influenced by small impoundments off the main channel of the river. The lower portion of the reach is often dewatered, with the river flow stopping before the confluence with the Gulf of Mexico (IBWC 2001b). The fish community has had a significant shift toward estuarine (a mixture of fresh and salt water) type species (IBWC 1994; Contreras and Lozano 1994). There has also been a significant loss of the native fish fauna in the Mexican tributaries in the last several decades (Hubbs *et al.* 1977; Almada-Villela 1990; Platania 1990), apparently due to poor water quality (e.g., see Texas Water Development Board 2001; TNRCC 1996). Finally, invasive weeds such as hydrilla and hyacinth have clogged many areas of the reach and reduced the amount of dissolved oxygen in the water (IBWC 2001b).

8. *Pecos River from Santa Rosa Reservoir to Sumner Reservoir, New Mexico.* This reach is only 55 miles long and is typified by wide fluctuations in flows due to releases from Santa Rosa Reservoir (Hoagstrom 2000). The silvery minnow has not been collected in the reach since 1939 (Bestgen and Platania 1991; Service 1999). Much of the surrounding topography consists of steep cliffs and canyons (Hoagstrom 2000). This reach does not offer suitable habitat for the silvery minnow, which prefers shallow, braided streams with sandy substrates (Bestgen and Platania 1991; Dudley and Platania 1997; Remshardt *et al.* 2002).

9. *Downstream of Brantley Reservoir, New Mexico to Red Bluff Reservoir, Texas.* This reach is short, with a highly variable flow regime that is dependent on agricultural demand. It is also highly segmented with small closely placed impoundments, such as permanent and temporary diversion dams, that pond water and impede fish movements. These impoundments do not allow for adequate stream length to ensure the survival of downstream drift of eggs and larvae and recruitment of adult silvery minnows (Platania and Altenbach 1998). Additionally, agricultural and oil field pollution and permian salts (brine) are added to the river in the reach, decreasing water quality to levels that likely would not support the silvery minnow (Campbell

1959; Larson 1994). Silvery minnow were historically uncommon within this reach; only 14 specimens from two collections are known (Bestgen and Platania 1991).

10. *Downstream of Red Bluff Reservoir to the confluence with the Rio Grande, Texas.* Historically silvery minnows occurred in this reach, though their exact distribution and abundance is unclear (Campbell 1958; Trevino-Robinson 1959; James and De La Cruz 1989; Linam and Kleinsasser 1996; Garrett 1997; Service 1999). Bestgen and Platania (1991) suggest that silvery minnows may have been uncommon within the reach because of pond habitat and high water salinity. However, the area may not have been well surveyed when the silvery minnow was still extant in the Pecos River (D. Propst, New Mexico Game and Fish, pers. comm. 2001). Sampling the middle and lower parts of this river reach has been historically difficult because of dense vegetation, steep canyon banks and lack of public access (Campbell 1959).

The upper segment of the reach can be characterized as devoid of suitable habitat. There is a highly variable flow regime caused by the release of water from Red Bluff Reservoir for agricultural use. Many freshwater springs that historically augmented the Pecos River throughout the reach have been diminished or gone dry (Campbell 1959; Brune 1981, cited in Hoagstrom 2000; Barker *et al.* 1994; El-Hage and Moulton 1998b). The water quality in this upper portion is also poor and is characterized by high salinity (Hiss 1970; Hubbs 1990; Linam and Kleinsasser 1996; Miyamoto *et al.* 1995; El-Hage and Moulton 1998b). Additionally, algal blooms have essentially eliminated all the fishes throughout from Malaga, New Mexico to Amistad Reservoir, Texas (James and De la Cruz 1989; Hubbs 1990; Rhodes and Hubbs 1992). The river channel is also somewhat incised and dominated by non-native vegetation in parts (Koidin 2000; Harman 1999; IBWC 2001b).

Agricultural needs diminish south of Girvin, Texas, and water quality conditions, such as salinity, could begin to improve from the confluence with Independence Creek downstream to Amistad Reservoir (Hubbs 1990; Linam and Kleinsasser 1996). This improvement could result from the freshwater springs within the lower 100 mile stretch of the reach. Nevertheless, gaging records from the lower segment indicate that there is virtually no flow during drought conditions (Texas Water Development Board 2001) and poor water quality (e.g., total dissolved solids) at Shumla Bend, just upstream of Amistad Reservoir, would be expected to have a deleterious affect on aquatic life (IBWC 1994).

The Service is not considering this portion of the reach as an alternative for critical habitat designation because the current or potential suitability for the silvery minnow is unknown; detailed habitat studies have not been conducted. It is believed that the area contains a network of steep canyons, with rock and coarse gravel substrate (Campbell 1959; Texas Parks and Wildlife 1999). Canyon habitat reduces stream channel width, which decreases sinuosity and meandering, and creates deep channels that do not provide suitable habitat (Bestgen and Platania 1991; Dudley and Platania 1997; Remshardt *et al.* 2001). Additionally, the presence of algal blooms is likely to continue to effect water quality.

Comparison of the Alternatives Studied in this FEIS

TABLE S-1		Summary of Alternatives—Areas and Entities Affected by Critical Habitat Designation								Sources of Combined Section 7 Impacts		
		Total Miles	Total River Miles	Latera l Extent	Miles Occupied Habitat	Miles Unocc. Habitat	# of Reaches	Miles on Pueblo Land	Pueblos Affected	Counties Affected	Silvery Minnow	Other
A	MRG	0	0	0	0	0	0	0	None	None	• Listing	• Listing of flycatcher
	LRG	0	0	0	0	0	0	0	None	None	None	None
	Pecos	0	0	0	0	0	0	0	None	None	None	• Listing of shiner • CH for shiner • Listing of flycatcher
B	MRG	214	Approx. 180	To levees, or 300 ft.	Approx. 180	Approx. 34 (reservoir)	5	45	Cochiti S. Domingo S. Felipe S. Ana Sandia Isleta	Sandoval Bernalillo Valencia Socorro	• Listing • Critical Habitat Desig.	• Listing of flycatcher
B-2	MRG	157	Approx. 132	To levees, or 300 ft.	Approx. 132	0	5	15	Cochiti S. Felipe	Sandoval Bernalillo Valencia Socorro	• Listing • Critical Habitat Desig.	• Listing of flycatcher

C	MRG	193	Approx 159	300 ft.	Approx. 159	Approx. 34 (reservoir)	4	?	S. Ana Sandia Isleta	Sandoval Bernalillo Valencia Socorro	<ul style="list-style-type: none"> • Listing • Critical Habitat Desig. 	<ul style="list-style-type: none"> • Listing of flycatcher
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TABLE S-1 cont.		Summary of Alternatives—Areas and Entities Affected by Critical Habitat Designation									Sources of Combined Section 7 Impacts	
		Total Miles	Total River Miles	Latera l Extent	Miles Occupied Habitat	Miles Unocc. Habitat	# of Reaches	Miles on Pueblo Land	Pueblos Affected	Counties Affected	Silvery Minnow	Other
D	MRG	120	120	300 ft.	120	0	4	45	Cochiti, S. Domingo S. Felipe S. Ana Sandia Isleta	Sandoval Bernalillo Valencia Socorro	<ul style="list-style-type: none"> • Listing • Critical Habitat Desig. 	<ul style="list-style-type: none"> • Listing of flycatcher
E	MRG	214	Approx. 180	To levees, or 300 ft.	Approx. 180	Approx. 34 (reservoir)	5	45	Cochiti S. Domingo S. Felipe S. Ana Sandia Isleta	Sandoval Bernalillo Valencia Socorro	<ul style="list-style-type: none"> • Listing • Critical Habitat Desig. 	<ul style="list-style-type: none"> • Listing of flycatcher
	LRG	236	236	300 ft.	0	236	1	0	None	Brewster Terrell	<ul style="list-style-type: none"> • Critical Habitat Desig. 	None
	Pecos	223	Approx. 210	300 ft.	0	223	1	0	None	De Baca Chaves Eddy	<ul style="list-style-type: none"> • Critical Habitat Desig. 	<ul style="list-style-type: none"> • Listing of shiner • CH for shiner • Listing of flycatcher

TABLE S-2		Impacts on Federal Agency Consultations			
		Expected baseline¹ consultation costs, 20 yrs.	Expected above baseline consultation costs, 20 yrs.	Expected baseline project modification costs, 20 yrs.	Expected above baseline project modification costs, 20 yrs.
A	MRG	\$835,300 (low) \$2,135,500 (high)	0	\$14.0 million (low) \$23.4 million (high)	0
	LRG	N/A, no baseline for minnow.	0	N/A, no baseline for minnow.	0
	Pecos	N/A, no baseline for minnow.	0	N/A, no baseline for minnow.	0
B	MRG	Same as in Alternative A (No Action), jeopardy consults continue	\$1,052,200 (low) \$2,662,500 (high)	Same as in Alternative A (No Action), jeopardy consults continue	\$4.5 million (low) \$8.1 million (high)
B-2		Same as in Alternative A (No Action), jeopardy consults continue	N/A - Expected to be lower than Alternative B due to a reduction in the area designated	Same as in Alternative A (No Action), jeopardy consults continue	N/A - Expected to be lower than Alternative B due to a reduction in the area designated
C	MRG	Same as Alt. A (No Action), jeopardy consults continue in non-designated reach.	\$832,600 (low) \$2,083,700 (high)	Same as Alt. A (No Action), jeopardy consults continue in non-designated reach.	\$3.5 million (low) \$6.4 million (high)

¹On the MRG, a historical baseline exists for consultations since 1994 regarding the silvery minnow and proposed or designated critical habitat for that species. “Baseline level” means consultations continuing at the annual rate established since 1994. “Above baseline” means additional consultations arising due to the new designation of critical habitat. On the LRG (Big Bend reach) and the Pecos, no such baseline for silvery minnow consultations exists.

TABLE S-2 cont.		Impacts on Federal Agency Consultations			
		Expected baseline² consultation costs, 20 yrs.	Expected above baseline consultation costs, 20 yrs.	Expected baseline project modification costs, 20 yrs.	Expected above baseline project modification costs, 20 yrs.
D	MRG	Same as Alt. A (No Action), jeopardy consults continue in non-designated reach.	\$792,800 (low) \$2,018,400 (high)	Same as Alt. A (No Action), jeopardy consults continue in non-designated reach.	\$2.7 million (low) \$4.3 million (high)
E	MRG	Same as in Alternative A (No Action), jeopardy consults continue	Same as Alternative B	Same as Alt. A (No Action), jeopardy consults continue in non-designated reach.	Same as Alternative B
	LRG	N/A, no baseline for minnow.	\$461,600 (low) \$569,000 (high)	N/A, no baseline for minnow.	\$3.6 million (low) \$7.8 million (high)
	Pecos	N/A, no baseline for minnow.	\$773,400 (low) \$2,048,400 (high)	N/A, no baseline for minnow.	\$11.6 million (low) \$19.4 million (high)

²On the MRG, a historical baseline exists for consultations since 1994 regarding the silvery minnow and proposed or designated critical habitat for that species. “Baseline level” means consultations continuing at the annual rate established since 1994. “Above baseline” means additional consultations arising due to the new designation of critical habitat. On the LRG (Big Bend reach) and the Pecos, no such baseline for silvery minnow consultations exists.

TABLE S-3		Impacts on Water Resources				
		Water Operations	Water Rights and Use	Supplemental Water for Target Flows		Possible sources of supplemental water
				Estimated Need/Year <u>95%</u> ³ 50%	Total Water Rights Cost <u>95%</u> 50%	
A	MRG	<p><u>Listing:</u> It is expected that changes in river management and water operations such as those outlined in the Service's 2001 Programmatic Biological Opinion will be continued. This includes operations of storage, diversion, and flood control facilities.</p> <p><u>Designation:</u> Will not occur; no additional impacts.</p>	<p><u>Listing:</u> Water rights may be transferred or leased, to provide supplemental flows and other conservation measures such as those outlined in the Service's 2001 Programmatic Biological Opinion. Federal management agencies, MRGCD, and ISC will continue to work in close coordination to ensure both adequate stream flows of the minnow and fulfillment of Rio Grande Compact obligations.</p> <p><u>Designation:</u> Will not occur; no additional impacts.</p>	40,427 ac-ft 5,635 ac-ft	\$205 million \$28.6 million	<ul style="list-style-type: none"> San Juan-Chama water, if available for lease. Native Rio Grande water, if available for sale or lease, or in a compact credit situation and stored in upstream reservoirs.
	LRG	No effect.	No effect.	0	0	N/A
	Pecos	No effect. Water operations would continue to be affected by the bluntnose shiner.	No effect. Water rights and use would continue to be affected by efforts to provide supplemental flows for the bluntnose shiner.	0	0	N/A

³95% = Annual supply of water sufficient to meet flow targets for the Middle Rio Grande set forth in the Service's 2001 Biological Opinion, and/or to supply 50 cfs at Acme gage on the Pecos River, 95 years out of 100, based on historical flow data. 50% = Annual supply to meet targets 50 years out of 100. Quantities and costs of existing supplemental water provided for the Pecos bluntnose shiner are not considered. (Industrial Economics 2003.)

TABLE S-3 cont.		Impacts on Water Resources				
		Water Operations	Water Rights and Use	Supplemental Water for Target Flows		Possible sources of supplemental water
				Estimated Need/Year <u>95%</u> ⁴ 50%	Total Water Rights Cost <u>95%</u> 50%	
B	MRG	<p><u>Listing with Designation</u>: Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically</u>: Additional consultation requirements and possible project modifications on flood control projects, and possibly other activities in the river floodplain.</p>	<p><u>Listing with Designation</u>: Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically</u>: Added focus on conservation of aquatic and riparian habitat may stimulate restoration efforts and potentially increase net depletions.</p>	<p><u>40,427 ac-ft</u> 5,635 ac-ft</p>	<p><u>\$205 million</u> \$28.6 million</p>	<ul style="list-style-type: none"> • San Juan-Chama water, if available for lease. • Native Rio Grande water, if available for sale or lease, or in a compact credit situation and stored in upstream reservoirs.

⁴95% = Annual supply of water sufficient to meet flow targets for the Middle Rio Grande set forth in the Service's 2001 Biological Opinion, and/or to supply 50 cfs at Acme gage on the Pecos River, 95 years out of 100, based on historical flow data. 50% = Annual supply to meet targets 50 years out of 100. Quantities and costs of existing supplemental water provided for the Pecos bluntnose shiner are not considered. (Industrial Economics 2003.)

TABLE S-3 cont.		Impacts on Water Resources				
		Water Operations	Water Rights and Use	Supplemental Water for Target Flows		Possible sources of supplemental water
				Estimated Need/Year <u>95%</u> ⁵ 50%	Total Water Rights Cost <u>95%</u> 50%	
B-2	MRG	<p><u>Listing with Designation</u>: Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically</u>: Additional consultation requirements and possible project modifications may be reduced from those anticipated under Alternative B due to a reduction in the area designated.</p>	<p><u>Listing with Designation</u>: Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically</u>: Added focus on conservation of aquatic and riparian habitat may stimulate restoration efforts and potentially increase net depletions.</p>	<p>N/A</p> <p>Expected to be equal to or less than the supplemental water estimates for Alternative B</p>	<p>N/A</p> <p>Expected to be equal to or less than the supplemental water estimates for Alternative B</p>	<ul style="list-style-type: none"> San Juan-Chama water, if available for lease. Native Rio Grande water, if available for sale or lease, or in a compact credit situation and stored in upstream reservoirs.

⁵95% = Annual supply of water sufficient to meet flow targets for the Middle Rio Grande set forth in the Service's 2001 Biological Opinion, and/or to supply 50 cfs at Acme gage on the Pecos River, 95 years out of 100, based on historical flow data. 50% = Annual supply to meet targets 50 years out of 100. Quantities and costs of existing supplemental water provided for the Pecos bluntnose shiner are not considered. (Industrial Economics 2003.)

TABLE S-3 cont.		Impacts on Water Resources				
		Water Operations	Water Rights and Use	Supplemental Water for Target Flows		Possible sources of supplemental water
				Estimated Need/Year <u>95%</u> ⁶ 50%	Total Water Rights Cost <u>95%</u> 50%	
C	MRG	<p><u>Listing with Designation</u>: Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically</u>: Possible added consultations and project modifications as described in Alt. B, but not pertaining to projects within and only affecting the Cochiti reach.</p>	<p><u>Listing with Designation</u>: Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically</u>: Added focus on conservation of aquatic and riparian habitat may stimulate restoration efforts and potentially increase net depletions. Restoration activities would proceed in the Cochiti reach, but possibly at a reduced rate than under Alternative B.</p>	<p><u>40,427 ac-ft</u> 5,635 ac-ft</p>	<p><u>\$205 million</u> \$28.6 million</p>	<p>As described for Alt. A (No Action).</p>

⁶95% = Annual supply of water sufficient to meet flow targets for the Middle Rio Grande set forth in the Service's 2001 Biological Opinion, and/or to supply 50 cfs at Acme gage on the Pecos River, 95 years out of 100, based on historical flow data. 50% = Annual supply to meet targets 50 years out of 100. Quantities and costs of existing supplemental water provided for the Pecos bluntnose shiner are not considered. (Industrial Economics 2003.)

TABLE S-3 cont.		Impacts on Water Resources				
		Water Operations	Water Rights and Use	Supplemental Water for Target Flows		Possible sources of supplemental water
				Estimated Need/Year <u>95%</u> ⁷ 50%	Total Water Rights Cost <u>95%</u> 50%	
D	MRG	<p><u>Listing with Designation</u>: Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically</u>: Possible added consultations and project modifications as described in Alt. B, but not pertaining to projects within and only affecting the San Acacia reach.</p>	<p><u>Listing with Designation</u>: Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically</u>: Added focus on conservation of aquatic and riparian habitat may stimulate restoration efforts and potentially increase net depletions. Restoration activities would proceed in the San Acacia reach, but possibly at a reduced rate than under Alternative B.</p>	<p><u>40,427 ac-ft</u> 5,635 ac-ft</p>	<p><u>\$205 million</u> \$28.6 million</p>	<p>As described for Alt. A (No Action).</p>

⁷95% = Annual supply of water sufficient to meet flow targets for the Middle Rio Grande set forth in the Service's 2001 Biological Opinion, and/or to supply 50 cfs at Acme gage on the Pecos River, 95 years out of 100, based on historical flow data. 50% = Annual supply to meet targets 50 years out of 100. Quantities and costs of existing supplemental water provided for the Pecos bluntnose shiner are not considered. (Industrial Economics 2003.)

TABLE S-3 cont.		Impacts on Water Resources				
		Water Operations	Water Rights and Use	Supplemental Water for Target Flows		Possible sources of supplemental water
				Estimated Need/Year <u>95%</u> ⁸ 50%	Total Water Rights Cost <u>95%</u> 50%	
E	MRG	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> Additional consultation requirements and possible project modifications on flood control projects, and possibly other activities in the river floodplain.</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> Added focus on conservation of aquatic and riparian habitat may stimulate restoration efforts and potentially increase net depletions.</p>	40,427 ac-ft 5,635 ac-ft	\$205 million \$28.6 million	As described for Alt. A (No Action).
	LRG	Should the need arise, consultation would be required for USIBWC boundary maintenance activities.	No transfer of rights or change in existing use is anticipated.	0	0	N/A
	Pecos	Likely continuation and augmentation of existing modified water operations as instituted to conserve and avoid jeopardy to the bluntnose shiner. Possible increase in supplemental flows to maintain suitable conditions for the minnow.	Any management plan to increase supplemental flows due to designation would result in an additional need to acquire or lease water rights. This would add to already significant cumulative impacts arising from Pecos River Compact obligations.	24,263 ac-ft 16,431 ac-ft	\$47.3 million \$28.6 million	Surface and groundwater rights, if available for lease or purchase.

⁸95% = Annual supply of water sufficient to meet flow targets for the Middle Rio Grande set forth in the Service's 2001 Biological Opinion, and/or to supply 50 cfs at Acme gage on the Pecos River, 95 years out of 100, based on historical flow data. 50% = Annual supply to meet targets 50 years out of 100. Quantities and costs of existing supplemental water provided for the Pecos bluntnose shiner are not considered. (Industrial Economics 2003.)

TABLE S-4		Biological Impacts of silvery minnow listing and critical habitat designation		
		Vegetation	Silvery Minnow	Fish and Wildlife
A	MRG	<p><u>Listing:</u> Native vegetation may benefit from agency actions undertaken to conserve or avoid jeopardy to the minnow, including implementation of a more natural hydrological regime and habitat restoration including saltcedar eradication.</p> <p><u>Designation:</u> Will not occur; no additional benefits.</p>	<p><u>Listing:</u> Under the ESA, the minnow may benefit from conservation actions that may be implemented under section 7(a)(1), regulatory protections afforded by the section 7(a)(2) jeopardy standard, and the section 9 take prohibition. Significant benefits include the actions spelled out as an RPA in the Service's recent Programmatic Biological Opinion (Service 2001b). The minnow will likely continue to benefit from the acquisition of supplemental water to maintain target flows, pumping of water from the LFCC, rescue and relocation efforts undertaken by the Service, and habitat restoration activities undertaken by Federal agencies.</p> <p><u>Designation:</u> Will not occur; no additional benefits. An opportunity to identify and focus additional management attention on habitat features considered essential to the conservation of the species will be lost.</p>	<p><u>Listing:</u> Native fish species will continue to benefit from improved hydrological regime and river channel restoration activities undertaken to benefit the minnow. Riparian-zone species including endangered southwestern willow flycatcher benefit from habitat restoration. Migratory cranes and waterfowl may be adversely impacted if loss of agricultural production affects winter food base.</p> <p><u>Designation:</u> Will not occur; no additional benefits.</p>
	LRG	No effect.	Potential habitat for reintroduction would receive no extra protection.	No effect.
	Pecos	No effect.	Potential habitat for reintroduction would receive no extra protection.	No effect.

TABLE S-4		Biological Impacts of silvery minnow listing and critical habitat designation		
		Vegetation	Silvery Minnow	Fish and Wildlife
B	MRG	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> In all reaches native vegetation may benefit from additional protections to the river floodplain within 300' of the river channel.</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> In all reaches the minnow will benefit from any additional protections to physical and biological features present in the reach and considered essential to the conservation of the species. The minnow will benefit from increased conservation attention focused on the river channel and 300' of adjacent floodplain.</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> In all reaches native fish may benefit from any additional protections to the river channel and water quality provided by designation. Various riparian-zone species including flycatcher may benefit from added floodplain protection.</p>
	MRG	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> In designated critical habitat native vegetation may benefit from additional protections to the river floodplain within 300' of the river channel. In Pueblo Management Areas (PMAs), vegetation may benefit from protections provided by the special management plans</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> In all reaches, including the excluded PMAs, the minnow will benefit from any additional protections to physical and biological features present in the reach and considered essential to the conservation of the species. The minnow will benefit from increased conservation attention focused on the river channel and 300' of adjacent floodplain. These additional protections to the river channel and adjacent floodplain should be provided by the special management plans that have been established for the PMAs that are excluded under this sub-alternative.</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> In all reaches native fish may benefit from any additional protections to the river channel and water quality provided by designation or the special management plans. Various riparian-zone species including flycatcher may benefit from added floodplain protection provided by the designation and special management plans.</p>

TABLE S-4 cont.		Biological Impacts of silvery minnow listing and critical habitat designation		
		Vegetation	Silvery Minnow	Fish and Wildlife
C	MRG	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> South of Angostura Diversion Dam, native vegetation may benefit from additional protections to the river floodplain within 300' of the river channel. These benefits will not be present in the Cochiti reach.</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> South of Angostura Diversion Dam, the minnow will benefit from any additional protections to physical and biological features present in the reach and considered essential to the conservation of the species. The minnow will benefit from increased conservation attention focused on the river channel and 300' of adjacent floodplain. These additional protections and benefits will not be present in the Cochiti reach.</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> South of Angostura Diversion Dam native fish will benefit from any additional protections to the river channel provided by designation. Various riparian-zone species including flycatcher may benefit from added floodplain protection. These benefits will not be present in the Cochiti reach.</p>
		<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> North of San Acacia Diversion Dam, native vegetation may benefit from additional protections to the river floodplain within 300' of the river channel. These benefits will not be present in the San Acacia reach.</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> North of San Acacia Diversion Dam, the minnow will benefit from any additional protections to physical and biological features present in the reach and considered essential to the conservation of the species. The minnow will benefit from increased conservation attention focused on the river channel and 300' of adjacent floodplain. These additional protections and benefits will not be present in the San Acacia reach.</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> North of San Acacia Diversion Dam native fish will benefit from any additional protections to the river channel and water quality provided by designation. Various riparian-zone species including flycatcher may benefit from added floodplain protection. These benefits will not be present in the San Acacia reach.</p>

TABLE S-4 cont.		Biological Impacts of silvery minnow listing and critical habitat designation		
		Vegetation	Silvery Minnow	Fish and Wildlife
E	MRG	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> In all reaches native vegetation may benefit from additional protections to the river floodplain within 300' of the river channel.</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> In all reaches the minnow will benefit from any additional protections to physical and biological features present in the reach and considered essential to the conservation of the species. The minnow will benefit from increased conservation attention focused on the river channel and 300' of adjacent floodplain.</p>	<p><u>Listing with Designation:</u> Impacts attributable to the listing of the species remain as described in Alt. A (No Action).</p> <p><u>Designation Specifically:</u> In all reaches native fish may benefit from any additional protections to the river channel and water quality provided by designation. Various riparian-zone species including flycatcher may benefit from added floodplain protection.</p>
	LRG	No effect.	No direct impacts, but potential habitat for reintroduction would receive extra protection.	No effect.
	Pecos	Native vegetation may benefit if additional habitat restoration is carried out as a result of designation.	Potential habitat for reintroduction would receive extra protection.	Native fish species may benefit if additional management attention is devoted to conserving and/or improving aquatic habitat as a result of designation. Riparian-zone species may benefit from added protections or habitat restoration in the river floodplain.

TABLE S-5 95% ⁹ 50% (target flow scenarios)		Land Use and Economic Impacts of Acquiring Water to Maintain Target Flows (Data from Final Economic Analysis. Impacts Under Alternatives B, B-2,C, and D are identical)								
		Lost agricultural production--alfalfa acres	Percent regional alfalfa acreage lost	Percent state alf. acreage lost	Value of foregone agricultural production	Effect on regional economic output	Percent of regional economic output lost	Jobs Lost	Percent effect on regional employment	Other industries affected
A	MRG	9,094 (95%) 1,266 (50%)	(4 counties) 26.7% 3.7%	3.1% .4 %	\$5.98 million \$.83 million	\$8.39 million \$1.17 million	.026% .0036%	362 51	.081% .011%	real estate, wholes ale trade, agricultural services, doctors and dentists, eating and drinking, hospitals.
	LRG	0	0	0	0	0	0	0	0	0
	Pecos	None for minnow; target flows for shiner not considered.	None due to minnow.	None due to minnow.	None due to minnow.	None due to minnow.	None due to minnow.	None due to minnow.	None due to minnow.	None due to minnow.
B, B-2, C, D,	MRG	9,094 (95%) 1,266 (50%)	(4 counties) 26.7% 3.7%	3.1% .4 %	\$5.98 million \$.83 million	\$8.39 million \$1.17 million	.026% .0036%	362 51	.081% .011%	real estate, wholes ale trade, agricultural services, doctors and dentists, eating and drinking, hospitals.

⁹95% = Cost of obtaining water sufficient to meet flow targets set forth in the Service's 2001 Biological Opinion 95 years out of 100, based on historical flow data. 50% = Cost of meeting targets 50 years out of 100. (Industrial Economics 2003.)

TABLE S-5 cont. <u>95%</u> ¹⁰ 50% (target flow scenarios)		Land Use and Economic Impacts of Acquiring Water to Maintain Target Flows (Data from Final Economic Analysis. Impacts Under Alternatives B, C, and D are identical)								
		Lost agricultural production--alfalfa acres	Percent regional alfalfa acreage lost	Percent state alf. acreage lost	Value of foregone agricultural production	Effect on regional economic output	Percent of regional economic output lost	Jobs Lost	Percent effect on regional employment	Other industries affected
E	MRG	<u>9,094</u> (95%) 1,266 (50%)	(4 counties) <u>26.7%</u> 3.7%	<u>3.1%</u> .4 %	<u>\$5.98 million</u> \$.83 million	<u>\$8.39 million</u> \$1.17 million	<u>.026%</u> .0036%	<u>362</u> 51	<u>.081%</u> .011%	real estate, wholesale trade, agricultural services, doctors and dentists, eating and drinking, hospitals.
	LRG	0	0	0	0	0	0	0	0	0
	Pecos	<u>5,839</u> 3,921	(3 counties) <u>6.2%</u> 4.2%	<u>2.0%</u> 1.3%	<u>\$4.21 million</u> \$2.83 million	<u>\$6.24 million</u> \$4.19 million	<u>.012%</u> .008%	<u>158</u> 106	<u>.28%</u> .19%	agricultural services real estate, wholesale trade, petroleum refining, facility maintenance and repair.

¹⁰95% = Cost of obtaining water sufficient to meet flow targets set forth in the Service's 2001 Biological Opinion 95 years out of 100, based on historical flow data. 50% = Cost of meeting targets 50 years out of 100. (Industrial Economics 2003.)

TABLE S-6		Indian Trust Resources	Environmental Justice	Cultural Resources	Recreation
A	MRG	<p><u>Listing</u>: Should have no effect on Federal Indian water rights. Nothing in the current biological opinion issued by the Service should affect or impair Indian Pueblo and Tribal trust resources on the Middle Rio Grande.</p> <p><u>Designation</u>: Will not occur; no additional impacts.</p>	<p><u>Listing</u>: Possible disproportionate impacts on minority and low income communities, particularly in Socorro County, stemming from supplemental water acquisition.</p> <p><u>Designation</u>: Will not occur; no additional impacts.</p>	<p><u>Listing</u>: Possible limited negative impacts stemming from changes in water operations and river channel management on historical and archeological sites. Insufficient information to assess possible impacts to sacred sites on Tribal lands. Either no impact or possible positive impact on Tribal use of Rio Grande water for ceremonial purposes.</p> <p><u>Designation</u>: Will not occur; no additional impacts.</p>	<p><u>Listing</u>: Possible loss of fishing or boating opportunities stemming from reservoir draw downs to maintain target flows. Possible loss of hunting or wildlife viewing opportunities if migratory waterfowl are negatively affected by water operations for maintaining target flows. Possible increase in recreation and wildlife viewing opportunities in the Rio Grande bosque due to habitat restoration.</p> <p><u>Designation</u>: Will not occur; no additional impacts.</p>
	LRG	No effect.	No effect.	No effect.	No effect.
	Pecos	No effect.	No effect.	No effect.	No effect.
B	MRG	<p><u>Listing with Designation</u>: Same as Alternative A (No Action).</p> <p><u>Designation Specifically</u>: Should have no effect on Federal Indian water rights. Some Middle Rio Grande Pueblos may benefit if designation leads to greater Federal support for Tribal habitat restoration activities, or focuses more management attention on the need to maintain water flow and quality on Tribal lands.</p>	<p><u>Listing with Designation</u>: Same as Alternative A (No Action).</p> <p><u>Designation Specifically</u>: No additional environmental justice concerns.</p>	<p><u>Listing with Designation</u>: Same as Alternative A (No Action).</p> <p><u>Designation Specifically</u>: Possible benefits stemming from additional consultation requirement for actions in the river floodplain. However, additional consultation requirements may place an additional burden on Tribal related consultations.</p>	<p><u>Listing with Designation</u>: Same as Alternative A (No Action).</p> <p><u>Designation Specifically</u>: Possible benefits stemming from additional focus on habitat conservation and restoration in the river floodplain. However, additional consultation requirements may place an additional burden on Tribal related consultations.</p>

TABLE S-6 cont.		Indian Trust Resources	Environmental Justice	Cultural Resources	Recreation
B-2	MRG	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> Should have no effect on Federal Indian water rights. Exclusion of the PMAs located on Pueblo lands (Pueblos of Santo Domingo, Santa Ana, Sandia, and Isleta) may have the positive effect of assuring these four Pueblos that they have the relative freedom to manage their own river and riparian restoration efforts.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> No additional environmental justice concerns.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> Additional burden stemming from increased consultation requirements would be reduced for the Pueblo lands considered to be PMAs.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> Additional burden stemming from increased consultation requirements would be reduced for the Pueblo lands considered to be PMAs.</p>
C	MRG	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> No adverse impacts. Possible benefits stemming from increased Federal support for Tribal habitat conservation activities will not be present in the Cochiti reach.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> No additional environmental justice concerns.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> South of Angostura Diversion Dam, possible benefits stemming from additional consultation requirement for actions in the river floodplain. These benefits will not be present in the Cochiti reach.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> South of Angostura Diversion Dam, possible benefits stemming from additional focus on habitat conservation and restoration in the river floodplain. These benefits will not be present in the Cochiti reach.</p>

TABLE S-6 cont.		Indian Trust Resources	Environmental Justice	Cultural Resources	Recreation
D	MRG	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> Same as Alt. B, Indian Trust Resources unaffected by the exclusion of San Acacia reach.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> No additional environmental justice concerns.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> North of San Acacia Diversion Dam, possible benefits stemming from additional consultation requirement for actions in the river floodplain. These benefits will not be present in the San Acacia reach.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> North of San Acacia Diversion Dam, possible benefits stemming from additional focus on habitat conservation and restoration in the river floodplain. These benefits will not be present in the San Acacia reach.</p>
	MRG	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> Should have no effect on Federal Indian water rights. Some Middle Rio Grande Pueblos may benefit if designation leads to greater Federal support for Tribal habitat restoration activities, or focuses more management attention on the need to maintain water flow and quality on Tribal lands.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> No additional environmental justice concerns.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> Possible benefits stemming from additional consultation requirement for actions in the river floodplain.</p>	<p><u>Listing with Designation:</u> Same as Alternative A (No Action).</p> <p><u>Designation Specifically:</u> Possible benefits stemming from additional focus on habitat conservation and restoration in the river floodplain.</p>
	LRG	No Indian trust issues identified.	No environmental justice issues identified.	No impacts.	No adverse impacts.
	Pecos	No Indian trust issues identified.	If future actions are taken to provide supplemental water for the silvery minnow, there may be disproportionate economic impacts on low income communities, particularly in De Baca County.	No adverse impacts.	Possible increase in recreation and wildlife viewing opportunities due to habitat protection and restoration in the river floodplain. If designation leads to future changes in water operations, possible negative impacts on recreational use of reservoirs and some loss of hunting opportunities.

Chapter 3. Affected Environment

Introduction

All of the alternatives for critical habitat designation studied in this FEIS are located within one or more of these areas: the Middle Rio Grande Basin in New Mexico, the Big Bend region including Big Bend National Park and the Rio Grande Wild and Scenic River corridor in Texas, and the Middle Pecos River Valley in New Mexico. This chapter describes each of these areas in turn, including topics highlighted during scoping.

Middle Rio Grande

Geography

Climate

The Rio Grande, together with the natural and human communities it supports, is strongly affected by the climate of northern and central New Mexico. In general, temperatures increase and precipitation decreases from north to south down the Middle Rio Grande Basin. Latitudinal differences in temperature are greater in the winter than in the summer. Average maximum summer temperatures (typically July and August) range from 32.6°C (90.6°F) at Cochiti Dam to 35.4°C (95.7°F) at Bosque del Apache National Wildlife Refuge (Bosque del Apache NWR) and 33.8°C (92.8°F) at Elephant Butte Dam. Winter minimum temperatures occur in December and January; winter monthly averages range from -6.3°C (20.7°F) at Cochiti to 12.2°C (53.9°F) at Elephant Butte Dam. (Western Regional Climate Center, <http://wrcc.sage.dri.edu/summary/climsmnm.html>).

Annual precipitation is also variable throughout the area, averaging 32 centimeters (cm) (12.59 inches (in)) at Cochiti, 22.4 cm (8.83 in) at Bosque del Apache NWR, and 23.5 cm (9.27 in) at Elephant Butte Dam (Western Regional Climate Center, <http://wrcc.sage.dri.edu/summary/climsmnm.html>). Rainfall is provided both by frontal storms during the winter months and, typically to a greater degree, by “summer monsoon” weather patterns that normally bring intense thunderstorm activity to the region from July to early September. Snowfall is generally minimal in the Middle Rio Grande Valley, but mountain snows at higher elevations in Colorado and northern New Mexico provide most of the water that travels down the Rio Grande during spring runoff. The winter snowpack can be highly variable from year to year.

A major cause of yearly climatic variation in many semi-arid regions is the El Niño – Southern Oscillation (ENSO) phenomenon. Studies using both meteorological records and tree-ring data spanning over 2000 years have demonstrated a strong correlation between ENSO patterns and climate in the southwestern United States, including the Middle Rio Grande Basin.

ENSO effects in New Mexico are most significant during the winter months. Winter precipitation is often over 50 percent above long term averages during the El Niño phase, and a similar degree below normal during the La Niña phase of the cycle. This ENSO climatic connection results in significant variability in winter and spring flows in the Rio Grande. (See Sevilleta LTER Research, <http://sevilleta.unm.edu/research/local/climate/enso/report/>).

Recent climatic trends in the southwestern United States are significant to any discussion of surface water hydrology and patterns of water consumption. Following a drought in the 1950s, the region has experienced several decades of precipitation far in excess of the long-term average, as established by tree-ring data spanning the past 3,000 years (Grissino-Mayer 1995). Water supply in the 1980s and 1990s was particularly abundant. In the future it is possible and even likely that precipitation will return to a level considerably below what many have come to view as “normal” in recent decades.

Natural topography

From its headwaters in the San Juan Mountains of Colorado to its outfall in the Gulf of Mexico near Brownsville, Texas, the Rio Grande is over 3,219 kilometers (2,000 miles) long. In northern New Mexico, the river descends through the steep-walled Rio Grande Gorge into the Española Valley, where it is joined from the northwest by the Rio Chama, its largest tributary in the state. This flow from the northwest originates in part from the natural runoff of the Rio Chama watershed and in part from water imported from the San Juan River Basin in northwestern New Mexico by Reclamation’s San Juan-Chama Project. Further downstream, the river enters the storage and regulation facility of Cochiti Reservoir, which marks the northern boundary of the Middle Rio Grande Valley.

The Middle Rio Grande, constituting about 8 percent of the river’s total length, extends roughly 170 river-miles from Cochiti Dam downstream to the headwaters of Elephant Butte Reservoir. The drainage basin for the Middle Rio Grande encompasses an area of some 6475 square kilometers (2,500 square miles). Natural topography in this region varies from high mountains to broad, mid-elevation plains. The river valley follows a chain of sub-basins within the Rio Grande rift. These sub-basins have been down-faulted thousands of feet, and are bounded on both sides by major fault zones. Uplifting on both sides of the rift has produced the Sangre de Cristo, Sandia, Manzano, and Los Pinos mountain ranges to the east, and the Jemez, Ladron, Magdalena, and San Mateo Mountains to the west. On its western flank, the drainage basin is bounded by the Continental Divide. The Albuquerque Basin is the largest basin within the Middle Rio Grande, extending about 161 kilometers (100 miles) in length from north to south. This basin houses the aquifer from which the city of Albuquerque draws groundwater. To the south, the drainage extends through the Socorro and San Marcial Basins.

Political boundaries

The Middle Rio Grande flows through Sandoval, Bernalillo, Valencia, and Socorro Counties in New Mexico. Through this stretch the Rio Grande passes through or close to the Pueblos of Cochiti, Santo Domingo, San Felipe, Santa Ana, Sandia, and Isleta. Urban areas also occur in this stretch of river, including the Albuquerque metropolitan area (including Rio Rancho, Bernalillo, and Corrales), the communities of Los Lunas, Bosque Farms, and Belen and the City of Socorro .

River reaches

As in the DEIS and final rule, this FEIS recognizes five distinct reaches on the Middle Rio Grande as follows:

The Jemez Reach (8 kilometers (5 miles)) begins immediately downstream from Jemez Canyon Dam on the Jemez River, a tributary of the Rio Grande, and extends to the confluence of the Jemez River and the Rio Grande. Included within this reach is the Pueblo of Santa Ana.

The Cochiti Reach (34 kilometers (21 miles)) begins immediately downstream from Cochiti Dam and extends to the Angostura Diversion Dam in the community of Algodones, north of Albuquerque. Included within this reach are the Pueblos of Cochiti, Santo Domingo, and San Felipe.

The Angostura Reach (61 kilometers (38 miles)) begins immediately downstream of the Angostura Diversion Dam and extends to the Isleta Diversion Dam just south of Albuquerque. Included within this reach is the entire Albuquerque metropolitan area, and the Pueblos of Santa Ana and Sandia.

The Isleta Reach (90 kilometers (56 miles)) begins immediately downstream of the Isleta Diversion Dam and extends to the San Acacia Diversion Dam. Included within this reach are the Isleta Pueblo and the communities of Los Lunas and Belen.

The San Acacia Reach (147 kilometers (92 miles)) begins immediately downstream of San Acacia Diversion Dam and extends to Elephant Butte Dam, although the waters of Elephant Butte Reservoir are not included in any of the alternatives being considered in this FEIS. Included within the San Acacia reach are the City of Socorro, the Bosque del Apache National Wildlife Refuge (NWR), and Reclamation's Low Flow Conveyance Channel (LFCC).

Water and Hydrology

The ancestral Middle Rio Grande developed into a single river system about 5 million years ago. Incision of the middle valley has been cyclic, and has produced gravel, sand, and silt terraces 9-53 meters (30 - 175 feet) above the current floodplain. The Rio Grande is thought to

have reached maximum entrenchment between 10,000 and 20,000 years ago, at a depth 18 - 40 meters (60 - 130 feet) below the current valley floor. Since that time, sediment influx from tributaries has resulted in a gradual aggradation (raising up) of the river bed. Historically, this process led to frequent avulsions, or shifts in the river channel from areas of higher to areas of lower elevation. The historical river channel was braided and sinuous with a shifting sand substrate, and would freely migrate across the floodplain, limited only by valley terraces and bedrock outcroppings (Crawford et al. 1993).

It is believed that prior to human settlement and development the Middle Rio Grande generally supported perennial flows, although riverbed drying may have occurred in downstream areas during periods of prolonged drought (Crawford et al. 1993). Hydrographic patterns of the unregulated river would have mirrored the seasonal events of spring snowmelt and late-summer precipitation. Inputs from two tributaries in this region, the Rio Puerco and Rio Salado, were probably not perennial but were likely far more consistent than those provided by the mostly dry riverbeds present today.

Irrigation history of the Middle Rio Grande

The Middle Rio Grande is the oldest continually inhabited area of the United States. The waters of the Rio Grande have been used by agricultural societies continuously for the past 700 years. Prior to the arrival of Europeans, Pueblo farmers practiced floodwater agriculture relying on overbank flows and surface run-off, and also limited diversions of channel flows (Wozniak 1998). When Coronado's expedition reached the Middle Rio Grande in 1540, it is estimated that 1012 hectares (25,000 acres) of land were under cultivation. Ditch irrigation based on a network of canals and acequias became widespread with the establishment of Spanish settlements in the sixteenth and seventeenth centuries. More and more land in the floodplain was cleared for farming, and cottonwood forests were removed to provide timber for building material, fenceposts, and firewood. By 1850 most valley communities were established in their present locations, and the area of irrigated land reached a maximum of about 125,000 acres between Cochiti and San Marcial in 1880 (Crawford et al. 1993).

In the following decade, irrigated land use in the Middle Rio Grande dropped back below 20,234 hectares (50,000 acres), a level at which it would remain until the 1930s. A combination of ecological and hydrological factors contributed to the decline. Overgrazing and deforestation of surrounding lands resulted in high sediment loads and rates of aggradation in the riverbed. This in turn produced more frequent flooding and saturation of cultivated lands, and a general raising of the water table. At the same time, increasing demand for water upstream, particularly in the San Luis Valley of southern Colorado, resulted in a decreased supply of water for irrigation in the Middle Rio Grande. This resulted in more frequent drying of the river in the southern reaches, and supply shortages in the El Paso/Juarez area in the late 1880s and 1890s. The problems of uneven distribution of water and the waterlogging of lands within the valley persisted through the early stages of modern river management (Crawford et al. 1993; MRGCD 1993).

River management and operations

A number of small-scale water management facilities were constructed on the Middle Rio Grande prior to 1900. Nineteenth-century diversion structures were often unable to withstand periodic floods, and had to be continually repaired or replaced. The era of large-scale, federally-funded river management began shortly after the passage of the Reclamation Act in 1902. One of the newly-formed Bureau of Reclamation's first major actions was to begin planning for a dam at Elephant Butte that would serve the water needs of southern New Mexico and west Texas. Further north, the Middle Rio Grande Conservancy District (MRGCD) was formed in 1925, with a goal of providing the middle valley with an efficient system of irrigation, drainage, and flood control. Over the past century the various projects of Reclamation, the Corps, and the MRGCD transformed the Rio Grande in New Mexico into a fully managed and regulated river system. These projects continue to operate, and they determine the hydrology and character of the Rio Grande today.

Water management within the Middle Rio Grande Valley today is affected by numerous developments and activities within the valley, by the interconnected operation of facilities in the tributaries to the Rio Grande, and by the importation of water from the San Juan Basin. The following is a brief overview of the major projects, facilities, and operations that influence the Middle Rio Grande habitat of the silvery minnow.

Elephant Butte Dam and the Rio Grande Project

Construction of Elephant Butte Dam, the centerpiece of Reclamation's Rio Grande Project, was begun in 1908 and completed in 1916. Elephant Butte Reservoir has a capacity of over two million acre-feet (ac-ft) of water, which is used for irrigation and year-round power generation. Winter discharges from the Elephant Butte Powerplant are impounded at the project's second major facility, Caballo Dam, for irrigation use during the summer. The Rio Grande Project also includes 6 diversion dams, 224 kilometers (139 miles) of canals, 735 kilometers (457 miles) of laterals, and 748 kilometers (465 miles) of drains. Lands served by the project lie to the south of the Middle Rio Grande Valley, in southern New Mexico and west Texas. In total the project provides irrigation water supply for about 72,034 hectares (178,000 acres) of land. The project includes facilities constructed and operated by the USIBWC, the Rio Grande Canalization Project, to regulate water deliveries to Mexico, in accordance with provisions of the Convention of May 21, 1906, between the United States and Mexico. Elephant Butte Reservoir is also the downstream delivery point for New Mexico water obligations under the Rio Grande Compact.

The MRGCD and the Middle Rio Grande Project

As noted, the MRGCD was formed to address problems posed by the waterlogging of riparian lands in Middle Rio Grande corridor, and by frequent flooding of many areas—including

downtown Albuquerque. In the 1930s, the MRGCD undertook a series of projects resulting in the construction of El Vado Dam and Reservoir, a storage facility on the Rio Chama about 257 kilometers (160 miles) north of Albuquerque, and the Cochiti, Angostura, Isleta, and San Acacia Diversion Dams on the Middle Rio Grande. The MRGCD also improved and carried out new construction of water conveyance facilities, producing an extensive water supply and drainage network along the length of the valley. Some measure of flood control was achieved through river channel modifications, and the construction of a system of levees. However the wet years of 1941 and 1942 caused numerous failures in MRGCD-built levees and extensive flooding of both urban and agricultural land.

The Middle Rio Grande Project was authorized by Congress in the 1948 Flood Control Act to improve and stabilize the economy of the Middle Rio Grande Valley, by rehabilitation of the MRGCD facilities and by controlling sedimentation in the Rio Grande. Following passage of the Flood Control Act, Reclamation rehabilitated and assumed management responsibility for El Vado Dam, and the Angostura, Isleta, and San Acacia Diversion Dams. It has since turned the management of the diversion dams over to the MRGCD.

Today El Vado Reservoir, the only storage facility managed as part of Reclamation's Middle Rio Grande Project, has a storage capacity of 196,000 ac-ft and is used primarily to store Rio Chama spring flows for summer release to irrigators in the Middle Rio Grande Valley. The reservoir also provides storage for San Juan-Chama water contractors (discussed below), and for the six Indian Pueblos in the middle valley. The series of diversion dams along the middle valley, noted above, and the supply and drainage networks to which they deliver water are managed by the MRGCD. This extensive system includes over 1,287 kilometers (800 miles) of irrigation canals, laterals, and acequias, and over 644 kilometers (400 miles) of drains. The latter intercept shallow ground water from irrigation uses or river seepage and return it to the river or canal system.

As part of the Middle Rio Grande Project, Reclamation began an extensive program of channel modification in 1953. River and channel maintenance continue to be major components of Reclamation activities in the Middle Rio Grande Valley today. The overall goals of these activities have been to maintain the Rio Grande's capacity to pass high flows and transport sediments, and to more efficiently deliver water to downstream users and to Elephant Butte Reservoir. Four general categories of channel maintenance activities are included in the Reclamation program. Bank stabilization is accomplished through the installation of jetty jacks designed to reduce water velocities near the banks. This may encourage sediment deposition and the establishment of riparian vegetation. River training is used to align flows and manage overbank flooding. Sediment removal is carried out by a variety of means to maintain flow capacity. Finally, vegetation control and snag removal help to increase the floodway's capacity for the passage of extreme flows.

The Flood Control Act also authorized construction by Reclamation of what would become the LFCC, from San Acacia to Elephant Butte Reservoir. Built in several phases during

the 1950s, the LFCC was created to provide efficient delivery of water to Elephant Butte Reservoir, through an area of high water loss. A dramatic decrease in deliveries to Elephant Butte Reservoir had occurred in the 1940s, due to huge sediment deposits in the upper delta area and a deteriorating, saltcedar-infested river channel south of Socorro. The completed channel began conveying water from San Acacia to Elephant Butte in 1959. The LFCC itself eventually became filled with sediment, causing diversions into the channel at San Acacia to be discontinued in 1985. However, because of the configuration of the LFCC (i.e. positioned below and adjacent to the river), the LFCC continues to function as a drain and carries substantial flows of groundwater seeped from the Rio Grande channel and irrigation returns.

Corps facilities

The Flood Control Act authorized the Corps to construct flood and sediment control dams on the two main upstream tributaries of the Middle Rio Grande, the Jemez River and the Rio Chama. Jemez Canyon Dam was completed in 1953, and Abiquiu Dam was completed in 1963. Jemez Canyon Dam, on the Jemez River 8 kilometers (5 miles) upstream of its confluence with the Rio Grande, is used to regulate summer floods, and also trap sediment that would otherwise be transported downstream. Jemez Canyon Reservoir has a storage capacity of 113,100 ac-ft, with 73,000 ac-ft authorized for flood-control and 27,000 ac-ft for sediment retention. Water stored in the reservoir is evacuated as quickly as possible, since the entire flood storage capacity of this small facility is potentially needed to control subsequent thunderstorm events. In 1979, a sediment retention pool of 2,000 ac-ft was established by the NMISC using water exchanged from the San Juan-Chama Project. In 1986, this pool was expanded to the entire capacity of the allocated sediment space. Water was released from this storage pool in 2000 and 2001 for the silvery minnow.

Abiquiu Dam is the primary flood control structure on the Rio Chama. The dam and reservoir are operated within the operating criteria in the Flood Control Act of 1960. Located 51 kilometers (32 miles) upstream from the Rio Grande, Abiquiu Reservoir has a potential storage capacity of more than 1,200,000 ac-ft, with 502,00 ac-ft authorized for flood control and 77,000 ac-ft for sediment retention. In 1981, Public Law 97-140 authorized the Corps to use Abiquiu Reservoir for storage of up to 200,000 ac-ft of San Juan-Chama water intended for agricultural and municipal use. Approximately 189,000 ac-ft of this water is currently stored under easements held by the City of Albuquerque. In 1988, Public Law 100-522 authorized the storage of up to 200,000 ac-ft of Rio Grande system water when the space is not required for the storage of San Juan-Chama water authorized by Public Law 97-140.

Cochiti Dam and Lake, and the much smaller Galisteo Dam, on Galisteo Creek, were authorized by the Flood Control Act of 1960, 12 years following the first legislation of 1948. Galisteo Dam was completed by the Corps in 1970 to control summer flooding and sediment transport from Galisteo Creek into the Rio Grande. Galisteo Dam is located 19 kilometers (12 miles) upstream from the confluence with the Rio Grande. The Galisteo Reservoir holds water only during flood flows, and empties as soon as the water can flow through the dam's

uncontrolled outlet. About 79,600 ac-ft of storage capacity in Galisteo Reservoir is dedicated to flood control, and 9,400 ac-ft is used for sediment storage.

Cochiti Dam, completed in 1975 and operated by the Corps, is the primary flood control structure on the Middle Rio Grande. Cochiti Lake's storage allocations include 503,000 ac-ft for flood control and 105,000 ac-ft for sediment retention. Operation of Cochiti Dam for flood control is coordinated with Jemez Canyon and Galisteo dams in order to regulate for the maximum safe flow at Albuquerque. Cochiti Lake is also used to provide a recreational pool of 486 surface hectares (1,200 acres), or 50,000 ac-ft of storage. An annual allocation of 5,000 ac-ft of San Juan-Chama water is reserved to replace evaporative losses from Cochiti Lake. No part of Cochiti's storage is allocated to irrigation or municipal uses.

According to Corps management guidelines, flood waters are stored and regulated releases are made from the reservoir during the period April 1 through June 30. If, after this period, there is at least 212,000 ac-ft of storage available within the reservoir and river flows are less than 1,500 cubic feet per second (cfs) at the Otowi gage, flood water will be carried over until November 1 when these waters will be evacuated. By March 31, all flood control storage is available within the reservoir for the following year.

Since the 1950s, the Corps has also received authorization and funding to rebuild the original MRGCD levee system in the Middle Rio Grande Valley, particularly in the Albuquerque reach. Flood protection is also achieved by several flood-water drainage facilities, located primarily in urban areas. Authorized by the Flood Control Act of 1954, the North and South Diversion Channels in Albuquerque were constructed by the Corps to convey flood waters originating on the slopes of the Sandia Mountains through developed areas of the city. The Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA), which operates and maintains the two diversion channels, has built several small detention dams and additional conveyance channels which help to guide flood waters into the Rio Grande.

San Juan-Chama Project

Another important project affecting Middle Rio Grande hydrology is Reclamation's San Juan-Chama Project, authorized by Congress in 1962 through Public Law 87-483 and constructed during the 1960s and early 1970s. The project consists of a system of diversion structures and tunnels for the transport of up to 110,000 ac-ft per year of Colorado River Basin water into the Rio Grande Basin. Water passes through the Continental Divide and is discharged into Willow Creek, a tributary of the Rio Chama. Primary purposes of the San Juan-Chama Project are to provide additional water supply to the Middle Rio Grande Valley for municipal, domestic, industrial, and irrigation uses. Project waters are also authorized for incidental recreation and fish and wildlife benefits.

Willow Creek flows into Heron Reservoir, a facility with a 400,000 ac-ft capacity constructed and operated by Reclamation to store San Juan-Chama project waters only. Releases

are made at the request of San Juan-Chama contract holders (see *Water Rights and Use*, below). Reclamation requires that contractors for San Juan-Chama Project water downstream accept delivery of their water by December 31 of each year. Users are not entitled to carryover storage in Heron Reservoir. This constraint led to the release of large flows down the Rio Chama in December of each year. Such releases and their subsequent effects on the sport fishery resources of the Rio Chama led to negotiations between Reclamation and the Service. With the concurrence of project water use contractors, Reclamation has, on a year-to-year basis, extended the December delivery deadline to March and April to permit Heron Reservoir releases for sport fish enhancement during the winter months.

Treaty with Mexico; Rio Grande Compact

Treaty of 1906

The Convention of May 21, 1906, between the United States and Mexico allocates the waters of the Rio Grande upstream from Fort Quitman, Texas. The treaty provides for an annual delivery by the United States of 60,000 ac-ft, in accordance with a monthly schedule, to the headgate of Mexico's Acequia Madre just above Juarez. Water used to meet the delivery obligation is stored in Elephant Butte Reservoir, which was constructed in part for this purpose. Water deliveries to Mexico are overseen by Reclamation and the IBWC.

Rio Grande Compact

The Rio Grande Compact was signed by the states of Colorado, New Mexico, and Texas in 1938 and approved by Congress in 1939. It specifies New Mexico's annual delivery obligation to Texas based upon the inflow measured at the Otowi gage, located on San Ildefonso Pueblo in the northern part of the state. Article XVI of the Rio Grande Compact specifies that the obligations of the United States to Mexico or to Indian tribes are not affected by the compact. Article XVI also specifies that the compact cannot impair the rights of Indian tribes.

The Rio Grande Compact also provides rules for accruing and repaying water credits and debits between the states, water storage restrictions, and the operation of reservoirs. Under the compact, credits and debits can accrue from year to year. A maximum of 200,000 ac-ft is permitted to accrue under the compact. A violation of this limit may have severe consequences, in particular legal action against the state of New Mexico by the state of Texas or another party (Reclamation 2000). New Mexico's Rio Grande Compact deliveries are overseen by the NMISC and the New Mexico Office of the State Engineer (OSE).

Inflow recorded at the U.S. Geological Survey (USGS) gaging station at Otowi Bridge is corrected for the operation of reservoirs constructed after 1929 in the drainage basin between Lobatos, Colorado and Otowi gage. These reservoirs include El Vado, Heron, and Abiquiu. San Juan-Chama water is for exclusive, consumptive use within the Middle Rio Grande Region and does not affect compact delivery requirements.

New Mexico's downstream delivery point for Compact waters is Elephant Butte Reservoir. The downstream delivery obligation, or Elephant Butte Scheduled Delivery, is recorded on the Rio Grande below Elephant Butte Dam. Evaporation from Elephant Butte Reservoir is borne out of New Mexico's compact allocation of Rio Grande River water. The amount of water that must be delivered to Elephant Butte Reservoir is dependent upon the corrected flow at Otowi gage, or the Otowi Index Supply. In years of low to normal water supply, the compact requires that New Mexico deliver 57 percent of the Otowi Index Supply to Elephant Butte Reservoir. During wetter years, the percentage of the flow required at Elephant Butte Reservoir increases to 86 percent of the Otowi Index Supply. The maximum amount of water available for consumptive use in the Middle Rio Grande is capped at 405,000 ac-ft per year, plus tributary flows minus Elephant Butte Reservoir evaporation. (Note: San Juan-Chama water is water that is outside the compact and not subject to delivery to Texas.)

During the 1940s and 1950s, New Mexico accumulated a deficit in deliveries under the Rio Grande Compact of over 500,000 ac-ft. During the 1950's, construction of the LFCC, floodway clearing, and river channelization projects were undertaken to minimize depletions within New Mexico (see *The MRGCD and the Middle Rio Grande Project* above). Analysis by Reclamation indicates that annual streamflow depletions dropped from the pre-1956 rate of 102,000 ac-ft/year to 66,000 ac-ft/year, when the LFCC was in full operation. In the period between 1987 and 1995, when there were no diversions to the LFCC, streamflow depletions averaged 100,000 ac-ft/year (Reclamation 2000).

Throughout the 1990s, New Mexico exceeded scheduled deliveries and accrued a credit of 170,000 ac-ft as of January 1, 2000. At least in part because of supplemental flows provided to the Rio Grande during the 2000 irrigation season, the state had accrued additional credit by early 2001, which became the basis for the conservation water agreement described in Chapter 4. However, the ability of New Mexico to satisfy compact delivery requirements is affected by year-to-year variability in the Otowi inflow, consumptive uses in the Middle Rio Grande, and variability in evaporative losses from Elephant Butte Reservoir (Papadopoulos 2000) (See *Supply and Consumptive Use* below).

Surface flows and channel characteristics

Historic and seasonal patterns

Prior to measurable human influence on the system, the Rio Grande was a perennially flowing, naturally aggrading river system with a shifting sand substrate. The river was sinuous, braided, and freely migrated across the floodplain. Prehistoric and early historic evidence of large fish species indicates that the river was in the past a clearer, larger, and more stable stream than has been observed over the past century (Scurlock 1998). Prior to the development of Colorado's San Luis Valley in the 1870s, there were only two records of flow in the Middle Rio Grande ceasing, during prolonged and severe droughts in 1752 and 1861 (Service 2001b). Over

the past century, however, the Rio Grande has been consistently dewatered in the Angostura, Isleta, and San Acacia reaches, as irrigation diversions and drains have significantly reduced the overall volume of water in the river. Reaches particularly susceptible to drying in recent years include: 1) the area immediately downstream of Isleta Diversion Dam; 2) a 8-kilometers (5-miles) reach near Tome; 3) a 8-kilometer (5-mile) reach near the U.S. Highway 60 bridge; and 4) an extended 58-kilometer (36-mile) reach from Brown Arroyo, downstream of Socorro, to Elephant Butte Reservoir (Service 2001b).

A primary purpose of the various flood and sediment control facilities authorized under the 1948 Flood Control Act was to reverse the continuing aggradation of the river. This has largely been achieved by trapping sediment in the reservoirs, and using sediment-free reservoir releases as scouring flows to degrade (lower) the riverbed. These actions have increased channel capacity, reduced flood risk, and restored function to many MRGCD drains whose outfalls formerly lay below the aggraded riverbed. At the same time, levees and channel modifications have greatly constrained the historic meander of the river across a wide floodplain, and produced a narrower, swifter flowing stream.

A significant cumulative effect of water management activities on the Middle Rio Grande has been to reduce the magnitude of spring run-off and summer thunderstorm peak flow events. While seasonal extremes in the river's annual flow remain present to some degree, the historic flow regime that provided a high spring peak flow leading to overbank flooding has largely been eliminated as a regular hydrological pattern (Crawford *et al.* 1993). The current flow regime as dictated by irrigation, municipal uses, flood control, and water delivery obligations has substantially reduced the volume of peak flows and also altered their timing. Over the past decade, the effects of these changes on the Middle Rio Grande Valley's riparian ecosystem have received increasing attention from researchers and management agencies.

Changes in flow regime have gone hand in hand with constraints on the river channel resulting from structures and modifications in the floodplain. A dampening of peak discharges, and subsequent decrease in sediment movement, have resulted in channel narrowing. Levee construction and channel straightening have allowed increased human development and use of the floodplain, while greatly restricting the width available to the active river channel. Between Cochiti and Elephant Butte Reservoir, river channel area was reduced by roughly 50 percent between 1935 and 1989 (Crawford *et al.* 1993). Floodway capacity for sustained spring flows ranges from around 20,000 cfs in the Albuquerque area to around 7,500 cubic feet per second (cfs) in adjacent river stretches north and south. The capacity of the Rio Grande river channel itself, within the floodway, is maintained by Reclamation at around 7,000 cfs (Crawford *et al.* 1993).

The active river channel continues to be modified, especially by the invasion of non-native plant species. For decades on the Middle Rio Grande, saltcedar and Russian olive have been replacing native vegetation. These exotic species are highly erosion-resistant, and river flows often scour out the streambed rather than erode the plants. Erosion-resistant vegetation

thus produces a narrower, deeper river channel that may not suit the habitat requirements of native aquatic species, including the silvery minnow. As a result of all of these changes, the amount of habitat characterized by sandy substrate, shallow water, and consistent, low-velocity flows has been greatly reduced.

Stream flows and channel characteristics in the five reaches of the Middle Rio Grande included in the alternatives being studied in this FEIS are discussed in greater detail below. The hydrology of the Middle Rio Grande is greatly affected by the existing framework of rights and delivery obligations, and patterns of water consumption within the valley. These are discussed under *Water Rights and Use*.

Jemez Canyon Reach

This reach is on the Jemez River, a tributary of the Rio Grande, and consists of five miles of river from Jemez Canyon Reservoir downstream to the confluence with the Rio Grande, which is at the Angostura Diversion Dam. Jemez Canyon Dam regulates the Jemez River for flood control and sediment retention in conformity with the Flood Control Act of 1960 (Public Law 86-645). Jemez River flows are passed through the reservoir with little regulation, although reservoir releases are limited by the channel capacity of the Rio Grande downstream (Reclamation and Corps 2001).

Cochiti Reach

This reach has flow throughout the year regulated by the Corps' management of Cochiti Dam. In years with high flow, the peak is reduced by holding water for extended release in Cochiti Reservoir. Under flood control operations, Cochiti Dam passes flows ranging between 5,000 and 8,500 cfs. The dam has largely eliminated spring flood damage downstream, while allowing greater total annual discharge. Flow in the river at Cochiti Dam is now generally clear, cool, and free of sediment. Water temperature increases during the summer in downstream areas. The relatively clear water and associated light penetration allows for algal growth throughout this reach. Levees on both sides of river confine overbank flows and isolate riparian vegetation from the river channel.

The river channel averages 84 meters (275 feet) in width. The incision of the river channel in the Cochiti Reach renders it unlikely that controlled Rio Grande discharges will overtop the river banks under current management. Banks in this reach are sandy and unstable in some areas, but Reclamation has stabilized some banks using riprap materials. There is relatively little channel braiding, and areas with reduced velocity and sand or silt substrates are uncommon. Substrate immediately downstream of the dam is often armored cobble (rounded rock fragments generally 8 to 30 cm (3 to 12 inches) in diameter). Further downstream the riverbed is gravel with some sand material. Ephemeral tributaries including Galisteo Creek and Tonque Arroyo introduce sediment to the lower sections of this reach, and some of this is transported downstream with higher flows. The accumulation of heavier sediments results in local channel aggradation and unstable channel configurations (Service 2001b; 1999).

Angostura Reach

This reach currently has a perennial, highly managed flow. The hydrograph follows the seasonal peaks of releases from Cochiti Dam, reduced by water diverted for irrigation at the Angostura Diversion Dam. Downstream irrigation returns augment flows in this reach during the summer, as does inflow from the Jemez River, which enters just below Angostura Diversion Dam. Water temperatures are significantly warmer than in the river downstream from Cochiti Dam. This reach represents a transitional area between warm-water and cool-water habitat and fish communities.

The river channel averages about 183 meters (600 feet) in width. Levees on both sides protect developed valley areas, but a strip of riparian vegetation lies between the levees and river banks. Recovering from the degradation imposed by Cochiti Dam, the Rio Grande gains sediment below Angostura and becomes a predominately sand bed river with low, sandy banks in the downstream portion of the reach. There are numerous sand bars and extensive braiding within the channel margins. The Corrales portion of the Corps levee system runs on the western edge of the river from the northern boundary of the Village of Corrales to the northern limits of the City of Albuquerque. At less than bank-to-bank flows, and within the constraints of the levee and other river works, the river is establishing a sinuous configuration.

Storm events sometimes produce significant runoff that enters the river through different diversion channels in the Albuquerque area. AMAFCA's North Diversion Channel has carried runoff flows as high as 11,000 cfs (Bullard and Wells 1992). The City of Albuquerque's wastewater treatment plant continuously discharges an average of about 80 cfs into the river, at a point about 12.4 kilometers (7.7 miles) upstream of Isleta Diversion Dam. Constant flow in this reach has been due in part to Albuquerque's agreement with MRGCD, which expires in 2002, to maintain a minimum flow of 250 cfs. This flow helps dilute effluent discharge from the wastewater treatment plant (Service 2001b; 1999).

Isleta Reach

This reach generally provides continuous flow, although several areas are subject to drying in recent years. Upstream portions can become isolated during summer and autumn months. There is a peak spring flow reflecting releases from Cochiti Reservoir, and also summer storm peaks. Riverside drains near the towns of Bernardo and San Acacia help maintain flows in these downstream sections of the reach, and flows are supplemented by storm run-off from the Rio Salado and Rio Puerco. These ephemeral flows introduce high sediment loads into the Rio Grande, producing aggradation (or raising) of the riverbed and increased channel mobility downstream of the Rio Puerco confluence. Water temperature, conductivity, and turbidity are higher than in the Angostura Reach upstream.

The river is leveed on both banks, in portions of this reach, such as the Belen area, and routine channel maintenance activities are performed. The sandy river channel averages 122-

152 meters (400-500 feet) in width and contains numerous sandbars and islands. Aquatic habitats in the Isleta Reach are thought to be the most adversely impacted, due to water diversions, of any of the Middle Rio Grande reaches (Service 1999). At Isleta Diversion Dam, up to 1,070 cfs can be diverted to east and west bank channels. Diverted water generally remains in the 716 kilometers (445 miles) of drains and canals in this reach, as there are few points of return in the upper and middle segments (Service 2001b; 1999).

San Acacia Reach

Portions of this reach have been subject to drying in recent years. Leakage at San Acacia Diversion Dam often provides the only flow for the upper portion of this segment. Late summer flow to this reach is generally supplied by summer rainstorm events, when they occur, either in the upper portion of the drainage or via inflow from the Rio Puerco or Rio Salado. Above Escondida the channel is narrow and degrading, with the channel bed is partially gravel. The channel widens and becomes sand bedded approaching Bosque del Apache NWR. Below the Refuge the channel is dominated by sand/silt substrate and is aggrading. Channel maintenance is required to maintain stream gradient. The stream has a higher sinuosity than upstream reaches, and is highly braided within the channel margins.

This is a warm water reach with high sediment loads, which cause the buildup of extensive deltas and channel shifts approaching Elephant Butte Reservoir. Sediment transport is limited by the low slope of the channel and by saltcedar infestation within the floodplain. The Atchison, Topeka & Santa Fe railroad bridge at San Marcial is a significant feature affecting flows in the reach in that it limits the magnitude of spring runoff releases that can be made from Cochiti Reservoir. (Aggradation of the riverbed has resulted in the river passing very close to the bottom of the bridge.) The river channel below San Marcial has been reconstructed after previous inundation from Elephant Butte Reservoir.

Habitats in the San Acacia Reach are negatively impacted by water diversion from the Rio Grande. Prior to 1996, there was only one point in this section, at Brown Arroyo, where water diverted at the San Acacia Diversion Dam could be returned to the river. After its use, irrigation water from the Socorro Main Canal and water used by the Bosque del Apache NWR was moved into the LFCC and transported directly to Elephant Butte Reservoir. In 1996, Reclamation constructed a temporary outfall between the LFCC and the Rio Grande about 14 kilometers (9 miles) downstream of San Acacia Diversion Dam. More recently, Reclamation has installed pumps in the LFCC to convey water back to the river.

Groundwater

Following the river valley, there is a general flow of groundwater from north to south across a series of interconnected basins. Within each basin, groundwater drains toward the river. Sub-surface waters include the shallow valley-fill groundwater system running throughout the valley, and the deeper Santa Fe Group aquifer. A strong hydrological connection exists between

surface and sub-surface drainage systems in Middle Rio Grande Valley. Because of this connection, pumping of groundwater affects the available surface water supply. Water taken from the shallow aquifer eventually results in a reduction in surface flows. These effects may continue for years after groundwater pumping is ceased, as the aquifer is slowly replenished by seepage from the river. In areas where riverbed aggradation has elevated the river above the surrounding terrain, water drains out of the river and into the local groundwater system resulting in a raising of the water table. Across most of the middle valley, groundwater is usually only a few meters below the level of the floodplain (Crawford *et al.* 1993).

Groundwater supplies virtually all municipal and domestic water uses and some supplementary irrigation in the valley. Extraction of sub-surface water has increased proportionally with population. Since the 1920s, the City of Albuquerque has developed an extensive system of deep wells to provide municipal and industrial water. From 1960 to 1990, the city's groundwater pumping increased from 42,000 ac-ft to 118,000 ac-ft per year, causing a substantial decline in water tables (Crawford *et al.* 1993). More than half of the water pumped by the City from the aquifer is not being replenished (City of Albuquerque 1997). The City's new water resources strategy is to begin surface diversions and municipal consumption of Albuquerque's San Juan-Chama contract water by 2005. It is hoped that this will reduce groundwater pumping to an amount that can be replenished—around 50,000 ac-ft a year (City of Albuquerque 2002).

The current level of pumping in the entire Basin is roughly 157,000 ac-ft per year (Papadopulos 2000). Some of the groundwater pumped from the aquifer in urban areas eventually makes its way, via municipal wastewater treatment facilities, back into the river as return flows. Stormwater conveyance in urban areas also results in greater local inflow to the river, and less recharge of groundwater systems, than occurred in the past.

Water quality

Water quality in the Middle Rio Grande is influenced by a number of factors. Sediment loads are highly affected by precipitation patterns, and by dams and diversions on the river and its tributaries. Chemical characteristics of the river also vary with season and location. In addition to a wide range of naturally occurring ions and compounds, the waters of the Rio Grande carry a variety of human-generated pollutants from both point sources (such as wastewater treatment plants) and non-point sources (such as septic tanks and agriculture).

In general, sediments and dissolved solids increase downstream from Cochiti to Elephant Butte Reservoir. Total dissolved and suspended solids tend to be low during spring snowmelt run-off, and high when the river is carrying run-off from summer thunderstorms. Large precipitation events wash more sediments and pollutants into the river from surrounding lands, through storm drains and intermittent tributaries. Below Albuquerque sediment loads increase dramatically, largely due to contributions from the Rio Puerco. Total suspended solids increase from around 2,000 mg/l at Bernardo, immediately upstream of the Rio Puerco confluence, to

around 20,000 mg/l at San Acacia (Crawford *et al.* 1993). Water releases from Cochiti Reservoir are relatively cool, but temperatures rise as the river flows downstream. Mean water temperature increases from around 13° C (55° F) downstream from Cochiti to around 16° C (61° F) at San Acacia. Dissolved oxygen, which tends to vary inversely with temperature, decreases slightly from north to south (*Id.*).

Regulatory framework

The water quality of New Mexico's rivers is subject to a number of regulatory requirements. The Federal Water Pollution Control Act, popularly known as the Clean Water Act, requires the establishment of water quality standards for surface water. States and tribes may set those standards in lieu of the Federal government, subject to the approval of the U.S. Environmental Protection Agency (EPA). The New Mexico Water Quality Control Commission (WQCC), under the authority of the New Mexico Water Quality Act of 1978, sets water quality standards for rivers in the state, including the Middle Rio Grande. Isleta and Sandia Pueblos both have water quality standards for the Rio Grande through Pueblo lands, approved by EPA.

Under the state program, the WQCC develops minimum water quality standards after designating uses of certain stream reaches, and evaluating the standards necessary to maintain these uses. Water quality standards consist of three elements: (1) the designated beneficial use or uses of a water body or segment of a water body; (2) the water quality criteria necessary to protect the use or uses of that particular water body; and (3) an anti-degradation policy. Designated uses range from protection of aquatic life to recreation. Water quality criteria describe the quality of water that will support a designated use, and may be expressed as either numeric limits or a narrative statement. The designated reaches along the Rio Grande, the uses of the water, and the associated standards adopted by the state are presented in **Table 3-1**.

The water quality standards set by the Pueblo of Isleta and the Pueblo of Sandia differ from and in some areas are more stringent than the state standards. One distinction between state standards and those of the two Pueblos is that the Pueblos designate the Rio Grande through the Pueblos for both primary contact ceremonial use and primary contact recreational use. Both Pueblos are currently in the process of revising their water quality standards.

Surface water quality is maintained in part by the monitoring and control of pollutant discharge. EPA issues discharge permits under the National Pollutant Discharge Elimination System (NPDES), which specify discharge limits on pollutants and other provisions to ensure that the discharge does not adversely affect water quality. A number of municipalities and industries in the Middle Rio Grande Valley hold NPDES permits for discharge into the Rio Grande, including Albuquerque, Belen, Bernalillo, Bosque Farms, Los Lunas, Rio Rancho, and Socorro. The City of Albuquerque, together with AMAFCA and other co-applicants, have an application for an NPDES permit for stormwater discharge currently pending with EPA.

The Clean Water Act also requires states to develop total maximum daily load (TMDL) management plans for water bodies determined to be water quality limited. A TMDL documents the amount of a pollutant a water body can assimilate without violating a state's or tribe's water quality standards. When a water body has been identified as impaired, NMED is required to develop a TMDL for the pollutant involved. A TMDL is a specific water quality goal and a means for recommending controls needed to meet water quality standards in a particular watercourse.

Thirty-five miles of the Middle Rio Grande, from the northern boundary of Isleta Pueblo upstream to the Jemez River, have been identified as impaired, with fecal coliform identified as the pollutant of concern (WQCC 2000). The state Water Quality Control Commission adopted a TMDL on fecal coliform associated with stormwater in November of 2001. The TMDL includes a general plan outlining activities, such as best management practices, which, when implemented in the middle Rio Grande stormwater drainage area, should result in a reduction of fecal coliform bacteria inputs in the river (NM Environment Dept. 2001).

Table 3-1: Water Quality Standards for the Middle Rio Grande (WQCC Regulations, 20 NMAC 6.2100)

Reach	Designated Uses	Water Quality Standard
The main stem of the Rio Grande from Angostura Diversion works upstream to Cochiti Dam	<ul style="list-style-type: none"> • Irrigation • Livestock watering • Wildlife habitat • Secondary contact • Coldwater fishery • Warmwater fishery 	pH: 6.6 - 9.0 Temp: ≤ 25°C (77°F) Other standards at 20 NMAC 6.1.2108, 6.1.3100 (WQCC regs.)
The main stem of the Rio Grande from Alameda Bridge (Corrales Bridge) upstream to the Angostura Diversion Works	<ul style="list-style-type: none"> • Irrigation • Limited warmwater fishery • Livestock watering • Wildlife habitat • Secondary contact 	DO > 5.0 mg/L pH: 6.6 - 9.0 Temp: < 32.2°C (90°F) Other standards at 20 NMAC 6.1.2105.1, 6.1.3100 (WQCC regs)
The main stem of the Rio Grande from the headwaters of Elephant Butte Reservoir upstream to Alameda Bridge (Corrales Bridge), the Jemez River from the Jemez Pueblo boundary upstream to the Rio Guadalupe, and intermittent flow below the perennial reaches of the Rio Puerco and Jemez River which enters the mainstem of the Rio Grande	<ul style="list-style-type: none"> • Irrigation • Limited warmwater fishery • Livestock watering • Wildlife habitat • Secondary contact 	pH: 6.6 - 9.0 Temp.: ≤ 32.2°C (90°F) Other standards at 20 NMAC 6.1.2105, 6.1.3100 (WQCC regs.)
Elephant Butte Reservoir	<ul style="list-style-type: none"> • Irrigation storage • Livestock watering • Wildlife habitat • Primary contact • Warmwater fishery 	pH: 6.6 - 9.0 Temp.: ≤ 32.2°C (90°F) Turbidity: ≤ 50 NTU Other standards at 20 NMAC 6.1.2104, 6.1.3100 (WQCC regs.)

Definitions: (WQCC Regulations, 20 NMAC 6.1.1007)

- **NTU:** nephelometric turbidity units based on a standard method using formazin polymer or its equivalent as the standard reference suspension.
- **Coldwater fishery:** surface water of the State where the water temperature and other characteristics are suitable for the support or propagation or both of coldwater fishes.
- **Irrigation:** water of the State used as a supply of water for crops.
- **Limited warmwater fishery:** surface water of the State where intermittent flow may severely limit the ability of the reach to sustain a natural fish population on a continuous annual basis; or a surface water of the State where historical data indicate that water temperature may routinely exceed 32.2°C (90°F).
- **Livestock watering:** surface water of the State used as a supply of water for consumption by livestock
- **Primary contact:** any recreational or other water use in which there is prolonged intimate contact with the water, such as swimming and water skiing, involving considerable risk of ingesting water in quantities sufficient to pose a significant health hazard. Primary contact also means any use of surface waters of the State for Native American traditional cultural, religious, or ceremonial purposes in which there is intimate contact with the water

that involves considerable risk sufficient to pose a significant health risk. The contact may include but is not limited to ingestion or immersion.

- **Secondary contact:** any recreational or other water use in which contact with the water may occur and in which the probability of ingesting appreciable quantities of water is minimal, such as fishing, wading, commercial and recreational boating and any limited seasonal contact.
- **Warmwater fishery:** surface water of the State where the water temperature and other characteristics are suitable for the support or propagation or both of warmwater fishes.
- **Wildlife habitat:** surface water of the State used by plants and animals not considered as pathogens, vectors for pathogens or intermediate hosts for pathogens for humans or domesticated livestock and plants.

Pending water-quality studies

The Service is expected to receive funds through the Endangered Species Act Collaborative Program (see *Regional water resources planning* below) to continue the implementation of a water-quality monitoring network and performance of a water-quality assessment of silvery minnow habitat in the Middle Rio Grande (Reclamation 2001c). The Service will obtain, through the study, requisite scientific information that will be considered during current and future minnow augmentations, habitat restoration planning, and population management activities. A four-year project, the assessment will include the collection, analysis and interpretation of surface-water, bottom-material, and fish-tissue data, together with a review of compiled and collected hydrologic, biologic, and water-quality data.

In conjunction with this study of water-quality parameters, the Service will also be sampling the Middle Rio Grande to obtain data which will be analyzed to describe suitable habitat conditions for silvery minnow and to identify unsuitable habitat conditions, relative to river channel intermittency. The results should provide insights on habitat use by the silvery minnow.

The Pueblo of Isleta and the Pueblo of Sandia may also be undertaking water-quality studies according to the draft fiscal year 2002 detailed spending plan for the ESA Collaborative Program (see *Regional Water Resources Planning* below). As part of its conservation planning efforts, the Pueblo of Isleta is interested in determining water-quality suitability for silvery minnow habitat to assist in the design of river restoration projects. Coordinating with the studies being conducted by the Service, the Pueblo of Isleta will develop a sampling and analysis plan, collect water, suspended sediment and bed materials, conduct toxicity testing, and evaluate the results from four sites, two above the Isleta Diversion Dam and two below. According to the FY2002 detailed spending plan for the ESA Collaborative Program, the Pueblo of Sandia would like to continue its ongoing water-quality monitoring effort to facilitate a better understanding of water-quality issues and their impact on the river, riparian habitat, and endangered species (Reclamation 2002).

Water Rights and Use

Water management in the Rio Grande is governed by the Rio Grande Compact, treaty obligations with Mexico, reservoir legislation, flood protection legislation, and various other federal and state laws. Any discussion of water use in the Middle Rio Grande should recognize that this is a fully appropriated river system. The existing water rights framework includes federal Indian water rights, San Juan-Chama contract rights, and rights administered by the State of New Mexico.

Existing water rights framework

Federal Indian water rights

The Pueblos have significant water rights under Federal law, with priority dates that reach back to “time immemorial.” These rights are recognized as senior to other aboriginal claims to Rio Grande waters.

The water-right claims of the Pueblos in the Rio Grande Basin, including the six Pueblos of the Middle Rio Grande Valley, have not been adjudicated or fully quantified. The MRGCD diverts and delivers water to the six Pueblos—Cochiti, Santo Domingo, San Felipe, Santa Ana, Sandia, and Isleta—pursuant to a 1928 Federal law and 1928 agreement (45.Stat.312). The Pueblos have “prior and paramount” water rights for 3580 hectares (8,847 acres) as well as domestic stock purposes. These do not constitute the full extent of Pueblo rights, and it is likely that the Pueblos will seek to develop their additional rights in the future. Approximately 4856 hectares additional (12,000 acres) are “newly reclaimed” and are statutorily recognized. All these areas, as well as the domestic stock needs are provided water by MRGCD pursuant to Federal law and agreement.

Depletions that result from the exercise of Federal Indian water rights are not subject to state law restrictions, nor are they administered by the State. Such depletions are not subject to Rio Grande Compact considerations and delivery obligations. Article XVI of the Rio Grande Compact provides that “[n]othing 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.”

San Juan-Chama contract rights

Under the authorizing legislation for the San Juan-Chama Project, Public Law 87-483, the NMISC prioritizes and presents to Reclamation which entities should be granted contracts for San Juan-Chama water and what their allocation will be. San Juan-Chama water is currently committed, primarily by contract, to the following uses:

Table 3-2: San Juan-Chama Contracts

Municipal and industrial supplies

City of Albuquerque	48,200 ac-ft
Jicarilla Apache Nation	6,500 ac-ft
City and County of Santa Fe	5,605 ac-ft
San Juan Pueblo	2,000 ac-ft
County of Los Alamos	1,200 ac-ft
City of Española	1,000 ac-ft
Town of Belen	500 ac-ft
Village of Los Lunas	400 ac-ft
Village of Taos	400 ac-ft
Town of Bernalillo	400 ac-ft
Town of Red River	60 ac-ft
Twining Water & Sanitation District	15 ac-ft

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

Taos Area	2,990 ac-ft
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Irrigation

MRGCD	20,900 ac-ft
Pojoaque Valley Irrigation District	1,030 ac-ft

Recreation

Corps - Cochiti Recreation Pool	Up to 5,000 ac-ft
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The Jicarilla Apache Nation's San Juan-Chama water was assigned to the Nation in a 1992 settlement contract as approved by Public Law 102-441. Contract conditions giving the Nation access to this water were met in 1999. Recently Reclamation has been leasing the Nation's San Juan-Chama contract rights for a two-year term ending on December 31, 2002, to benefit the silvery minnow. San Juan Pueblo is also leasing its San Juan-Chama water to Reclamation under a five year lease from 2002 through 2006.

The City of Albuquerque's Water Resources Management Strategy anticipates the use of the city's contracted San-Juan Chama water to meet municipal needs, accompanied by a decreased reliance on groundwater pumping. The proposed plan involves the diversion of up to 94,000 ac-ft of water—including the city's San Juan-Chama water, which would be released from upstream reservoir storage—for drinking water purposes. A DEIS on the drinking water project was issued in June 2002, and the project is targeted to begin in 2006. Through the year 2000, Albuquerque's San Juan-Chama water was used to provide supplemental flows to benefit the silvery minnow. The City is now accumulating its water in storage so that, when it starts to divert water into the new water treatment facility, it can use the stored water in part to make up depletions in the river caused by the delayed effect of groundwater pumping (City of Albuquerque 2002).

State-administered rights

Article XVI, section 2, of the New Mexico Constitution establishes the basic principles of New Mexico water law: "The unappropriated water of every natural stream, perennial or torrential, within the state of New Mexico, is hereby declared to belong to the public and to be subject to appropriation for beneficial use, in accordance with the laws of the state. Priority of appropriation shall give the better right." Section 3 continues: "Beneficial use shall be the basis, the measure and the limit of the right to use water." The OSE is responsible for the supervision, measurement, appropriation and distribution of the state's water, in accordance with these basic principles. At least since the signing of the Rio Grande Compact in 1938, the surface waters of the Rio Grande have been considered fully appropriated, and new appropriations have not been permitted.

Adjudication is the process by which the status and seniority of water rights are determined, and the amount quantified. Adjudications are undertaken in Federal or State district court, and ultimately lead to a legal determination regarding the ownership and extent of water rights. The OSE is charged with performing hydrographic surveys and representing the interests of the State in court. Only through this process is the legal title to water established with complete certainty, but adjudication cases have consistently proven to be complex and extremely time consuming. Water rights—under both State and Federal law—on the Middle Rio Grande are still awaiting adjudication.

The broader responsibilities of the OSE include maintaining compliance with the Rio Grande Compact, protecting the integrity of existing rights, and lengthening the life of the aquifer by limiting the rate at which groundwater levels are declining. Groundwater pumping within the basin is also managed by the OSE under the concept of conjunctive management, which recognizes that groundwater pumping can affect surface flow. OSE guidelines require an applicant for a groundwater diversion permit to purchase a valid water right in an amount sufficient to offset the impact of the pumping on the Rio Grande surface flows. An exception is made for domestic wells; the State Engineer is required by State law to issue permits for wells

for domestic use, watering livestock and irrigation not to exceed one acre of trees, lawn or garden (Sec. 72-12-1, NMSA 1978).

Status of instream flow as a beneficial use

Neither the New Mexico Constitution nor New Mexico statutes, the two sources from which the OSE derives its authority, contain any direct reference to use of water for wildlife protection. The state Constitution declares that the OSE may only permit water usage if an applicant shows that the water it desires will be put to "beneficial use" (NM Constitution, Article XVI, §§1-5). "Beneficial use" is not defined by statute. In the past, applicants demonstrated beneficial use of water by constructing diversion works, such as a ditch or dam, to harness water for agriculture, grazing, industry, or municipalities.

A 1998 New Mexico Attorney General opinion concluded that existing law does not preclude the recognition of instream flow—the act of leaving water in a streambed for recreational, fish or wildlife, or ecological purposes—as a "beneficial use" of water (Attorney General Opinion No. 98-01). However, there is no statutory mandate to consider instream flow a beneficial use.

Municipalities

Under New Mexico State law, water rights can be lost through non-use. An exception exists for municipalities, counties and certain other local entities, which are allowed a water use planning period of up to 40 years (Sec. 72-1-9, NMSA 1978). Municipalities holding vested water rights in the Middle Rio Grande Valley include, as of 1993, Albuquerque (21,848 ac-ft), Santa Fe (9,905 ac-ft), Rio Rancho (1,868 ac-ft), Belen (779 ac-ft), Bernalillo (775 ac-ft, as of 1993), Los Lunas (642 ac-ft), and Socorro (421 ac-ft) (MRGCD 1993). Most of these estimates will likely have increased since 1993.

Middle Rio Grande Conservancy District

The MRGCD was established in 1925 under the Conservancy Act, passed by the New Mexico Legislature in 1923. Most agricultural lands within the Middle Rio Grande Valley, including lands of the six Middle Rio Grande Pueblos, obtain water through the MRGCD's distribution system.

As reported in its 1993 Water Policies Plan, the MRGCD holds rights both to surface water and to groundwater, including:

- Pre-1907 surface water rights: Rights claimed by persons who owned and irrigated lands prior to 1907, when the territorial engineer took jurisdiction over water rights in New Mexico. These water rights do not require a permit to be valid under state law.

- 1907-1927 surface water rights: Rights held by persons who placed land under irrigation after 1907 and before the formation of the MRGCD. These rights, which are few in number, are held by permit.
- In 1931, the MRGCD was granted a change in point of diversion for 32,693 hectares (80,785 acres) of irrigated land with perfected water rights (pre-1907 rights and any 1907-1927 permitted rights). The rights are still held by the individuals owning them.
- Permitted surface rights of the MRGCD: The MRGCD itself holds permits for surface rights to irrigate 17,192 hectares (42,482 acres) of land.
- Federal Indian water rights: Senior Pueblo rights include the right to irrigate 3,580 hectares (8,847 acres) of Indian lands. This water may also be used for domestic and livestock purposes. This is not considered the full extent of the Pueblos' federal water rights.
- San Juan-Chama contracted rights: The MRGCD holds 20,900 ac-ft of consumptive use of water from the San-Juan Chama Project (MRGCD 1993).

Water supply and consumptive use

The present water supply to the Middle Rio Grande includes native flow from the Rio Grande and Rio Chama, San Juan-Chama Project water diverted into the Rio Grande Basin via the Rio Chama, surface water flowing into the Rio Grande from tributaries within the region, and groundwater, found primarily in the Albuquerque Basin and in stream-connected aquifers to the north and south. Average annual native inflow into the middle valley from 1895 to 1995 (as measured at Otowi gage) was roughly 1.1 million ac-ft, with annual variability frequently in the range of .5 to 1.5 million ac-ft. Total inflows from Cochiti to Elephant Butte Reservoir, including all of the sources mentioned above, average about 1.25 million ac-ft.

Scheduled deliveries to Elephant Butte Reservoir under the Rio Grande Compact result in only a fraction of the Otowi inflow being available for use in the Middle Rio Grande region. In wet years, a maximum of 405,000 ac-ft of native inflow, plus San Juan-Chama diversions and tributary and groundwater inflow, represents the actual water supply for the region (Papadopoulos 2000).

The Middle Rio Grande Water Supply Study (Papadopoulos 2000), commissioned by the NMISC and the Corps, provides a probabilistic description of patterns of water supply and consumptive use, based on historical data and the constraints of the Rio Grande Compact. Consumptive water uses include evapotranspiration by both irrigated crops and riparian vegetation, open water evaporation from the river, conveyance channels and reservoirs, and

direct consumption for domestic, municipal, and industrial use (**Table 3-3**). Outflow from the valley at Elephant Butte Reservoir averages around 670,000 ac-ft. The difference between inflow and outflow is the result of these consumptive uses within the Middle Rio Grande Valley.

Table 3-3 Middle Rio Grande, Mean total depletions

Mean total Middle Rio Grande depletions (including groundwater storage) under present conditions:

Crops	34%
Riparian Vegetation	33%
Reservoir Evaporation	19%
Urban/Municipal Use	14%

Between 1985 and 1998, for the entire region from Cochiti to Elephant Butte Reservoir, average annual water consumption by crops and riparian vegetation was about 248,000 and 246,500 ac-ft, respectively, with a small amount of this provided by precipitation. Evaporation from Cochiti Lake averages between 5,000 and 8,000 ac-ft per year. Evaporation from Elephant Butte Reservoir is highly variable due to large changes in surface area; annual losses have ranged from 50,000 ac-ft to 250,000 ac-ft in the past 50 years, accounting for 10 percent - 30 percent of the overall basin depletion. Groundwater pumping in the Albuquerque Basin averages around 157,000 ac-ft per year. Total consumptive use in the Middle Rio Grande averages around 613,000 ac-ft per year. Together, consumptive use and downstream delivery obligations account for almost the entire supply of water in the Middle Rio Grande (Papadopulos 2000).

The average annual diversion of water in the Middle Rio Grande by the MRGCD was roughly 572,000 ac-ft for the period from 1975 to 1999. About 192,000 ac-ft of this annual diversion eventually returned to the river, and another 193,000 ac-ft was lost to evaporation, groundwater seepage, and riparian vegetation. Although agriculture represents the primary managed use of water in the Middle Rio Grande, crops actually consume less than one-third of the total agricultural diversion (Papadopulos 2000).

Water use in the Middle Rio Grande Valley has increased steadily over the past half century, particularly during the recent decades of abnormally high water supply. Because of this increase, flows in the Rio Grande have remained barely adequate to meet delivery obligations and growing human needs. Most valley communities, including the City of Albuquerque and the surrounding metropolitan area, have been relying on sub-surface water to meet growing demands. Because of the hydrological connection between sub-surface and surface waters, groundwater pumping further reduces flows in the already fully appropriated river. The Middle Rio Grande Water Supply Study concluded that, at present levels of use, New Mexico can barely meet compact delivery and supply obligations (Papadopulos 2000).

Regional water resources planning

In addition to the management and regulatory framework described thus far, a number of multi-agency and non-governmental planning projects are taking place in the Middle Rio Grande region. The general focus of all of these projects is sustainability: of the water supply, of biological resources, and of the agrarian way of life of the Middle Rio Grande Valley. Collaborative efforts towards regional resource planning have been trying to address some of the complexities of water management in the valley, and lay the groundwork for solutions among the various constituencies. These projects will likely continue to play a strong role in shaping river management strategies, including responses to the presence of endangered species in the river and Bosque restoration efforts.

Middle Rio Grande Endangered Species Act Collaborative Program

In January 2000, several parties in the Middle Rio Grande signed a Memorandum of Understanding to develop a long-term strategy that would assist in the conservation and recovery of the Rio Grande silvery minnow and the southwestern willow flycatcher, while protecting existing and future water uses. Participation has grown significantly since January 2000, to include additional state agencies, water interests, and Indian Tribes and Pueblos. Key participants include the Service, Reclamation, the Corps, BIA, the City of Albuquerque, the MRGCD, the NMISC, the New Mexico Department of Game and Fish (NMDGF), and the Alliance for the Rio Grande Heritage. The participants are commonly referred to as the ESA Workgroup.

The strategy being developed by the group has been termed the Middle Rio Grande Collaborative Program (Program). The proposed action area for the program extends 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. A program document is currently under development and will serve as the guidance document for the implementation of the Program activities. Reclamation and the Corps will serve as lead Federal agencies for NEPA and ESA compliance and will submit the Program document to the Service for consultation on behalf of the ESA Workgroup.

To date, Congress has appropriated several million dollars for the Program through write-in funds added on to Reclamation's budgetary appropriations. The funding is being used for obtaining water from willing lessees, and support Reclamation's pumping program; propagation activities and genetic research for the silvery minnow; monitoring of the silvery minnow and the willow flycatcher; and habitat restoration along the Middle Rio Grande.

Upper Rio Grande Basin Water Operations Review

"Upper Rio Grande" references the upper half of the length of the Rio Grande, from Fort Quitman, Texas, north to the river's headwaters in Colorado. (The Middle Rio Grande discussed

in this FEIS is actually the middle of the Upper Rio Grande.) Reclamation, the Corps, and the NMISC are leading the Upper Rio Grande Basin Operations Review and preparing an EIS on the operations of the two federal agencies in the Upper Rio Grande Basin. The Draft EIS, scheduled for publication in 2004, will evaluate a range of alternatives for operating dams, reservoirs, and other facilities and could result in changes in the operation of upstream reservoirs and maintenance of the river. The review is ongoing and its outcome cannot be predicted.

Regional Water Planning

Regional water planning has been underway in New Mexico since 1987, when the State Legislature began appropriating funds to the NMISC to make grants to the different regions in the state to plan for their water future. Two regions have been delineated in the Middle Rio Grande Valley for regional water planning purposes: (1) Socorro and Sierra Counties, and (2) the Rio Grande Valley from Cochiti Dam south to the southern boundary of Valencia County (including most of Sandoval, Bernalillo, and Valencia Counties).

During 2001, contractors for the Socorro/Sierra Regional Water Planning Steering Committee prepared draft reports on a water rights inventory, population projections, historic and current water demands and a non-tributary groundwater supply study. A Middle Rio Grande Water Assembly, in partnership with the Middle Rio Grande Council of Governments, is taking the lead on the regional planning process for the Rio Grande Valley region north of Socorro and Sierra Counties. A report on historical and current water use in the Middle Rio Grande region as well as a report on the attitudes and preferences of residents of the region on water issues were prepared in June 2000. A final draft report on future water use projections was issued in September 2001. Completion of the regional plan is expected in 2003.

Bosque Improvement Group

The Middle Rio Grande Ecosystem: Bosque Biological Management Plan (Crawford *et al.* 1993) was produced by an interagency team comprised of agency and university biologists. It assessed the condition of the Rio Grande bosque and made recommendations on bosque management, and continues today to serve as an important reference and guide for bosque and river restoration efforts. An inter-agency group called the Bosque Improvement Group continues to oversee and support a range of projects on bosque management, restoration efforts, and preservation.

Vegetation

Plant associations of the Middle Rio Grande

The Middle Rio Grande corridor extends through a surrounding matrix of Plains–Mesa Sand Scrub and Desert Grassland vegetation in the north, and Chihuahuan Desert Scrub in the south (Dick-Peddie 1993). Within the river floodplain, however, vegetation consists of riparian

associations that differ markedly from those of adjacent upland areas. The majority of riparian habitat along the middle valley is dominated by Rio Grande cottonwood, which forms a sparse to dense canopy in the river floodplain. In areas of relatively intact native vegetation, cottonwoods sometimes share dominance with one of several native willows, particularly Gooding willow and Peachleaf willow. These species may also be a significant component of the understory. Other common native species in understory layers include coyote willow, New Mexico olive, skunkbush, rabbitbrush, and sandbar willow. (See *Appendix D* for a list of scientific names.)

For cottonwoods and some willows, seed dispersal, germination, and seedling development typically take place only when the river overflows its banks and spills into the floodplain. High flows scour existing vegetation and deposit bare sediments required for the successful establishment of these species. Overbank flooding also helps facilitate vegetative reproduction of cottonwoods by layering or suckering (Dick-Peddie 1993).

The cottonwood forest, or bosque, has been heavily impacted by human activities. Historically, cottonwoods were extensively harvested as fuel and building material. However an even greater impact has resulted from twentieth-century flood control activities. Prior to human intervention, conditions necessary for cottonwood reproduction were a fairly regular—though not an annual—occurrence in most areas. Since the establishment of the levee system and flood control facilities, these conditions have been rare to non-existent. For example, the majority of cottonwoods of the Middle Rio Grande bosque today are roughly the same age, and were likely established during the last significant overbank flooding in 1941 (Crawford *et al.* 1993). Lack of flooding not only inhibits reproduction of cottonwoods and other native species; it also disrupts natural processes of decomposition, soil formation, and nutrient cycling. Lower river flows in general have also reduced the rate of growth of established riparian vegetation. As a result of these factors, many of the Middle Rio Grande's cottonwood gallery forests are retreating, with a population of aging trees not being replaced by new growth. If these declines continue, non-native saltcedar and Russian olive will become the dominant plant species in the Rio Grande bosque (see below) (Crawford *et al.* 1993; Molles *et al.* 1998; Ellis *et al.* 1999).

In addition to riparian forests, other types of plant communities occur in limited areas. Sandbar communities consisting of grasses, forbs, and seedlings of cottonwood and willow exist in some locations, but are often scoured by high flows. Wetland habitat is limited in extent but present in some areas, particularly between the San Marcial Railroad Bridge and the delta of Elephant Butte Reservoir. Wetlands may include cattail marshes, with cattail and bulrush, and wet meadows dominated by saltgrass, sedges, and young willows.

Exotic species

The failure of the cottonwood bosque to re-establish itself has coincided with an explosive invasion of non-native species over the past 80 years. In many areas of the Middle Rio Grande, cottonwood associations are being replaced by stands dominated by one or both of two fast-growing exotics: saltcedar (or tamarisk) and Russian olive. These invaders colonize the

same kinds of open areas necessary for cottonwood and willow recruitment. Where not dominant, these species often form a significant component of the shrubby understory. Particularly where there is no shady canopy to block sunlight, saltcedar will form large, uniform stands in the river floodplain. Saltcedar is most prevalent in the southern end of the valley, particularly in the San Acacia Reach, but extensive stands may be found throughout the Middle Rio Grande.

In areas of dense growth, saltcedar can significantly impact river and floodplain hydrology. Saltcedar thickets consume large amounts of water, and may locally deplete the water table (see *Evapotranspiration*, below.) Because saltcedar is highly erosion resistant, thick stands growing alongside the river may contribute to bank stabilization and river channelization. Saltcedar eradication projects have been undertaken at Bosque del Apache NWR, Rio Grande Valley State Park in Albuquerque, and other locations.

Russian olive is the major exotic species in many locations in the northern part of the valley. This species sometimes occurs in uniform stands, with few other species present, and often forms a dense understory in association with cottonwood. Other introduced species such as Siberian elm, tree-of-heaven, china-berry tree, mulberry, and black locust are found in the bosque, particularly along levee roads and in other disturbed areas. In the Corrales bosque north of Albuquerque, Siberian elm may be poised to become the main overstory tree species as the cottonwoods die off over the coming decades (Crawford *et al.* 1999). Suitability of non-native vegetation habitat for wildlife has been the subject of much debate. Most studies indicate that saltcedar, Russian olive, and other exotics provide lower quality habitat than native vegetation. However these species do provide cover for wildlife, and both foraging and nesting substrate for many resident and migratory birds (Crawford *et al.* 1993).

Evapotranspiration

In the Middle Rio Grande Valley, evapotranspiration by agricultural crops and riparian vegetation account for two-thirds of the total consumptive use of water (34 percent and 33 percent respectively; Papadopulos 2000). Saltcedar, a relatively high water-use phreatophyte, has been the focus of numerous eradication efforts due to its limited habitat value and high water consumption. Restoration projects are being designed to replace saltcedar stands with riparian habitat that resembles the historic cottonwood–willow bosque. While these efforts will reintroduce native vegetation that is of greater habitat value than non-native species, the extent to which they will result in increased flow in the Rio Grande (for example, by a reduction in evapotranspiration) is still being studied.

The effects of evapotranspiration on streamflow are not well quantified, and are currently the subject of numerous studies. Reclamation has initiated an interagency evapotranspiration workgroup, and has developed an evapotranspiration monitoring network known as the ET Toolbox. This project incorporates remote sensing and GIS land use maps with modeling technologies in researching new ways to measure water vapor flux from crops and riparian

vegetation (Hansen 2000). The results of these studies, if they continue to be funded, will help to quantify more precisely the amount of water consumed by evapotranspiration processes and the relative effects of phreatophytes on river flows.

The transpiration dynamics of different types of riparian vegetation are being studied at the University of New Mexico. The UNM Hydrogeoecology Research Project is studying the effects of flooding and vegetation type on evapotranspiration. Factors important to evapotranspiration rates, such as vegetation density, leaf area index, flooding intervals, and temperature, are being analyzed in conjunction with techniques for quantifying evapotranspiration rates for specific areas. Through this study researchers plan to estimate annual evapotranspiration rates for native and non-native riparian plant communities, and evaluate the various techniques for estimating evapotranspiration (http://sevilleta.unm.edu/~cdahm/bosque_et.htm).

Research indicates that evapotranspiration rates at any given site depend on a number of factors, including the species present and the depth of the water table. Saltcedar has an extensive deep root system that maintains contact with groundwater, enabling it to consume water at a rate independent of water table depth. In contrast, the consumptive use of cottonwood rises and falls with the underlying water table. At a groundwater depth of around 3 meters (11 feet), the consumptive use of saltcedar (according to one report, approx. 1 meter (3.2 feet) per year) greatly exceeds that of cottonwood (approx. 0.6 meters (1.86 feet) per year, per the same report). But when the water table rises to roughly 7 feet below ground, the evapotranspiration rates of the two species are nearly equal (Flanigan and Balleau 1998). Numbers reported for both species vary greatly between studies, depending in part on how water consumption is measured. See the preliminary water budget for a forthcoming restoration project in Los Lunas for other estimates, described in *Impacts on Water Supply*, Chapter 4.

Following saltcedar eradication, the local water table begins to rise. A rising water table will likely be accompanied by increased evapotranspiration from cottonwoods and other native vegetation. In addition, increases in the local water table due to saltcedar eradication are attenuated within the local groundwater system—not all of the reduced consumption translates into increased river flows. Thus the total savings that may be achieved by modifications of riparian vegetation remain difficult to measure.

Federally-listed (threatened and endangered) plant species

No federally-listed plant species have been identified within the area being considered for critical habitat designation on the Middle Rio Grande.

Fish and Wildlife

Rio Grande silvery minnow

The Rio Grande silvery minnow formerly occupied the Rio Grande from Española, New Mexico, to the Gulf of Mexico. The species is currently found only within the 274-kilometer (170-mile) segment of the river from Cochiti Dam to the headwaters of Elephant Butte Reservoir, less than five percent of the silvery minnow's historic range. As recently as 1978 the silvery minnow was collected upstream of Cochiti Reservoir; however numerous surveys since 1983 suggest that the fish is now extirpated from this area. No specimens of the Rio Grande silvery minnow have been collected in New Mexico downstream of Elephant Butte Dam since the 1940s. The reaches of the Middle Rio Grande being considered among the alternatives for critical habitat designation include the last remaining occupied habitat of the silvery minnow.

Although population size of the short-lived silvery minnow fluctuates widely on an annual and a seasonal basis, general trends can be described. Historically, the silvery minnow was an abundant fish in the Middle Rio Grande, particularly between the present day Cochiti Reservoir and Socorro. It was present in 26 of 28 collections taken between 1926 and 1959, and was the most common species in half of these samples. In an extensive series of fish collections made between Cochiti and Elephant Butte Reservoir in 1977, the silvery minnow was present in 19 of 23 samples and was the second most common species. Declines in the silvery minnow population probably began with the closing of Elephant Butte Dam in 1916. The silvery minnow's situation was likely worsened by the building of Cochiti Dam 1975, and became acute in the late 1980s, particularly in the northern part of the fish's range. Forty-six collections between Cochiti Pueblo and Bosque del Apache NWR from 1990 to April of 1992 produced 23 species and over 38,000 fish specimens, but only 10 specimens of the silvery minnow. The fish was absent from locations where it had been numerically dominant prior to a series of regional summer droughts from 1987 - 1991, which left large sections of the river below Isleta Diversion Dam dry for prolonged periods (Platania 1993; Service 1999).

Extensive summer surveys in 1992 again detected fairly large numbers of the silvery minnow, in some areas. About 20 percent of silvery minnows counted in 1992 were from the Angostura reach, and 70 percent from the San Acacia reach. Surveys on Santo Domingo and San Felipe Pueblo lands in 1994 yielded a few specimens still present in the Cochiti reach upstream of the Angostura Diversion Dam (Service 1999). Although a limited recovery from the 1987-1991 population plunge occurred in the early 1990s, severe and extensive dewatering of the river in 1996 resulted in the loss of a significant percentage of the remaining silvery minnow population (Service 2001b). Drying events in several of the years since 1996 have further concentrated the silvery minnow population in the San Acacia reach, and reduced the silvery minnow in the Isleta and Angostura reaches.

Bi-monthly Reclamation monitoring at multiple locations in 2000 detected a total of only six silvery minnows in the Isleta and Angostura reaches. In 2001, monitoring indicated a slight increase in silvery minnow numbers in these reaches. A single school of a few hundred individuals was detected in the Isleta reach in February 2001. June and August 2001 sampling revealed small numbers of silvery minnows at several locations in the Isleta reach and Angostura reaches, and a school of 188 individuals as far north as Rio Rancho. Currently, the majority of the silvery minnow population is collected within the reach between San Acacia Diversion Dam

and Elephant Butte Reservoir. Even in this reach, the silvery minnow population remains greatly reduced from pre-1996 levels (Dudley and Platania 2001; S. Platania, UNM, pers. comm. 2002).

Fish communities of the Middle Rio Grande

Forty-three percent of the native fish species of the Rio Grande in New Mexico have been extirpated or are extinct. The historic native fish fauna of the Middle Rio Grande is thought to have included at least 16 species, four of which were endemic to the region. A number of these native species have been extirpated, including big river fishes such as the shovelnose sturgeon, long nose gar, blue sucker, gray redhorse, and freshwater drum. Four species of native minnow have also disappeared from the Middle Rio Grande: the speckled chub, Rio Grande shiner, phantom shiner, and Rio Grande bluntnose shiner. The latter two species are thought to be extinct (Bestgen and Platania 1991). Of five Rio Grande endemic minnows, only the Rio Grande silvery minnow remains present in the New Mexico portion of the river (Propst 1999; Platania 1993). See *Appendix D* for a list of scientific names.

A substantial number of non-native fish species have been introduced into the Middle Rio Grande through both accidental releases and sportfish management by the NMDGF (Crawford *et al.* 1993). The fish fauna of the Middle Rio Grande today includes at least 26 species, of which 9 are native and 17 are non-native to the drainage. All of the native species are members of the Order Cypriniformes, and include six minnows and three suckers. Non-native species include representatives of five additional orders. A list of species present based on Platania's extensive 1987-1990 surveys is shown in **Table 3-4** (Platania 1993). Some non-native fish species entering the Middle Rio Grande from Cochiti Lake or Elephant Butte Reservoir may prey upon the silvery minnow.

Native fish species, although less diverse than the non-native species, are numerically dominant. Of the nearly 32,000 Middle Rio Grande fish specimens collected by Platania in the late 1980s and early 1990s, native species comprised 85 percent of the total catch. This was due largely to the extremely high abundance of the red shiner (53 percent of the total catch), and the high abundance of the Rio Grande silvery minnow (18 percent of the total catch) prior to its population plunge from 1989 - 1992. Surveys conducted in 2000 further demonstrate the dominance of the red shiner in Middle Rio Grande fish communities. Flathead chub and fathead minnow were the next most common native species in the early 1990s; by 2000 flathead chub had declined and river carpsucker was the second most common native species. Eight of the 17 non-native species sampled were represented by three or fewer specimens. Western mosquitofish, white sucker, and channel catfish were the most common non-native species (Platania 1993; Dudley and Platania 2001).

Different reaches of the Middle Rio Grande support somewhat different fish communities. The relatively cool, fast-flowing Cochiti reach differs markedly from downstream sections. Red shiner is present only in small numbers in the Cochiti reach, where the dominant species are white sucker, long nose dace, and fathead minnow. In the Angostura reach red

shiner assumes dominance, which it maintains across the subsequent downstream reaches, while white sucker and longnose dace decrease in abundance. As noted, silvery minnow abundance is higher in the downstream reaches. Apart from these differences, the Angostura, Isleta, and San Acacia reaches contain broadly similar, warm-water fish communities.

Platania 1993: Rio Grande Fishes and Habitat Association

Table 3-4: Summary of 1987-1990 Rio Grande and Low-Flow Conveyance Canal ichthyofaunal composition between Velarde and Elephant Butte Reservoir (N=88 collections).

	Resident Status	Total Number of Specimens	Rank Abundance	Frequency of Occurrence	% Total
Salmon and Trout					
rainbow trout	I	1	23	1	0.003
brown trout	I	3	18	3	0.01
Herrings					
grizzard shad	I	30	13	8	0.10
Carp and Minnows					
common carp	I	51	10	20	0.16
red shiner	N	16,670	1	75	52.59
Rio Grande chub	N	43	11	5	0.14
RG silvery minnow	N	5,669	2	46	17.88
fathead minnow	N	1,077	6	62	3.40
fathead chub	N	2,098	4	64	6.62
long nose dace	N	608	8	44	1.92
Suckers					
river carpsucker	N	795	7	43	2.51
white sucker	I	1,811	5	52	5.71
smallmouth buffalo	N	2	20	1	0.006
Rio Grande sucker	N	8	17	3	0.03
Bullhead Catfishes					
black bullhead	I	21	14	9	0.07
yellow bullhead	I	11	16	6	0.03
channel catfish	I	463	9	48	1.46
flathead catfish	I	1	23	1	0.003
Livebearers					
western mosquitofish	I	2,280	3	61	7.19
Sunfishes					
green sunfish	I	2	20	2	0.006
bluegill	I	3	18	3	0.01
longear sunfish	I	1	23	1	0.003
largemouth bass	I	14	15	9	0.04
white bass	I	1	23	1	0.003
white crappie	I	34	12	18	0.11
black crappie	I	2	20	1	0.006
Total		31,699			

(STATUS: N = NATIVE, I = INTRODUCED)

Federally-listed (threatened and endangered) species

The Rio Grande silvery minnow is the only federally-listed fish species in the Middle Rio Grande. Five other federally listed species and one species which is a candidate for federal listing occur (or may occur) in the Middle Rio Grande Valley. The southwestern willow flycatcher, bald eagle, whooping crane, and interior least tern have all been the subject of recent Section 7 consultations, and were considered along with the silvery minnow in the June 2001 Programmatic Biological Assessment on Reclamation and Corps water management activities in the region, and the subsequent Biological Opinion published by the Service (Reclamation and Corps 2001; Service 2001b). See *Appendix D* for a list of scientific names.

Southwestern Willow Flycatcher. The southwestern willow flycatcher (flycatcher) is a migrant songbird that nests in riparian areas adjacent to rivers, streams, or wetlands. The flycatcher's breeding range extends from southern California to west Texas, and north into Utah and possibly southwestern Colorado. The flycatcher uses riparian corridors along New Mexico rivers both as breeding habitat and as stop-over habitat during spring and fall migration. In summer the flycatcher nests along the Middle Rio Grande from Elephant Butte Reservoir to Velarde. Approximately 938 territories are thought to remain in the Southwest; surveys conducted in the 2000 found that New Mexico contains roughly 28 percent of the breeding population. Habitat and overall numbers of flycatchers have declined statewide during the past century. The "southwestern" sub-species was listed by the Service as endangered in 1995 (60 FR 10694). Critical habitat was designated in 1997, but did not include any areas along the Rio Grande (62 FR 39129). Critical Habitat designation was overturned by the U.S. Court of Appeals for the Tenth Circuit in May 2001 (New Mexico Cattle Growers Ass'n v. U.S. Fish and Wildlife Service, 248 F.3d 1277 (10th Cir. 2001)). A final Recovery Plan for the flycatcher was published by the Service in April 2001.

Flycatcher declines in the Middle Rio Grande have been attributed to loss or degradation of habitat brought about by river and floodplain management activities, and by an increase in urban and agricultural development. Flycatchers require dense riparian vegetation for nesting, and prefer patches dominated by native willows. Additional threats include habitat degradation due to livestock grazing, and risk of catastrophic fires in riparian areas. Concurrent with habitat loss has been a rise in nest parasitism by brown-headed cowbirds (Service 2001c; Lehman et al. 2001).

Recent surveys along the Middle Rio Grande have found flycatchers nesting in dense willow cottonwood, saltcedar, and Russian olive habitats within 46 meters (150 feet) of surface water. Nesting usually appears to be initiated only after surface water or high groundwater levels have created moist soil conditions underneath the nest tree (J. Taylor, Service, pers. comm. 2002). Nesting in the Middle Rio Grande occurs primarily in the Isleta and San Acacia reaches, as well as in the Velarde and Española reaches upstream from Cochiti. The absence of breeding flycatchers in the Cochiti and Angostura reaches has been attributed to the dominance of older, even-aged cottonwood stands and lack of surveys in this area. A total of 55 breeding territories were located along the southern reaches in 2000. In some parts of the San Acacia

reach, particularly the region between San Marcial and Elephant Butte Reservoir, flycatchers have been increasing in recent years (Reclamation and Corps 2001). However, dewatering of the river in areas adjacent to flycatcher territories appears to limit breeding success (Service 2001b).

Various measures have been taken or are under consideration to maintain river flows and expand or improve habitat for the flycatcher in the Middle Rio Grande, in conjunction with efforts to provide improved conditions for the Rio Grande silvery minnow (Service 2001b). These are described in Chapter 4.

Bald Eagle. The bald eagle, federally-listed as a threatened species, has been proposed for delisting (64 FR 36454). Bald eagles breed only sporadically in New Mexico, but winter in moderate to substantial numbers at several locations in the Middle Rio Grande Valley. Eagles prey mostly on fish and waterfowl, and require large trees or cliffs near water for roosting. Bald eagles generally arrive in the region about mid-November and depart about mid-March. A wintering population of 30-40 birds has been seen annually in the vicinity of Elephant Butte Reservoir, and Bosque del Apache NWR hosts 30-40 bald eagles that feed primarily on wintering waterfowl. Over 90 bald eagles were recorded at the refuge during the winter of 2000-2001 (J. Taylor, Service, pers. comm. 2002). A number of individuals have been included in recent winter counts in the Albuquerque area, and annual winter surveys by the Corps have detected 5 - 25 bald eagles along the Rio Grande between Albuquerque and Cochiti Dam. Principal threats in the Middle Rio Grande are degradation of wintering habitat (including declines in prey and in roost-site availability), environmental contamination, and illegal killing.

Whooping Crane. The whooping crane is a federally- and state-listed endangered species. One whooping crane, the last survivor of experiments to establish the endangered species in an Idaho to New Mexico migration route, winters in the Middle Rio Grande Valley. One formerly wintered with sandhill cranes at the Bosque del Apache NWR, but was absent in the winter of 2001-2002 (J. Taylor, Service, pers. comm. 2002). Another individual formerly wintered in the Middle Rio Grande Valley near Belen, at the Casa Colorada Wildlife Management Area, but did not return in the winter of 2002-2003 and is presumed to be dead. Overall decline of the species is attributed to habitat loss and degradation.

Interior Least Tern. The interior population of the least tern is federally listed as endangered, and state listed as threatened. The tern is present in the Middle Rio Grande only as an uncommon spring migrant. In areas outside of New Mexico, terns nest on bare sandbars and alluvial islands, and are strongly affected by changes in water levels and release patterns. Habitat loss from river channelization and dam construction acts to eliminate potential roosting and nesting sites.

State-listed species and other species of concern

Arizona Bell's Vireo. This sub-species of the Bell's vireo is state listed as threatened. It is a riparian-nesting species, with habitat requirements similar to those of the southwestern willow flycatcher. It occurs along river drainages in the southern part of the state, including the Rio Grande south of Elephant Butte Dam, and north into downstream portions of the Middle Rio Grande Valley. Like the flycatcher, it is threatened by loss of suitable riparian habitat.

Neotropic Cormorant. This species is state listed as threatened. It occurs in small numbers in the vicinity of Elephant Butte Reservoir and at Bosque del Apache NWR, particularly in wetland areas with flooded trees.

Peregrine Falcon. This species has recently been federally delisted, but remains state listed as threatened. The wide-ranging species breeds in scattered locations in New Mexico. The falcon has been regularly observed during spring and fall migration at Bosque del Apache NWR and around Elephant Butte Reservoir. Optimal breeding habitat in the Southwest is associated with high cliffs bordering bodies of water.

Western Yellow-billed Cuckoo. The yellow-billed cuckoo, west of the Rocky Mountains, was recently added to the candidate species list for Federal listing by the Service because of serious declines throughout the region (66 FR 38611). Biologists estimate that more than 90 percent of the bird's riparian habitat has been lost or degraded. Preferred habitat includes larger stands of dense willow and cottonwood. Breeding cuckoos have been detected mostly in mid-aged and mature stands of riparian habitat along the Middle Rio Grande. Causes for the cuckoo's decline remain poorly understood. Like other riparian species, the cuckoo may be threatened by altered flow and sediment regimes, river channelization, conversion of riparian habitat to agriculture, and the spread of exotic vegetation.

Meadow Jumping Mouse. The *luteus* subspecies of this widely distributed mouse is endemic to Arizona and New Mexico, and is state listed as threatened. It occurs both in mountain habitats and in the Rio Grande Valley from Bosque del Apache NWR north to Española. It may also use irrigation waterways adjacent to agricultural areas. The subspecies persists in fair numbers in most locations and may be considered for delisting.

Other wildlife

The Middle Rio Grande, like other riparian corridors in the desert southwest, supports great concentrations of biological diversity. The valley fauna is made up of riparian species, as well as species associated with adjacent biotic communities of Chihuahuan desert scrub, desert grasslands, and pinyon-juniper woodlands. Complementing this diversity are a large number of migratory species that pass through the Rio Grande Valley and use riparian vegetation as seasonal habitat. In general, the most abundant species are also the most widespread across the region. However, central and southern New Mexico is also a region of intersection between the biogeographic provinces of the Rocky Mountain region and northern Mexico, and a number of species reach the northern or southern extent of their distribution within the Middle Rio Grande.

Changes in latitude and elevation between the Cochiti and San Acacia reaches also result in different biological communities.

Birds. Bird studies in the Middle Rio Grande corridor have documented close to 300 species, and breeding bird densities of over 1,000 birds per 40 hectares (100 acres) have been estimated for some areas. Recent spring and fall mist netting at Bosque del Apache NWR and the Rio Grande Nature Center in Albuquerque between 1994-1997 yielded 157 species. Combined with point counts, a total of 222 species were detected (Means and Finch 1999). Bird communities include permanent and summer resident species, as well as transient species that only pass through the valley on migration. In the summer, numerically dominant species across much of the middle valley include the black-chinned hummingbird, mourning dove, and blue grosbeak. Red-winged blackbird and common yellowthroat may be locally abundant in wetland areas. Other common species include northern flicker, ash-throated flycatcher, black-headed grosbeak, spotted towhee, white-breasted nuthatch, and western kingbird. Bewick's wren, a species not noted as breeding in the valley at the time of Hink and Ohmart's 1984 biological survey, has since become a common to abundant nesting species in many areas (Taylor *in press*). See *Appendix D* for a list of scientific names.

Common winter residents in the riparian zone include white-crowned sparrow, dark-eyed junco, yellow-rumped warbler, house finch, lesser goldfinch, and American crow. Resident winter waterfowl along the river channel and drains include mallard, American wigeon, gadwall, green-winged teal, northern shoveler, northern pintail, and Canada goose. Snow geese, Ross's geese, and sandhill cranes are present in winter in very large numbers across the valley, with concentrations at the Bernardo Wildlife Management Area and at Bosque del Apache NWR. The Festival of the Cranes at Bosque del Apache NWR has gained international attention for the tens of thousands of sandhill cranes and geese that winter there every year.

A variety of neotropical migrant songbirds--including warblers, vireos, flycatchers, tanagers, and orioles--pass through the valley on their spring and fall migrations. Abundant migrants include Wilson's warbler, MacGillivray's warbler, pine siskin, and chipping sparrow. Of greater biological importance may be the many less common species that utilize riparian habitat in the valley every year, either as stop-over or breeding habitat. Monitoring data suggest that many long-distance migratory songbirds are showing moderate to severe declines. Disturbance and changes in riparian habitat in the Middle Rio Grande Valley, including the loss of native trees and the spread of exotic vegetation, may potentially contribute to the decline of some neotropical migrant species.

Reptiles and Amphibians. Fifty-seven species of reptiles have been recorded in the Middle Rio Grande Valley (Degenhardt *et al.* 1996). Perhaps more representative of the valley's reptile community are the 38 species documented by Hink and Ohmart (1984), including three turtles, 17 lizards, and 18 snakes. Even this group includes a number of upland species not commonly observed in riparian habitats. Turtles generally present in the river and wetland areas include the spiny softshell and the painted turtle, a species that has declined in recent years. The most common lizards occupy relatively open areas, and include the New Mexico whiptail,

eastern fence lizard, and plateau lizard. Other reptiles such as Great Plains skinks and common gartersnakes favor moister, more densely vegetated habitat. Other common snake species include the gopher snake and western coachwhip.

Thirteen amphibian species have been documented in the Middle Rio Grande Valley (Degendardt et al. 1996). The Woodhouse toad is abundant in sandy and sparsely vegetated habitat; the Great Plains toad and spadefoot toad are also present in these areas. The most common amphibian is the non-native bullfrog, abundant along drains and canals. Other amphibians associated with temporary or permanent water include the tiger salamander and western chorus frog. In general those species that require moist and aquatic conditions—such as the chorus frog, painted turtle, spiny softshell turtle, common garter snake, and Great Plains skink—are the most sensitive to disturbances in the river and adjacent riparian habitats.

Mammals. The white-footed mouse, western harvest mouse, and house mouse are the most numerous of 19 small mammals captured in surveys along the Middle Rio Grande (Stuart and Bogan 1996; Hink and Ohmart 1984). Intermediate-age cottonwood habitat had the highest capture rates. Eighteen large mammal species were documented in the Rio Grande by Hink and Ohmart (1984). Species especially dependent upon riparian areas include beaver, muskrat, and raccoon. Two bat species are restricted to riparian areas, the Yuma myotis and little brown bat. At least 11 species of bats have been found along the Rio Grande (Findley et al. 1975).

Land Use Plans and Policies

Federal. Two National Wildlife Refuges, Sevilleta and Bosque del Apache, are located on the Rio Grande in Socorro County. While not a land use plan per se, a five year plan for the management of waterfowl, sandhill cranes, and other migratory birds in the Middle Rio Grande Valley of New Mexico, adopted by the Service, the NMDGF, and APHIS-Wildlife Services, U.S. Department of Agriculture, is in effect.

The Bureau of Land Management (BLM) administers land in the counties of the Middle Rio Grande, primarily in Sandoval and Socorro counties, but little of it is on the river. Reclamation has jurisdiction over lands at the north end of Elephant Butte Reservoir, including grazing allotments that BLM manages for Reclamation under a memorandum of understanding. All of these lands are governed by resource management plans.

State. The state of New Mexico does not have a state-wide land use plan. The State Land Office has adopted regulations governing the management and leasing of state trust lands, but there is very little state trust land along the Rio Grande.

The NMDGF's Ladd S. Gordon Waterfowl Management Complex, which consists of the Belen, Bernardo, Casa Colorada, and La Joya Waterfowl Management Areas in Valencia and Socorro Counties, is subject to the migratory bird management plan noted above.

Pueblos. It is unknown if any of the six Middle Rio Grande Pueblos have formally adopted land use plans. Land use policy is governed by the respective Pueblos' tribal councils.

MRGCD. The MRGCD adopted a Water Policies Plan in 1993. The plan considers a variety of water issues affecting the MRGCD, their legal, economic, and land-use context, and the role and responsibilities of the MRGCD with regard to these issues (MRGCD 1993).

In 1995, the MRGCD commissioned a study and scoping report for a "MRGCD Bosque Protection Master Plan." The study was described as a "preliminary assessment of the effort and process required in the development of a bosque management master plan which will provide guidelines for municipalities and Pueblos in the development of local bosque plans" (MRGCD 1995).

Local Governments. Sandoval and Socorro counties have comprehensive plans, while Valencia County does not. Albuquerque and Bernalillo County have a joint comprehensive plan. They have also adopted a Albuquerque-Bernalillo County Groundwater Protection and Action Plan. At the municipal level, comprehensive or master plans exist or are being developed for a number of the cities and villages in the Middle Rio Grande Valley.

In 2000 the Middle Rio Grande Council of Governments of New Mexico (MRGCOG) adopted the Focus 2050 Regional Plan. MRGCOG is a regional planning body representing county and municipal governments in Sandoval, Bernalillo, Valencia, and Torrance Counties. The plan identifies a regional land use and growth strategy based on sets of specific goals in the areas of community identity, economic development, housing, irrigated agriculture, transportation, and water (MRGCOG 2000).

Land Ownership and Use

Sandoval County. Land ownership in Sandoval County is approximately 40 percent federal, 4 percent state, 28 percent Native American, and 28 percent private (Williams 1986). Most of the federal land in the county is BLM land or Santa Fe National Forest located in the northern and western part of the county. Of the six Middle Rio Grande Pueblos, five—the Pueblos of Cochiti, Santo Domingo, San Felipe, Santa Ana and Sandia—are located wholly or partly in the county (*see Figure 3-1*).

Besides the Middle Rio Grande Pueblos, communities along the Rio Grande in Sandoval County include, from north to south, the small farming communities of Pena Blanca and Algodones as well as the larger community of Bernalillo. Part of the Village of Corrales is also in Sandoval County.

Bernalillo County. Land ownership in Bernalillo County is approximately 20 percent federal, 5 percent state, 30 percent Native American, and 45 percent private (Williams 1986). Federal land includes the Cibola National Forest and the Kirtland Air Force Base, with little

federal land along the Rio Grande. The lands of the Pueblo of Sandia toward the northern end of the county and the Pueblo of Isleta at the southern end are situated along the Rio Grande, while those of the To'hajilee Navajo Chapter are located in the western part of the county.

Middle Rio Grande

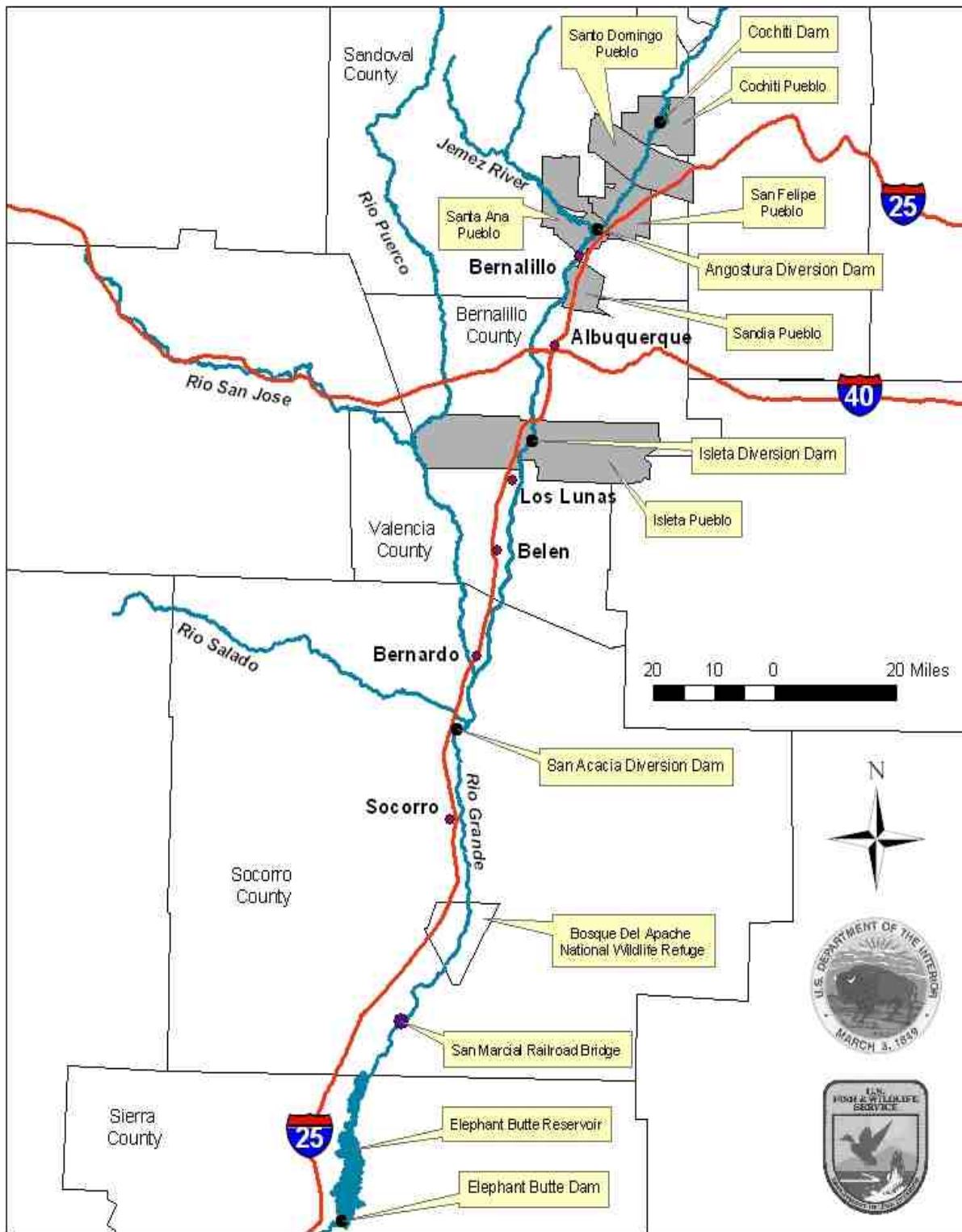


Figure 3-1. Political Boundaries along the Middle Rio Grande

Managed by the City of Albuquerque Open Space Division, in coordination with MRGCD, the Rio Grande Valley State Park is a 2,023 hectare (5,000 acre) state park extending along the Rio Grande through Albuquerque, on lands owned by the MRGCD. At the north of the state park, the Alameda/Rio Grande Open Space property is owned by the City of Albuquerque and the County of Bernalillo (Linderoth 1999).

Valencia County. Land ownership in Valencia is approximately 6 percent federal, 3 percent state, 23.5 percent Native American, and 67.5 percent private. Isleta Pueblo is situated on the Rio Grande in the northern half of the county. Much of the land along the Rio Grande in Valencia County, both on Isleta Pueblo and to the south, is used for farming.

Socorro County. Land ownership in Socorro County is approximately 51.6 percent federal, 14.4 percent state, 1.3 percent Native American, and 29.3 percent private, with 3.3 percent in other ownership (Socorro County Board of Commissioners 1998). Most of the federal land is national forest land in the western half of the county, while the Sevilleta NWR and Long Term Ecological Research Station and the Bosque del Apache NWR are both located along or near the river. The Gordon S. Ladd Waterfowl Complex, described earlier, is located largely in Socorro County, on state lands, on or near the Rio Grande. Private land along the Rio Grande is generally used for agriculture. Livestock grazing is common, especially toward the southern end of the county at the north end of Elephant Butte Reservoir, where BLM manages some grazing allotments for Reclamation.

Social and Economic Conditions

The four counties of the Middle Rio Grande are a remarkably diverse region. As noted elsewhere, the Rio Grande passes through or close to the Pueblos of Cochiti, Santo Domingo, San Felipe, Santa Ana, Sandia, and Isleta. The great majority of the region's human population is concentrated in settlements along the river corridor that bisects all four counties. All but the southernmost county, Socorro, are included in the Albuquerque Metropolitan Statistical Area (MSA), whose nearly 713,000 people constitute almost 40 percent of New Mexico's population. Socorro County is the second largest New Mexico county in terms of land area but has a population density of less than 3 persons per square mile, while at the other end of the scale Bernalillo County (the third smallest in land area) has 447 persons per square mile.

One institution that extends throughout the region is the MRGCD.² Nearly all of the surface water delivery on the Rio Grande mainstem in the four counties of the region is provided through the extensive system of diversion dams, ditches, and drains owned and managed by the MRGCD. It is likely that the agricultural data cited below fail to count a significant number of small farm and garden plots that take water from MRGCD ditches. Such plots provide supplemental income or subsistence benefits to low income residents in the Middle Rio Grande

² The MRGCD assumed the physical assets of more than 70 separate community acequias during the 1930s, and reclaimed several thousand acres of agricultural land that had become unusable because of waterlogging (Wozniak 1988; see also Rivera 1998 regarding effects on traditional acequia communities).

region, but their owners do not participate in the market economy for agricultural products. For instance in Valencia County, *New Mexico Agricultural Statistics 1999* (URL source: www.nass.usda.gov/nm) counts 639 farms in 1997, while county records show 2551 farm plots, nearly four times as many, with a median farm size of 1.7 hectares (4.2 acres).³

Sandoval County

At the upstream end of the Middle Rio Grande is Sandoval County, encompassing an area of 9,606 square kilometers (3,709 square miles). In the decade of the 1990s it became the fifth largest and second fastest growing county in New Mexico in terms of population (42 percent increase), which in 2000 stood at 89,908. This growth, which continues, was anchored by the expansion of Intel's semiconductor manufacturing facility in Rio Rancho. By now the county's largest city, Rio Rancho has become both a center of employment and a residential community with a population of 51,765 in 2000. Though overall the county's population density is less than 24 persons per square mile, its center has shifted from older towns like Cuba and Bernalillo toward the Sandoval-Bernalillo county line in Rio Rancho and Corrales. (Placitas, a residential community in the foothills of the Sandia mountains also grew rapidly during the 1990s.) Based on demographers' projections, Sandoval County's population is expected to grow another 89 percent by 2020.

In 1995, more than 70 percent of the county's residents obtained their domestic water from municipal supplies. Almost all residential, commercial, and industrial water uses involve groundwater, while irrigation, including that of the five Middle Rio Grande Pueblos in Sandoval County, relies almost totally on surface water withdrawals (54,817 ac-ft/yr), much of it delivered through the MRGCD ditch system.⁴

Several Native American tribes occupy reservation or trust lands in the Sandoval County. Besides Cochiti, Santo Domingo, San Felipe and Santa Ana Pueblos, Zia and Jemez Pueblos are situated wholly within the county, while Sandia and Laguna Pueblos and the Jicarilla Apache Nation are situated partly in the county. They are included in county socio-economic data, although the five Middle Rio Grande Pueblos are also described separately in the next section. Sandoval County has the largest Native American population of the four Middle Rio Grande counties.

There were 353 farms and ranches in Sandoval County in 1997, and 3,784 hectares (9,350 acres) of irrigated cropland. Crop sales constituted 21 percent of the market value of the nearly \$10 million in agricultural products sold. Livestock sales comprised the remainder of this figure. Farm earnings in 1999 were about \$1.4 million, 0.2 percent of total earnings, while full-

³ Data supplied by Marcel Reynolds, Valencia Co. Soil and Water Conservation District Board, from county assessors' rolls. Median farm size calculated by authors.

⁴ Water data in this section is from U.S. Geological Survey, *1995 Water Use Data* as reported in the Final Economic Analysis (Industrial Economics 2003). Note that values are provided for withdrawals only, and do not reflect water returned to the source. Consumptive use is significantly lower than total withdrawals.

or part-time employment in farming was 400. As noted above, these data probably undercount or omit a number of individuals and families that supplement their income or food supply through small-scale, off-market crop production.

In 1999, Sandoval County residents had a total personal income of \$1.9 billion, with a per capita personal income of \$20,747. This was five percent lower than the state average (\$21,836) and 27 percent lower than the national average (\$28,546). Income growth over the decade averaged 4.6 percent per year, slightly above the annual growth rate for the state (4.5 percent) and the nation (4.4 percent). Total earnings of persons employed in the county increased from about \$224 million in 1989 to \$891 million in 1999, an average annual growth rate of 14.8 percent. The top non-agricultural employment sectors in 1999 were services (7,909 jobs, full- or part-time), government (3,897), and retail trade (5,425).

Bernalillo County

With 556,678 residents in 2000, making it by far the most populous county in New Mexico, Bernalillo County grew less rapidly during the 1990s than did its northern and southern neighbors in the metropolitan area. In fact, its growth of 15.8 percent during the 1990s was less than the state average of 20.1 percent. Bounded by the Cibola National Forest (the Sandia and Manzano mountains) to the east, Sandia Pueblo to the north and Isleta Pueblo on its southern border, the county's seat of government and major city, Albuquerque, can expand geographically only to the west. The population density of the county, 447 persons per square mile, is not high by urban standards, but is over 18 times that of Sandoval County. The availability of water may be a limiting condition on the city's and county's future rate of urban and suburban growth. Nonetheless, if current trends continue, the county's population is expected to reach 679,538 by 2020, an increase of 22 percent.

Both to avoid depleting the aquifer and to meet the water needs of this growing population, the City of Albuquerque anticipates beginning in 2005 to replace its municipal water supply, currently obtained entirely from groundwater, with San Juan-Chama water, surface water drawn from the Rio Grande but supplied by an inter-basin transfer of Colorado Basin water through the San Juan-Chama Project, described earlier in this chapter. Bernalillo is primarily an urban and suburban county, in contrast to much of the rest of the state, with significant groundwater withdrawals for commercial, industrial, power generation, and even mining uses. As of 1995, most (96 percent) of Bernalillo County residents received domestic water from municipal supplies. Albuquerque's wastewater treatment plant returns approximately 60,000 ac-ft of treated effluent to the river each year. Irrigated agriculture in Bernalillo County draws substantial surface water from the Rio Grande (69,177 ac-ft/yr in 1995) via the MRGCD system.

There were 468 farms and ranches in Bernalillo County in 1997, including 3,646 hectares (9,010 acres) of irrigated cropland. Crop sales constituted 18 percent of the \$31 million in agricultural products sold, while livestock sales comprised 82 percent. In 1999 hay, most of it alfalfa, was the principal crop, grown on nearly three-quarters of the irrigated acreage. Farm

earnings in 1999 were about \$11.2 million, 0.1 percent of total earnings, while full- or part-time employment in farming was 616. However, as noted above, these data are likely not to include a sizeable number of individuals and families that supplement their income or food supply through small-scale, off-market crop production.

In 1999 Bernalillo County residents had a total personal income of \$14.3 billion, with a per capita personal income of \$27,287. This was 25 percent higher than the state average, but four percent below the national average. Bernalillo County's annual income growth rate over the preceding decade was 4.9 percent, which was above the average for both the state (4.5 percent) and the nation (4.4 percent). Total earnings of persons employed in Bernalillo County increased from about \$6.5 billion in 1989 to \$11.5 billion in 1999, an average annual growth rate of 5.8 percent. The largest employment sectors in the county in 1999 were services (137,311 jobs, full- or part-time), retail trade (67,979), government (63,423), manufacturing (21,219), and construction (24,634).

Valencia County

One of New Mexico's smallest counties in land area at 2,766 square kilometers (1,068 square miles), Valencia had a 2000 population of 66,152, giving it a density of nearly 62 persons per square mile. The Rio Grande bisects the county and its three incorporated communities. Los Lunas (the county seat), Belen, and Bosque Farms lie along the river valley, as does the Isleta Pueblo at the northern end of the county. The population growth rate was 46.2 percent during the decade of the 1990s, the highest of all counties in the region. Much of this growth involves conversion of farmland and is attributable to development of new residential subdivisions and communities whose residents commute to jobs in Albuquerque. Demographic projections indicate a 71 percent increase in Valencia County's population by 2020, to nearly 113,000.

In 1995, nearly half of Valencia County residents received water from municipal supplies, indicating that individual wells and small mutual domestics continue to be a significant source of domestic water. In addition, commercial and industrial uses are supplied by groundwater withdrawals. Irrigation is the only use drawn principally (95 percent) from surface water (191,584 ac-ft/yr in 1995), via the MRGCD system.

The census of agriculture for 1997 documented 639 farms and ranches in Valencia County. In 1999 farmland included irrigated crops on 21,833 acres. Crop sales constituted 24 percent of the market value of the \$26.6 million in sales of agricultural products, a somewhat larger ratio of crops to livestock sold than elsewhere in the Middle Rio Grande region. In 1999 these crops included 12,000 acres of alfalfa and 8,245 acres in pasture or hay. Farm earnings in 1999 were about \$10.7 million, or 2.4 percent of total earnings, while full- or part-time employment in farming was 818. However, as discussed above using data from Valencia County, agricultural statistics are likely to undercount the number of individuals and families that supplement their income or food supply through small-scale, off-market crop production.

In 1999 Valencia County residents had a total personal income of \$1.2 billion, yielding a per capita personal income of \$18,961. This was 13 percent lower than the state average, and 34 percent below the national average. Valencia County's annual income growth rate over the preceding decade was 4.1 percent, which was below the average growth rate for both the state (4.5 percent) and for the nation (4.4 percent). Total earnings of persons employed in Valencia County increased from about \$180 million in 1989 to \$387 million in 1999, an average annual growth rate of 7.5 percent. The largest employment sectors in the county in 1999 were government (4,363 jobs, full- or part-time), services (3,973), manufacturing (2,420), and construction (1,551).

Socorro County

The southernmost county within the Middle Rio Grande, Socorro is the only county not within the Albuquerque Metropolitan Statistical Area, and displays a far more rural character, reflecting its 19th and early 20th century history as a mining and ranching center. The end of the cattle boom and a decline in mining by the 1920s sent the county into a long economic decline. During the 1980s and 1990s government spending in connection with the New Mexico Institute of Mining and Technology and the Very Large Array radio telescope have helped to spur the county's economy and renewed population growth. Neither these nor the Alamo Navajo community (population about 1,700), located in the Magdalena mountains in the northwest part of the county, are oriented toward the Rio Grande. However, the great majority of the county's people live in the county seat of Socorro or in scattered farming communities along the river. The total population of Socorro County in 2000 was 18,078, and the average density was 2.7 people per square mile. Projected growth over the next two decades is 11.5 percent, to 20,156 people.

In 1995, just over three-quarters of Socorro County residents received water from municipal supplies, which currently consist entirely of groundwater withdrawals. In addition, commercial, industrial, mining, and livestock uses are supplied primarily by groundwater withdrawals. Irrigation is the only use drawn primarily (66 percent) from surface water (160,404 ac-ft/yr in 1995). Most irrigation water is supplied by the MRGCD system, though one independent, community-based acequia system, La Joya, has survived.

In 1997, 395 farms and ranches were documented in Socorro County. Agricultural statistics for 1999 show irrigated crops on 8,717 hectares (21,541 acres). Crop sales comprised 19 percent and livestock sales 81 percent of the market value of the \$25.3 million in agricultural products sold in that year. Alfalfa was again the largest crop, planted on almost 13,000 acres. Farm earnings in 1999 were about \$9.8 million, or 6.3 percent of total earnings, while full- or part-time employment in farming was 593. Once again, as noted above, agricultural statistics are likely to understate the number of individuals and families that supplement their income or food supply through small-scale, off-market crop production.

In 1999 Socorro County residents had a total personal income of \$262 million; per capita personal income was \$15,866. This was 27 percent lower than the state average, and 44 percent

below the national average. Socorro County's annual income growth rate over the preceding decade was 3.6 percent, well below the average growth rate for both the state (4.5 percent) and for the nation (4.4 percent). Total earnings of persons employed in Valencia County increased from about \$109 million in 1989 to \$155 million in 1999, an average annual growth rate of 3.6 percent. The largest non-agricultural employment sectors in the county in 1999 were government (2,339 jobs, full- or part-time), services (2,112), retail trade (972), and finance, insurance, and real estate (269).

Table 3-5: Middle Rio Grande Socioeconomic Data.

	1	2	3	4	5	6	7	8	9	10	Percentages of county population by race and Hispanic origin			
	Population 2000	Pop. change since 1990	Proj. pop. change 2000-2020	PCPI 1999	PCPI Rank in State	PCPI Percent of state avg.	Percentage of persons below pov	Percentage of children 5 to 17 below pov	Food stamp reciprocity incidence	Unemploy- ment rate in 2000	White non-Hispanic only	Native American only	Other or more than one race	Hispanic all races
Sandoval	89,908	42.0%	89%	\$ 20,747	6	95%	12.9%	17.6%	6.7%	3.3%	50.3%	15.8%	4.4%	29.4%
Bernalillo	556,678	15.8%	22%	\$ 27,287	3	125%	14.6%	19.7%	6.7%	3.2%	48.3%	3.6%	6.2%	42.0%
Valencia	66,152	46.2%	71%	\$ 18,961	13	87%	18.3%	24.1%	11.5%	4.0%	39.4%	2.6%	3.0%	55.0%
Socorro	18,078	22.4%	11%	\$ 15,866	27	73%	31.4%	41.4%	19.2%	5.5%	37.6%	10.3%	3.3%	48.7%

Notes:

- Col.: 1. U.S. Bureau of the Census 2000.
 2. Population growth in New Mexico Counties 1990-2000. Accessed at www.edd.state.nm.us.
 3. Calculated from NM Economic Development Department, County Profiles. Accessed at: www.edd.state.nm.us/COMMUNITIES/counties.htm.
 4-6. Regional information system, Bureau of Economic Analysis. Accessed at www.bea.doc.gov/bea/regional/bearfacts
 7-10. New Mexico Department of Labor. 2001 [June]. New Mexico Labor Market Annual Social and Economic Indicators. Accessed at www.dol.state.nm.us/api.PDF

Table 3-6: Middle Rio Grande Agricultural Data.

	1	2	3	4	5	6	7	8	9
	1999 FT/ PT empl. in farming	Irrigated crop acres 1999	Number of farms 1997	Computed average farm size (acres)	1999 total personal income (\$ millions)	1999 farm income (\$ millions)	All farm commodities sold 2000 (\$ thousands)	Crops sold 2000 (\$ thousands)	Crops as a percentage of commodities sold (computed)
MRG									
Sandoval	400	9,350	353	26.5	\$ 1,872	\$ 1.4	\$ 15,598	\$ 3,788	24%
Bernalillo	616	9,010	468	19.3	\$ 14,284	\$ 11.2	\$ 34,095	\$ 6,654	20%
Valencia	818	21,833	639	34.2	\$ 1,234	\$ 10.7	\$ 37,978	\$ 6,920	18%
Socorro	593	21,541	395	54.5	\$ 262	\$ 9.8	\$ 51,719	\$ 8,492	16%

Notes: Col.:

1. Bureau of Economic Analysis Regional Accounts Data. Accessed at www.bea.doc.gov/bea/regional/reis. Does not include agricultural services for which some county data are unavailable.
2. NM Agricultural Statistics 2000. Accessed at www.nass.usda.gov/nm.
3. NM Agricultural Statistics 2000.
4. For Valencia county, data provided by the SWCD on farmland acreage (20,061) and number of parcels (2551) yields a mean farm size of <7.9 acres. This is < one-fourth of the average size shown in this column. The difference can be explained by the fact that NM Agricultural Statistics reports as "farms" only those which produce crops for the market, not subsistence-level crops used by the producer's families or traded "off-market."
- 5-6. Bureau of Economic Analysis Regional Accounts Data. Accessed at www.bea.doc.gov/bea/regional/reis/.
- 7-8. NM Agricultural Statistics 2000.

Indian Trust Resources

Six Indian Pueblos occupying land along the Middle Rio Grande are being considered for possible critical habitat designation. The Pueblos of Cochiti, Santo Domingo, San Felipe, Santa Ana, Sandia and Isleta (from north to south) are all situated on lands bisected by or bordering the river. The largest of these Pueblos (Isleta and Santo Domingo) have enrolled memberships of over 4000; the smallest (Sandia and Santa Ana) have memberships between 400 and 700 (BIA 1995). As discussed in Chapter 2, the possibility exists for particular Pueblo governments to undertake their own conservation management plans for the Rio Grande silvery minnow. Conservation management plans (CMP) developed by the Pueblos that meet the Service's criteria for such plans, could allow for those Pueblo lands covered by the CMP to be excluded from critical habitat designation.

The Pueblo of Cochiti, the northernmost pueblo on the Middle Rio Grande, had an enrolled membership of 1,175 in 1995 (BIA 1995). According to the 2000 census, 1,502 people lived on the Pueblo, with 695 people identifying themselves as Native American. The Pueblo has a land base of 20,583 hectares (50,861 acres). (Tiller 1996)

The Pueblo of Santo Domingo had an enrolled membership of 4,041 persons in 1995. According to the 2000 census, 3,166 people reside on the Pueblo, with 3,085 of them being Native American. The Pueblo has a land base of 28,877 hectares (71,356 acres).

The Pueblo of San Felipe has an enrolled membership of at least 3,157 people (BIA 1995). Total population on the Pueblo, according to the 2000 census, is 3,185, with 2,465 people identifying themselves as Native American. The Pueblo has a land base of 19,801 hectares (48,930 acres).

The Pueblo of Santa Ana had 664 members as of 1995 (BIA 1995). Its total population on reservation, according to the 2000 census, is 487, and 473 of those residents identified themselves as Native American. The Pueblo has a land base of at least 25,064 hectares (61,935 acres).

The Pueblo of Sandia had 420 members as of 1995. Total population on the Pueblo, according to the 2000 census, was 4,414, with 500 people identifying themselves as Native American. The Pueblo contains at least 9,263 hectares (22,890 acres).

The Pueblo of Isleta had 4,812 members as of 1995 (BIA 1995). Of the 3,166 people living on the Pueblo, 2,675 identify themselves as Native Americans, according to the 2000 census. Situated south of Albuquerque, the Pueblo has a land base of 85,407 hectares (211,045 acres).

San Felipe, Santa Ana, Sandia, and Isleta Pueblos operate casinos on their lands. This enterprise has had, particularly for the three Pueblo communities located nearest to Albuquerque

(Santa Ana, Sandia, and Isleta), significant impacts on their economies, enabling them to make new investments in additional tourism and recreation-related facilities, as well as in community facilities and housing, and reducing unemployment.

The Pueblos along the Middle Rio Grande hold Federal Indian water rights which are senior to those of other holders of water rights on the Middle Rio Grande. Not all of their rights have been developed or exercised, and future development of those rights is likely in the future. As noted previously, the Pueblos have the right to irrigate at least 3,580 hectares (8,847 acres) through the MRGCD delivery system, but this is not the full extent of their water rights.

It is clear that irrigated agriculture remains important both to the economies and to the traditional ways of life of the Pueblos, though the scale of agriculture varies from community to community. At Santa Ana Pueblo, for instance, Santa Ana Agricultural Enterprises has land in commercial production, growing blue corn for domestic and international markets, and growing plants for both the Santa Ana Native Plant and Tree Nursery and the Santa Ana Garden Center, a retail outlet (http://www.newmexico.org/culture/pueblo_santaana.html). Isleta Pueblo operates an agricultural cooperative and has had as much as 1,821 hectares (4,500 acres) in farmland. For Sandia, Santo Domingo, and San Felipe Pueblo, farming and ranching continue to be significant sources of income for portions of the population. Agriculture has been practiced on a smaller scale, and family farms have predominated (Tiller 1996). All of the Pueblos have been irrigating their farmlands for centuries and farming is, and long has been, an essential part of the Pueblos' cultures.

As important as agriculture is for the Pueblos on the Middle Rio Grande, it is not the only use of the river that Pueblo individuals find important. Most, if not all, of the Pueblos along the Middle Rio Grande use the waters of the Rio Grande to carry out their traditional religious and cultural ceremonies.

Environmental Justice

Overall, New Mexico ranks as one of the United States' poorest states, with a per capita personal income (PCPI) only 75 percent of the national average. Within the counties of the Middle Rio Grande Valley, such factors as low income and significant Hispanic and Native American populations, raise the possibility of environmental justice issues arising in association with any action that influences the regional economy. Accordingly, environmental justice-related impacts of each of the alternatives for critical habitat designation are discussed in Chapter 4.

Social and Cultural Values

Valuing both farming and the natural landscape

Survey research conducted at the University of New Mexico’s Institute for Public Policy (IPP) bears directly on the significance of basic value orientations to the question of habitat protection for the Rio Grande silvery minnow. The IPP’s Spring 2000 Public Opinion Profile telephone survey of the attitudes and preferences of residents of the Middle Rio Grande region and New Mexico generally (Brown *et al.* 2000) shows that, overall, New Mexicans assigned high value to green landscapes along New Mexico’s rivers and streams. Both survey groups placed high value on both the natural landscape (i.e., the bosque and riparian habitat) *and* irrigated farmland (**Table 3-7**).

Table 3-7: Middle Rio Grande Water Survey

		<u>MRG</u>	<u>Rest of state</u>
# 76. Indoor use in existing homes	Mean	8.17	8.32
	Median	9	9
# 84. Preserving the native cottonwood forest and vegetation along river banks known as the bosque, that creates habitat for a variety of different animal species	Mean	7.69	7.50
	Median	8	8
# 72. Irrigation for farms	Mean	7.59	7.99
	Median	8	8
# 82. Providing food and refuge for fish, birds and other animals	Mean	7.54	7.56
	Median	8	8
# 78. Indoor use in new housing developments	Mean	6.62	6.94
	Median	7	7
# 83. Cultural and religious uses in some villages and pueblos	Mean	6.38	6.34
	Median	7	6
# 74. Recreation, such as fishing and rafting	Mean	6.14	6.40
	Median	6	6
# 81. Community parks and sports fields	Mean	5.66	5.52
	Median	5	5
# 75. New industrial uses, such as manufacturing processes	Mean	5.29	5.41
	Median	5	5
# 77. Watering existing yards and landscaping	Mean	4.40	4.57
	Median	5	5
# 79. Use for yards and landscaping in new developments	Mean	3.82	4.14
	Median	4	4
# 73. Watering golf courses	Mean	3.18	2.93
	Median	3	2
# 80. Swimming pools for individual homes	Mean	2.68	2.58
	Median	2	2

Scale: 0 (don’t care whether water is available for that use) to 10 (want to be sure that water is available for that use) (Brown *et al.* 2000).

Valuing the agricultural traditions of the Valley

In commenting on the April 1999 draft Environmental Assessment for designation of critical habitat for the silvery minnow, the MRGCD included transcripts of interviews of eleven individuals who depend on water from the Rio Grande for irrigation. This was not meant to be a random sample, but a selection chosen to illustrate the range of variability among water users.

The MRGCD's summary of the comments notes that "very little of the irrigated agriculture in the Middle Valley is commercial.... [It] is smaller in physical and economic scale than elsewhere, but ... the passionate feelings about irrigated agriculture run no less deep here than among farmers anywhere" (Appendix 5:1, MRGCD 1999). Although six of the eleven people interviewed said that farming supplemented their income, only one was entirely dependent on the farm for income. Most stressed the value of farming as a way of life, which they wanted their children to be able to continue. Over half knew of the history (and sometimes prehistory) of their farms. Several noted the environmental, wildlife, and recreational values supported by their farms, or by the irrigation system (MRGCD 1999).

Valuing instream flows

Contingency valuation (CV) is a survey-based method for estimating the economic value of nonmarket goods, including non-use or "existence" values. While still somewhat controversial, CV studies are being increasingly used to evaluate nonmarket benefits of protecting instream flows in the western U.S. and internationally. Study designs are becoming increasingly rigorous, including tests of theoretical validity and reliability, as well as sensitivity to variations in information.

Using contingency valuation, Berrens and his colleagues at the University of New Mexico (2000, 1996) found that New Mexicans viewed instream flow as an environmental "good," ranking on a zero-to-ten scale of importance at a mean greater than 8.2. In statewide telephone surveys conducted in 1995 and 1996, a strong majority of respondents also expressed support for an institutional change to allow protection of instream flows in the state. They stated that they would vote "yes" to allow a state agency "to buy or lease water from willing parties" to do so. Combined data from the two surveys also allowed researchers to estimate respondents' willingness to pay for the provision of flow for environmental purposes. In their answers to carefully constructed "contingent valuation" questions, over two-thirds of the New Mexico households surveyed expressed their willingness to make an annual contribution for five years to a hypothetical special trust fund, that would be used to buy or lease water from willing parties for the purpose of maintaining instream flows.

In the 1995 study, respondents were willing to contribute an average amount of \$28.73 per year to provide water to the Middle Rio Grande in order to protect the silvery minnow, and an average of \$89.68 per year to maintain flows on all major New Mexico rivers, to help protect 11 threatened and endangered fish species in the state. The 1996 study was conducted to test the

validity of the 1995 one, and the results were statistically consistent. Using the median, which is generally a more conservative number than the mean, respondents were willing to pay a median of \$25 to protect instream flows in the Middle Rio Grande. The researchers concluded that the results indicate significant non-market values for the protection of instream flows in New Mexico (Berrens et al. 1996, 2000).

Cultural Resources

Cultural resources include archaeological sites, historic features, and traditional cultural properties and Native American sacred sites. For this analysis, sites have been identified that fall or may fall within the lateral boundaries of the river reaches being considered among the alternatives for designation.

Archaeological sites

The Middle Rio Grande has been an area of human settlement and use for thousands of years. No general summary of the cultural history of the region will be attempted here. Pueblo Indian and early European agricultural practices and uses of the Rio Grande are described above under *Water and Hydrology*.

Archaeological sites consist of structures, scatterings of artifacts, or other physical manifestations of past human occupation. These sites may be divided into two categories. Prehistoric sites are those representing Native American presence prior to European contact. This Paleoindian period in the region began circa 12,000 BC, and contact between Spanish and Pueblo societies began occurring in the mid-1500s. Historic sites are those representing post-contact use or occupation of the region, from the mid-1500s up to the 1950s.

Prehistoric sites in the Middle Rio Grande Valley are numerous, and provide evidence of a wide range of past human activities. Sites represent several different cultural groups, including Paleoindian and Archaic peoples and ancestral Puebloan (Anasazi) groups. Historic sites are also abundant and document the past four and a half centuries of occupancy and interaction among Pueblo Indians, Apache peoples, Spanish Colonials, Mexicans, and Euro-Americans. The New Mexico Historic Preservation Division (NMHPD) has over 135,000 prehistoric and historic sites on record for the state; 7,000 new sites were added to the database in the last year (T. Seaman, NMHPD, pers. comm. 2001)

A search of the NMHPD database revealed relatively few sites along the Middle Rio Grande within the narrow confines of the areas being considered for critical habitat designation. There is only very limited potential for preservation and subsequent location of prehistoric and older historic resources in the floodplain of the Rio Grande. Materials not removed by floods and river scouring are buried by sedimentation. In upstream reaches, sites occurring on Pueblo lands are generally not documented. In the San Acacia reach, sites have been inundated by the filling of Elephant Butte Reservoir in 1916, and subsequent sediment build-up extending

upstream beyond San Marcial. Up to 12 meters (40 feet) of silt has accumulated on the known location of historic Hispanic villages in this area (Reclamation 2000).

A reach-by-reach summary of sites present in the NMHPD database within the zone of proposed critical habitat is presented in **Table 3-8**. The database contains little or no information on sites located on Pueblo lands. Figures for the San Acacia Reach include sites now buried under sediment deposits, or submerged by Elephant Butte Reservoir.

Table 3-8: Archeological Sites.

<u>Reach</u>	<u>Prehistoric</u>	<u>Historic</u>	<u>Both</u>	<u>Unknown</u>	<u>Total</u>
Cochiti	0	0	0	0	0
Angostura	0	1	4	0	5
Isleta	8	6	2	1	17
San Acacia	27	4	2	8	41
Total	35	11	8	9	63

Historic features

Several important and large-scale features constructed in the first half of the 20th Century are present within or along the Middle Rio Grande. These include the levees, diversions, and drainage facilities originally constructed by the MRGCD in the 1920s. These facilities, most of which have undergone substantial modification and improvement over the years, remain in use. These features possess historic value due to their central place in the agricultural history and rural lifeways of the valley.

The Atchison, Topeka, and Santa Fe Railroad bridge near San Marcial, originally constructed in the 1890s, is considered eligible for inclusion on the National Register of Historic Places. Reclamation is committed to documenting the historical significance of this feature. In its recent Draft EIS on Rio Grande and LFCC modifications, Reclamation notes that the LFCC itself may be a “borderline” historic feature, as it is now nearly 50 years old (Reclamation 2000).

Traditional cultural properties and Native American sacred sites

Pueblos along the Middle Rio Grande have irrigated their farmlands for centuries. These irrigated lands, and the practices associated with farming, may be considered an essential part of Pueblo heritage and tradition. Hispanic communities also have longstanding cultural ties to village sites and irrigated lands in the Rio Grande Valley. See discussion under *Social and Cultural Values*, above.

It may be assumed that Pueblo lands within the Middle Rio Grande Valley include sites and features deemed sacred by Pueblos and essential to the practice of Pueblo religion. Pueblos also use water from the Rio Grande to carry out religious and cultural ceremonies. Details concerning such sites, features, and practices are generally not made public.

Executive Order 13007 deals with accommodation of sacred sites occurring on federal lands. The order defines “Federal Lands” as “any land or interests in land owned by the United States, except Indian trust lands.” “Sacred site” is defined as “any specific, discrete, narrowly delineated location on federal land that is identified by an Indian tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion; provided that the tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such a site.” Sacred sites as defined in Executive Order 13007 may be present on federal lands within the Middle Rio Grande Valley.

Recreation

The Middle Rio Grande and adjacent lands offer a variety of recreational opportunities. At the northern and southern boundaries of the Middle Rio Grande Valley, Cochiti Lake and Elephant Butte Reservoir are heavily used for fishing, water sports, and camping. Along the river, recreational activities include hiking, boating, wildlife viewing, hunting and fishing, and appreciation of natural, cultural, and historic sites. These activities are enjoyed both by residents of the Middle Rio Grande Valley and by tourists from outside the region. Recreational opportunities occur in a number of different settings, including federally-managed wildlife refuges, state and municipal parklands, and rural valley communities.

Tourism in the Middle Rio Grande

Tourism is a vital and growing component of the New Mexico economy. The state currently ranks 11th in the nation in per-capita tourism dollars. Tourism in New Mexico is driven largely by the state’s outstanding natural and cultural features. For over a century, visitors have been attracted by New Mexico’s unique blend of Native American and Hispanic cultures, and this continues to be the case today. The six Middle Rio Grande Pueblos attract tourists both because of their cultural significance and, increasingly, because of a new suite of recreational opportunities including resort amenities, golf, and casino gambling. For example,

the new Hyatt Regency Tamaya Resort and Spa at Santa Ana Pueblo offers luxury accommodations and a variety of resort activities, as well as access to a section of the Rio Grande where the Pueblo has undertaken significant habitat restoration.

Traditionally Hispanic communities along the river valley are also attracting growing numbers of tourists interested in experiencing aspects of regional culture, and the agricultural and natural setting of the Middle Rio Grande. The Village of Corrales is an excellent example. Some 19 bed and breakfasts now accommodate tourists, who are encouraged to visit historical sites and art galleries, hike bosque trails or along the village acequia, and participate in one of the town's annual cultural or harvest festivals. Further south, the City of Socorro and the small village of San Antonio host visitors drawn to the annual Festival of the Cranes, celebrating the arrival of migratory flocks at Bosque del Apache NWR in late autumn.

Recreational sites and activities

The City of Albuquerque currently manages over 2,023 hectares (5,000 acres) of bosque habitat as open space along the Rio Grande. This area includes trails and levee roads used for hiking and outdoor enjoyment by city residents; river and bosque access is available at a number of locations in the city. A paved bicycle trail paralleling much of the valley open space is widely used, as are adjacent paths along the MRGCD ditches and drains. Open space and river access are also present in Corrales, to the north, and to a lesser extent in the valley communities to the south. During the winter months, the NMDGF stocks catchable-size rainbow trout for anglers in the Albuquerque area drains, extending from Bernalillo to Belen. Fishing is also available in the Albuquerque area at Tingley Beach, in the central part of the city, and on small lakes located on the Isleta and Sandia Pueblos.

The Rio Grande Nature Center State Park is located along the river in Albuquerque's North Valley. Covering 109 hectares (270 acres), the Nature Center offers a trail system along the river, a visitor's center with classroom and library facilities, and wildlife habitat and viewing areas. The park supports wintering ducks, geese, and sandhill cranes, and is the site of ongoing studies of migratory songbirds.

The NMDGF operates the Ladd S. Gordon Waterfowl Management Complex, which includes the Belen, Bernardo, Casa Colorada, and La Joya Waterfowl Management Areas (WMAs) between Albuquerque and Socorro. The Belen and Casa Colorada WMAs contain roughly 243 hectares (600 acres) of croplands for wintering birds, with hunting allowed at Casa Colorada. The Bernardo WMA consists of 637 hectares (1,573 acres), including about 182 hectares (450 acres) of crops. Waterfowl hunting is permitted on a rotational basis in accordance with the current waterfowl proclamation. Fishing access is limited and posted, with boat use restricted to those without motors. The La Joya Game Refuge, seven miles south of Bernardo, covers 1,437 hectares (3,550 acres) and consists of six interconnected ponds fed by the dammed waters of Geronimo Springs and diverted waters from the Rio Grande. Wildlife viewing

includes a wide variety of ducks, shorebirds, Canada geese, and desert bird species. Hunting takes place in the fall and winter.

Sevilleta National Wildlife Refuge is a research refuge covering 92,269 hectares (228,000 acres), 80 kilometers (50 miles) south of Albuquerque. The refuge is run by the Service and is part of a Long-Term Ecological Research program conducted by the University of New Mexico. There is also a fairly small area of aquatic habitat for water birds, which is open to waterfowl hunting. Though largely off limits to the general public, the refuge hosts an annual open house and allows limited opportunities for public wildlife viewing and photography. Limited hunting of ducks and doves is permitted, and educational tours are available by request.

The Bosque del Apache NWR extends over nine miles of the Rio Grande Valley, and covers nearly 24,281 hectares (60,000 acres). The refuge is managed by the Service and is renowned for its concentrations of migratory cranes and waterfowl. It also provides seasonal or year-round habitat for numerous other bird and animal species. A visitor's center offers interpretive displays and natural history information. Wildlife viewing, photography, and birdwatching are the prime recreational activities, with the Festival of the Cranes taking place in November each year. Limited hunting is permitted in season.

Elephant Butte Reservoir is the largest and most-visited lake in New Mexico. The reservoir stretches over 64 kilometers (40 miles) in length, with 322 kilometers (200 miles) of shoreline. It is used primarily for motorized boating, sailing, and fishing. Campgrounds and marinas at Elephant Butte State Park are operational year-round.

Big Bend National Park and Rio Grande Wild and Scenic River

Big Bend National Park (the Park) encompasses over 323,750 hectares (800,000 acres) in the southern part of Brewster County, Texas (*see Figure 3-2*), and constitutes the largest protected area of Chihuahuan Desert ecology in the United States. Established in 1944, the Park receives 250,000 to 350,000 visitors annually. The Lower Rio Grande flows for 190 kilometers (118 miles) through the Park, serving both as the Park's southern boundary and the international border between the United States and Mexico. In 1978, Congress designated a 111-kilometer (69-mile) section of the river within the Park, together with an additional 204-kilometer (127-mile) corridor downstream (east) of the Park boundary, as the Rio Grande Wild and Scenic River (RGWSR), under the Wild and Scenic Rivers Act

of 1968. In this FEIS, “Big Bend reach” refers to the entire portion of the Lower Rio Grande in Texas, including the Park and the RGWSR segments. “Big Bend region” is used to refer to the geographic area of the Big Bend reach and surrounding lands.

The river in this area, although subject to decreased flows and diminished water-quality over the past several decades, retains high ecological value as evidenced by the continuing presence of a number of native fish species extirpated in other reaches of the Rio Grande. Water flow in this reach is continuous, but may vary significantly depending on precipitation and the scheduling of upstream releases in Mexico. A significant but recently declining percentage of water flowing through the Park enters the Rio Grande through the Rio Conchos, upstream from Park boundaries. Declines in Rio Conchos flow since 1995 have been caused by increased use and reservoir storage of water in the Rio Conchos Basin, and by below-normal precipitation (Brock *et al.* 2001; Kelly 2002).

Geography

Climate

Climate in the Big Bend region is generally mild in the winter, and hot in the late spring and summer. Average summer temperatures in the Park range from the mid-80s to mid-90s, and areas along the Rio Grande itself may be 5 - 10 degrees higher. Relative humidity is generally low, ranging from 25 percent - 40 percent year-round. Average annual precipitation in the Park ranges from over 16 inches in the Chisos Mountains to less than 7 inches in the river corridor at Rio Grande Village. Most rainfall comes in the form of thunderstorms, occurring from mid-June to early October. During this time locally heavy thunderstorms can produce flash floods, and rapid rises in the level of the Rio Grande. Fall precipitation events in the Rio Conchos drainage may also bring about spikes in stream flow in October and November.

Natural topography

The present-day topography of the Big Bend region is the result of a long geological history of uplifting, folding, faulting, and erosion. It is the latter process that dominates today. The linkage of drainage basins along the Lower Rio Grande is a relatively recent phenomenon. The river began flowing through to the Gulf of Mexico only within the last two million years, making it the youngest major river system in the United States (<http://www.nps.gov/bibe/geology.htm>). Several small tributaries enter the Rio Grande from the Mexican side in the stretch between Presidio, about 161 river-kilometers (100 river-miles) upstream from the Park, and Amistad Reservoir, downstream of the reach proposed for designation. One large upstream Mexican tributary, the Rio Conchos, accounts for much of the water flowing in the Rio Grande through this reach, as discussed below.

Over time, the Rio Grande has created three major canyon areas in the Park. Santa Elena Canyon, on the upstream end at the Park’s western border, is about 32 kilometers (20 miles)

long and includes a 11-kilometer (7-mile) stretch in which limestone walls rise up to 457 meters (1500 feet) on either side of the river. Santa Elena Canyon also includes a stretch of heavy whitewater during periods of high flow. Marsical Canyon, where the river's flow bends abruptly to the northeast, is 16 kilometers (10 miles) long, up to 366 meters (1200 feet) deep, and contains mild to moderate rapids. Boquillas Canyon, near the eastern edge of the Park, is the longest (29 kilometers (18 miles)) and calmest of the three canyon areas, with only mild rapids. Downstream from the Park boundary, the RGWSR segment includes the so-called "Lower Canyons", deeply cut canyon areas with a number of whitewater sections.

The channel of the Rio Grande is fairly narrow and confined in canyon reaches. Other areas are less steeply cut, and between canyons lies a highly productive riparian zone, extending into the desert along creeks and arroyos. The Rio Grande riparian zone varies from small intra-canyon banks to floodplains more than one-half mile wide, as occur downstream from Boquillas Canyon. The RGWSR segment passes through areas of open desert, as well as rugged hills and canyons. In open areas the river channel is braided in some sections. Substrate throughout the river corridor ranges from silt to cobble and boulder depending on local conditions.

Political boundaries

The portion of the Lower Rio Grande evaluated as an alternative in this FEIS includes the 190-kilometer (118-mile) southern perimeter of the Park, in Brewster County, Texas, together with the 204-kilometer (127-mile) portion of the RGWSR downstream from the Park boundary to the Terrell/Val Verde county line. The Rio Grande in this area also serves as the international border between Mexico and the United States. The official border lies in the center of the river's deepest channel; thus the main breadth of the river may lie predominantly to one side or the other of the international boundary, according to local conditions. The Mexican states of Chihuahua and Coahuila border the reach to the south. Included in these states and adjacent to the Park are two Mexican protected areas: the Maderas del Carmen and Canon de Santa Elena Protected Areas for Flora and Fauna. On the U.S. side, the lower 111 kilometers (69 miles) of river corridor within the Park are included within the larger 315-kilometer (196-mile) RGWSR, designated in 1978. Because of its ecological significance, the Park was also designated a U.S. Biosphere Reserve by the United Nations Education, Science and Conservation Organization's Man and the Biosphere Program in 1976.

There is little human development and no large-scale agricultural activity adjacent to the Rio Grande through this entire reach. The small Texas communities of Lajitas, Terlingua, and Study Butte lie immediately west (upstream) of Park boundaries. Below the Park to the east, there are only a few private land holdings and no towns or communities along the U.S. side of the river. The nearest population centers along the Rio Grande itself are the border towns of Ojinaga, Chihuahua, and Presidio, Texas, about 72 kilometers (45 miles) upstream from the Park, and the town of Langtry about 32 kilometers (20 miles) downstream from the Terrell/Val Verde county line. Within the Park, the National Park Service (NPS) maintains campgrounds, visitor center facilities, and developed river access points at several locations in the river

corridor. The Castolon Historic District, just downstream from Santa Elena Canyon, was a farming community for much of the 20th century. It is now a popular visitor attraction and the location of the 35-site Cottonwood Campground. Upstream from Boquillas Canyon, Rio Grande Village includes a visitor center, gas station, laundromat, grocery store, and 25-site RV hookup area. The Rio Grande Village Campground is located adjacent to the river and has 100 sites for tents and RVs, and an RV dump station. This campground and associated areas are irrigated with water from the Rio Grande. This and Castolon are the only locations where water is diverted from the river in the Park.

The only other human settlements in this reach lie on the Mexican side of the river. From Castolon, Park visitors can take a rowboat across to Santa Elena, a rural village of fewer than 200 people in the state of Chihuahua. Inhabitants of Santa Elena derive their income primarily from small-scale farming and ranching activities. A few small restaurants and shops cater to tourists. Another Mexican town along this reach, Boquillas, lies downstream and across from Rio Grande Village. A ferry brings visitors to Boquillas from the Park. Approximately 25 families live in the village. The local economy centers on tourism, subsistence farming and ranching, and the gathering of native plant materials. Other small farming and ranching communities on the Mexican side of the Big Bend reach include San Vicente and La Linda.

Water and Hydrology

Although the Lower Rio Grande once flowed steadily from El Paso to the Gulf of Mexico, today diversions for flood control, irrigation, power generation, and municipal use in New Mexico and Texas result in a greatly diminished flow. The annual volume of flow in the Rio Grande above the mouth of the Rio Conchos has decreased from about 400,000 ac-ft in the 1920s and 1930s to less than 100,000 ac-ft in the 1990s (USGS: <http://tx.usgs.gov/project.asp?cc=4648&ac=20300>). Limited return flows and a lack of natural tributaries south of El Paso also contribute to low flows in the Rio Grande, and a degradation of water quality. With lower flows, the river cannot clean out the sediment deposited by its tributary streams. As a result, the river often lacks a clearly defined channel between Ft. Quitman, about 113 kilometers (70 miles) southeast of El Paso, and Presidio. Surface flows in this area upstream of the Big Bend reach are greatly reduced by evaporative losses caused by the deterioration of the channel and by the proliferation of saltcedar. Portions of the Rio Grande are seasonally intermittent between Fort Quitman and Presidio, although measurable flows at Presidio just upstream from the Rio Conchos confluence have been maintained since 1980. (IBWC flow data at http://www.ibwc.state.gov/wad/rio_grande.htm.)

Water quantity and quality in the Big Bend reach are heavily influenced by the Rio Conchos. Originating in the Mapimi drainage basin of northwestern Chihuahua, the Rio Conchos channels water from the Sierra Madre Occidental into the Rio Grande just below Presidio. Prior to 1995 an average annual flow of 736,934 ac-ft was recorded at the point of inflow into the Rio Grande (<http://twri.tamu.edu/reports/1995/169/>). In past decades, depending on precipitation, the Conchos flow has accounted for 69 to 86 percent of the water reaching the

Park (<http://www.nps.gov/bibe/riogrande.htm>). Significant declines in the Rio Conchos flow in recent years have lowered the Conchos's percent contribution to flow in the Big Bend reach.

River management and operations

No Federally owned or operated river impoundments or diversions exist in the Big Bend reach. Upstream, the closest Federally operated facilities on the Rio Grande are the Riverside and American diversion dams in El Paso County, more than 483 river-kilometers (300 river-miles) from the Park. These two facilities are the southernmost components of Reclamation's Rio Grande Project. The American Diversion Dam and Canal, located just north of the international border, are operated by the U.S. Section of the IBWC for the diversion and allocation of water in accordance with the 1906 treaty between the United States and Mexico. Riverside Diversion Dam is located on the international section of the river 24 kilometers (15 miles) south of El Paso. This facility is no longer in operation, its functions having been superseded by the recently completed American Canal Extension, which delivers water diverted at American Dam to agricultural districts in west Texas. Further north are Reclamation's Rio Grande Project facilities in New Mexico, including several diversion dams and the major river impoundment structure of Elephant Butte Dam.

The IBWC is a binational body consisting of a U.S. Section and a Mexican Section. The USIBWC is a Federal entity with shared jurisdiction over the Rio Grande channel from Fort Quitman to the Gulf. The USIBWC is also charged with administering and enforcing treaty obligations with Mexico and, with its Mexican counterpart, maintaining the river channel as an international boundary. The IBWC conducts stream flow and water quality monitoring at a number of points along the Rio Grande below Fort Quitman, in cooperation with the TNRCC. Currently the IBWC operates two gaging stations within the Park, and one just downstream of the RGWSR near Langtry.

The proposed El Paso-Las Cruces Regional Sustainable Water Project would provide an additional 174.5 million gallons per day of surface water from the Rio Grande Project for municipal drinking water supply in the El Paso-Las Cruces region. According to current estimates, implementation-which involves the conversion of water from agricultural to municipal use-will occur in stages through 2030. A recent EIS prepared by the USIBWC analyzes and compares the impacts of various alternative scenarios for this project. In the Executive Summary for the Draft EIS, USIBWC notes: "Project feature development with the Preferred Alternative would affect the amount and timing of flows, and potentially the riverine ecosystem in reaches of the Rio Grande from Elephant Butte Reservoir downstream to Fort Quitman." (IBWC 2000).

Surface flows and groundwater

Rio Grande flows in the Big Bend reach vary considerably, on an annual and a seasonal basis. During a period of drought in the 1950s, gaging stations within the Park recorded zero

flow on a number of occasions. Flows typically drop to fairly low levels during the dry spring and early summer months, and increase—sometimes dramatically—during the period from July to October. IBWC flow data, discussed in the following section, are available on the Internet at http://www.ibwc.state.gov/wad/rio_grande.htm. Dams on the Rio Conchos are operated primarily for water storage, not flood control, and as a result high peak flows on the Rio Grande sometimes occur. A maximum daily flow of 65,000 cfs was recorded in October of 1978. Although a distant connection between Rio Grande Project operations and flows in the Big Bend reach may exist, today flows in the reach are primarily determined by other factors—namely, input from the Rio Conchos in Mexico, local and regional precipitation patterns, and the timing and magnitude of state-regulated agricultural diversions downstream from Presidio.

Historically, the Rio Conchos has supplied the large majority of water passing through the Park and down the RGWSR, but since the mid-1990s its influence has been greatly reduced. Persistent drought conditions in northern Mexico, increased agricultural development in the Rio Conchos Basin, and a decision by the Mexican government to store more water in Rio Conchos reservoirs for irrigation use in Chihuahua have all contributed to the decreased flow. Less water from the Rio Conchos has led to below-average Rio Grande surface flows in the Big Bend reach since 1995. Even at these lower levels, however, Rio Conchos flow still accounts for slightly more than half of the water passing through the Park annually. Much of this annual contribution occurs during isolated peak flow events. The importance of the Rio Conchos flow extends throughout the Big Bend reach, although the Rio Grande receives additional water from springs downstream of the Park in the RGWSR segment (Brock *et al.* 2001; Carol Purchase, NPS, pers. comm. 2001).

Flows reaching Presidio via the main channel of the Rio Grande have in the past been negligible in comparison to flows from the Rio Conchos. Virtually all of the water in the Rio Grande between El Paso and Presidio consists of irrigation returns, municipal discharges, and storm runoff. Although intermittent flows and riverbed drying occur in parts of this reach, IBWC gaging data indicate that measureable flows in the Rio Grande just above the confluence with the Rio Conchos have been maintained since 1980. In recent years these flows have been highly variable, from under 50 cfs to well over 200 cfs. As Rio Conchos flows have decreased, these Rio Grande flows from above the confluence have taken on greater significance. Particularly during dry periods, the majority of water passing through the Park in recent years has been supplied by the main channel of the Rio Grande, not the Rio Conchos. (Brock *et al.* 2001; TWDB 2001; C. Purchase, NPS, pers. comm. 2001; IBWC flow data).

Although the river has not run dry since the 1950s, flows through the Park have dropped below 50 cfs over periods of days to weeks in 1995, 1996, 1998, 1999, 2000, and 2001. Flows of less than 10 cfs have been recorded on rare occasions. During several of these periods commercial rafting operations in the Park have been curtailed or ceased. Ongoing development and increased demand for water in the Rio Conchos watershed will likely place continuing pressure on the availability of water in the Big Bend reach.

Groundwater in the Big Bend region occurs in alluvial deposits along the Rio Grande and intermittent streams. Geothermal springs are also present and form a local tourist attraction. Spring discharge contributes a modest amount of water to the flow of the Rio Grande within the Park, but is more important as a source of water and habitat for wildlife, including the endangered Big Bend gambusia, which occupy three spring-fed ponds less than 200 meters (656 feet) from the river.

Below the Park, in the RGWSR section, water from springs adds appreciably to Rio Grande river flows. At Foster Ranch, near the downstream boundary of the reach, flows even in the driest periods of the 1990s have not dropped below 100 cfs (IBWC flow data).

Water quality

Over the last 20 years extensive development and population growth has occurred in the United States-Mexico border region, particularly in the El Paso/Juarez metropolitan area, some 483 kilometers (300 miles) upstream from the Park. This growth, fueled in part by more than 1400 maquiladora (product assembly) plants on the Mexican side of the border, has resulted in increased potential for water quality degradation and toxic chemical contamination. Heightened public and government attention was focused on these issues in 1993 when American Rivers, the principal river conservation organization in the United States, listed the Rio Grande/Rio Conchos as the most endangered river system in America.

Sources of contaminants in the area immediately upstream from the Park include untreated sewage from Ojinaga and smaller border villages, livestock grazing in riparian areas, agricultural runoff, and mining activities including past underground mining for mercury near Terlingua just outside of Park boundaries. However, the largest potential sources of toxic contaminants in the Big Bend reach are further upstream. Point and nonpoint sources include agricultural runoff from farming operations around El Paso/Ciudad Juarez and in the upstream watershed of the Rio Conchos; drainage from past and current mining activities in Mexico; and both treated and untreated municipal and industrial wastewater from El Paso/Juarez. Elevated fecal coliform levels, as well as heavy metals and pesticides, have been identified in several segments of the Rio Grande in Texas, particularly downstream from border cities.

In 1992 the United States and Mexico issued an *Integrated Environmental Plan for the Mexican-U.S. Border Area*, in which the two countries agreed to work together to solve environmental problems. An intensive, binational water quality investigation of the Rio Grande, from El Paso to Brownsville, was initiated. Under the direction of the Mexican and U.S. Sections of the IBWC, the TNRCC, and other U.S. and Mexican agencies, the study included sampling for chemicals and contaminants in water, sediment, and fish tissue. All three phases of the study have now been completed.

During Phase One, sampling was conducted at 45 sites along the Rio Grande and its tributaries, including two sites in the Park. The Phase One study found some potential impact on

water quality, but no instances of human health risk or severe impairment to aquatic plants or animals. These findings were incorporated into the Park's 1997 Recreational River Use Management Plan. Sampling for Phase Two was conducted in 1995, and results were published in 1998. Overall the studies found a lower than expected number of chemical-related problems in the lower Rio Grande, but several areas of concern were identified. Concentrations of chemical pollutants generally increased downstream from El Paso to Santa Elena Canyon in the Park. While fish and aquatic insect communities generally were healthy, three sites were identified as being of concern for toxic chemical impact. Two of these were locations at or just above the mouth of the Rio Conchos, about 72 kilometers (45 miles) upstream from the Park. Elevated levels of arsenic, barium, selenium, and DDE in sediment were also noted as a concern in the area below the Rio Conchos confluence (TNRCC 1996). Phase Three sampling—focusing exclusively on the reach between El Paso and the Park—was conducted in 1998. These results are still under review by the EPA.

Although toxic chemicals derived from pesticides and industrial uses are present, salinity is probably the greatest threat to water quality in the stretch of the Rio Grande from Presidio to Amistad Reservoir (IBWC 2001b; C. Purchase, NPS, pers. comm. 2001) In the recent low-flow years from 1995 on, water quality in the Big Bend reach has decreased. Monitoring by National Park Service (NPS) staff in conjunction with the USIBWC's Texas Clean Rivers Program indicates that the Rio Grande in the Park and RGWSR frequently violates state water quality standards for chlorides, sulfates, total dissolved solids, and fecal coliform (IBWC 2001b). Occasional die-offs of fish in the Park have been occurring periodically for some time. The cause is not known, but die-offs are usually associated with large storms after prolonged periods of low flow (C. Purchase pers. comm. 2001) As noted earlier, water quality generally improves downstream from the Park on the RGWSR, due to the presence of springs which help to maintain higher flows and provide greater dilution of salts and other pollutants.

Water rights and use

U.S. rights to Rio Grande river water flowing below Ft. Quitman are allocated under the Treaty of February 3, 1944, for "Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande." Under the 1944 Treaty, the United States is allocated one-half of the flows occurring in the main channel of the Rio Grande downstream from Fort Quitman, and one-third of the flows reaching the main channel from six Mexican tributaries including the Rio Conchos. The Rio Conchos is by far the largest of the six tributaries. The treaty also provides that this third shall not be less, as an average amount over a five year cycle, than 350,000 ac-ft annually. This treaty also entrusts the IBWC with the application of its terms.

Water rights on federally-owned property in the Park belong exclusively to the U.S. under Texas state law. The Park holds state-administered rights to approximately 1,500 ac-ft of water per year, of which it typically uses around 600 ac-ft for campground irrigation.

Recent low flows in the Park are in part the result of Mexico failing to meet its treaty obligation to deliver a minimum annual average of 350,000 ac-ft. During the 1992-1997 cycle, Mexico accumulated a deficit of slightly more than one million ac-ft. In March of 2001, an agreement (IBWC Minute No. 307) was reached between the United States and Mexico whereby the deficit would be reduced by the delivery of 600,000 ac-ft of water by September 30, 2001. Only a portion of this amount was actually delivered, and negotiations about the remaining deficit are ongoing. The current five-year cycle is scheduled to conclude in the fall of 2002.

The TNRCC's Rio Grande Watermaster Office is responsible for allocating, monitoring, and controlling the use of surface water in the Rio Grande basin from Fort Quitman to the Gulf. From the mouth of the Conchos downstream to the Park, a number of private parties own state-administered water rights. Water diversions in the Presidio Valley are primarily for agriculture. A rapidly expanding resort development at Lajitas, just outside of Park boundaries, is placing increasing demand on river water. Extensive landscaping, new guest facilities, and a new 18-hole golf course are all under construction in 2001. From the Park downstream to Amistad Reservoir, water diversions from the river for consumptive use are minimal. Very little irrigated agriculture occurs in this reach, and virtually none within the alternative analyzed in this FEIS. Other private uses are for stock and rural domestic use.

Vegetation

The riparian zone in the Big Bend reach once included lance-leaf cottonwoods and willows. Forests were probably not extensive, as riparian vegetation was often cleared by scouring floods. Prior to the establishment of the Park most of the larger floodplain areas were cleared for farming and grazing, and native cottonwoods were nearly eliminated by woodcutters. These activities, along with continued grazing by trespass livestock from Mexico, have greatly altered the character of the riparian zone. Native trees such as huisache and willow are still common near the river in some areas, but much of the river floodplain is now dominated by non-native species. Bermuda grass is widespread on many sections of riverbank. Throughout the river corridor, extensive stands of introduced giant reed, along with native common reed, line the shore. Non-native saltcedar occupies extensive areas, out-competing native species for water and nutrients. In drier areas of the floodplain, particularly in the RGWSR segment, characteristic Chihuahuan Desert species such as mesquite, saltbush, and creosote bush continue to dominate. See *Appendix D* for a list of scientific names.

Federally-listed (threatened and endangered) plant species

Two federally threatened species of cactus—bunched cory cactus and Chisos Mountain hedgehog cactus—are present in the Park and on lands adjacent to the RGWSR. Both species occur primarily in upland areas, but may be found within the river corridor in a few locations (NPS 1997).

Fish and Wildlife

Rio Grande silvery minnow

The historical distribution of the Rio Grande silvery minnow extended from Española, New Mexico, to the Gulf of Mexico, and included the stretch of the Rio Grande in what are now the Park and the RGWSR. Seven collections made between 1938 and 1960 document that the silvery minnow was among the most common fishes of the Big Bend reach. The species has not been found in the area since 1960, despite sampling from 1977 to the present. There are no records of the silvery minnow in the Rio Conchos in either historic or recent collections.

Fish communities of the lower Rio Grande

The portion of the Rio Grande between Presidio and Amistad Reservoir contains a somewhat different and more diverse fish fauna than upstream or downstream reaches. Forty-six known species of fish have been recorded in the Big Bend reach. Thirty-four are native, and 12 have been introduced (NPS 1997). Extensive sampling of the reach between Presidio and Amistad Reservoir during the period from 1991-1995 produced a total of 34 species. A comparison of data collected by Bestgen and Platania in 1988 with an earlier survey conducted by Hubbs *et al.* in 1977 indicated that the density and diversity of fish populations in the Rio Grande downstream from the Rio Conchos had decreased significantly, possibly due to a decline in water quality (Bestgen and Platania 1988).

This reach is characterized by at least two major categories of fishes: large-bodied, long-lived, big-river fishes and small bodied, short-lived fishes. Examples of the former include the long nose gar, gizzard shad, river carpsucker, blue sucker, smallmouth buffalo, and carp. Several species of catfish are present and caught by anglers in the Park. The majority of the native fish in the Big Bend reach are of minnow size. At least 12 species of minnow, 10 of which are native, occur in this reach of the Rio Grande. Two of these species (speckled chub and Rio Grande shiner) are—like the Rio Grande silvery minnow—pelagic spawners, producing semi-buoyant eggs that drift downstream. Both are widespread throughout the reach. Other common members of the fish fauna in the Big Bend reach include the red shiner, Tamaulipas shiner, Mexican tetra, and mosquitofish. See *Appendix D* for a list of scientific names.

Federally-listed (threatened and endangered) species

_____ The Rio Grande in this reach presently contains no federally-listed threatened or endangered species. One candidate species for Federal listing, the Texas hornshell (a freshwater mussel), is probably present in this reach. Dead shells were found in 1999 and 2000, confirming the recent presence of the species (F. Deckert, NPS, pers.comm.2002). This species was formerly widespread in the Rio Grande and Pecos River drainage basins; the only confirmed extant population today exists in the Black River in New Mexico.

One Federally endangered fish species, the Big Bend gambusia, occupies shallow, spring-fed natural pools near Rio Grande Village. When discovered, the species occupied a single spring near Boquillas Crossing. Individuals were introduced into three spring-fed pools near the river corridor, where the species currently persists. Two of these, the Spring 4 overflow pond and the “beaver pond”, are located within the lateral boundary of proposed critical habitat (F. Deckert, NPS, pers. comm. 2002). This species remains threatened due to the greatly restricted area of its habitat. The gambusia is vulnerable to the introduction of other minnow species to the isolated pools in which it occurs.

There are no records of the southwestern willow flycatcher in the Park, although its presence at the extreme eastern edge of its geographic range is a possibility. The bald eagle is a Federally threatened species (currently proposed for delisting) that occasionally uses the Park during migration. This species is a rare visitor to the river floodplain during spring and fall. The peregrine falcon, which nests in canyons above the river corridor along the Big Bend reach, was de-listed in 1999. The Park continues to protect falcon nesting habitat by closing certain canyon areas to hiking and camping for parts of the year. Other Federally-listed wildlife species present within the Park, but largely outside of the river corridor, are the black-capped vireo and the Mexican long-nosed bat.

State-listed species and other species of concern

This Big Bend reach includes a number of freshwater fish species of concern, including the Chihuahua shiner, Mexican stoneroller, Proserpine shiner, Rio Grande darter, Rio Grande shiner, and blue sucker. The Mexican stoneroller, Chihuahua shiner, Proserpine shiner, and blue sucker are all listed as threatened in the state of Texas.

Other wildlife

_____The river corridor in the Big Bend reach is used extensively by a large number of wildlife species. A number of medium-sized mammals including gray fox, raccoon, and striped skunk inhabit the riparian zone. Several broad-ranging mammals, including black bear and mountain lion may sometimes pass through the river corridor in the Park. Mexican beaver, a Mexican endangered species, occupies areas along the Rio Grande throughout the Big Bend reach. Nutria, a non-native mammal species, has invaded the river corridor and caused degradation of aquatic habitat in some areas by consuming aquatic vegetation (R. Skiles, NPS, pers. comm.2001).

More bird species have been recorded at Big Bend than any other National Park. Many resident and migrant species make use of the riparian vegetation along the river corridor. Common nesters in riparian habitat include the mourning dove, yellow-billed cuckoo, black-chinned hummingbird, ladder-backed woodpecker, Bell's vireo, common yellowthroat, yellow-breasted chat, orchard oriole, summer tanager, cardinal, blue grosbeak, and painted

bunting. Somewhat less common are white-winged and ground doves, western screech-owl, elf owl, vermilion flycatcher, and hooded oriole.

The most common amphibians along the river are Rio Grande leopard frog and red-spotted toad. Three native species of turtle reside in the river corridor: Big Bend slider, yellow mud turtle, and spiny softshell. The non-native elegant slider is also present, and may be threatening the Big Bend slider by hybridization. Lizard species present in the floodplain include the Texas banded gecko, southwestern earless lizard, desert spiny lizard, canyon lizard, side-blotched lizard, and marbled whiptail. Common snakes include the coachwhip, spotted night snake, and western diamondback rattlesnake. Less common to rare are the trans-Pecos blind snake, glossy snake, Great Plains rat snake, desert kingsnake, blotched water snake, checkered garter snake, and Big Bend patch-nosed snake. Common amphibians include the Texas toad and the Rio Grande leopard frog.

Land Use Plans and Policies

Federal

Big Bend National Park was authorized by the Congress in 1935 (49 Stat. 393), and established in 1944, to preserve and protect a representative area of the Chihuahuan Desert along the Rio Grande for the benefit and enjoyment of present and future generations. The purpose of the Park is to:

- preserve and protect all natural and significant cultural resources and values;
- provide recreational opportunities that are compatible with the protection and appreciation of Park resources for diverse groups; and
- provide educational opportunities to foster understanding and appreciation of the natural and human history of the region.

All lands included within the Park are administered by the NPS and operated under a General Management Plan (GMP) adopted in 1981. The NPS is currently in the process of negotiating management authority with private landowners in the RGWSR corridor outside of Park boundaries, as discussed below. A new GMP for the Park, and a RGWSR Management Plan, are currently under development, and are scheduled for completion and implementation in 2002.

Recreational use management of the Rio Grande in the Park

Most of the area encompassing the river corridor in the Park is classified and managed by the NPS “as a natural zone where natural resources and processes remain largely unaltered by human activity, except for approved development essential to management, use, and appreciation of the Park” (NPS 1997). The Park’s 1997 Recreational River Use Management Plan provides specific guidelines and policies for zoning, motor use, fishing access, human waste, and recreational use limits affecting the Rio Grande inside of Park boundaries. The plan divides the river corridor into Threshold, Primitive, and Wild management zones. The three

zones describe areas of decreasing user density, developed access, and active management activities, and increasing restrictions on float trip launches and on some activities such as the use of motorized watercraft. The Plan also provides guidelines for further restrictions on commercial river trips that may be implemented during low water periods, when flow drops below 200 cfs at the Presidio gage (NPS 1997).

Management of the Rio Grande Wild and Scenic River

In 1978, Congress designated a 315-kilometer (196-mile) portion of the Rio Grande from the Chihuahua/Coahuila state line in Mexico to the Terrell/Val Verde county line in Texas as part of the National Wild and Scenic Rivers System. The Wild and Scenic Rivers Act of 1968 directs that designated rivers “be preserved in free-flowing condition, and that they and their immediate environments be protected for the benefit and enjoyment of the present and future generations.” The NPS administers the entire 196-mile section as the RGWSR. The upper 111 kilometers (69 miles) of the RGWSR occur within Park boundaries.

The purpose of the RGWSR is to:

- preserve the free-flowing condition, except as provided by international treaties, and essentially primitive character of the river;
- protect the scenic, geologic, fish and wildlife, recreational, scientific, and other similar values along the river way; and
- provide opportunities for river-oriented recreation which is dependent upon the free-flowing condition of the river and consistent with the primitive character of the surroundings. (www.nps.gov/bibe/rgwsr.htm)

Officially the RGWSR includes only the river area from the United States/Mexico international boundary in the middle of the deepest channel to the gradient boundary at the edge of the river on the U.S. side. The gradient boundary, as recognized by the state of Texas, is defined as located midway between the lower level of the flowing water that just reaches the cut bank and the higher level of it that just does not overtop the cut bank. The NPS’s management authority in the RGWSR segment is set by cooperative agreement with private landowners. The current NPS position is to accept private property lines, and to enter into cooperative agreements to manage river resources up to 1/4 mile from the river.

A new RGWSR Management Plan is currently being prepared through a collaborative effort between the NPS and a Partnership Planning Team representing county officials, private landowners, river users, state government, and other interested citizens.

State and County

State and county land use plans do not apply within the Federal jurisdiction of Big Bend National Park. Just east of the national park, the Black Gap Wildlife Management Area is

owned and managed by the state of Texas. The stream bed of the Rio Grande, to the gradient boundary (see above), is the property of the state of Texas. Other lands within the RGWSR corridor are privately owned, and are subject to any existing county land use policies.

Indian Tribes

No tribal lands are present in the Big Bend reach.

Land Ownership and Use

The Park occupies roughly 323,750 hectares (800,000 acres), or 25 percent of the total land area in Brewster County. Lands within the Park are owned by the United States and used primarily for recreational and conservation purposes. Grazing is not allowed in the Park, but is legally allowed on private ranches adjacent to the RGWSR downstream of Park boundaries. Grazing of trespass livestock from Mexico is sometimes a problem in the Park. The U.S. Department of Agriculture, in cooperation with the NPS, conducts periodic trespass livestock round-ups.

Surrounding lands are used for a variety of purposes, primarily recreation, ranching, and agriculture. To the northwest, Big Bend Ranch State Park occupies over 113,312 hectares (280,000 acres) along the Rio Grande from southeast of Presidio to near Lajitas. The State Park offers camping, lodging, and a variety of recreational activities for visitors. To the east, the Black Gap Wildlife Management Area borders the Park, encompassing 40,469 hectares (100,000 acres) including a 48-mile (30-mile) stretch of the RGWSR. This remote area is undeveloped and receives relatively few visitors. The mountain region to the north of the Park also provides recreational opportunities and attracts tourists to Alpine, the largest town in Brewster County with a population of roughly 6,000. Elsewhere throughout Brewster and Terrell counties, as across the border in Mexico, grazing and relatively small-scale agriculture remain the predominant land uses.

Aside from Black Gap Wildlife Management Area, lands downstream from the Park are owned by 12-15 private landowners. These very large holdings are minimally grazed. Although some cattle are present on private lands along the RGWSR, the remoteness and ruggedness of the region make active livestock management difficult or impossible (L. Good, pers. comm. 2002). As noted, the riverbed in the RGWSR section is the property of the state of Texas.

Social and Economic Conditions

Brewster County

The Big Bend region is one of the most sparsely populated regions of the country. Brewster County had a year 2000 population of 8,866 people spread out over 160,580 square

kilometers (6,200 square miles), resulting in a population density of 1.4 persons per square mile. The county population grew by 2.5 percent from 1990 to 2000, and is projected to grow to around 18,000 by 2050. Forty-four percent of the population reports being of Hispanic or Latino origin. Median household income is about \$25,000; average earnings per job is about \$19,000. Twenty-three percent of the population lives in poverty, according to a 1997 model-based estimate by U.S. Census Bureau's Small Area Income and Poverty Estimates Program.

Brewster County is a rural county dominated by private ranches and some 1.2 million hectares (3 million acres) of rangeland. No ranching or grazing activities occur in the Park, the only part of the county potentially affected by designation of critical habitat. Business statistics indicate 286 private non-farm establishments in 1999. The Park is one of the largest employers in Brewster County. Park staffing in 2000 included 90 permanent and 45 seasonal NPS employees. Park concessions employed an additional 56 permanent and 15 seasonal workers (Statistics from www.fedstats.gov; TDWP 2001; Brock *et al.* 2001).

Terrell County

Terrell County had a year 2000 population of roughly 1,081. This total represents a significant decline (23 percent) from 1990. Unlike all of the other counties along the Lower Rio Grande, virtually no population growth is projected for Terrell County through 2050. Population density in Terrell County is .5 persons per square mile. Forty-seven percent of the population reports being of Hispanic or Latino origin. Median household income in Terrell County is about \$25,000; average earnings per job is about \$14,000. Twenty-one percent of the population lives in poverty, according to a 1997 model-based estimate by U.S. Census Bureau's Small Area Income and Poverty Estimates Program.

Terrell County is a sparsely settled area dominated almost entirely by rangeland. The population density is 180 times lower than that of the State of Texas as a whole. Sanderson, the county seat, is the only significant population center. The county has declined significantly in the past decade, with a reported loss of 23 percent of its population and a loss of 140 jobs between 1990 and 1997. Business statistics indicate a total of 23 private non-farm establishments, all employing fewer than 20 people (Statistics from www.fedstats.gov; TDWP 2001; Brock *et al.* 2001).

Indian Trust Resources

There are no issues regarding Federal Indian trust resources in the Big Bend reach.

Environmental Justice

The social and economic data cited above for Brewster and Terrell counties—including low income levels, high rates of poverty, and significant Hispanic populations—indicate that there may be environmental justice concerns associated with any economic impacts that may result

from a designation of critical habitat. Accordingly, possible environmental justice-related impacts will be examined in Chapter 4 of this FEIS.

Social and Cultural Values

We have little information pertaining to social and cultural values in the Big Bend reach. It may be assumed that many visitors to the Park and the RGWSR value the natural features and recreational opportunities that are maintained and preserved on these lands.

Cultural Resources

Although no complete survey has ever been done, archeologists estimate that the Park may contain 5,000 - 10,000 archeological sites, which contain evidence and material remains of 10,000 years of Native American occupation. Two prehistoric archeological sites are presently considered public: the Hot Springs pictograph site and the Chimneys. No data are available on the exact number of prehistoric sites that may be present within the lateral boundaries of the area proposed for designation.

There are six National Historic Register sites or districts in the Park. These include the Castolon Historic District, Hot Springs Historic Site, the Mariscal Mining District, the Homer Wilson Ranch Site, Rancho Estelle, and Luna's Jacal. Hot Springs Historical District lies largely within 91.4 meters (300 feet) of the river and thus within proposed critical habitat. The site consists of an old motel, store, and post office, all no longer in use. The RGWSR downstream of the Park contains additional prehistoric and historic sites, mostly on private property. The NPS is working with private landowners to preserve these sites, which may be disturbed by or lose artifacts to river users. A thorough inventory of sites in the Big Bend Reach is not currently available.

Recreation

Throughout the 1990s, numbers of Park visitors have ranged from 250,000 to 350,000 per year. The river zone is a primary recreational area for Park visitors. Users of the Rio Grande corridor include private and commercial recreational boaters, anglers, non-boating riverside campers, and day-use recreationists. Approximately three percent of Park visitors participate in either a commercial or private river trip. Five commercial outfitters currently operate out of the gateway communities of Lajitas, Terlingua, and Study Butte. River trip options range from half-day trips through Santa Elena canyon to wilderness trips of many days extending through the Lower Canyons of the RGWSR. Those visitors not taking a boat trip visit the river corridor for hiking, camping, and wildlife viewing opportunities (NPS 1997).

There is little recreational use of the RGWSR except for float trips originating primarily at La Linda, downstream of the Park, and fishing parties boating from privately owned access

points further downstream (F. Deckert, NPS, pers. comm. 2002). Visitors to this remote region enjoy the opportunities it offers for wilderness solitude, and nature and wildlife viewing. River traffic from recreational boaters in the RGWSR averages range from 1,100 to 1,500 visitors per year. All river and backcountry users must obtain a permit from the NPS. Limits are placed on the size of groups and numbers of launches per day, according to the Recreational River Use Management Plan (NPS 1997).

Pecos River Between Sumner Dam and Brantley Reservoir

The Pecos River originates in the Sangre de Cristo Mountains of northern New Mexico, and travels 676 kilometers (420 miles) south before joining the Rio Grande near Langtry, Texas. The river crosses the high plains of eastern New Mexico, and Chihuahuan Desert country in the southeast part of the state. The 359-kilometer (223-mile) reach discussed in this section extends from Sumner Dam, north of the town of Fort Sumner, New Mexico, to Brantley Dam, south of Artesia. Different names for this reach appear in the literature. For the purposes of this FEIS, the “Middle Pecos” reach is the river reach between Sumner Dam and Brantley Dam. The term “Middle Pecos River Valley” will be used when referring to the Middle Pecos reach and surrounding lands.

Four dams regulate flows on the Pecos River in New Mexico: Santa Rosa Dam, Sumner Dam, Fort Sumner Irrigation District (FSID) diversion dam, and Brantley Dam. As on the Middle Rio Grande, dams and reservoirs on the Middle Pecos have disrupted natural flow patterns, including flooding. Diversions for agricultural use have greatly reduced the total volume of river flow. The Middle Pecos reach has one federally threatened fish species, the Pecos bluntnose shiner (*Notropis simus pecosensis*). Critical habitat was designated for the shiner in 1987, concurrent with listing as threatened, and exists along portions of the reach being considered for designation for the Rio Grande silvery minnow.

Geography

Climate

Climatic conditions vary considerably within the watershed, in correlation with latitude and elevation. Within the area proposed for designation, summers are hot and winters are fairly mild. Maximum summer temperatures occur in June and July, and average 34°C (93°F) at Sumner Lake, 35°C (95°F) in Artesia. Minimum temperatures for the area occur in January and are close to -5°C (23°F). Average annual precipitation varies from about 30 centimeters (12 inches) in the vicinity of Artesia to 38 centimeters (15 inches) at Sumner Lake. About 75 percent of the mean annual precipitation occurs from July through September. This pattern of rainfall, often torrential and of brief duration, results in frequent floods. (Western Regional Climate Center, <http://wrcc.sage.dri.edu/summary/climsnm.html>).

Snowfall is generally minimal in the Middle Pecos River Valley, but mountain snows at higher elevations in northern New Mexico provide most of the water that travels down the Pecos River during the spring runoff. The winter snowpack can be highly variable from year to year. Like the Middle Rio Grande, climate in the Middle Pecos River Valley is sometimes strongly affected by the El Niño–Southern Oscillation phenomenon, which may cause significantly above-average or below-average precipitation in some years.

Natural topography

The Pecos River drains approximately 64,750 square kilometers (25,000 square miles) in New Mexico and 49,210 square kilometers (19,000 square miles) in Texas. Watershed elevations in the basin vary from 3,962 meters (13,000 feet) at the river's source, to about 305 meters (1,000 feet) at its mouth. The Middle Pecos reach lies within the Pecos River Valley, which extends from Fort Sumner south to the Texas-New Mexico border, although a critical habitat designation would stop at Brantley Dam. The drainage basin as known today was formed fairly recently, in the middle Pleistocene, when a more eastward flowing stream was captured in what is now the southward sloping river valley. The largely flat and mid-elevation reach from Sumner Lake to Brantley Reservoir is situated along the southwestern border of the Great Plains. Cutting of the river channel and valley has isolated the plains region known as the Llano Estacado, to the east, from the plains extending down from the flanks of the Sacramento Mountains, to the west. The river occupies a fairly wide and sandy floodplain, which narrows somewhat approaching Brantley Reservoir.

Political boundaries

Sumner Lake, at the northern boundary of the Middle Pecos reach is located at the northern boundary of De Baca County. The Pecos River flows south through De Baca, Chavez, and Eddy counties in New Mexico. Brantley Dam, at the southern boundary of the study area, is in Eddy County. Through this stretch the Pecos River passes through or close to the towns of Fort Sumner, the county seat of DeBaca County; Roswell, the county seat of Chavez County; and Artesia, in Eddy County. The city of Carlsbad, the county seat of Eddy County, is south of Brantley Dam.

Water and Hydrology

Surface flows and channel characteristics

The historical floodplain of the Middle Pecos is fairly broad, except in the southern section of the reach where the river passes through a canyon area as it approaches Brantley Reservoir. The northern segment of the river, from approximately Fort Sumner to the Near Non-native (located 171 kilometers (106 miles) south of Sumner Dam, just north of Roswell) is

characterized by a channel that is relatively wide, on average 30 - 75 meters (100-250 ft.) in lateral extent. In this area the river flows through a wide flood plain, with a predominantly sand substrate and a braided channel. Flow events cause the sandy substrate to shift. In contrast, the reach from near Roswell to the headwaters of Brantley Reservoir is characterized by deep entrenchment, and the river is confined to a single channel. The sand-silt substrate in this portion of the reach is relatively unresponsive to floe events (Tashjian 1995; Reclamation 2001a).

Regulation of the river has altered its natural flow regime. High flows that generally accompanied annual spring runoff events have been eliminated in all but the wettest conditions. Baseflows that had historically flowed down the Pecos are now stored behind Sumner Dam during the non-irrigation season (typically November 1 through February 14). Additionally, native flows greater than 100 cfs are now stored behind Sumner Dam during the irrigation season rather than being passed over the FSID diversion dam. These alterations in the natural regime have resulted in reduced base flow in the Pecos (*Id*).

Flows are often minimal in the area immediately below Sumner Dam. Between Fort Sumner and Roswell, flows are maintained by groundwater discharge and irrigation returns during periods when no water is being released from Sumner. Approaching the Near Acme gage, spring seepage is depleted by local groundwater pumping and contributes little to base flow. This is therefore often the driest section of the Middle Pecos River between Sumner and Brantley Dams. Flow intermittency at the Near Acme gage was observed frequently between 1938 and 1991. Continuous flows have largely been maintained at the Near Acme gage for the past ten years, until 2001 when segments experienced drying. The Near Acme gage is now the site for target flows specified by the Service to avoid causing jeopardy to the threatened Pecos bluntnose shiner (Service 2001a).

Overall the 171-kilometer (106-mile) stretch from Sumner Dam to the Near Acme gage is characterized as a “losing” reach. Surface water is lost through seepage, evaporation, and transpiration. Depending on the time of year, these losses may be as high as 50 percent by the time river water reaches to the Near Acme gage (Reclamation 2001a). From the Near Acme gage downstream, the river begins to gain water. Groundwater inflows in this section are significant, supplying relatively stable base flows. Seepage losses deplete river flows between Artesia and Brantley Reservoir, but base flows are typically maintained as a result of the gains in the reach immediately upstream (*Id*).

Groundwater

The most significant groundwater resource along the Middle Pecos River in New Mexico is the Roswell artesian aquifer, which underlays a shallow alluvial aquifer in the Roswell area. The artesian aquifer is composed of carbonate rock, and is recharged by flow from the Sacramento and Guadalupe Mountains. The water table slopes downward from the mountain

ranges west of the Pecos River to the riverbed. The groundwater quality west of the river is good, while the groundwater east of the river is unpotable and high in salt (Pecos Valley Water Users Org. 2001). The discovery and development of this resource in the early 20th century spurred much of the agricultural growth in the region.

River management and operations

Early irrigation systems were implemented within the Pecos River Basin by the Spanish in the 16th century. American settlers entered the area in large numbers in the middle of the 19th century, and continued to use the traditional irrigation systems. These systems consisted mainly of community ditches, which diverted river flow without permanent diversion structures. In the Middle Pecos, more extensive agricultural development occurred around the late 1880's and early 1890's. Farmers in Chaves and Eddy counties constructed irrigation ditches that depended largely upon the springs and spring-fed streams along the river valley. It is estimated that by 1904, 485 artesian wells had been drilled and 8,094 hectares (20,000 acres) of land were irrigated in the Roswell basin. By 1928, 18,211 hectares (45,000 acres) were being irrigated in Chaves County with 1,424 wells (Hall 2002).

The first large-scale irrigation projects in the Pecos River Basin began in the early 20th century in Eddy County, and McMillan Dam and Avalon Dam were constructed for water storage just north of Carlsbad. Today, four dams control the flow of the Pecos River in New Mexico. The uppermost, Santa Rosa, is operated by the Corps for flood control. Sumner Dam and Brantley Dam are operated by Reclamation for storage and irrigation purposes. Sumner Dam was built in 1937 and is 55 miles downstream from Santa Rosa Dam. The FSID Diversion Dam is located 23 kilometers (14 miles) downstream of Sumner Dam and was completed in 1951. Brantley Dam was completed in 1989 to replace McMillan Dam. Other than unregulated tributaries entering the river, operation of the four dams permits almost total control of the streamflow from Santa Rosa, New Mexico, downstream to the New Mexico-Texas border (Service 2001a).

Water operations by the Carlsbad and Fort Sumner Irrigation Districts to supply farmers in the Pecos River Valley are discussed later in this chapter.

Water quality

The regulatory framework for developing and maintaining water quality in New Mexico was described in the Middle Rio Grande section. Some of the basic water quality standards for the Pecos River are outlined in **Table 3-9**. On the Middle Pecos River, no segments have been identified as impaired (WQCC 2000). The major water quality issue along the Pecos is salinity, which increases as the river flows south (Pecos Valley Water Users Org.2001). Significant increases in salinity are observed near Puerto de Luna and near Malaga Bend, and render the water unusable for many purposes as the Pecos enters Texas (*Id.*).

Table 3-9: Water Quality Standards for the Pecos River
(WQCC Regulations, 20 NMAC 6.2200)

Reach	Designated Uses	Water Quality Standard
The mainstem of the Pecos River from Salt Creek (near Acme gage) upstream to Sumner Dam	<ul style="list-style-type: none"> • Irrigation • Limited warmwater fishery • Livestock watering • Wildlife habitat • Secondary contact 	pH: 6.6 - 9.0 Temp: ≤ 32.2°C (90°F) WQCC Regulations, 20 NMAC 6.1.3100
The mainstem of the Pecos River from the headwaters of Brantley Reservoir upstream to Salt Creek (near Acme gage), the Rio Peñasco downstream from State Highway 24 near Dunken, any flow at the mouth of the Rio Hondo and any flow from the Rio Felix which enters the mainstem of the Pecos River	<ul style="list-style-type: none"> • Irrigation, • Livestock watering • Wildlife habitat • Secondary contact • Warmwater fishery 	pH: 6.6 - 9.0 Temp: ≤ 32.2°C (90°F) WQCC Regulations, 20 NMAC 6.1.3100
Brantley Reservoir	<ul style="list-style-type: none"> • Irrigation storage • Livestock watering • Wildlife habitat • Primary contact • Warmwater fishery 	pH: 6.6 - 9.0 Temp: ≤ 32.2°C (90°F) WQCC Regulations, 20 NMAC 6.1.3100

Water rights and management

Fort Sumner and Carlsbad Irrigation Districts

The FSID provides irrigation water to farmers in DeBaca County. The water is supplied by the FSID Diversion Dam, which diverts up to 100 cfs from February 15 through October 31. FSID has no storage rights in Santa Rosa Reservoir or Sumner Lake upstream, but is entitled to water rights that predate Sumner Dam construction in 1937 (Service 2001a). The water entitlement is based on a calculation made by the OSE from flow data collected every two weeks throughout the irrigation season. Sumner Dam bypasses water for FSID and the water travels 23 kilometers (14 miles) downstream to the FSID Diversion Dam. If there are no supplemental bypass releases from Sumner Dam, the river may be dewatered downstream of the FSID Diversion Dam. The main FSID canal is 24 kilometers (15 miles) long, and water is diverted into smaller lateral canals. The system also includes drain canals that collect seepage and runoff from the fields and carry these return flows back to the main canal. These return flows to the Pecos River may be up to half of the amount diverted.

The Carlsbad Irrigation District (CID) supplies irrigators with water on 10,117 hectares (25,000 acres) east of the river near Carlsbad and west of the river south of Carlsbad. The water

CID uses is stored in Santa Rosa and Sumner Lake upstream. The CID may issue calls for releases of water by Reclamation from Sumner Lake. CID also has water released from Brantley Reservoir for irrigation purposed, and has leased water to the NMISC to help augment Pecos River Compact deliveries. River flow and channel morphology in the study area have historically been greatly affected by CID calls for block releases from Sumner Lake (Service 2001a).

The Roswell artesian aquifer is the most heavily used aquifer in the Pecos Valley, with current groundwater withdrawals at approximately 345,000 ac-ft per year (Pecos Valley Water Users Org. 2001). In contrast, use of groundwater for irrigation totals roughly 45,000 ac-ft per year in the Fort Sumner area and 94,000ac-ft per year in Carlsbad. Large development of groundwater resources, including both the shallow and artesian aquifers, led to water level declines of 3 to 24 meters (10 to 80 feet) during the 1938 - 1960 period (*Id*). In response to this decline, actions were taken by the OSE and others to manage groundwater withdrawals. Water rights in the basin were adjudicated and several thousand acres of irrigated farmlands were retired (<http://www.seo.state.nm.us/water-info/pecos/index.html>). In addition, wells were metered and conservation measures were taken (Pecos Valley Water Users Org. 2001).

The OSE considers the waters of the Pecos River within New Mexico to be fully appropriated and has not been allowing new appropriations. The OSE has made progress in adjudicating water rights along the Pecos, and senior and junior rights are better known and better quantified than on the Middle Rio Grande (<http://www.ose.state.nm.us/publications/98-99-annual-report>).

Pecos River Compact

In 1949, New Mexico and Texas entered into the Pecos River Compact. Prior to that time, significant agricultural development had occurred in the Pecos River Valley, and the two states had attempted to reach a water use agreement with a proposed Compact in 1924. However, the 1924 Compact was not approved. After further study of the Pecos River and many years of compact negotiations, the 1949 Pecos River Compact was developed and approved.

The Pecos River Compact was instituted to apportion Pecos River water between the two states. The Pecos River Compact requires New Mexico “not to deplete by man’s activities the flow of the Pecos River at the New Mexico-Texas state line below an amount which will give Texas a quantity of water equivalent to that available to Texas under the 1947 condition.” The interpretation of “the 1947 condition” became the subject of litigation between Texas and New Mexico that reached the Supreme Court. In its 1987 ruling, the Court more specifically defined New Mexico’s delivery obligation to Texas.

In its findings, the Supreme Court adopted a complicated method for determining the annual amount of water that must pass into Texas each year. Roughly approximated, one-half of the releases from Sumner Dam and one-half of the flood inflows to the Pecos River below

Sumner Dam are owed to Texas. Delivery of this water to the Texas state line must occur the same year. Although New Mexico is permitted to accrue a credit in its deliveries to Texas, New Mexico is not permitted to accrue a net deficit. In the case of a measured deficit, New Mexico is required to provide the River Master a plan that describes the remedy for the shortfall. Pending approval or modification from the River Master and Texas, the shortfall must be remedied within 6 months (<http://www.seo.state.nm.us/water-info/pecos>).

With funding from the New Mexico Legislature, the NMISC has been actively acquiring and leasing water rights to meet compact obligations to Texas. Between 1991 and 1999, approximately \$27.8 million was spent on the Pecos River water rights acquisition program. To date, about 27,000 ac-ft of Pecos River water rights have been acquired by the NMISC, resulting in increased state-line deliveries to the Texas state line of about 8,600 ac-ft per year (NMISC 2001). The NMISC also leases water from the CID to augment flows at the state line. The leasing program comprises an important component of the NMISC's effort to meet compact obligations and avoid the administration of priority water rights over junior appropriators.

Despite these efforts, New Mexico faced potential shortfalls in its delivery obligation to Texas in 2001 (<http://www.seo.state.nm.us/water-info/pecos/index.html>). The NMISC convened an ad hoc Pecos River Basin Committee to work towards a solution to the problem for 2001, and to develop alternatives to address long-term management strategies. The State Engineer warned Pecos River Basin water users that he would make a priority call for water if another solution weren't found (*Id.*). Since the waters of the Pecos River Basin are fully appropriated, increased deliveries to Texas were going to have to come from other uses in the basin. The Committee passed a resolution in January 2002 recommending that certain steps be taken for the state to acquire water rights, with the cost of the program estimated at \$6.8 million.

Water management for the Pecos bluntnose shiner

In addition to management for the irrigation districts and to meet compact deliveries, the Middle Pecos is currently managed to maintain the Pecos bluntnose shiner, a fish species that is federally-listed as a threatened species. Bluntnose shiner critical habitat includes a 103-kilometer (64-mile) reach of the Pecos River extending from a point 16 kilometers (10 miles) south of Fort Sumner downstream to the De Baca/Chaves County line and a 60-kilometer (37-mile) reach from near Hagerman to near Artesia (Service 2001a).

Reclamation has, in the recent past, carried out a supplemental water program on the Middle Pecos to benefit the shiner, which involves bypassing natural inflows to Sumner Lake. This strategy is employed to improve base flows, achieve a target flow of 35 cfs at the Near Acme gage, and prevent river intermittency (Service 2001a).

Block releases have also been managed by Reclamation to meet Carlsbad Irrigation District demand and stay within entitlement storage volumes set by the NMISC. For example, in 2001 Reclamation submitted a BA to the Service on the effects of Reclamation's proposed Pecos

River 2001 Irrigation Season Operations on the Pecos Bluntnose Shiner. In their BA, Reclamation stated that block releases over 500 cfs would be limited to 15 days, with a period of at least 2 weeks in between block releases. The BA also stated that the cumulative period of block releases would not exceed 65 days per year.

To manage for a target flow of 35 cfs at the Near Acme gage, Reclamation assumed operation of Sumner Dam in during the winter of 1998-99 (<http://www.seo.state.nm.us/publications/waterlines/wl-winter-98-99>). Since that time, Reclamation has used bypass to provide some flows in the Pecos River at the Near Acme gage. And Reclamation has made efforts to secure water through voluntary leases and forbearance agreements with owners of water rights and use of its well rights over the past few years to meet the target flow of 35 cfs at the Near Acme gage.

Details concerning the recent history of water operations stemming from consultation between Reclamation and the Service on the bluntnose shiner can be found in the Service's May 21, 2001 "Biological Opinion on Reclamation's 2001 Discretionary Actions Related to Water Management on the Pecos River, New Mexico" (Service 2001a). The impacts of shiner management are discussed in Chapter 4.

Regional Water Resources Planning

Pecos River Water Management and Operations Plan and EIS.

Reclamation and the NMISC are engaged in a multi-year process to develop modified operations at Sumner Dam to benefit the Pecos bluntnose shiner, pursue new water acquisition and management options, and assess the impacts of these activities. Models are being developed to assist in planning and impact assessment. The Plan and EIS are not expected to be completed for some time.

Lower Pecos Valley Regional Water Plan

The Pecos Valley Water Users Organization was formed under a joint powers agreement in 1995 to develop the regional water plan for New Mexico's "Lower Pecos River Basin," a 43,512 square kilometer (16,800 square mile) area covering De Baca, Chaves, and Eddy counties, as well as parts of Lincoln and Otero counties. The Plan, adopted by the Water Users Organization and accepted by the NMISC in August 2001, is a major report on water supply and projected water requirements on the Middle Pecos reach. It considers a number of alternatives and makes recommendations for meeting regional water requirements (Pecos Valley Water Users Org. 2001). (Note that here "Lower Pecos Valley" refers to the river valley in the southern part of New Mexico; this includes a large portion of the Middle Pecos River as defined in this document.)

Vegetation

The Pecos River in New Mexico extends through a surrounding matrix of Plains-Mesa Grassland in the north, and Desert Grassland and Chihuahuan Desert Scrub in the south. Along the river corridor, vegetation is characterized as floodplain-plains riparian (Dick-Peddie 1993). As in New Mexico's other river systems, riparian vegetation along the Pecos has been greatly altered by hydrological changes, and by the spread of exotic species—saltcedar in particular.

The riparian woodland community along the Pecos is not as extensive or fully developed as that which occurs along the Middle Rio Grande. Native associations along the Pecos to the north include areas dominated by Fremont cottonwood, but extensive cottonwood gallery forests do not occur. Gooding willow and other small willows may be dominant species in some locations, particularly near tributary mouths. Scattered stands of plains riparian associations are dominated by western soapberry and little walnut. Further south, thickets of floodplain vegetation may consist of such species as tornillo, skunkbush, and seep willow. Dryer areas on the river floodplain are dominated by honey mesquite, as well as some common Chihuahuan Desert species including creosotebush and four-wing saltbush. Grassy areas are dominated by saltgrass and alkali sacaton. See *Appendix D* for a list of scientific names.

In many locations native vegetation has been largely or completely replaced by saltcedar, which grows in dense stands near the river and across portions of the floodplain. Saltcedar dominance is greatest in the southern half of the study area. Saline conditions in the Pecos River drainage may give saltcedar an even greater competitive advantage over native riparian species than it has elsewhere.

Federally-listed (threatened and endangered) plant species

The Pecos sunflower, a Federally-listed endangered species, is found at three sites in Chaves County within the Middle Pecos River Valley, at Bitter Lake National Wildlife Refuge (Bitter Lake NWR), and the Dexter National Fish Hatchery. The sunflower occurs in wetland habitat created by spring-fed impoundments managed by the Service to mimic a natural hydrograph.

Fish and Wildlife

Rio Grande silvery minnow

The Rio Grande silvery minnow inhabited the Pecos River from Santa Rosa downstream to the confluence with the Rio Grande until the early 1970s (Bestgen and Platania 1991). It was most prevalent between Fort Sumner and Carlsbad, preferring slow moving water running over a sandy substrate. It was commonly found in the main channel and seasonally found in low velocity areas such as backwaters. The silvery minnow was formerly one of the most common fish species in the reach between Sumner Lake and the current site of Brantley Reservoir. It was the second most abundant species in six collections taken in this reach between 1939 and 1955.

Downstream from the Carlsbad area it is thought to have been less common, due to saline water intrusions. The silvery minnow was last collected in the Pecos River near Roswell in 1968. Its disappearance coincided with the first verified specimens of the plains minnow, a species not native to the Pecos River drainage. Competition and possibly hybridization with this closely related species may have played a role in the extirpation of the silvery minnow from the Middle Pecos, although this has not yet been confirmed (Service 1999).

Fish communities of the middle Pecos

The Pecos River supports one of the most diverse fish faunas in the Southwest. The Middle Pecos supports a warm water fish community throughout the reach being considered for critical habitat designation for the silvery minnow. There is a low predator population in the upper sections, and a low to moderate predator population in the section between Roswell and Brantley Reservoir. The fish fauna between Sumner Dam and Brantley Reservoir is currently composed of 38 species, 26 of which are native and 12 non-native (Hoagstrom *et al.* 1995). In collections carried out in the 1980s and 1990s, native species represented nearly 70 percent of the fish collected. Dominant native species are red shiner, Rio Grande shiner, and western mosquitofish. Native Pecos bluntnose shiner, sand shiner, fathead minnow, and plains killifish were also relatively common (see *Appendix D* for a list of scientific names). The most common non-natives are the plains minnow and the Arkansas River shiner (Service 1999).

Federally-listed (threatened and endangered) species

Pecos bluntnose shiner. The bluntnose shiner is endemic to the Rio Grande and Pecos River drainage basins. The Pecos River subspecies formerly occupied the river from Santa Rosa to the current site of Brantley Reservoir. It is now restricted to the segment between Sumner Dam and Brantley Reservoir. Declines in distribution and abundance over the past 50 years prompted the Service to list the bluntnose shiner as threatened with critical habitat in 1987. At that time two stretches of the Middle Pecos were designated as critical habitat: a 103-kilometer (64-mile) reach extending from south of Fort Sumner to the De Baca/Chaves County line, and a 60-kilometer (37-mile) reach from near Hagerman to near Artesia. The Pecos bluntnose shiner has since maintained its highest population density in the section of the Middle Pecos in central Chaves County, between the two designated areas of critical habitat. The shiner has been state listed as threatened by the State of New Mexico since 1976.

The upstream portion of the present range (Fort Sumner to Roswell) contains most favorable habitat conditions and supports a stable and self-sustaining shiner population. The area downstream from Roswell is less favorable, and the population in this segment is supported by the contribution of eggs and larvae from upstream areas. The Pecos bluntnose shiner favors low velocity laminar flows, and at depth from 17 to 41 centimeters (7 to 16 inches) (Hatch *et al.* 1985). Bluntnose shiner habitat consists of shallow runs with a shifting sand substrate (Hoagstrom 2000). Like the silvery minnow, the bluntnose shiner is a pelagic broadcast spawner, and uses elevated spring flows as a cue to initiate spawning. Principal reasons for its

decline are thought to be river drying and habitat alteration due to restricted flows from reservoirs and water diversions, as well as siltation and pollution from agricultural activities along the river (52 FR 5295). The bluntnose shiner continues to be dependent upon the release of water from Sumner Dam for its existence (Service 2001a).

Pecos gambusia. This species was federally-listed as endangered in 1970. A Final Recovery Plan was published by the Service in 1983. The species is also state listed as endangered. The Pecos gambusia is endemic to springs and sinkholes along the Pecos River in southeastern New Mexico and western Texas. It apparently did not regularly inhabit the Pecos River itself. Springs and gypsum sinkholes on Bitter Lake NWR, and Blue Spring outflow near Whites City, are the only areas of regular occurrence in New Mexico. In these limited areas the fish may be common to abundant.

Bald Eagle. The bald eagle is federally listed as threatened but is being proposed for delisting. Bald eagles breed only sporadically in New Mexico, but winter in moderate to substantial numbers at a number of locations in the state. The eagle may be present in the Pecos River Valley in winter, particularly in northern reaches. Aerial surveys conducted by the NMDGF from the headwaters of the Pecos River to the vicinity of Fort Sumner show an upward trend in overwintering populations in recent years. Principal threats are degradation of wintering habitat (including declines in prey and roost-site availability), environmental contamination, and illegal killing.

Interior Least Tern. The interior population of the least tern is federally listed as endangered, and state listed as threatened. Terns nest on bare sandbars and alluvial islands, and thus are strongly affected by changes in water levels and release patterns. Habitat loss from river channelization and dam construction act to eliminate potential roosting and nesting sites. The Pecos Valley lies at the southwestern periphery of the interior least tern's historic range. A small population of least terns has been using the area in and around Bitter Lake NWR for the past half century.

State-listed species and other species of concern

Pecos pupfish. The Pecos pupfish occurs irregularly in sections of the Pecos River in Chaves County, particularly favoring off-channel habitats including ephemeral pools or seeps in the river bed. It also occupies sinkholes, pools, and wetland areas in and around Bitter Lake NWR and Bottomless Lakes State Park. It has been eliminated from most of its range in Texas. The pupfish is highly tolerant of the saline conditions associated with the Middle Pecos River drainage. It is threatened largely by hybridization with the non-native sheepshead minnow, and by loss of backwater habitat and seasonal stream dewatering. The Pecos pupfish was proposed for Federal listing as endangered. The Service withdrew this proposal on March 17, 2001, because a conservation agreement for the species was adopted. The Pecos pupfish is listed by the State of New Mexico as threatened.

Arkansas River shiner. Although the Arkansas River shiner is federally-listed as threatened, the New Mexico population in the Middle Pecos River is specifically excluded from this Federal listing. Formerly widespread in plains streams of the Southwest, the Arkansas River shiner is now greatly reduced in distribution. The species was introduced into the Pecos River around 1978, and has become established across much of the Middle Pecos reach. The Arkansas River shiner is state-listed as endangered.

Mexican tetra. This species is state-listed as threatened. In New Mexico, it occurs mainly in small streams and spring systems in the Pecos River drainage, from Bitter Lake NWR downstream to the Texas border. It is rare in mainstem Pecos River habitats.

Suckermouth minnow. This species is state-listed as threatened. It is present (due to accidental introduction) in the Pecos River but is not native to the drainage.

Gray redhorse. This species is state-listed as threatened. It formerly occupied the Pecos River as far north as Roswell, but is currently present only below Brantley Reservoir.

Greenthroat darter. This species is state-listed as threatened. It is present in Middle Pecos River drainage, occupying spring-fed pools and impoundments on the Bitter Lake NWR.

Western yellow-billed cuckoo. The yellow-billed cuckoo west of the Rocky Mountains was recently added to the candidate species list for Federal listing because of serious declines throughout the region. Biologists estimate that more than 90 percent of the bird's riparian habitat has been lost or degraded. Preferred habitat includes larger stands of dense willow and cottonwood. Breeding cuckoos have been detected in riparian areas along the Pecos River, including habitat dominated by saltcedar. The cuckoo is threatened by altered flow and sediment regimes, river channelization, conversion of riparian habitat to agriculture, and the spread of exotic vegetation.

Other wildlife

As along the Middle Rio Grande, wintering waterfowl are abundant along the Middle Pecos River. Thousands of ducks, geese, and sandhill cranes are present in the winter at Bitter Lake NWR, the W.S. Huey Waterfowl Area, and adjacent wetlands and agricultural fields. Bitter Lake NWR is also a good habitat for wading birds, and for migrating gulls, terns, and shorebirds. White pelicans may be common in the spring and fall at the refuge and at Brantley Reservoir. A number of songbirds that subsist on grain and seeds winter in shrub and woodland habitat along the river.

Riparian areas along the Middle Pecos River in New Mexico, although frequently dominated by saltcedar, provide important habitat for migratory songbirds. This habitat also supports breeding populations of a number of species, including roadrunner, western kingbird, northern mockingbird, spotted towhee, blue grosbeak, mourning dove, indigo and painted

bunting, pyrrhuloxia, crissal thrasher, and cassin sparrow. A number of eastern species reach the western limit of their distributional range in the Middle Pecos River Valley. Examples include blue jay, Mississippi kite, and painted bunting. See *Appendix D* for a list of scientific names.

A number of small to medium sized mammals, such as the white-footed mouse, desert cottontail, black-tailed jackrabbit, porcupine, striped skunk, raccoon, gray fox, coyote, and mule deer, inhabit the river corridor. Yellow mud turtle and spiny softshell turtle are fairly common and widespread in the Middle Pecos River. Common lizard and snakes in the riparian zone include the side-blotched lizard, checkered whiptail, striped whiptail, western coachwhip, and gopher snake. Amphibian communities are dominated by Couch's spadefoot toad and Woodhouse toad (Hildebrandt and Ohmart 1982).

Land Use Plans and Policies

Federal. Federal land along the Pecos River is administered by the BLM and, at Bitter Lake NWR, the Service. The BLM has adopted state-wide standards for public land health, and its Roswell District is governed by a resource management plan adopted in 1997.

State. The State of New Mexico does not have either a state-wide or a regional land use plan, although, as noted earlier, the Pecos Valley Water Users Organization has prepared and adopted a Lower Pecos Valley Regional Water Plan, approved by the NMISC in August 2001.

County. All three of the counties in the Middle Pecos reach have similar land use policies, adopted by ordinance in the early 1990s. These policies are intended to guide the use of public lands and public resources, to protect the rights of private landowners, and to promote coordination and cooperation between local, state, and Federal agencies in decisions affecting the uses of public lands and resources. Federal and state agencies proposing actions that will impact the local plan are asked to prepare and submit reports on estimated impacts to the county commission. This FEIS was provided to the County Commissions of De Baca, Chaves, and Eddy Counties, in a timely manner, for review and comment.

Land Ownership and Use

Currently, about 98 percent of the watershed of the Middle Pecos River is used for grazing, the remainder for cropland and municipal development. The primary use of water along the river is diversion for irrigation. About 64 percent of the total area is privately owned, 18 percent is state owned, and 18 percent is Federally-owned or administered.

De Baca County. Approximately 6 percent of the land in De Baca County is in federal ownership, 16 percent is state-owned, and 78 percent is privately-owned (Williams 1986). The primary Federal land manager in the county is the BLM, which leases land for grazing and oil and gas. The state-owned lands are largely state trust lands, which also are leased for grazing and oil and gas.

The Fort Sumner Irrigation District is in De Baca County. The area serviced by FSID includes roughly 2,630 hectares (6,500 acres) of irrigable land. The principal crops grown include alfalfa, hay, corn, grain sorghum, wheat, vegetables, apples, and grapes. There are currently 282 farms served by FSID (L. Armstrong, letter 2001).

Chaves County. Approximately 31 percent of the land in Chaves County is in federal ownership, while 26 percent is state land. Forty-three percent of the land in the county is in private ownership (Chaves County 2001). The Bitter Lakes NWR, administered by the Service, and a substantial amount of BLM-administered land are in the county. The BLM land is primarily leased for grazing and oil and gas. The state land is primarily state trust land, which too is leased for grazing and oil and gas.

Eddy County. The area being considered as an alternative for critical habitat designation for the silvery minnow extends south about halfway into Eddy County. The designation boundary would be at Brantley Reservoir Dam which is north of the city of Carlsbad and the lands of CID. The land ownership in Eddy County as a whole is approximately 62 percent Federal, 16.5 percent state, and 20.5 private. Besides BLM-administered land, Federal lands in Eddy County include Brantley Reservoir, Carlsbad Caverns National Park south of the city of Carlsbad, national forest to the west.

Social and Economic Conditions

The three counties of the Middle Pecos River Valley potentially affected by this alternative have economies that rely more on agriculture than those of the Middle Rio Grande. Largely unsettled before the last quarter of the 19th century, they remain sparsely populated, with population concentrations in a few communities, primarily along the river corridor. Decisions affecting water use and management have region-wide impacts. Sumner Lake at the north end of the Middle Pecos, for instance, serves as storage for CID at the southern end. Groundwater pumping, particularly in the Roswell area, is generally understood to affect river flow and thus New Mexico's ability to deliver its Pecos River Compact requirement to Texas. Such interactions may have important implications for the economies of the three counties.

De Baca County

The northernmost of the counties on the Middle Pecos, and spread over 6,022 square kilometers (2,325 square miles), De Baca County's economy is based on the livestock industry. It had a population of 2,240 residents in 2000, giving it an average density of just about one person per square mile. During the decade of the 1990s, the county lost population (a half of one percent). Despite this decline, demographic projections suggest that by the year 2020 the county's population will grow by nearly 20 percent to 2,678.

In 1995, the vast majority (86 percent) of De Baca County residents received water from municipal supplies, which consist presently of groundwater withdrawals. Irrigation is the only significant use that draws from surface water (57,967 ac-ft/yr in 1995), and accounts for 76 percent of all water withdrawals for the county.

The agricultural census for 1997 documented 191 farms and ranches in De Baca County. In 1999 farmland included irrigated crops on 4,199 hectares (10,377 acres). Crop sales constituted 18 percent of the nearly \$25.2 million in sales of agricultural products, while livestock accounted for 82 percent. In 1999 crops included 2,837 hectares (7,010 acres) of alfalfa and another 405 hectares (1,000 acres) in irrigated pasture or hay. Cattle and calves were by far the top agricultural commodity, accounting for \$20 million in sales. Farm earnings in 1999 were about \$5.2 million, or 24 percent of total earnings, while full- or part-time employment in farming was 334.

In 1999 De Baca County residents had a total personal income of \$41 million, with a per capita personal income of \$17,268. This was 21 percent lower than the state average, and 40 percent below the national average. The county's average annual income growth rate over the preceding decade was 3.8 percent, which was below the average growth rate for both the state (4.5 percent) and for the nation (4.4 percent). Total earnings of persons employed in De Baca County increased from about \$12.2 million in 1989 to \$21.5 million in 1999, an average annual growth rate of 5.8 percent. The largest non-agricultural employment sectors in the county in 1999 were government (256 jobs, full- or part-time), services (177), retail trade (159), and construction (71). Farming, with 334 persons employed, was the largest employment sector.

Chaves County

Chaves lies just south of De Baca County. New Mexico's fourth largest county at 15,724 square kilometers (6,071 square miles), its economy is heavily agricultural, and it has emerged as the center of the state's dairy industry. Its population in 2000 was 61,382, giving the county an average density of just over 10 people per square mile. The county seat, Roswell, is a regional trade and service center and home to manufacturing facilities. During the 1990s, Chaves County's population grew at a rate of 6.1 percent. By the year 2020 it is expected to gain an additional 12.3 percent, growing to nearly 69,000.

In 1995, the vast majority (90 percent) of Chaves County residents received water from the municipal supply, which consists entirely of groundwater withdrawals. All other water uses (commercial, industrial, mining and livestock) also draw extensively from groundwater resources in the Roswell underground basin, including irrigation, which pumped at a rate of 294,050 ac-ft/yr in 1995. Less than 10 percent of all water used in Chaves County comes from surface water resources.

The agricultural census for 1997 documented 562 farms and ranches in Chaves County. In 1999 farmland included irrigated crops on 35,222 hectares (87,036 acres), more than two-

thirds of which were in alfalfa. Crop sales constituted 15 percent of the more than \$329 million in sales of agricultural products. Dairy products accounted for more than 43 percent of these sales. Cattle and calves were the second agricultural commodity, accounting for \$38 million in sales. Over 150 million cattle are raised annually in the county. Farm earnings in 1999 were about \$146 million, or nearly 19 percent of total earnings, while full- or part-time employment in farming was 1,618.

In 1999, Chaves County residents had a total personal income of \$1.2 billion, with a per capita personal income of \$19,356. This was 11 percent lower than the state average, and 32 percent below the national average. The county's average annual income growth rate over the preceding decade was 3.6 percent, which was below the average growth rate for both the state (4.5 percent) and for the nation (4.4 percent). Total earnings of persons employed in Chaves County increased from about \$494 million in 1989 to \$772 million in 1999, an average annual growth rate of 4.6 percent. The largest non-agricultural employment sectors in the county in 1999 were services (6,826 jobs, full- or part-time), retail trade (5,324), government (4,891), manufacturing (2,420), and construction (1,551).

Table 3-10: Pecos, New Mexico County Socioeconomic Data.

	1	2	3	4	5	6	7	8	9	10	Percentages of county population by race and Hispanic origin			
	Population 2000	Pop. change since 1990	Proj. pop. change 2000-2020	PCPI 1999	PCPI rank in State	PCPI percent of state avg.	Percentage of persons below pov	Percentage of children 5 to 17 below poverty	Food stamp reciprocity incidence	Unemployment rate 2000	White non-Hispanic only	Native American only	Other or more than one race	Hispanic all races
PECOS														
De Baca	2,240	-0.5%	20%	\$ 17,268	20	79%	22.0%	31.5%	6.6%	4.5%	62.8%	0.6%	1.2%	35.3%
Chaves	61,382	6.1%	12%	\$ 19,356	11	89%	23.1%	30.7%	11.9%	6.3%	52.1%	0.7%	3.5%	43.8%
Eddy	51,685	6.3%	26%	\$ 19,843	8	91%	18.6%	23.6%	9.8%	6.6%	57.7%	0.7%	2.8%	38.8%

Notes:

- Col.: 1. U.S. Bureau of the Census 2000.
 2. Population growth in New Mexico Counties 1990-2000. Accessed at www.edd.state.nm.us.
 3. Calculated from NM Economic Development Department, County Profiles. Accessed at: www.edd.state.nm.us/COMMUNITIES/counties.htm.
 4-6. Regional information system, Bureau of Economic Analysis. Accessed at www.bea.doc.gov/bea/regional/bearfacts.
 7-10. New Mexico Department of Labor, 2001 [June]. New Mexico Labor Market Annual Social and Economic Indicators. Accessed at www.dol.state.nm.us/api.PDF

Table 3-11: Pecos, Agricultural Data.

	1	2	3	4	5	6	7	8	9
	1999 FT/ PT Empl. In farming	Irrigated crop acres 1999	Number of farms 1997	Computed average farm size (acres)	1999 Total personal income (\$ millions)	1999 Farm income (\$ millions)	All farm commodities sold 2000 (\$ thousands)	Crops sold 2000 (\$ thousands)	Crops as a Percentage of commodities sold (computed)
PECOS									
DeBaca	334	10,377	191	54.3	\$ 41	\$ 5.2	\$ 22,338	\$ 4,558	20%
Chaves	1618	87,036	562	154.9	\$ 1,208	\$ 146.0	\$ 338,005	\$ 43,317	13%
Eddy	847	43,159	467	92.4	\$ 1,054	\$ 26.8	\$ 98,632	\$ 31,878	32%

Notes: Col.:

1. Bureau of Economic Analysis Regional Accounts Data. Accessed at www.bea.doc.gov/bea/regional/reis/ Does not include agricultural services for which some county data are unavailable.
- 2-4. NM Agricultural Statistics 2000. Accessed at www.nass.usda.gov/nm.
- 5-6. Bureau of Economic Analysis Regional Accounts Data. Accessed at www.bea.doc.gov/bea/regional/reis/.
- 7-8. NM Agricultural Statistics 2000.

Eddy County

Eddy County is the southernmost of the counties on the Middle Pecos River in New Mexico. The county's land area is 10,831 square kilometers (4,182 square miles). Eddy County's population in 2000 was 51,658 residents, an average density of 12.4 people per square mile. The county seat, Carlsbad, is home to the Waste Isolation Pilot Project, a national depository for low-level transuranic nuclear waste. Tourism (Carlsbad Caverns National Park) and potash mining also contribute to the county's economic base. During the decade of the 1990s, the county realized population growth of 6.3 percent. By the year 2020, the county's population is expected to grow by about 26 percent to 65,295.

In 1995, most Eddy County residents (93 percent) received water from the municipal supply, which consists almost entirely of groundwater withdrawals. Other water uses drawing on groundwater included mining (11,132 ac-ft/yr). Irrigation is the only significant use that draws from surface water (237,640 ac-ft/yr in 1995), and accounts for almost half of all the water used in the county.

The agricultural census for 1997 documented 467 farms and ranches in Eddy County. In 1999 farmland included irrigated crops on 43,159 acres in the Pecos Valley. Most of the county, over 90 percent of the land, is classified as rangeland. Crop sales constituted 30 percent of the nearly \$84.6 million in sales of agricultural products, while livestock accounted for 70 percent. The top agricultural commodity, accounting for over half of sales (nearly \$45.6 million), was dairy products. In 1999 irrigated crops included 25,394 acres of alfalfa and 10,000 acres of cotton. Farm earnings in 1999 were about \$26.8 million, or 3.8 percent of total earnings, while full- or part-time employment in farming was 847.

In 1999 Eddy County residents had a total personal income of \$1.1 billion, with a per capita personal income of \$19,843. This was nine percent lower than the state average, and 30 percent below the national average. The county's average annual income growth rate over the preceding decade was 3.7 percent, which was below the average growth rate for both the state (4.5 percent) and for the nation (4.4 percent). Total earnings of persons employed in Eddy County increased from about \$432 million in 1989 to \$700 million in 1999, an average annual growth rate of 4.9 percent. The largest non-agricultural employment sectors in the county in 1999 were services (6,936 jobs, full- or part-time), retail trade (4,675), government (3,595), mining (2,645), and transportation and utilities (1,813).

Indian Trust Resources

There are no issues regarding Indian trust resources in the Middle Pecos River reach.

Environmental Justice

With only 2,240 people, De Baca County is one of New Mexico's least populous counties and experienced negative growth during the 1990s. Of the counties in the region, it is the most dependent on agriculture, which accounts for 24 percent of earnings. Per capita personal earnings in 1999 were 79 percent of the state average, and the county ranked 20th among the state's 33 counties in per capita personal income, and 32nd in total personal income. De Baca County's relatively low level of unemployment (around 5 percent) is accompanied by high poverty statistics; 31.5 percent of the county's children live in poverty.

Demographically, De Baca County differs from state norms in having a high percentage of its population of retirement age (Ashcroft 2001). The percentage of persons over the age of 65 in New Mexico is 11.7 percent while the percentage in De Baca County is 27.3 percent. De Baca County also has an additional 5.8 percent within 5 years of age 65 compared to 3.9 percent statewide. An older population is possibly due to the lack of economic opportunity within the county and the increasing age of farm operators (*Id.*).

The Chaves County economy is many times larger than that of De Baca County, and less dependent on agriculture. However, the size of the agricultural sector, which accounts for 18 percent of earnings, and the labor force in that sector, nearly seven percent, suggest that impacts on low-income people and ethnic minorities, largely Hispanic, could be significant. (Non-Hispanic whites constitute only 52 percent of Chaves County's residents.) In Eddy County, where agriculture represents just 3.8 percent of total earnings, and the percentage of all persons and children in poverty is lower, it would appear that disparate impacts on low income and minority residents would be proportionally smaller.

Social and Cultural Values

Agriculture plays a larger role in the economies of De Baca and Chaves Counties than it does in the economies of the counties of the Middle Rio Grande Valley. Ranching, in particular, plays a large role in sparsely-populated De Baca County.

Cultural Resources

Cultural resources include archaeological sites, historic features, and traditional cultural properties and Native American sacred sites. For this analysis, sites have been identified that fall or may fall within the lateral boundaries of the river reaches being considered within the alternative for designation.

Archaeological sites

Archaeological sites consist of structures, scatterings of artifacts, or other physical manifestations of past human occupation. These sites may be divided into two categories. Prehistoric sites are those representing Native American presence prior to European contact. This Paleoindian period in the region began circa 12,000 BC, and contact between Spanish and Native American societies began occurring in the mid-1500s. Historic sites are those representing post-contact use or occupation of the region, from the mid-1500s up to the 1950s.

A search of the NMHPD database revealed relatively few sites along the Middle Pecos River corridor between Sumner Dam and Brantley Reservoir within the narrow confines of the area being considered for critical habitat designation. There is limited potential for preservation and subsequent location of prehistoric and older historic resources in the river floodplain. Materials not removed by floods and river scouring are buried by sedimentation.

Table 3-12: Archeological Sites on the Pecos River Within the Proposed Designation

	<u>Prehistoric</u>	<u>Historic</u>	<u>Unknown</u>	<u>Total</u>
Structural	8	4	2	14
Non-structural	8	0	3	11
Total	16	4	5	25

Traditional cultural properties and Native American sacred sites

No traditional cultural properties or Native American sacred sites have been identified on the Middle Pecos River reach.

Recreation

Santa Rosa Lake State Park lies upstream (north) of the Middle Pecos River reach. Santa Rosa Lake covers 1,538 hectares (3,800-acres) and provides a multitude of recreational activities. When water levels permit, water sports include fishing, boating, water skiing and wind surfing. Birdwatching, fossil hunting and wildlife viewing are enjoyed from the many hiking trails around the lake.

Sumner Lake is a 1,821-hectare (4,500-acre) Reclamation impoundment created by Sumner Dam, the upper boundary of the Middle Pecos River reach. Sumner Lake State Park lies sixteen miles northwest of Fort Sumner at 1,372 meters (4,500 feet) and includes 2,711 hectares (6,700 acres) of parkland. Water levels permitting, water sports include power boating, sailing,

windsurfing, and jetskiing. Fishing is popular year round. Wildlife viewing centers on migratory waterfowl. Campground facilities include both developed and primitive sites.

Bitter Lake NWR covers (23,000 acres) of mixed habitat, from Chihuahuan Desert to wetlands. The refuge extends across both sides of the Pecos River. The primary attraction is wildlife viewing, especially in winter when the refuge supports large numbers of migratory cranes and waterfowl. Hunting is also allowed in some areas. The refuge also supports rare grassland and natural springs habitats which are an attraction to some visitors.

Bottomless Lakes State Park lies adjacent to the Pecos River about 26 kilometers (16 miles) southeast of Roswell. The park includes seven small lakes formed by the collapse of underground caverns. It offers boating, fishing, and camping, and scuba diving, and there is a designated swimming beach with lifeguards. Hiking trails circle the park allowing opportunities for wildlife viewing and birdwatching.

The W.S. Huey Waterfowl Area straddles the Pecos River near Artesia. It is managed by the NMDGF and offers opportunities for viewing wintering ducks, geese, and sandhill cranes. Limited hunting (dove, quail, pheasant, and crane) is allowed.

Brantley Lake State Park is located 24 kilometers (15 miles) north of Carlsbad. Brantley Dam marks the downstream boundary of the reach of the Pecos River being considered as an alternative for critical habitat designation for the silvery minnow (with the waters of the reservoir being excluded from designation by definition). Brantley Reservoir offers recreational opportunities on its 1,619-hectare (4,000-acre) surface including year round fishing and boating. Water sports include waterskiing, jetskiing and sailing. The state park offers an additional 1,214 hectares (3,000 acres) for camping, hiking and wildlife viewing.

Chapter 4. Environmental Consequences

Introduction

This FEIS and, in particular, the analysis of impacts, poses a set of unusual if not unique challenges. Environmental impacts that may be attributable to critical habitat designation (proposed action) may be attributable at the same time to the fact that a species is listed under the Endangered Species Act (ESA), the fact that Federal agencies may be required to take conservation measures because of such listing, or the fact that other federally listed species with similar habitat needs or geographic locations may also require conservation measures.

The Tenth Circuit U.S. Court of Appeals, in a case involving critical habitat designation for the southwestern willow flycatcher, concluded that: “Congress intended that the Service conduct a full analysis of all of the economic impacts of a critical habitat designation, regardless of whether those impacts are attributable co-extensively to other causes.” New Mexico Cattle Growers Ass’n v. U.S. Fish and Wildlife Service, 248 F.3d 1277 (10th Cir. 2001). Although the Tenth Circuit’s opinion was addressed to economic analyses under the ESA, the Service has concluded that the same approach should be taken in this FEIS under NEPA.

In keeping with the Tenth Circuit’s opinion, the Service’s analysis of impacts of critical habitat designation for the silvery minnow takes a broad perspective. In a real sense, what the court has asked for is an assessment of the possible impacts of ESA section 7(a)(2), and that is largely what the Service has tried to provide. At the same time, however, it remains true that this analysis—as its title indicates—was necessitated by designation of critical habitat alone; Federal listing under the ESA itself is not subject to NEPA analysis. Thus, the Service has also tried to identify and analyze, to the greatest extent possible, those impacts that would result solely from critical habitat designation.

It is important to emphasize that the requirements placed upon this analysis—namely, to assess the impacts of designation even if such impacts are “attributable co-extensively to other causes”—may result in some of its findings being misunderstood or misinterpreted. Not all of the impacts identified in this chapter are or would be a direct consequence of critical habitat designation. The Rio Grande silvery minnow was listed as endangered in 1994, and this fact has influenced management actions on the Middle Rio Grande ever since. Changes in river management in New Mexico have also been influenced by the presence of two other federally listed species: the southwestern willow flycatcher and (on the Pecos River) the Pecos bluntnose shiner. To avoid confusion it should be kept in mind, and this will be pointed out periodically, that impacts arising from critical habitat designation can be difficult to separate from impacts arising due to listing alone.

Effects of Listing and Designation

Section 7(a)(2) is the only part of the ESA that has mandatory requirements arising from the designation of critical habitat. This section requires that Federal agencies, in consultation with the Service, ensure that the actions they carry out, fund, or authorize neither jeopardize the continued existence of a listed species nor destroy or adversely modify designated critical habitat. The following discussion outlines in general terms what may result from a species receiving protection under the provision. It may be useful to keep this relatively simple framework in mind when considering the many complex details of ESA implementation for the silvery minnow.

Compliance with section 7(a)(2) produces direct and indirect effects, and produces them in the following sequence:

- | | |
|--------------------------|--|
| Direct Effect I: | Federal agency consultation on actions proposed to be authorized, funded or carried out. |
| Direct Effect II: | Proposed Actions may be modified as a result of consultation. |
| Indirect Effects: | Environmental, social, and economic impacts of any modified actions. |

The consultation process is often referred to as “section 7 consultation.” A Federal agency must consult with the Service if the action it is considering funding, authorizing or carrying out “may affect” a listed species or its designated critical habitat. Section 7 and the regulations implementing it apply to all actions in which there is discretionary Federal involvement or control (50 CFR 402.03).

The Consultation Process

Compliance with section 7(a)(2) may involve informal or formal consultation. When a Federal agency determines that the action to be funded, authorized or carried out “may affect” listed species or its designated critical habitat, the agency will typically engage in informal consultation with the Service. Informal consultation is an optional process. The Federal agency may enter into formal consultation without first participating in informal consultation. Informal consultation is concluded when the agency determines that the action is “not likely to adversely affect” the listed species or its designated critical habitat (e.g., the effects are beneficial, insignificant, or discountable) and the Service concurs with that determination in writing. The impact of section 7(a)(2) compliance on the Federal agency in this situation would be limited to the time and expense associated with the consultation. During informal consultation, the Service may suggest modifications to the action that the Federal agency or the applicant for a Federal permit or Federal funds, if any, could implement to avoid or minimize adverse effects. In this instance, the impact of section 7(a)(2) may include the cost and effect of implementing the modifications (50 CFR 402.13). However, incorporating project modifications early in the

process so that the Service can concur with a “not likely to adversely affect” determination, would avoid the costs and increased time requirements associated with formal consultations.

If a Federal agency determines that the action is “likely to adversely affect” a listed species or designated critical habitat, then the agency must request formal consultation. This request is made in writing to the Service with a complete initiation package as defined in 50 CFR 402, often including a biological assessment. A biological assessment is required if a listed species or designated critical habitat may be present in the subject area, and major construction activity or a comparable undertaking is involved (50 CFR 402.02 and 402.12). Formal consultation concludes with the issuance of a biological opinion from the Service. The biological opinion is the document that states the opinion of the Service as to whether the action to be funded, authorized or carried out by the Federal agency is likely to jeopardize the continued existence of the listed species or result in the destruction or adverse modification of designated critical habitat (50 CFR 402.14).

When the Service determines, through the issuance of a biological opinion, that an action is likely to cause “jeopardy” to the species or “adverse modification” of the species’ critical habitat, the Service, with the assistance of the Federal agency, develops reasonable and prudent alternatives (RPAs) that may be undertaken to avoid jeopardy or adverse modification. Upon the issuance of a biological opinion with RPAs, the Federal agency determines whether and how to proceed with its proposed action. The action agency may: (1) adopt the RPAs; (2) not undertake the project (e.g. deny the permit or not fund the action); (3) request an exemption from the Endangered Species Committee; (4) reinstate consultation based on modification of the proposed action or the development of RPAs not previously considered; or (5) proceed with the action if it believes, upon review of the biological opinion, that the action will not cause jeopardy or adverse modification. The agency must notify the Service of its final decision (50 CFR 402.15). In these situations, the Federal agency and the applicant, if any, will have incurred the time and expense of consultation and modifying or canceling their action, or taking an alternative form of action.

If the Service’s opinion is that an action is not jeopardy or adverse modification, but the action may result in *take* (see *Glossary*) of a listed species, an incidental take statement (ITS) is provided in the biological opinion. The ITS anticipates the amount and form of take of a species that will occur as a result of the proposed action and is incidental to an otherwise lawful activity. When take is anticipated, the ITS may include reasonable and prudent *measures* (see *Glossary*), along with their implementing terms and conditions that are nondiscretionary actions designed to minimize the impacts of take. In these situations, the Federal agency and any applicant, will have incurred the time and expense of consultation and undertaking the any terms and conditions provided in the incidental take statement.

Effects of the Action as Modified

The indirect effects of ESA section 7 compliance include the impacts of the alternative actions developed, or modifications to proposed actions made, as a result of the consultation process. In such cases, impacts are evaluated in terms of effects resulting from the action as modified due to section 7(a)(2) requirements.

The impact of critical habitat designation on non-Federal entities is the subject of some confusion. Formal critical habitat designation only affects non-Federal parties if their actions are dependent on Federal agency funding, permitting, or other activity. A person applying for a permit from the Corps to discharge dredged or fill material into waters of the U.S. under section 404 of the Clean Water Act will be affected if the application is denied or modifications requested as a result of the Corps' consultation with the Service. Similarly, a state highway department may be affected if its construction of a highway through designated critical habitat is federally-funded. An irrigator in a reclamation project may be affected if a Federal water manager's discretionary actions are modified through consultation. On the other hand, a landowner raising livestock or building a road on private land with no Federal involvement is not affected by designation, even if the land is in the center of designated critical habitat.¹

Another subject of confusion is the meaning of "adverse modification" of designated critical habitat. Actions can have adverse effects without causing adverse modification. Adverse modification is defined in 50 CFR 402.02 as:

a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. Such alterations include, but are not limited to, alterations adversely modifying any of those physical or biological features that were the basis for determining the habitat to be critical.

Critical habitat is not the same as a wilderness designation. Many activities can be expected to take place within critical habitat without conflicting with the prohibitions found in section 7(a)(2) (Service 1998). This should be kept in mind as the impacts of the different alternatives for critical habitat are identified and analyzed in this FEIS, and in the Final Economic Analysis incorporated herein by reference.

Assumptions Used in the Analysis

For purposes of the analysis, this FEIS assumes that Federal, state, and local water managers will continue to cooperate in intensely managing the Rio Grande and the Pecos River for endangered species protection, compact compliance, and other purposes. It also assumes, for purposes of the analysis, that water managers will continue to supplement flows to meet target

¹The landowner would have an obligation not to "take" members of the species under section 9 of the ESA (see *Glossary* for the definition of "take"), but would not have to consult with the Service on designated critical habitat under section 7.

flows and that the acquisition of any necessary water will take place in the water market. These assumptions are based on the fact that, during the period 1996 - 2001, officials leased water from willing sellers to supplement flows. The assumptions are not intended to reflect the legal obligations of the various water managers, including the Bureau of Reclamation. Questions regarding the scope of Federal agency discretion in the management or delivery of water and other issues are being debated in other forums, including the courts (e.g., Minnow v. McDonald, U.S District Court for the District of New Mexico, Civ. No. 99-1230). Like the Final Economic Analysis, this analysis focuses on the economic and other consequences associated with providing certain target flows in the Rio Grande and the Pecos, and does not address the method or responsibility for acquiring this water (Industrial Economics 2003).

Alternative A - No Action Alternative

Under the No Action Alternative, the Service would forego the designation of critical habitat for the Rio Grande silvery minnow altogether. No section 7 consultations or modification of agency actions would occur under the critical habitat provisions of ESA section 7. No direct or indirect effects of designation would occur. The silvery minnow would remain a Federally listed species, however, and all ESA provisions and protections except for those pertaining to critical habitat would continue to apply.

As discussed in the Introduction to this chapter, the Service has attempted to prepare this FEIS in a manner consistent with recent court rulings. Thus, effects of listing and critical habitat designation have, in previous alternatives, been considered together as coextensive factors arising under ESA section 7(a)(2). At the same time, the Service has tried to note those situations in which possible impacts can be specifically and exclusively attributable to listing or to designation. On the Middle Rio Grande, as discussed in greatest detail in Alternative B, listing of the silvery minnow has resulted in changes to Federal agency management of Rio Grande water operations and river maintenance activities.

Under NEPA a “No Action” alternative typically describes a set of baseline conditions existing prior to or independently of the project action(s) considered. In this case, however, due to the unusual set of circumstances reviewed above, the No Action Alternative for the Middle Rio Grande shares many impacts in common with those described in Alternatives B, C, D and E, because it includes the effects of listing. Thus the following analysis focuses on the consequences of NOT designating critical habitat; listing impacts remain as discussed in previous alternatives.

Middle Rio Grande in New Mexico

(A) Impacts on Federal Agency Consultations, MRG

Under the No Action alternative, consultation will take place with regard to possible jeopardy to the species but not with regard to possible adverse modification of critical habitat. As a result, there may be fewer Federal agency consultations than could occur under some of the action alternatives. For the Middle Rio Grande, the Final Economic Analysis estimates 35 formal and 95 informal consultations occurring at the historical “baseline” rate, under a no critical habitat scenario, over the next 20 years. The Final Economic Analysis also estimates 13 additional formal and 39 additional informal consultations taking place due to critical habitat designation over the 20-year period. These additional consultations would not occur under the No Action Alternative. This would result in savings in consultation costs over 20 years on the Middle Rio Grande ranging from \$265,000 to \$599,000 over Alternative B (Industrial Economics 2003). The Service, Reclamation, and the Corps would be the principal agencies affected by this reduction.

(A) Impacts on Federal Agency Actions, MRG

A number of river management actions have been affected and will continue to be affected by the consultation process undertaken by Reclamation and the Corps, stemming from the listing of the silvery minnow and the flycatcher. These impacts will continue to be realized on the Middle Rio Grande, regardless of designation. Actions currently being undertaken to voluntarily secure supplemental water to maintain flows in downstream reaches will be unaffected by the absence of critical habitat designation. To the extent that designation would result in additional conservation measures for of the species, and increase support for the maintenance of target flows such as those specified in the Service’s 2001 Biological Opinion RPA, such additional support would be lacking under this alternative.

One possible result of designation is to focus management attention on the habitat requirements of the silvery minnow, and to increase support for habitat restoration efforts. Habitat restoration projects on the Middle Rio Grande could receive less agency support if no critical habitat is designated. Future Federal agency projects may be designed differently for a section 7 consultation process involving only the standard of jeopardy and not the standard of adverse modification. There may be less impact on proposed actions taking place in the river floodplain, within the 91.4-meter (300-foot) lateral boundary. Consequently, it may be estimated that Middle Rio Grande project modification costs will be reduced. The Final Economic Analysis estimates project modification costs at historical “baseline” levels, under a no critical habitat scenario, ranging from \$14.9 million to \$23.4 million. The Final Economic Analysis also estimates additional project modification costs ranging from \$4.5 million to \$8.1 million arising due to the proposed critical habitat designation (Industrial Economics 2003). These additional costs would not occur under the No Action Alternative; baseline costs would be maintained.

(A) Impacts on water supply and use, MRG

A decision to forego critical habitat designation would have no direct impacts on water supply and use in the Middle Rio Grande. The principal impacts of water supply and use have resulted, and will continue to result from, the listed status of the silvery minnow and the need to avoid jeopardy to the species. It is possible that habitat restoration efforts could increase or decrease net depletions. If an increase were to occur, any such increase would not occur under this alternative.

Under the No Action Alternative, the Service's 2001 Programmatic Biological Opinion and RPA would continue to guide Federal (and non-Federal) water operations on the Middle Rio Grande. Efforts would continue to be made by Federal agencies to provide supplemental water to the river in reaches that experience drying, with the cooperation of other entities such as the NMISC, MRGCD, the City of Albuquerque, and the Pueblos. In the absence of designation, the need to manage the river in a way that both meets the needs of the silvery minnow and complies with the Rio Grande Compact would continue to place demands on the water supply. Reclamation would continue to try to voluntarily lease San Juan-Chama water and supplemental water would have to be voluntarily leased or purchased (or forbearances purchased) on the "water market." A more detailed account of past and possible future sources of supplemental water, and of the amount of water required to maintain target flows needed to avoid jeopardy to the silvery minnow, can be found in Alternative B.

(A) Impacts on water rights, MRG

Existing water rights would be affected under this alternative, as under the proposed designation, to the extent that holders of such rights might, in the future, voluntarily sell or lease them to management agencies seeking to maintain river flows. As discussed in Alternative B, there would be no impact on Federal Indian water rights held by the Pueblos, which are recognized as senior to other claims to Rio Grande waters. No significant impacts on water rights are expected to result directly from designation, nor to be relieved by lack of designation as proposed in this alternative.

(A) Impacts on water quality, MRG

State and Pueblo water quality standards already limit adverse impacts on water quality across the Middle Rio Grande. In section 7 consultations on NPDES permitting, the Service may continue to recommend additional toxicity testing at times to ensure that wastewater discharges do not jeopardize the silvery minnow. These protections will continue in the absence of designation.

(A) Impacts on vegetation, MRG

In the absence of designation, there would still be considerable management activity aimed at eradicating saltcedar and restoring native vegetation along the Middle Rio Grande. Riparian restoration projects may originate and receive impetus from multiple sources, including

Federal agency conservation efforts and section 7 consultations under the ESA, and from bosque restoration initiatives outside of the context of endangered species management. It is possible however that management attention and agency funding for such projects could be slightly reduced if critical habitat is not designated.

Vegetation may be affected by changes in water operations on the river, and by direct manipulation occurring during construction, channel maintenance, or habitat restoration activities. Although Federal agencies will continue to consult to avoid jeopardy to the silvery minnow and flycatcher, lack of designation would eliminate the requirement that consultation address possible adverse modification of critical habitat. This may result in a somewhat lower level of protection (relative to the proposed designation) for riparian vegetation within the 91.4-meter (300-foot) lateral boundary of critical habitat.

In general, native vegetation in all Middle Rio Grande reaches is expected to benefit from water operations, river maintenance, and restoration activities by Federal management agencies intended to avoid the likelihood of jeopardy to the silvery minnow and the flycatcher (Service 2001b). Over time, such actions are expected to benefit multiple species by promoting the conservation of biological diversity, protecting ecological services (Altieri 1999, Falkenmark 2000), and contributing to the ecosystem health (Rapport and Whitford 1999, Rapport 2000) of the Middle Rio Grande Valley (Crawford *et al.* 1993).

One possible benefit of critical habitat designation, as opposed to listing alone, is that it may result in more consistent and long-term protections to physical and biological features essential to the future conservation and recovery of the species. If for example the silvery minnow were to become extirpated from an area of presently occupied habitat, some degree of protection would be maintained by the critical habitat designation that would not be maintained if the species were no longer present.

(A) Impacts on the Rio Grande silvery minnow, MRG

Under this alternative the silvery minnow would continue to receive protection from the jeopardy analysis during consultation and “take” prohibitions under the ESA. The species would continue to benefit from the river management, habitat restoration, and target flow provisions in the Service’s 2001 Programmatic Biological Opinion, as well as whatever similar provisions may result from future programmatic consultations regarding river management activities of Reclamation and the Corps. Failure to designate critical habitat would not preclude implementation of the Recovery Plan in the Middle Rio Grande. However, because habitat identified as being important to the conservation and survival of the species would not receive the added protections of critical habitat designation, adoption of this alternative could hinder efforts to meet the goals of the Recovery Plan.

It is possible that some areas of existing or potential silvery minnow habitat on the Middle Rio Grande may be adversely modified or destroyed as a result of Federal actions that

would have been avoided or changed as a result of critical habitat designation. There may also be some negative impacts on the silvery minnow if lack of designation results in decreased management attention, or slows efforts to restore or create more areas of suitable habitat. In that case, current river flow and channel characteristics unfavorable to the silvery minnow may be more likely to persist for a longer time and/or over a wider area. In the long term, continuing habitat protection might be more secure under the action alternatives than under this alternative.

(A) Impacts on other fish species, MRG

As described in Alternative B, efforts made on behalf of the silvery minnow to create a more natural hydrograph on the Middle Rio Grande, and to restore aquatic and riparian habitat, are likely to benefit other native fish species as well. Under this alternative, native fish species in the Middle Rio Grande would continue to benefit from water operations, river maintenance, and restoration activities by Federal management agencies intended to avoid the likelihood of jeopardy to the silvery minnow and willow flycatcher (Service 2001b).

It is possible that some areas of existing or potential silvery minnow habitat may be adversely modified or destroyed as a result of Federal actions that would have been avoided or changed as a result of designating critical habitat. This might have a negative impact on other fish species with similar habitat requirements. There may also be some negative impacts on native fish if lack of designation results in decreased management attention to the habitat requirements of the silvery minnow, or slows efforts to restore or create more areas of suitable habitat in the Middle Rio Grande.

(A) Impacts on other threatened and endangered species, MRG

Southwestern willow flycatcher

The southwestern willow flycatcher (the flycatcher) is a federally listed species, and any Federal agency actions affecting the bird or its riparian habitat would continue to require consultation. In all Middle Rio Grande reaches the flycatcher is likely to benefit from water operations, river maintenance, and restoration activities by Federal management agencies intended to avoid the likelihood of jeopardy to the species, and to the silvery minnow (Service 2001b). To the extent that critical habitat designation for the minnow might result in any additional protections to current or potential future flycatcher habitat, or may serve as an additional stimulus to riparian habitat restoration efforts in the Rio Grande bosque, the flycatcher may fail to receive some benefits under this alternative that would be present under the proposed designation.

Bald eagle, whooping crane, interior least tern, piping plover

The whooping crane, least tern, and piping plover are not likely to be significantly affected by silvery minnow listing or critical habitat designation on the Middle Rio Grande.

Thus there is little difference between this alternative and the proposed designation. In its 2001 Programmatic Biological Opinion, the Service concurred with Reclamation's determination that its proposed water operations and maintenance activities "may affect" but were "not likely to adversely affect" the eagle, crane, and tern (Service 2001b). (The same set of activities was found to be likely to jeopardize the continued existence of the silvery minnow and the flycatcher.) While the provision of target flows may conceivably have consequences that would affect these species, such impacts are not considered to be likely or severe, and only a small number of individuals would be affected.

The bald eagle may be slightly affected by water operations, river maintenance, and restoration activities such as those called for in the Service's 2001 RPA, and from critical habitat designation. Habitat protections and restoration activities may benefit the eagle by helping to conserve bosque vegetation used as roosting habitat. Water operations to benefit the silvery minnow result in changing patterns of reservoir water storage and release, which may have some impact on the species. Limited negative impacts are possible, if for example management actions alter the distribution or availability of fish or other species on which the eagles feed. Overall, however, a return to a more natural hydrograph on the Middle Rio Grande, as envisioned in the 2001 Biological Opinion, is likely to produce net benefits for the species. To the extent that designation might result in any additional protections to the cottonwood bosque, or may serve as an additional stimulus to riparian habitat restoration efforts, the eagle may fail to receive some benefits under this alternative that would be present under the proposed designation.

Western yellow-billed cuckoo, a candidate species

Because the cuckoo has habitat requirements broadly similar to those of the flycatcher, impacts on the cuckoo will be largely the same as those discussed for that species above. Although significant impacts are not expected, the cuckoo may fail to receive some benefits under this alternative that would be present under the proposed designation.

(A) Impacts on other wildlife, MRG

To the extent that this alternative results in any decreased attention to riparian habitat restoration in the Middle Rio Grande Valley, some species may fail to receive some benefits present under the proposed designation. However, as noted repeatedly, restoration efforts are expected to continue in the absence of designation. These would benefit many species in riparian areas, but some negative impacts on migratory cranes and waterfowl are possible if water needed to grow crops used as winter forage is instead used to help maintain river flows.

In all Middle Rio Grande reaches, regardless of designation, a variety of wildlife species may receive some benefit from water operations, river maintenance, and restoration activities by Federal management agencies intended to avoid the likelihood of jeopardy to the silvery minnow and willow flycatcher (Service 2001b). Over time, such actions may benefit multiple species by promoting the conservation of biological diversity, protecting ecological functions (Altieri 1999, Falkenmark 2000), and contributing to the ecosystem health (Rapport and Whitford 1999,

Rapport 2000) of the Middle Rio Grande Valley (Crawford *et al.* 1993). Wildlife species that may benefit from this management approach include reptiles and amphibians, small mammals inhabiting the riparian corridor, and a large number of migratory songbirds that use the Rio Grande bosque as breeding or migratory stopover habitat.

(A) Impacts on land ownership and use, MRG

A decision to forego critical habitat designation would result in no significant impacts on land use in the Middle Rio Grande. The need for supplemental water downstream would be the same under all alternatives, and the same acreage could potentially be voluntarily taken out of agricultural production. As described in Alternative B, impacts on land use associated with the provision of supplemental water are derived from actions undertaken to avoid jeopardy to the silvery minnow.

Under the critical habitat designation, new construction or other new development of land uses within the 300-foot lateral boundary could be affected, if there is Federal involvement. The Service is not aware of any such plans or circumstances, and based on the virtual absence of residential or commercial development within the 91.4-meter (300-foot) boundary along the Middle Rio Grande, such an impact is not considered likely. Under this alternative any such impact arising from section 7 consultation regarding critical habitat on the Middle Rio Grande would not occur. Designation is not otherwise expected to affect the land use practices of the Pueblos, or of any private parties next to the river, so no unique impacts are expected to result from a decision not to designate critical habitat.

(A) Social and economic impacts, MRG

Potential social and economic impacts associated with the listing of the silvery minnow arise largely from the efforts of Federal water managers to leave water in the river, or deliver water to specific river reaches, for the benefit of the species. As discussed in Alternative B, there may be economic and social impacts associated with acquiring water sufficient to maintain target flows for the Isleta and San Acacia reaches. These impacts include the cost of acquiring supplemental water (leased or purchased from willing parties) and the secondary social and economic impacts of retiring land from agricultural production. These impacts will remain present in this alternative, in the absence of critical habitat designation. See the discussion in Alternative B, and the Final economic analysis (Industrial Economics 2003).

Under the No Action Alternative, there would be no section 7 consultations on critical habitat associated with any commercial, agricultural, or other economic activity within the 91.4-meter (300-foot) lateral boundary of the proposed designation. Any administrative burden that might result from such consultations would not occur. However, activities in the river floodplain would continue to be subject to consultation to ensure that actions do not jeopardize the silvery minnow. Many such consultations have taken place in the past, due to the ecological relationship between the river and the adjacent riparian areas. Any social or economic impacts

resulting from consultations under the jeopardy analysis would remain in the absence of critical habitat designation.

(A) Impacts on Indian trust resources, MRG

Although significant impacts of critical habitat designation on the Pueblos and Indian trust resources are not expected, principles of tribal sovereignty and self-government may be furthered if, as under this alternative, designation does not occur. Lack of designation may have the positive effect of assuring the Pueblos that they have relative freedom to manage their own conservation and restoration efforts. On the other hand, a possible reduced focus on habitat restoration by Federal and State agencies could result in less funding for those efforts on Tribal lands.

As in the proposed designation, there should be no adverse impact on Federal Indian water rights held by the Pueblos, which are recognized as senior to other claims to Rio Grande waters. Even in the absence of designation, Pueblo water rights may be affected if the Pueblos choose to voluntarily develop a means of leasing water to Federal management agencies to provide downstream flows. Leasing of San Juan-Chama contract water by the Jicarilla Apache Nation and San Juan Pueblo has already taken place, on a voluntary basis, and may continue in the future regardless of designation.

Section 7 requirements may be seen as placing an additional administrative burden on the future development of Pueblo water rights, to the extent that such development might occur through projects with Federal agency involvement. Lack of designation would reduce this administrative burden somewhat in that future consultations would only have to address jeopardy to the species and not adverse modification of critical habitat.

(A) Environmental justice effects, MRG

Some of the Pueblos commented during the scoping process that they should not bear the burden of conservation measures to remedy problems that are not of their making. Others have commented that they should not be constrained in the development of their water rights just because they have not had the opportunity to develop them. Concerns of this nature may be reduced for those Pueblos whose lands would be excluded from designation under this alternative.

No other environmental justice concerns are expected to be relieved by lack of designation. Because of the presence of the silvery minnow in the Middle Rio Grande and the periodic need for supplemental flows to avoid jeopardy to the species, it remains possible under this alternative that the acquisition of water by sale, lease, or forbearance agreement could result in agricultural land being taken out of production. Economic and environmental justice effects associated with the voluntary acquisition and supply of supplemental water to downstream reaches are expected to remain as described in Alternative B, regardless of critical habitat designation on the Middle Rio Grande.

(A) Impacts on cultural resources, MRG

Archeological sites and historic features present in the Middle Rio Grande are discussed in Chapter 3. Without designation effects on cultural resources are still largely as described under Alternative B, and stem primarily from efforts to conserve and avoid jeopardy to the silvery minnow. Archeological sites may be impacted by deliberate overbank flooding intended to restore riparian habitat, or by uncontrolled flooding. To the extent that restoration work in the Middle Rio Grande may receive any less attention owing to lack of designation, there may be some slightly lower risk of disturbance to sites. Under this alternative, lack of any consultation requirement for critical habitat may take away some incidental added protection for archeological sites within the 91.4-meter (300-foot) lateral boundary that would be present under the proposed designation.

Some Pueblos have already embarked on extensive bosque restoration projects, including the use of overbank flooding to stimulate the growth of native vegetation. As these projects are carried out under Pueblo authority and control, no negative impacts on any known sacred or archeological sites are anticipated. The ability of the Pueblos along the Middle Rio Grande to conserve, protect, and have access to sacred sites will remain the same whether critical habitat is designated or not, such activities are not expected to affect critical habitat. (See the discussion in Alternative B for the general approach being taken with regard to cultural resources in this FEIS).

(A) Impacts on recreation, MRG

Recreational activities on or near the river are unlikely to be directly affected by critical habitat designation, and no adverse impacts would be relieved by lack of designation. The likelihood of those hypothetical negative impacts discussed under Alternative B—loss of fishing, boating, hunting, and wildlife viewing opportunities due to the effects of water operations on reservoirs and refuges—would remain the same under this alternative, and would stem from ongoing management efforts to avoid jeopardy to the silvery minnow. Any positive impacts on recreational use and enjoyment of the Rio Grande bosque that might be attributable to designation would not occur under this alternative.

Lower Rio Grande Through Big Bend National Park and Rio Grande Wild and Scenic River

Under the No Action Alternative, the Service would forego the designation of critical habitat for the Rio Grande silvery minnow in the Lower Rio Grande in Texas. No section 7 protections or provisions associated with silvery minnow critical habitat would be present in the Big Bend reach.

(A) Impacts on Federal Agency Consultations, LRG

No Federal agency would be required to consult regarding the Rio Grande silvery minnow under the critical habitat provisions of ESA section 7. The Final Economic Analysis estimates a total of 12 formal and 6 informal consultations over the next 20 years if silvery minnow critical habitat is designated in the Big Bend reach. Under the No Action Alternative, no such consultations would be required. This would result in an estimated savings in consultation costs ranging from \$188,000 to \$351,000 over Alternative E (Industrial Economics 2003). The Service, NPS, USIBWC, and EPA would be the agencies affected by this reduction.

(A) Impacts on Federal Agency Actions, LRG

In and upstream from the Park, and along the RGWSR, Federal actions would continue to be subject to existing environmental regulations. The NPS would continue to manage the river and riparian habitat within the Big Bend reach in such a way as to provide for recreation and to preserve the area's ecological character and biological diversity. Adoption of this alternative or other alternatives, does not preclude the Service from considering the Big Bend reach as a site for reintroduction of the silvery minnow, as recommended in the Recovery Plan for the species (Service 1999).

The Final Economic Analysis estimates project modification costs ranging from \$3.6 million to \$7.8 million over the next 20 years if silvery minnow critical habitat is designated in the Big Bend reach. These costs are in addition to the increased consultation costs detail above. Under the No Action Alternative, no such costs would occur (Industrial Economics 2003).

(A) Impacts on water supply and use, LRG

None of the factors currently affecting stream flow in the Big Bend reach would be influenced either positively or negatively by this alternative. No alteration of naturally occurring hydrological processes would result from a decision to forego designation. Recent reductions in river flows through the Big Bend reach may continue, depending on climatic conditions and compliance by Mexico with treaty requirements. Opportunities to conserve or improve the water resource in this reach may be reduced if, as a result of not being designated, aquatic habitat becomes impaired by actions that would have been avoided or changed through section 7 consultation had designation occurred.

(A) Impacts on water rights, LRG

A decision to forego designation would have no impact on existing water rights and management arrangements. Irrigation diversions by the Park may still be reduced under the provisions of the forthcoming General Management Plan.

(A) Impacts on water quality, LRG

A decision to forego designation of the Big Bend reach would have no direct impact on water quality. Adverse impacts on water quality resulting from recent reductions in river flow,

and from point and non-point sources upstream from the Big Bend reach in the U.S. and Mexico, would remain.

(A) Impacts on vegetation, LRG

The present status of vegetation in the Big Bend reach, including threatened and endangered species, would remain unchanged if critical habitat is not designated. It is possible that some species may suffer future declines if, as a result of not being designated, habitat in the Big Bend reach becomes impaired by actions that would have been avoided or changed through section 7 consultation had designation occurred.

(A) Impacts on the Rio Grande silvery minnow, LRG

The silvery minnow is not currently present in the Big Bend reach and would not be directly impacted by lack of designation. The Rio Grande silvery minnow recovery team stated in the Recovery Plan that it recognizes the necessity for reestablishing the silvery minnow in portions of its historic range outside of the Middle Rio Grande in New Mexico (Service 1999). Chances for the silvery minnow's eventual recovery and delisting may be reduced if, as a result of not designating critical habitat in the Park and RGWSR, these areas could become impaired by actions that would have been avoided or changed if critical habitat were designated. However, as discussed in Alternative E, relatively few Federal actions take place in this reach that could have an adverse impact on the aquatic environment.

This portion of the silvery minnow's historic range would continue to receive protections stemming from its status as a National Park and a National Wild and Scenic River. It should be noted that designation is not a prerequisite for reintroduction, and this alternative does not in any way rule out or prevent the future reestablishment of the silvery minnow in the Big Bend reach.

(A) Impacts on other fish species, LRG

The present status of Rio Grande fish species and communities in the Big Bend reach is likely to remain unchanged if critical habitat is not designated. It is possible that some species may suffer future declines if, as a result of not being designated, habitat in the Rio Grande becomes impaired by actions that would have been avoided or changed through section 7 consultation had designation occurred.

(A) Impacts on threatened and endangered species, LRG

The present status of threatened and endangered species in the Big Bend reach is likely to remain unchanged if critical habitat is not designated. No other threatened or endangered species are expected to receive significant incidental benefits from designation. The Big Bend gambusia, the only Federally listed species present within the 91.4-meter (300-foot) boundary

of proposed critical habitat, is already protected under the ESA and would not be affected by a decision not to designate.

(A) Impacts on other wildlife, LRG

The present status of other wildlife in the Big Bend reach would remain unchanged if critical habitat is not designated. It is possible that some riparian species would suffer future declines if, as a result of not being designated, habitat becomes impaired by actions that would have been avoided or changed through section 7 consultation had critical habitat been designated.

(A) Impacts on land ownership and use, LRG

A decision to forego designation would have no impact on existing land use patterns and policies in the Big Bend region.

(A) Social and economic impacts, LRG

A decision to forego designation would have no direct social or economic impacts in the Big Bend region. If reintroduction of the silvery minnow were to occur at some future date, there may be an unknown delayed cost if any additional restoration measures are required to correct habitat impairment that might have been avoided through section 7 consultation had critical habitat been designated.

(A) Impacts on Indian trust resources, LRG

No issues regarding Indian trust resources exist in the Big Bend reach. There would be no impact on Indian trust resources under this alternative.

(A) Environmental justice effects, LRG

No environmental justice issues have been identified in the Big Bend reach. No environmental justice impacts would result from this alternative.

(A) Impacts on cultural resources, LRG

A decision to forego designation would have no impact on cultural resources. No significant impacts on cultural resources are anticipated under Alternative E. Archeological sites and historic features within the Park would continue to be protected under NPS regulations.

(A) Impacts on recreation, LRG

Recreational use of the Park and RGWSR would be largely unaffected by this alternative. The NPS will continue to exercise authority over recreational use of the river, and to maintain a

permitting process that places limits on the size and number of private and commercial river rafting trips through the Park and RGWSR. Opportunities to enjoy and appreciate some wildlife species, and the physical and ecological character of the Rio Grande, might be lessened if these resources become impaired by actions that might have been avoided or changed through section 7 consultation had critical habitat been designated.

Pecos River from Sumner Dam to Brantley Reservoir

(A) Impacts on Federal Agency Consultations, Pecos

Under the No Action alternative, consultations will continue to take place with regard to jeopardy and adverse modification of critical habitat for the Pecos bluntnose shiner. No consultations regarding critical habitat for silvery minnow would occur. Based on a doubling of the historical consultation rate for the Pecos bluntnose shiner, the Final Economic Analysis estimates 22 formal and 82 informal consultations associated with the silvery minnow, over the next 20 years, if critical habitat were designated. These consultations would not occur under the No Action Alternative. This would result in estimated savings in consultation costs over 20 years on the Pecos River ranging from \$773,000 to \$2 million over Alternative E (Industrial Economics 2003). The Service, Reclamation, and the Corps would be the principal agencies affected by this reduction.

(A) Impacts on Federal Agency Actions, Pecos

The need to avoid jeopardy to the Pecos bluntnose shiner and adverse modification of critical habitat designated for that species will continue to affect a number of Federal agency actions associated with water operations, river channel maintenance, flood control, and habitat restoration on the Pecos River. Under this alternative, the river will likely continue to be subject to management practices similar or identical to those established in recent years to benefit the shiner. Any impacts on agency actions associated with such operations will still be present. In this alternative, these impacts will be exclusively the result of management for the Pecos bluntnose shiner, and would not be associated with silvery minnow critical habitat. Adoption of this alternative or one of the other alternatives does not preclude the Service from considering the Middle Pecos River as a site for reintroduction of the silvery minnow, as recommended in the Recovery Plan for the species (Service 1999).

The Final Economic Analysis estimates project modification costs associated with silvery minnow critical habitat designation on the Pecos River ranging from \$11.6 million to \$19.4 million (Industrial Economics 2003). It should be noted that costs were associated with actions that may benefit both the Pecos bluntnose shiner and the silvery minnow. Under the No Action Alternative there would be no project modification costs associated with or attributable to silvery minnow critical habitat. Project modification costs stemming from actions undertaken to avoid jeopardy to the shiner, or avoid adverse modification of critical habitat designated for that species, would remain.

(A) Impacts on water supply and use, Pecos

The need to obtain additional water to meet minimum flow requirements for the shiner will continue as before. No additional water will be required to manage for silvery minnow critical habitat. Reintroduction of the silvery minnow into the Pecos reach at some future time remains an option under this alternative. Any additional water requirements associated with or following from such an action are beyond the scope of this analysis.

(A) Impacts on water rights, Pecos

This alternative will have no effect on water rights on the Pecos River. Any efforts to voluntarily provide and/or acquire rights to water sufficient to maintain target flows for the Pecos bluntnose shiner are expected to continue, and would not be affected by lack of designation.

(A) Impacts on water quality, Pecos

The No Action alternative will have no effect on water quality in the Pecos River. All existing water quality protections present under Federal and Miles regulations, and by virtue of the listed status of the Pecos bluntnose shiner, will remain in place.

(A) Impacts on vegetation, Pecos

No direct impacts on riparian habitat or plant communities would result from this alternative. The river management regime instituted to protect and conserve the Pecos bluntnose shiner would remain in place. Some impacts of Pecos bluntnose shiner management on vegetation are discussed under Alternative E, and would be identical under this alternative.

A decision to forego designation of critical habitat on the Pecos may possibly result in a lower level of management attention and resources being devoted to saltcedar eradication and riparian habitat restoration. Thus native vegetation may fail to receive some benefits that might be present with designation of critical habitat in this reach. It is also possible that in some locations, riparian vegetation may be adversely impacted by Federal agency actions that would have been avoided or changed, through section 7 consultation, had critical habitat been designated.

(A) Impacts on the Rio Grande silvery minnow, Pecos

No direct impacts on the Rio Grande silvery minnow would result from this alternative. A decision to forego designation would not preclude eventual reintroduction of the silvery minnow in the Pecos River. However, chances for the silvery minnow's eventual recovery and delisting might be reduced if habitat in the Pecos River becomes impaired by actions that would have been avoided or changed if critical habitat was designated in this reach. The Service has stated in the Recovery Plan that the silvery minnow cannot persist unless additional populations

are established outside of the Middle Rio Grande, and has named the Middle Pecos reach as a site that may be suitable for reintroduction (Service 1999).

(A) Impacts on other fish species, Pecos

Lack of designation would result in no adverse impacts on Pecos River fish species or fish communities. Fish species occupying the river channel may benefit from efforts to maintain target flows for the Pecos bluntnose shiner. These benefits would be maintained, as would benefits attributable to existing designated critical habitat for the shiner. Any additional protections to river habitat that might have resulted from silvery minnow critical habitat designation would not be realized.

(A) Impacts on other threatened and endangered species, Pecos

Pecos bluntnose shiner

No direct impacts on the Pecos bluntnose shiner are anticipated under this alternative. The shiner has benefitted and will continue to benefit from consultation requirements and management actions stemming from its status as a federally listed (threatened) species, and from designated critical habitat. These benefits would continue in the absence of critical habitat designation for the silvery minnow. Under this alternative, the shiner would fail to benefit from any potential increased management attention to conserving or restoring river habitat that might result from designation as proposed in Alternative E.

Bald eagle, interior least tern

Neither of these threatened or endangered species are likely to be significantly affected by a decision to forego designation, as proposed under this alternative.

Western yellow-billed cuckoo, a candidate species

No direct impacts are anticipated. The cuckoo would fail to benefit from any additional attention to riparian habitat conservation and restoration that might result from designation. The cuckoo may lose existing or potential habitat if riparian areas become adversely impacted by Federal agency actions that would have been avoided or mitigated, had silvery minnow critical habitat been designated.

(A) Impacts on other wildlife, Pecos

No significant effects on wildlife would result from a decision to forego designation on the Pecos River. Riparian species would fail to receive any benefits attributable to designation that would result under Alternative E. Some loss of habitat may occur due to Federal agency actions that would have been avoided or changed if critical habitat was designated in this reach.

Any impacts on wildlife that may result from efforts to provide supplemental water for the Pecos bluntnose shiner would still be present under this alternative.

(A) Impacts on land use, Pecos

A decision to forego designation would have no direct impacts on land use along the Pecos River. The need to avoid jeopardy to the Pecos bluntnose shiner would continue to require target flows as specified by the Service. Providing such flows could result in agricultural land voluntarily being taken out of production, as described in Alternative E. Under this alternative management of silvery minnow critical habitat would play no role in any such impact.

(A) Social and economic impacts, Pecos

In accordance with the Final Economic Analysis, Alternative E describes the potential economic impact in the Middle Pecos River Valley based on the reallocation of water from irrigation to instream flow to benefit the silvery minnow. Costs of the existing and ongoing reallocation to benefit the Pecos bluntnose shiner are not separately considered, and are beyond the scope of this document. Under the No Action Alternative, all social and economic impacts associated exclusively with maintaining critical habitat for the silvery minnow on the Pecos River would be reduced to zero. Any social and economic impacts that might in the future result from reintroduction of the silvery minnow into the Pecos River are speculative and beyond the scope of this analysis.

(A) Impacts on Indian trust resources, Pecos

No Indian trust resource issues exist in Pecos reach. Lack of designation will have no impact on Indian trust resources.

(A) Environmental justice effects, Pecos

The potential environmental justice impacts discussed in Alternative E, and attributed to silvery minnow critical habitat designation in keeping with the Final Economic Analysis, would not occur under this alternative. Any environmental justice effects associated with the provision of river flows to benefit the Pecos bluntnose shiner would still be present, but are beyond the scope of this document.

(A) Impacts on cultural resources, Pecos

No impacts on cultural resources would result from a decision to forego designation. Any impacts on cultural resources associated with the provision of river flows to benefit Pecos bluntnose shiner would still be present, but are beyond the scope of this document.

(A) Impacts on recreation, Pecos

No direct impacts on recreational opportunities or facilities in the Middle Pecos River Valley are anticipated. Possible negative impacts on recreational opportunities resulting from low lake levels at Sumner Lake due to water deliveries to the CID, Pecos River Compact deliveries, or the provision of target flows to benefit the Pecos bluntnose shiner would still be present, but are beyond the scope of this document.

Summary of Adverse Effects of Alternative A - No Action

On the Middle Rio Grande, it is important to note that current practices regarding the provision of supplemental water to achieve target flows in the Isleta and San Acacia reaches are not expected to change due to critical habitat designation, or to be affected by a decision to forego designation as proposed in this alternative. These practices were instituted by the Service to avoid jeopardy to the silvery minnow, through programmatic consultation with Reclamation and the Corps, in the absence of critical habitat designation. A management regime as outlined in the Service's 2001 Programmatic Biological Opinion and RPA, or one similar, is expected to be maintained for as long as necessary to avoid jeopardy to the silvery minnow. Impacts of such a regime are summarized in Alternative B.

The principal unique adverse effect of the No Action Alternative is that aquatic and riparian habitat would not be accorded the increased level of protection that designation may provide. On the Middle Rio Grande, consultation would still be required due to the presence and federally listed status of the silvery minnow, but adverse modification of critical habitat would not have to be considered. It is possible that some Federal actions could be affected differently by the consultation process under this alternative than the proposed designation. In addition, Federal agencies and others will not have designation to help them prioritize or guide their efforts to restore the river corridor, and less attention may be paid to river and riparian habitat restoration projects. On the Big Bend and Pecos reaches, adverse effects associated with this alternative are the lost opportunities to grant extra protections to habitat that may be important to the survival and recovery of the silvery minnow.

Comparing Short-Term Uses and Long-Term Productivity

In the short term, management of the Middle Rio Grande will continue to be guided by the Service's 2001 Programmatic Biological Opinion and RPA, regardless of critical habitat designation. In the future, depending on the outcome of ongoing ESA Work Group and URGWOP studies, future programmatic section 7 consultation by Reclamation and the Corps would likely result in a comparable set of management recommendations due to the ongoing need to avoid jeopardy to the silvery minnow. Social and economic impacts of such actions in the Middle Rio Grande Valley would not be relieved by the adoption of this alternative.

Short-term commitments of resources, in the form of Federal agency and third party expenses associated with the section 7 consultation process, would be reduced under this (No Action) alternative because impacts on critical habitat would not have to be considered. In the

long term, designation may also provide some added degree of consistency to habitat protection, regardless of the potentially changing biological status of the species; this benefit likewise would not be present. For these reasons, in the long run this alternative may result in a somewhat lower likelihood that habitat essential for the conservation and recovery of the silvery minnow will be conserved.

Irreversible and Irretrievable Commitments of Resources

This alternative would forego critical habitat designation in the last remaining occupied portion of the silvery minnow's historical range, the Middle Rio Grande. Under recent and historical river management practices, the Rio Grande in the Isleta and San Acacia reaches has experienced drying and the formation of isolated pools, particularly in years of below-average precipitation. The river channel has been highly modified by water depletions from agricultural and municipal use, dams and water diversion structures, bank stabilization, and the infrastructure for water delivery (e.g., irrigation ditches). These modifications have led to the loss of sediment, channel drying, separation of the river from the floodplain, and changes in river dynamics and resulting channel morphology. To the extent such practices are continued, it may become increasingly difficult to restore the natural functioning of the river and to create more favorable conditions for the silvery minnow. Designation could add support to restoration and other management efforts aimed at maintaining viable aquatic habitat and silvery minnow populations in the Middle Rio Grande. Lack of designation may have the opposite effect. Extirpation of the silvery minnow from the Middle Rio Grande would mean the extinction of the species in the wild, and would be an irreversible and irretrievable loss of a biological resource.

Other irreversible and irretrievable commitments of resources on the Middle Rio Grande are those associated with the listing of the silvery minnow, and would, under this alternative, be the same as the proposed designation. Possible irretrievable commitments in counties such as Socorro or De Baca would be the loss of the farming-related businesses, and agricultural way of life, that could be a consequence of the voluntary purchase, lease, or forbearance agreement used by entities trying to keep water in the river for endangered species protection and compact delivery requirements.

On the Big Bend and Pecos reaches, lack of designation may result in some lower degree of protection for potential silvery minnow habitat than would be present under Alternative E. However, because of other existing protections in these reaches, lack of critical habitat designation is not seen as resulting in any irreversible or irretrievable loss of any resource.

Cumulative Effects

“Cumulative impact” is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of the agency or person undertaking the actions (40 CFR 1508.7). The set of cumulative effects impacting the environment on the Middle Rio Grande, and influencing

management decisions and practices regarding the river and its floodplain, are summarized in Alternative B. These include the effects of past and present water operations and river management practices referred to throughout this document; delivery obligations under the Rio Grande Compact; population growth and consequent changes in water management in urban centers such as Albuquerque; the status of water rights held by the Pueblos and others; and the listed status of the flycatcher. Cumulative effects on the Pecos River include delivery obligations under the Pecos River Compact and the listed status—with designated critical habitat—of the Pecos bluntnose shiner. Cumulative effects in the Big Bend reach include recent changes in water quality and stream flows due to drought and to activities on the Rio Conchos watershed in Mexico. All of these effects on current or potential future habitat for the silvery minnow will be present, regardless of critical habitat designation.

Reintroduction of the Rio Grande silvery minnow to the lower Big Bend and/or middle Pecos reaches is a foreseeable future impact on the environment from this and alternatives C, D, and E analyzed in the FEIS. Such an action would be in accordance with the recommendations of the Recovery Plan, which calls for the reestablishment of self-sustaining populations of the Rio Grande silvery minnow in at least three reaches of suitable habitat outside of the Middle Rio Grande Valley. The Recovery Plan concludes that reestablishment potential is “good” in the Big Bend and Pecos reaches, although the possible role of the plains minnow in the extirpation of the silvery minnow in the Pecos is still being studied (Service 1999). Reintroduction remains a possibility under this and other alternatives. Designation does not automatically result in, favor, or establish a timetable for reintroduction.

This FEIS does not provide detailed analysis for the reintroduction of the silvery minnow because any future recovery efforts, including repatriation of the species to areas of its historic range using the authorities of section 10(j) of the ESA must be conducted in accordance with NEPA and the ESA. For example, in order to establish an experimental population, the Service must issue a proposed regulation and receive public comment on the proposal prior to publishing a final regulation. In addition, they would need to comply with NEPA. Also, the Service’s regulations require that, to the extent practicable, a regulation issued under section 10(j) of the Act, represents an agreement between the Service, the affected Miles and Federal agencies, and persons holding any interest in land that may be affected by the establishment of the experimental population (see 50 CFR §17.81 (d)). Therefore, the Service believes a more detailed analysis is not possible until a proposal to reestablish populations of the Rio Grande silvery minnow in unoccupied areas of its historic range is developed. At that time, the Service will comply with NEPA and the ESA.

Alternative B - The Middle Rio Grande from Cochiti Dam to Elephant Butte Dam, including the lower Jemez River

Under this alternative, the Middle Rio Grande, from Cochiti Reservoir downstream to the Elephant Butte Reservoir Dam, in Sandoval, Bernalillo, Valencia, and Socorro Counties, New Mexico would be designated as critical habitat for the silvery minnow. The stream reaches in the

Middle Rio Grande include: (a) Jemez Canyon Reach— 8 kilometers (5 miles) of river immediately downstream of Jemez Canyon Reservoir to the confluence of the Rio Grande; (b) Cochiti Dam to Angostura Diversion Dam (Cochiti Reach)—34 kilometers (21 miles) of river immediately downstream of Cochiti Reservoir to the Angostura Diversion Dam; (c) Angostura Diversion Dam to Isleta Diversion Dam (Angostura Reach)—61 kilometers (38 miles) of river immediately downstream of the Angostura Diversion Dam to the Isleta Diversion Dam; (d) Isleta Diversion Dam to San Acacia Diversion Dam (Isleta Reach)—90 kilometers (56 miles) of river immediately downstream of the Isleta Diversion Dam to the San Acacia Diversion Dam; and (e) San Acacia Diversion Dam to the Elephant Butte Reservoir Dam (San Acacia Reach)—147 kilometers (92 miles) of river immediately downstream of the San Acacia Diversion Dam to the Elephant Butte Reservoir Dam.

In each reach, proposed critical habitat includes the stream channels within the reach and the area within the reach that is included within the existing levees, or if no levees are present, then within a lateral distance of 91.4 m (300 ft) on each side of the stream width at bankfull discharge. Bankfull discharge is the flow at which water begins to leave the channel and move into the floodplain (Rosgen 1996).

Designation as proposed in this alternative would not include the ephemeral or perennial irrigation canals and ditches outside of natural stream channels, including the Low Flow Conveyance Channel (LFCC), which is adjacent to a portion of the stream reach within the Middle Rio Grande downstream of the southern boundary of Bosque del Apache NWR to Elephant Butte Reservoir.

Certain lands located within the exterior boundaries of the proposed critical habitat designation (i.e., within the existing levees, or if no levees are present, then within a lateral distance of 91.4 m (300 ft) on each side of the stream width at bankfull discharge), are not considered critical habitat and are therefore excluded by definition. These include: developed flood control facilities, existing paved roads, bridges, parking lots, dikes, levees, diversion structures, railroad tracks, railroad trestles, water diversion and irrigation canals outside of natural stream channels, the low flow conveyance channel, active gravel pits, cultivated agricultural land, and residential, commercial, and industrial developments. (Service 2003).

(B) Impacts on Federal Agency Consultations

Designation of critical habitat requires that Federal agencies consult with the Service to ensure that any actions that they fund, authorize, or carry out do not destroy or adversely modify critical habitat. To determine what Federal actions may be affected by the designation of critical habitat, the Service:

- reviewed the consultations that have taken place between Federal agencies and the Service since 1994, when the silvery minnow was listed as endangered;
- assumed that similar consultations will take place over the next 10-20 years;
- assumed that consultation specifically related to critical habitat will increase; and

- adjusted its assumptions based on any foreseeable Federal actions that may differ from those of the recent past.

Since 1994, consultations have taken place during periods in which critical habitat was proposed (before July 1999), while critical habitat was designated (July 1999 - March 2001), and after designation ceased to be in effect (April 2001- present). Most consultations that have occurred since listing have included consideration of actual or proposed silvery minnow critical habitat.

A range of activities funded, authorized, or carried out by Federal agencies have the potential to destroy or adversely modify critical habitat of the silvery minnow on the Middle Rio Grande. In its proposed rule, the Service listed a number of agency activities that will likely be reviewed under section 7 of the ESA. These included, but were not limited to:

1. Significantly and detrimentally altering the river flow or the natural flow regime of any of the designated stream segments. Possible actions would include groundwater pumping, impoundment, and water diversion with a Federal nexus (i.e., activities that are authorized, funded, or carried out by a Federal agency). Flow reductions that result from actions affecting tributaries of the designated stream reaches may also destroy or adversely modify critical habitat.

2. Significantly and detrimentally altering the characteristics of the 91.4-meter (300-foot) lateral width (e.g., parts of the floodplain). Possible actions with a Federal nexus could include vegetation manipulation, timber harvest, road construction and maintenance, prescribed fire, livestock grazing, powerline or pipeline construction and repair, mining, and urban and suburban development.

3. Significantly and detrimentally altering the channel morphology (e.g., depth, velocity, etc.) of any of the stream segments listed above. Possible actions with a Federal nexus would include channelization, impoundment, road and bridge construction, reduction of available floodplain, removal of gravel or floodplain terrace materials, reduction in stream flow, and excessive sedimentation from mining, livestock grazing, road construction, timber harvest, off-road vehicle use, and other watershed and floodplain disturbances.

4. Significantly and detrimentally altering the water quality in any of the designated stream segments. Possible actions with a Federal nexus would include release of chemical or biological pollutants into the surface water or connected groundwater at a point source or by dispersed release (non-point).

5. Introducing, spreading, or augmenting non-native aquatic species in any of the designated stream segments. Possible actions with a Federal nexus would include fish stocking for sport, aesthetics, biological control, or other purposes; use of live bait fish; aquaculture; and interbasin water transfers.

Not all of these activities are necessarily of current concern for the Middle Rio Grande, but they indicate the potential types of actions that may require consultation in the future. A summary of the major types of consultations anticipated, and the agencies affected, is presented in **Table 4-1**. The Service stated in the proposed rule that it did not expect that the designation of critical habitat on the Middle Rio Grande would result in an additional regulatory burden above that already in place due to the presence of the listed species. However, the Service does anticipate a possible increase in section 7 consultations from actions proposed in areas that are contained within the lateral boundaries of critical habitat (Service 2002).

Table 4-1: Summary of Consultations on the Middle Rio Grande, New Mexico

Current or Future Activities	Federal Agency	Anticipated Effects on Silvery Minnow?	Potential Changes to Projects ?
Fish Stocking	Service	Yes	No
Water Operations - Dam Releases & Supplemental Water	Reclamation, Corps	Yes	Yes
River Channel Maintenance	Reclamation	Yes	Yes
Habitat Restoration	Reclamation, Corps, Service	Yes	Yes
Flood Control / Levee Maintenance	Corps, Reclamation	Yes	Yes
Wastewater Discharge Permit Issuance	EPA	Yes	No
Construction Projects, Including Bridges	Reclamation, Corps	Yes	No
Silvery Minnow Rescue and Operation Plans	Service	Yes	No
Land Management Activities	BLM, Reclamation	Yes	No
Dredge & Fill Permitting	Corps	Yes	Yes

The economic analysis prepared by Industrial Economics quantifies, for all affected Federal agencies, total consultation activity likely to occur over a twenty year period under two scenarios. Under the “baseline” scenario, consultation is expected to continue, in the absence of critical habitat designation, at the historical rate established for each agency from 1994 to 2001. It is important to note that much of this historical consultation constituting the “baseline” has included consideration of critical habitat.

From 1992 - 2001, at least 13 formal consultations and 36 informal consultations have taken place on the Middle Rio Grande between Federal agencies and the Service since 1994. Formal consultations have involved the Service, Reclamation, the Corps, and EPA. Other additional Federal agencies, such as the Federal Energy Regulatory Commission (FERC) and the Federal Highway Administration (FHWA) have engaged with the Service in informal consultations regarding the silvery minnow (**Table 4-2**).

The Final Economic Analysis also quantifies the increase in Federal agency consultations, “above baseline”, that would be expected if critical habitat is designated on the Middle Rio Grande as proposed in this Alternative. To estimate the changes in consultation patterns that may occur in the future after critical habitat is designated, efforts were made to interview staff at Federal agencies with knowledge of upcoming agency activities and the critical habitat consultation process (Industrial Economics 2003). For agencies with a substantial consultation history, such as Reclamation or the Corps, projections were also made based on that history. Two Federal agencies that have not consulted regarding the silvery minnow in the past—the Federal Emergency Management Agency (FEMA) and the BIA—may engage in section 7 consultations on the Middle Rio Grande over the next 20 years (*Id.*).

Table 4-2: Total historical, expected baseline, and expected above-baseline consultations, by Federal agency (Industrial Economics 2003).

Agency	Total Consultations, 1994 - 2001	Total Consultations Expected at Historical Baseline Level, 20 yrs.	Estimated Additional Consultations if Critical Habitat is Designated, 20 yrs.
Service	3 formal, 8 informal	8 formal, 20 informal	4 formal, 10 informal
Reclamation	6 formal, 14 informal	15 formal, 35 informal	5 formal, 9 informal
Corps	4 formal, 7 informal	10 formal, 18 informal	3 formal, 5 informal
EPA	1 formal, 5 informal	3 formal, 13 informal	0 formal, 0 informal
FERC	0 formal, 1 informal	0 formal, 3 informal	0 formal, 0 informal
FHWA	0 formal, 1 informal	0 formal, 3 informal	0 formal, 0 informal
FEMA	0 formal, 0 informal	0 formal, 0 informal	1 formal, 4 informal
BIA	0 formal, 0 informal	0 formal, 0 informal	0 formal, 6 informal

1) Internal Service Consultations

The Service is required to carry out section 7 consultation at an intra-agency level, to ensure that its own activities do not jeopardize any federally listed species or adversely modify critical habitat. Since 1994 on the Middle Rio Grande, the Service has conducted intra-agency consultations on fish stocking programs, habitat management at Bosque del Apache NWR, and emergency rescue operations to save stranded Rio Grande silvery minnows.

The NMDGF, with funding from the Service's Division of Federal Aid, maintains a fish stocking program to support sport fisheries in the state. Fish are commonly stocked in recreational reservoirs such as Cochiti Reservoir. The stocked fish are generally non-native species, such as walleye, largemouth bass, and rainbow trout. The Service evaluates the potential of the stocking programs to affect endangered species through competition or predation. So far, consultations have resulted in findings that stocking operations were not likely to adversely affect the silvery minnow, since the stocked fish were prevented by Cochiti Dam from moving downstream and/or conditions in the river would not support the stocked fish (e.g., Cons.#2-22-95-I-308). Similar consultations will likely continue to take place, with similar results expected. The designation of critical habitat is not likely to cause an increase in the number or scope of these consultations.

The Service also engages in intra-Service consultations when it performs emergency rescue and relocation operations to save silvery minnows stranded in isolated pools. These operations have taken place in the Isleta and San Acacia reaches of the Middle Rio Grande. Although a rescue operation may result in the take of some minnows, the activity is considered to benefit the overall viability of the species. For example, consultation on rescue operations in the summer of 1999 (Cons.#2-22-99-E-398) resulted in concurrence with initial findings that the project was likely to adversely affect the silvery minnow, but was not likely to jeopardize the continued existence of the species. The Service also concurred with an initial finding of no effect on proposed silvery minnow critical habitat. Similar consultations (with like results) have taken place in other years as well. Rescue and relocation efforts will continue to be consulted upon. The designation of critical habitat is not likely to cause an increase in the number or scope of these consultations.

The Service's Bosque del Apache NWR engages in intra-Service consultations on actions that may affect listed species or their habitat. For example, the refuge consulted on a project to replace invasive saltcedar with native vegetation (Cons.#2-22-98-I-082). Saltcedar was targeted for removal because it has low habitat value, is a high water-use invasive species, and anchors the river bank, causing increased channelization. This project included diversion of water from the LFCC for habitat restoration. Consultation in this case resulted in concurrence with an initial finding of "may affect, not likely to adversely affect" the silvery minnow, and a determination that the project would not destroy or adversely modify critical habitat. Consultations of this nature will likely continue, but probably not increase in number or complexity if critical habitat is designated. Removal of saltcedar and reestablishment of native vegetation is likely to continue to be encouraged.

Intra-Service consultations on these and perhaps other programs are expected to continue. The Final Economic Analysis estimates that, at current baseline levels, the Service will engage in 8 formal and 20 informal intra-agency consultations regarding the silvery minnow on the Middle Rio Grande over the next 20 years. The analysis also estimates an additional 4 formal and 10 informal intra-Service consultations on the Middle Rio Grande over the next 20 years (Industrial Economics 2003). This increase is expected because, "as efforts to rehabilitate the silvery minnow continue, rescue/relocation efforts may intensify;" however, the increased

consultations “are not likely to be directly associated with the designation of critical habitat” (*Id.*). Estimated costs to the Federal government of the Service’s expected baseline and above-baseline consultations are shown in *Appendix A*.

2) Reclamation Consultations

Reclamation has consulted with the Service more than any other Federal agency, and its activities on the Middle Rio Grande are affected by section 7 consultation requirements. Reclamation has also undertaken actions benefitting threatened and endangered species, including the silvery minnow, under section 7 (a)(1) of the ESA. Reclamation engages in section 7 consultation with the Service regarding discretionary actions associated with the operation, maintenance, and/or oversight of its projects and facilities on the Middle Rio Grande and its upper basin tributaries. These projects include the San Luis Valley Project-Closed Basin Division, the San Juan-Chama Project, and the Middle Rio Grande Project (Reclamation and Corps 2001).

Section 7 consultation over individual components of Federal water operations on the Middle Rio Grande began in 1995, and Reclamation and the Corps completed joint formal consultations with the Service during the 1996 (Cons.#2-22-96-F-422) and 1997 (Cons.#2-22-97-F-300) irrigation seasons. The 1996 consultation resulted in a determination that the silvery minnow would not be adversely affected; in 1997 the Service concluded that the continued existence of the silvery minnow would not be jeopardized. In both cases, the Service expressed the opinion that the actions would not destroy or adversely modify proposed critical habitat.

In December 1997, Reclamation and the Corps notified the Service of their intent to initiate a programmatic consultation that would encompass both water operations and river maintenance activities, and reduce the logistical bottleneck imposed by having to carry out separate consultations on individual projects (Reclamation and Corps 2001). Programmatic biological assessments were submitted jointly to the Service in May 1998 and October 1999. After the Corps withdrew from the joint programmatic consultation in 2000, Reclamation submitted an updated biological assessment in January 2001. The Service responded with a draft biological opinion in February 2001 (Cons.#2-22-01-F-137). Subsequent pursuit of a settlement agreement among Reclamation, the Corps, the State of New Mexico, and the Service in the Minnow v. McDonald litigation led to the joint transmittal by Reclamation and the Corps of the June 8, 2001 “Programmatic Biological Assessment of Bureau of Reclamation’s Discretionary Actions Related to Water Management, U.S. Army Corps of Engineers Water-Operation Rules, and Related Non-Federal Actions on the Middle Rio Grande, New Mexico” (Reclamation and Corps 2001). This BA constituted a new request for formal consultation (Cons.#2-22-01-F-431), to which the Service responded with its June 29, 2001 Programmatic Biological Opinion (Service 2001b).

In the 2001 Programmatic Biological Opinion the Service stated its opinion that the combined Federal actions, as proposed, would likely jeopardize the continued existence of the

silvery minnow and flycatcher. The Service also proposed a “single reasonable and prudent alternative” (2001 RPA) consisting of a number of elements. Critical habitat was not designated when the Service issued its Programmatic Biological Opinion, and was not addressed in that document. The Programmatic Biological Opinion represented the culmination of Reclamation’s and the Corps’ programmatic consultation process to date, and states the Service’s position regarding proposed water operations and river maintenance actions for a project period extending from June 30, 2001 to December 31, 2003.

Over the past four years, while engaged in programmatic consultation, Reclamation has also carried out separate, project-specific consultations with the Service regarding activities not fully addressed through the programmatic process. Examples of such projects include habitat restoration at Santa Ana Pueblo (Cons.#2-22-98-I-168), construction of a temporary channel for sediment delivery to Elephant Butte Reservoir (Cons.#2-22-97-I-053), and the Elephant Butte/Caballo Reservoirs Resource Management Plan (Cons.#2-22-00-I-016).

In the broadest terms, Reclamation’s historical and ongoing consultations regarding the silvery minnow and the flycatcher may be divided into two categories: water operations and river maintenance. Both of these traditional domains of Reclamation activity have themselves been reshaped, in recent years, by policies favoring the integration of water resource management and environmental conservation (Reclamation and Corps 2001). On the Middle Rio Grande these changes have come about at least in part through Reclamation’s history of section 7 consultations with the Service, and its pursuit of section 7(a)(1) conservation recommendations. Additional impetus for modification of Reclamation activities has come from other efforts to restore and revitalize the Rio Grande bosque, such as those of the Bosque Improvement Group (see Chapter 3, *Regional Water Resources Planning*).

As a result of these modifications, many actions on which Reclamation consults with the Service today are different than they were ten years ago. Historically, for example, Reclamation’s river maintenance activities on the Middle Rio Grande focused largely on actions intended to stabilize the river channel, provide water for irrigation, and ensure the efficient transport of water to Elephant Butte Reservoir. Past activities resulted in a river that is heavily channelized, disconnected from its floodplain, and dewatered in certain segments—especially during dry years (Crawford *et al.* 1993; Service 1999). While traditional goals and methods remain important, Reclamation has recently stated a new set of objectives for its Middle Rio Grande Project river restoration and maintenance program. These include efforts to “rehabilitate the ecological health of the river and floodplain system” and to “protect and improve endangered species and their habitats” (Reclamation and Corps 2001). Various habitat enhancement projects are being developed and implemented for the Middle Rio Grande, in accordance with the Service’s 2001 BO RPA. These include a variety of techniques such as terrace and overbank lowering, bank destabilization and channel widening, placement of woody debris snags to provide instream habitat, increasing the sand load to areas where the channel is degrading, and the restoration of native riparian vegetation and habitat (*Id.*).

Programmatic consultation also reflects a shift in emphasis in water operations. To help conserve the silvery minnow and the flycatcher, Reclamation has developed a program to provide supplemental water to the Middle Rio Grande in coordination with other Federal agencies, State entities, and private parties (Reclamation 2001b). The main components of Reclamation's supplemental water program are: 1) leasing water from willing sellers during the irrigation season; 2) strategic water operations—in coordination with MRGCD, the Corps, and the State of New Mexico—designed to benefit the silvery minnow and the flycatcher during the pre-spring runoff, runoff, and post-runoff periods; and 3) pumping from the LFCC in the lower reaches of the Middle Rio Grande (Reclamation and Corps 2001). Some of these activities are discussed further in *Impacts on Federal Agency Actions* and *Impacts on Water Supply and Use*, below.

One foreseeable Reclamation action that will require section 7 consultation is the proposed realignment of the LFCC and the Rio Grande below San Marcial. Goals of this project are to improve conveyance of water to Elephant Butte, maintain effective valley drainage, manage sediment, and protect and promote the riverine and riparian ecosystems (Reclamation 2000). Reclamation issued a DEIS on this project in July of 2000, and is reviewing comments and considering alternatives.

In sum, virtually all of Reclamation's activities in the Middle Rio Grande may affect the minnow and its critical habitat, and both informal and formal section 7 consultations have taken place and will continue. It is expected that Reclamation consultations will either be maintained at current levels or will increase slightly if critical habitat is designated on the Middle Rio Grande. Effects of Reclamation activities on proposed or designated critical habitat have been addressed in past consultations, but critical habitat was previously defined as extending only to the river bank. An increase in the number and/or scope of consultations may occur if designation as proposed in this alternative—including an area extending either to the levee or 91.4 meters (300 feet) from either side of the river—widens the range of possible impacts of Reclamation activities on silvery minnow critical habitat.

The Final Economic Analysis, incorporated into this FEIS by reference, estimates that, at current baseline levels, Reclamation will engage in 15 formal and 35 informal consultations regarding Middle Rio Grande activities over the next 20 years. The analysis also estimates an additional 5 formal and 9 informal consultations with the Service because of critical habitat designation on the Middle Rio Grande over the next 20 years. This projected increase assumes that the agency will engage in formal consultation with the Service on an annual basis (Industrial Economics 2003). Estimated costs of baseline and above-baseline consultations are shown in *Appendix A*.

3) Corps Consultations

The Corps operates Jemez Canyon Dam, Abiquiu Dam, and Cochiti Dam, and constructs and maintains other flood control structures on the Middle Rio Grande. Since 1995, the Corps has entered into section 7 consultation with the Service regarding its water operations, flood control and levee maintenance, bridge construction, and section 404 permitting activities. Through this process, Corps projects have been modified to minimize and avoid impacts to the silvery minnow and the flycatcher. The history of the Corps' joint consultations with Reclamation on Middle Rio Grande water operations was outlined above. Review of this history and other Corps consultations provides an overview of the kinds of actions on which the Corps will likely continue to consult in the future.

As noted, a recent programmatic consultation (Cons.#2-22-01-F-431) has taken place regarding the Corps' operation of flood control facilities to manage spring runoff and summer thunderstorm runoff. This consultation has also addressed the timing and manner in which the Corps carries out winter releases of floodwaters from Abiquiu and Cochiti Reservoirs. The consultation process has resulted in guidelines by which the Corps may carry out these operations in a manner that is consistent with Rio Grande Compact compliance and the ESA (Reclamation and Corps 2001; Service 2001b).

The Corps consults independently with the Service on specific issues regarding the operation of its flood and sediment control facilities. For example, in 2000 the Corps consulted regarding a proposed partial evacuation of the sediment pool at Jemez Canyon Reservoir (Cons.#2-22-00-I-474). The Service concurred with the Corps' determination of "may affect, not likely to adversely affect" with regard to the silvery minnow, southwestern willow flycatcher, and bald eagle, and with the determination of no effect on designated critical habitat for the silvery minnow. Similar determinations were reached during consultations regarding winter releases of storage water from Abiquiu Reservoir (Cons.#2-22-96-I-011) and a project for increasing the channel capacity of the Rio Grande downstream of Cochiti and Jemez Canyon Dams (Cons.#2-22-96-I-144).

In 1992, the Corps initiated consultation with the Service on the rehabilitation of the Corrales levee system (Cons.#2-22-92-I-373). Formal consultation for that project concluded with the Service issuing a biological opinion stating that the proposed action would not jeopardize the continued existence of the bald eagle, silvery minnow, or flycatcher, and would not adversely modify proposed critical habitat for the silvery minnow. A subsequent mitigation plan, involving the creation of backwater channels to benefit the silvery minnow, was also accepted.

The Corps has also consulted on proposals to reconstruct levees along the river in the Isleta reach (Cons.# 2-22-95-F-158) and the San Acacia reach (Cons.#2-22-95-F-180). (These reaches are also known as the Belen and Socorro Divisions, respectively, in Corps terminology). In both of these cases the Corps prepared biological assessments. In both cases the Service

issued draft biological opinions expressing the Service's opinion that the projects as proposed would likely jeopardize the continued existence of the Rio Grande silvery minnow and the flycatcher, and result in destruction and adverse modification of proposed critical habitat for the silvery minnow. When issuing the draft opinions, the Service also proposed "reasonable and prudent alternatives." In both consultations, one RPA provided by the Service was that the projects be suspended until a comprehensive flood control project was developed for the entire Middle Rio Grande, from Cochiti Reservoir to Elephant Butte Reservoir. Discussions with the Service continue.

The Corps also carries out bridge construction and repair. Formal consultation over the Montañño Bridge project in Albuquerque (Cons.#2-22-95-I-001) resulted in the Service concurring with the Corps' findings that the proposed action, including approved mitigation measures, was not likely to adversely affect the silvery minnow, southwestern willow flycatcher, and bald eagle. Through consultation in that case, a set of protective measures was developed to minimize the negative impacts of bridge construction on the silvery minnow. Monitoring was conducted to gain information that may be useful in reducing future adverse impacts of construction projects.

The Corps is responsible for issuing permits under section 404 of the CWA, which regulates the placement of dredged and fill materials in waters of the United States. The Albuquerque Metropolitan Area Flood Control Authority (AMAFCA) and the Southern Sandoval County Arroyo Flood Control Authority (SSCAFCA) are examples of entities whose section 404 permits may be subject to section 7 consultation between the Corps and the Service. The one such consultation to date was a review by the Service of an application by the SSCAFCA for a section 404 permit to use excavated material to fill depressions in an outfall channel to the river, and to do other maintenance (Cons.#2-22-98-I-121). This review was made under the Fish and Wildlife Coordination Act rather than a Section 7 consultation.

In the future, the Corps will likely continue to engage in programmatic and project-specific consultations regarding its normal flood control activities, and regarding specific levee rehabilitation projects, other construction projects, and section 404 permit applications. It is expected that consultations will either be maintained at current levels or may increase if critical habitat is designated on the Middle Rio Grande. An increase in the number and/or scope of consultations may occur if designation as proposed in this alternative—including an area extending to the levees or 91.4 meters (300 feet) from either side of the river—widens the range of possible impacts of Corps activities on silvery minnow critical habitat.

The Final Economic Analysis estimates that, at current baseline levels, the Corps will engage in 10 formal and 18 informal consultations on the Middle Rio Grande over the next 20 years. The analysis also estimates an additional 3 formal and 5 informal consultations with the Service because of critical habitat designation for the silvery minnow (Industrial Economics 2003). Estimated costs of baseline and above-baseline consultations are shown in *Appendix A*.

4) EPA Consultations

The EPA is responsible under the CWA for issuing National Pollution Discharge Elimination System (NPDES) permits to entities that discharge pollutants into U.S. waters. Permit applicants include municipalities with wastewater treatment facilities that discharge into the rivers. During consultation, the Service evaluates the NPDES permit applications to ensure that federally listed species will not be adversely affected, and that downstream aquatic habitats will not be degraded by a particular discharge scheme. In 2001, EPA consultations for reissuance of NPDES permits for the Village of Los Lunas Wastewater Treatment Facility (Cons.#2-22-01-I-197) and the Socorro Municipal Wastewater Treatment Facility (Cons.#2-22-01-I-196) resulted in Service concurrence with EPA determinations that the reissuances “may affect, but are not likely to adversely affect,” the silvery minnow. In both cases, the Service concluded that the effluent water quality meets State standards, and would not measurably alter stream morphology, flow patterns, temperatures, water chemistry or silt loads. Formal consultation was not required.

Toxic effects of various chemicals on the silvery minnow have not been determined. Toxicity testing has been done on a related species, the fathead minnow, and toxicity levels considered safe for the fathead minnow have generally been considered safe for the silvery minnow for purposes of NPDES permit issuance (D. Hamilton, EPA, pers. comm. 2001). The Service sometimes recommends further toxicity testing during the course of consultation. For example, it was recommended that an NPDES permit applicant in Albuquerque conduct standard larval fathead minnow toxicity tests due to concerns regarding different forms of chromium that might be present in the discharge (Cons.#2-22-I-97-205).

Both informal and formal EPA consultations can be expected in the future, on both permit renewals and permit issuances. The City of Albuquerque, AMAFCA, the University of New Mexico, and the New Mexico State Highway and Transportation Department have a joint application pending for an MS4 permit, a special NPDES permit for stormwater discharge into the Rio Grande. EPA is consulting with the Service now on that application.

The Final Economic Analysis estimates that, at current baseline levels, EPA will engage in 3 formal and 13 informal consultations on the Middle Rio Grande over the next 20 years. The analysis states that EPA staff anticipate no increase in baseline consultation rates, so no additional formal or informal consultations with the Service are expected because of critical habitat designation (Industrial Economics 2003). Estimated costs of the expected baseline consultations are shown in *Appendix A*.

5) FERC Consultations

FERC is an independent regulatory agency within the Department of Energy that regulates and supervises various aspects of the energy markets within the United States, including various aspects of the markets in natural gas, oil and electricity. Consultations with

the Service on activities in the Middle Rio Grande have been minimal so far, confined to a single consultation on a permit application by Enron/Transwestern Pipeline Company to replace a damaged section of natural gas pipeline that crossed the river near Belen (Cons.#2-22-95-I-364). The Service concurred with the applicant's determination that the project was not likely to adversely impact the silvery minnow, provided that certain conservation measures were implemented. The Service recommended that construction in the river channel be limited to a 30 day period and that the channel be monitored for silvery minnows before and after construction. Effects on proposed critical habitat were not addressed.

Similar consultations may take place at infrequent intervals in the future. The Final Economic Analysis estimates that, at current baseline levels, FERC will engage in 0 formal and 3 informal consultations on the Middle Rio Grande over the next 20 years. The analysis also estimates no additional formal or informal consultations with the Service because of critical habitat designation (Industrial Economics 2003). Estimated costs of baseline and above-baseline consultations are shown in *Appendix A*.

6) FHWA Consultations

The Federal Highway Administration, part of the U.S. Department of Transportation (DOT), provides Federal assistance to states to construct and improve highways, roads, and bridges. In New Mexico, FHWA is involved in various bridge and road construction projects, in coordination with the New Mexico State Highway and Transportation Department. Since 1994, FHWA has been involved in one joint Federal/State consultation regarding effects of a road and bridge improvement project on the silvery minnow (Cons.#2-22-96-I-297). In that 1997 project, the Service concurred with the New Mexico agency's determination that there would be no effect on the silvery minnow, because the species did not occur in the immediate vicinity of the project area (the Cochiti Dam spillway bridge), and because adequate measures were specified to protect downstream water quality.

Similar consultations may take place at infrequent intervals in the future on the Middle Rio Grande. Bridge and highway construction projects often involve the use of heavy equipment and cause ground disturbance. Projects occurring on or near the river may require modification to avoid adverse impacts on the silvery minnow and on critical habitat. For example, the Service may make recommendations regarding the time of year the action occurs, to avoid disturbances during silvery minnow spawning season. Consultation may also result in precautions to avoid the accidental spill of toxic petrochemicals either into the water or on lands adjacent to the river. The Service may also make recommendations to minimize siltation and direct disturbance of the river channel.

The Final Economic Analysis estimates that, at current baseline levels, DOT will engage in 0 formal and 3 informal consultations on the Middle Rio Grande over the next 20 years. The analysis estimates no additional formal or informal consultations with the Service because of

critical habitat designation for the silvery minnow (Industrial Economics 2003). Estimated costs of baseline consultations are shown in *Appendix A*.

7) FEMA Consultations

The Federal Emergency Management Agency administers an emergency management program to both protect the national infrastructure and prepare for response to emergencies. An important component of FEMA is the National Flood Insurance Program, which enables communities that enforce floodplain management ordinances to receive federally-backed flood insurance available (<http://www.fema.gov>).

In a January 2001 lawsuit in New Mexico, FEMA was charged with violating the ESA by issuing insurance that could result in impacts on federally listed species without consulting with the Service. As a result of this and other recent lawsuits, FEMA now plans to consult with the Service on its flood insurance program. This increase in FEMA consultation is occurring independently of critical habitat designation. In New Mexico a programmatic consultation on all endangered riverine species is presently underway. In a personal communication with Industrial Economics, FEMA staff stated that disaster relief efforts are unlikely on New Mexico rivers (Cons.#2-22-01-I-217).

There is no baseline for FEMA consultations. The Final Economic Analysis estimates that one formal and 4 informal consultations with the Service because of critical habitat designation for the silvery minnow (Industrial Economics 2003). Estimated costs of the above-baseline consultations are shown in *Appendix A*.

8) BIA Consultations

To date, the Bureau of Indian Affairs has not consulted with the Service regarding activities affecting the Rio Grande silvery minnow. However, if the Pueblos along the Rio Grande were to use funds from the BIA to undertake an action in the riparian area, or to require BIA approval, section 7 consultation may become necessary. Pueblo river restoration activities will be increasing along the river, and some BIA consultations may result. Consultations (jeopardy analysis) will be required even in areas that are subject to independent Pueblo management plans, and excluded from critical habitat designation.

Additionally, as tribes become involved in water leasing or trading, future consultation with the Service is likely to occur, although consultations so far have originated with Reclamation rather than the BIA. (Reclamation consulted in 2001 on leases with the Jicarilla Apache Nation and San Juan Pueblo for San Juan-Chama water.) Tribal participation in the water market is likely to benefit the Rio Grande silvery minnow, and consultations are likely to remain informal.

There is no baseline for BIA consultations. The Final Economic Analysis estimates 0 formal and 6 informal consultation with the Service because of critical habitat designation on the Middle Rio Grande over the next 20 years (Industrial Economics 2003). Estimated costs of baseline and above-baseline consultations are shown in Appendix A.

(B) Impacts on Federal Agency Actions

Federal agencies are affected by the obligation to engage in section 7 consultation with the Service, and agency actions could be affected by the outcome of the consultation process. In many cases, such impacts are minimal and consist of voluntary agency compliance—in carrying out the proposed action—with guidelines or conservation recommendations issued by the Service during consultation. Several examples of such outcomes were provided in the sections on agency consultations, above.

More significant impacts on agency actions may occur when formal consultation results in the issuance of a biological opinion by the Service. If, through consultation, the Service determines that a proposed action is likely to result in jeopardy to a listed species, or destruction or adverse modification of critical habitat, then an agency may proceed with the action in accordance with the RPAs and RPMs as detailed in the BO. It should be noted that consultations cannot result in biological opinions that require actions that are outside an action agency's legal authority and jurisdiction, and any RPAs must be economically, and technologically feasible for the action agency.

To predict the impacts of silvery minnow critical habitat designation on Federal agency actions on the Middle Rio Grande, it is useful to examine both the history of section 7 consultations since 1994 and the language of the proposed rule designating critical habitat. The present analysis concentrates primarily on those types of actions that have been, and will continue to be, of primary concern on the Middle Rio Grande: those affecting river flows and the condition of the river channel.

The Proposed Rule

In the preamble of the proposed rule published in the Federal Register, the Service makes explicit important points regarding what designation of critical habitat will mean to Federal agencies on the Middle Rio Grande, and how the Service will approach agency consultations involving critical habitat. Because agency actions may be impacted by the consultation process, statements from the Service regarding its management goals and objectives for the silvery minnow and critical habitat are highly relevant to the discussion of future impacts.

Regarding the management of river flows, the Service states its belief that it is possible to manage the Middle Rio Grande in such a way as to avoid prolonged periods of low or no flow, and to provide sufficient flowing water during critical time periods for the silvery minnow. These goals were successfully achieved in 2001 through intensive monitoring and management

of river flows in conjunction with target flow guidelines provided by the Service in its 2001 BO RPA. At the same time, however, the Service recognized that some areas within the proposed critical habitat unit on the Middle Rio Grande have the potential for periods of low or no flow under certain conditions. Areas subject to low or no flow were included within the proposed critical habitat designation, and considered essential for the conservation of the silvery minnow because they likely serve as connecting corridors for fish movements between areas of sufficient flowing water. They are also considered to be essential for natural channel geomorphology to maintain or re-create habitat, by removing or redistributing sediment during high flow events (Service 2002).

The extent to which critical habitat designation may require changes to agency actions will be decided on a case-by-case basis, through section 7 consultation. In its proposed rule the Service states that these consultations will evaluate whether any Federal discretionary actions destroy or adversely modify critical habitat to the extent that the action appreciably diminishes the value of the critical habitat for the survival and recovery of the species. The adverse modification analysis will likely evaluate whether the adverse effect of prolonged periods of low or no flow is of sufficient magnitude (e.g., length of river) and duration that it would appreciably diminish the value of the critical habitat unit for the survival and recovery of the silvery minnow. For example, the effect of prolonged periods of low or no flow on habitat quality (e.g., depth of pools, water temperature, pool size, etc.) and the extent of fish mortality is related to the duration of the event (Bestgen and Platania 1991).

It is important to recognize this difference between adverse effects and a determination of adverse modification. In a system in which biological and hydrological conditions are highly variable through space and time, adverse effects may occur in localized areas for limited times without adverse modification of critical habitat (as could be the case with limited low or no river flow). In the preamble to the proposed rule, the Service states that adverse effects on primary constituent elements or segments of critical habitat likely would not result in an adverse modification determination unless that loss, when added to the environmental baseline, is likely to appreciably diminish the capability of the critical habitat unit to satisfy essential requirements of the species. In other words, activities that may destroy or adversely modify critical habitat include those that alter the primary constituent elements to such an extent that the value of the critical habitat unit for both the survival and recovery of the silvery minnow is appreciably reduced (Service 2002; 50 CFR 402.02).

Recent Impacts of Section 7 Consultation on Agency Actions

The principal agency actions that have been impacted by consultation regarding the silvery minnow have been, and will continue to be, water operations and river management actions undertaken by Reclamation and the Corps. Resolutions reached from year to year have varied depending on the specific set of conditions: the extent of spring runoff, timing and magnitude of summer thunderstorms, status of the silvery minnow population in the stream, and other factors. Environmental conditions will continue to vary, and it is not possible to pre-judge

the results of future consultations, or to say how past consultations might have been different had critical habitat been designated with the primary constituent elements as proposed in this alternative. Despite these uncertainties, however, some likely future impacts on agency actions can be inferred from the results of the programmatic consultation by Reclamation and the Corps in 2001.

The programmatic consultation culminated in the Service's 2001 Programmatic Biological Opinion, which covers a period extending through the end of 2003. The Programmatic Biological Opinion addresses actions proposed by Reclamation and the Corps in their June 8, 2001, Biological Assessment regarding water operations and river management activities, including actions intended to protect and improve the status of the silvery minnow and the flycatcher.

In the 2001 Programmatic Biological Opinion the Service determined that the agencies' proposed actions were likely to jeopardize the continued existence of the silvery minnow and the flycatcher and outlined a "single reasonable and prudent alternative" (the 2001 RPA) that contained several elements, including the following:

Target Flow Requirements

- Provide river flow from Cochiti Dam to Elephant Butte Reservoir from October 31 to April 30 each year.
- Provide a one-time increase in flow (spawning spike), if needed, between April 15 and June 15
- Provide 50 cfs at the San Marcial Floodway gage from May 1 to June 15 of each year
- Ramp down flows over San Acacia Diversion Dam from June 16 to July 1 to achieve 50 cfs over the diversion dam
- Provide a minimum of 50 cfs over San Acacia Diversion Dam between July 1 and October 31.
- Provide year-round river flow from Cochiti Dam to below Isleta Diversion Dam. Flows will not drop below 100 cfs below Isleta Diversion Dam.

Pumping from the LFCC

An integral part of the 2001 RPA is the requirement that water be pumped from the LFCC back to the Rio Grande. Reclamation pumps the LFCC to prevent river intermittency and initiates pumping 24 hours prior to a recession in flows. Reclamation estimates that pumping in the year 2002 and beyond will cost \$1.2 million a year (J. Gould, Reclamation, memorandum 2002).

Habitat/Ecosystem Restoration Projects

In the RPA, the Service identified restoration projects and river channel modifications that are important to reestablishing a healthy aquatic habitat for the minnow. These include:

- Increasing backwaters and oxbows
- Widening the river channel
- Lowering the riverbanks to produce shallow water habitats and overbank flooding
- Regenerating stands of cottonwoods and willows
- Monitoring the effectiveness of individual restoration projects
- Initiating procedures to provide for fish passage at the San Acacia Diversion Dam

In adopting the 2001 RPA, the Service found that the actions described in it would avoid the likelihood of jeopardizing the continued existence of the silvery minnow and the flycatcher (Service 2001b). The Service also believes that the types of actions and the management approach taken are the types of action and the type of approach that will promote more viable habitat while avoiding destruction or adverse modification of critical habitat for the silvery minnow (Service 2002). In the preamble to the proposed rule designating critical habitat, the Service states that “we do not anticipate that the amount of supplemental instream flow, provided by past consultations (e.g. Service 2001a, 2001b), will increase because an area is designated as critical habitat” (Service 2002). See also the primary constituent elements being proposed in the current rulemaking, also stated in Chapter 2 of this FEIS.

Captive Propagation

The 2001 RPA directs Reclamation and the Corps to contribute funding for captive propagation activities, intended to augment existing captive populations of silvery minnows and facilitate repopulating the upper reaches of the river (Service 2001b). Seven facilities have been involved in the captive propagation of silvery minnows. They are the Service’s Dexter and Mora National Fish Hatcheries and Technology Centers, the Service’s New Mexico Fishery Resources Office, the City of Albuquerque Biological Park, New Mexico State University, New Mexico Game and Fish Rock Lake State Fish Hatcher, and the USGS Biological Resources Division Yankton Lab. In October 2001, it was estimated that 101,250 silvery minnows were being raised in captive propagation facilities (J. Brooks, memorandum to ESA Work Group, 2001).

A larger refugium for rearing and breeding is planned for construction in Albuquerque in the spring and summer of 2002 (Water Line, Winter 2001). This facility will consist of indoor holding aquariums and research areas. It will also include an outdoor breeding pond and a supplemental rearing pond. The facility will be designed to produce up to 25,000 silvery minnows per year for reintroduction into the wild (*Id.*). An additional 25,000 fish will be kept as breeding stock in the facility. This program will be funded by the NMISC, and the City of Albuquerque.

A commentator asked during scoping whether captive rearing operations could serve as an alternative to critical habitat designation. The ESA does not provide this option; it directs the Service to designate critical habitat to the maximum extent prudent. It also expresses the intent that the ESA “provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved” (16 USC 1531(b)). According to the Service’s “Policy Regarding Controlled Propagation of Species Listed under the Endangered Species Act” (65 FR 56916), adopted in September 2000, controlled propagation has a supportive role in the recovery of some listed species, but is not a substitute for addressing factors responsible for a species’ decline. The Service’s first priority is to recover wild populations in their natural habitat wherever possible (64 FR 56916).

(B) Impacts on water supply and use

Target Flows

Beginning in 1996, the action agencies on the Rio Grande, in consultation with the Service, have been supplementing flows in the Rio Grande for the silvery minnow during the irrigation season. Reclamation, in particular, has been voluntarily leasing water or obtaining waivers from San Juan-Chama contractors, as well as using unallocated San Juan-Chama water, to obtain desired flows. With the cooperation of MRGCD, Reclamation has exchanged San Juan-Chama water, which is intended for use in the Rio Grande Basin in New Mexico, for native Rio Grande water, which can be used to meet compact deliveries to Texas. That is, MRGCD has diverted the San Juan-Chama water for irrigation and left native Rio Grande water in the river to provide flows past San Acacia Diversion Dam. Supplemental water was delivered to San Acacia during the years 1996 to 1999 in the following amounts (Balleau 1999):

1996	49,547 ac-ft
1997	13,736 ac-ft
1998	47,333 ac-ft
1999	58,000 ac-ft

In November 1999, a coalition of environmental groups brought suit in U.S. District Court for the District of New Mexico against Reclamation and the Corps for failure to comply with the ESA in the Middle Rio Grande (Minnow v. Martinez, Civ. No. 99-1230 JP/KBM-ACE). In the spring of 2000, in response to much lower-than-average spring runoff, the plaintiffs moved to compel Reclamation and the Corps to maintain flows to prevent the river from drying. As a result of court-ordered mediation, Reclamation, through voluntary leases and repayment agreements, and in cooperation with other entities, provided 168,000 ac-ft of water to the river for the silvery minnow and for irrigation purposes during the year 2000. Most of the water was stored San Juan-Chama water, and much of this water was provided by the City of Albuquerque from storage in Abiquiu Reservoir. All of the water was provided to and diverted by the MRGCD, which in turn left native Rio Grande waters in the river to maintain flows in the San Acacia reach. Critical habitat was first designated in July of 1999, with different constituent

elements. Because of the settlement resulting from court-ordered mediation in 2000, it is not clear how much designation of critical habitat, as opposed to the fact that the silvery minnow was a Federally listed species arguably in danger of extinction, played a role in the amount of supplemental water provided that year.

Except for water consumed by vegetation or open water evaporation, the water that Reclamation and others provided to the river was delivered to Elephant Butte. At least partially as a result of these supplemental flows, New Mexico realized a credit of 100,100 ac-ft toward its delivery obligations to Texas under the Rio Grande Compact. This brought New Mexico's accrued credit to 270,800 ac-ft. The credit formed the basis for an agreement in early 2001, whereby the Corps would seek to capture and store in Abiquiu and Jemez Canyon Reservoirs up to 103,000 ac-ft of native Rio Grande water that would otherwise be delivered to Elephant Butte for compact purposes.

This agreement, the "Conservation Water Agreement," called for storage of up to 103,000 ac-ft of native Rio Grande water and release of up to 30,000 ac-ft of this water annually for three years to augment flows for the silvery minnow. Any amount of "conservation water" not used one year could be carried over to the next. During the 2001 irrigation season, approximately 56,000 ac-ft were stored pursuant to the agreement and 26,000 ac-ft were used. This left approximately 30,000 ac-ft in storage for the year 2002. To what extent water can be captured in storage and made available for use in 2003, the last year of the agreement, depends on runoff and the weather. Use of "conservation water" in either year is contingent upon the Texas Compact Commissioner not withdrawing Texas' consent to the agreement, which he reserved the right to do.

In addition to the conservation water provided in 2001, Reclamation voluntarily leased 11,000 ac-ft from San Juan-Chama contractors and had 2,990 ac-ft of unallocated San Juan-Chama water available to provide supplemental water to the river. For the year 2002, Reclamation leased 10,160 ac-ft and again had 2,990 ac-ft of unallocated San Juan-Chama water available.

With the short time frame allowed for developing a proposed rule and the required economic analysis and EIS, the Service and its contractors used historical gage readings at San Acacia and San Marcial to estimate the amount of supplemental water that may be needed to meet the flow targets outlined in the 2001 Programmatic Biological Opinion and RPA (see *Target Flows* in the preceding section of this FEIS).² As noted earlier, the Service believes those

²Two multi-year projects, with sizable technical teams undertaking biological and hydrologic studies and refining their modeling capabilities, are underway to examine water operations on the Middle Rio Grande in light of the ESA. See Chapter 3, *Regional Water Resource Planning*. Both URGWOP and the ESA Work Group plan to produce NEPA compliance documents in 2 - 3 years.

The model, URGWOM, was not available for inclusion as an analyses in this EIS. Were it to become

flow targets outlined in the June 2001 BO reflect the types of flows that it believes would be maintained for critical habitat designation (Service 2002).

By comparing daily gage readings with the flows desired, and tabulating the daily water deficits, a hydrologist was able to calculate the historic annual river flow deficit below the flows desired for silvery minnow critical habitat. As explained in the Final Economic Analysis, it is estimated that 40,427 ac-ft of water per year would be needed to supplement flows at San Acacia to achieve target flows in 95 percent of all years, or 19 out of 20 years (Industrial Economics, Appendix B, 2002).

While the Service does not anticipate that supplemental flows beyond those established through past consultations will be required once critical habitat is designated, it remains possible that flow requirements will change (increase or decrease) in the future due to new information, or to changes in the distribution and/or biological status of the silvery minnow. It is also possible, though not foreseen, that such changes could result in a situation in which the standard of adverse modification (as applied to critical habitat) could require additional supplemental flows in some locations than those necessary by virtue of the listed status (jeopardy standard) of the species. It is not possible to predict if, when, or where such a circumstance might arise, or to what extent critical habitat designation might ever require flows in excess of those needed to avoid jeopardy.

Sources of Water to Meet Target Flows

San Juan-Chama water. In the past several years, Reclamation, with the cooperation of MRGCD and other agencies, has been able to lease or obtain contract waivers for the use of San Juan-Chama water, including San Juan-Chama water in storage, to supplement flows in the Rio Grande. See *Water Resources* in Chapter 3 of this FEIS for a list of San Juan-Chama contracts.

San Juan-Chama water that had been in storage was depleted in 2000, and most contractors are taking delivery of their water allocations at the present time. Two major past providers of contract water, the City of Albuquerque (48,200 ac-ft) and City of Santa Fe (5,605 ac-ft), are not expected to make their water available to Reclamation in the future.

Sources of water that Reclamation voluntarily leased in 2002 included, 6,500 ac-ft belonging to the Jicarilla Apache Nation, whose agreement expires at the end of 2002. At that time, Jicarilla will be free to lease their water to other bidders. In addition, San Juan Pueblo is voluntarily leasing 2,000 ac-ft to Reclamation for five years ending in 2006 (N. Purdy, Reclamation, pers. comm. 2001, 2002).

available, URGWOM would be a useful tool, along with others, for estimating the water needed to meet target flows.

Conservation water. The phrase “conservation water” refers to water that could be made available as described in the Conservation Water Agreement executed in 2001, that is, water that would have been used to meet compact deliveries but, because of a credit situation, is instead captured (runoff permitting), stored, and released in a manner beneficial to endangered species. Approximately 30,000 ac-ft of conservation water was available in 2002. Storage and release of conservation water for 2003 will depend on adequate snowfall, the State’s ability to store water in Abiquiu Reservoir, and the Rio Grande Compact Commission’s approval, among other things.

The “conservation water” concept may be useful in future years as well. It can be assumed that some percentage of any water acquired to meet target flows for the silvery minnow in any given year will arrive at Elephant Butte Reservoir and would be “counted” toward compact delivery. For example, 37,596 ac-ft of the 40,427 needed if target flows were to be maintained 95 percent of the years is calculated to arrive at Elephant Butte in the river channel or the LFCC (Industrial Economics, Appendix B, 2002). This is a high estimate of the water that would be delivered to Elephant Butte based on a 7 percent depletion rate between San Acacia and San Marcial, but it illustrates the possibility that water leased or purchased to provide flows for the silvery minnow would contribute towards New Mexico’s compact deliveries. If acquired by water managers to provide supplemental flows, the flows would be in addition to New Mexico’s normal compact deliveries and could, theoretically at least, form the basis for future conservation water agreements.

Voluntarily leasing or purchasing native flows. Of the 40,427 ac-ft/yr that would be needed to ensure that target flows are met in 95 percent of all years, some amount is likely to be provided by San Juan-Chama contractors. Some amount of conservation water may also be available as carryover from previous years, as suggested above, but this concept has yet to be tested. This FEIS, like the Final Economic Analysis, makes the conservative assumption that all additional water needed to meet target flows must be voluntarily acquired from existing uses of native Rio Grande water. This conservative assumption may overstate both the costs of acquiring the water and the impact of acquisition on local communities.

According to the Final Economic Analysis, the market value of an acre-foot of Rio Grande water is \$4,750. If purchased at \$4,750 an acre-foot, 40,427 ac-ft of water rights would cost \$192 million; the annualized cost of reallocating this volume of water, using a 3 percent discount rate, is \$6.2 million. To meet target flows in 50 percent of the years, 5,635 ac-ft of water rights would be required. These rights, if purchased at \$4,750 an acre-foot, would cost \$27 million, while the annualized cost would be \$860,000 (Industrial Economics 2003). Other costs associated with acquiring water using these assumptions are explained in the Final Economic Analysis, which is incorporated herein by reference, and reported under the section titled *Social and Economic Impacts*.

If Rio Grande water were voluntarily acquired to meet target flows for the silvery minnow, it would most likely come from irrigated acreage (*see* Final Economic Analysis).

Because the majority of farm acreage (56 percent) in the Middle Rio Grande Valley is devoted to alfalfa and because of that crop's annual planting and relatively high water requirements, the Final Economic Analysis uses alfalfa as the basis for calculating the value of foregone production and the secondary impacts on local communities (Industrial Economics 2003; *see also* Appendix A of this FEIS). If 4.45 ac-ft/yr of water is required to grow alfalfa, then an estimated 9,094 acres of alfalfa would go out of production to ensure water in 95 percent of all years. This would be reduced to 1,266 acres under the 50 percent scenario.

This FEIS relies on the Final Economic Analysis to develop an estimate of the possible economic effects of removing a quantity of water from agricultural use. However, a number of different approaches may be taken to acquire and deliver the water needed. The actual impacts of any particular approach to maintain target flows will depend on a number of variables and the resolution of a number of issues:

- Merely acquiring water rights is not sufficient. Any acquisition program must be designed to result in "wet water" being delivered to critical points in the river at critical times of the year.
- Any program to ensure flows to the river would need to be coordinated with the MRGCD, which makes most of the surface water withdrawals in the Middle Rio Grande Valley today.
- Forbearance programs, in which the MRGCD and/or individual irrigators are paid to voluntarily forbear from irrigating in order to provide flows to the river, have been discussed but not formalized (*see* Hernandez 1997).
- MRGCD holds some water rights as a district. If MRGCD were to enter the water market, or a forbearance program were developed, there would have to be a way to determine which members of the district would forego delivery of water to their fields and how they would be compensated.
- Senior Pueblo rights include the right to irrigate 8,847 acres through the MRGCD. The six Middle Rio Grande Pueblos may consider developing mechanisms for leasing their water rights in a manner that contributes to river flows.
- An alternative to the outright purchase or retirement of enough water to ensure availability even in the driest years would be a program wherein Federal water managers could purchase options to lease. By purchasing an option, the agency would be assured that it could obtain water when needed while minimizing the acreage lost permanently to farming.
- A water bank, such as that in use in the MRGCD currently, but expanded to allow for the voluntary leasing of water or water rights in the bank for instream flow, may be a possibility but, as with all of the possibilities, the managing entity would need to ensure that leasing that

water would increase downstream flows. Leasing rights that have not been exercised will not put more water in the river.

- Applications to the State Engineer to change the point of diversion or the place or purpose of use may be required depending on the manner in which the parties arrange for water to remain in the river. Transaction costs associated with transferring or leasing water rights must be recognized; the NMISC used a 15 percent figure for transaction costs recently when estimating the cost of acquiring water for Pecos River Compact compliance purposes (NMISC 2002).
- To date, Federal water managers on the Rio Grande and the Pecos, for ESA compliance purposes, and the NMISC on the Pecos, for compact delivery purposes, have been acquiring water from water users on a voluntary basis, whether by purchase or lease or through forbearance or San Juan-Chama contract waiver. It is assumed that water will be similarly acquired in the future.

Pumping Program

Another set of actions identified in the 2001 Programmatic Biological Opinion and RPA as crucial to reducing river drying is the pumping program undertaken by Reclamation. As described in Chapter 3, the LFCC acts as a drain across much of the San Acacia reach, reducing flows in the main river channel. Reclamation pumps water from the LFCC into the main channel of the Middle Rio Grande at a number of locations between San Acacia and Elephant Butte. Reclamation's costs for the pumping program for 2000 were approximately \$900,000 and for 2001 were \$1,467,000. Estimated costs for 2002 and beyond are \$1.2 million a year, until Reclamation does planning and construction for permanent pumping, for which costs have not been determined (J. Gould, memorandum 2002).

Habitat/Ecosystem Restoration Programs

A third set of actions addressed in the 2001 Programmatic Biological Opinion and RPA provides for restoration programs in the different reaches of the Middle Rio Grande, to benefit the silvery minnow and the flycatcher. Some of these programs will be funded, at least in part, by the recent \$11.2 million appropriation for initiatives of the Middle Rio Grande Endangered Species Act Collaborative Program.

One issue raised in scoping was the extent to which riverine and riparian restoration efforts increase or reduce depletions to the water supply. Research is being done – by Reclamation, by the Service, by the NMISC, and by university researchers – to understand and try to quantify the use of water by native and non-native vegetation. Efforts to eradicate non-native species like saltcedar, and reestablish native vegetation such as cottonwoods, should result in a reduced amount of water consumed by transpiration processes. This is due to the higher water use by the non-native species. The savings of water due to revegetation may be lower than

expected, however, because the evapotranspiration rate of native riparian vegetation will rise if the local water table rises (see *Vegetation* in Chapter 3).

Bioengineering activities such as increasing the width of the river channel may increase evaporation and seepage losses in a project reach. If, for example, the six restoration projects described in Element J of the RPA in the 2001 Programmatic Biological Opinion focused solely on widening the river, increased depletions due to open water evaporation could be as much as 1,845 ac-ft per year (M. Jones, consulting hydrologist, pers. comm. 2001).³

While the research is still being conducted, it is reasonably clear that the net gain or net loss to the water supply resulting from restoration activities will depend on the design of the project (see, e.g., Corps and Reclamation 2002). A project replacing non-native phreatophytes with an open mosaic of native vegetation, together with a limited increase in the amount of open water surface, may not result in increased depletions. A detailed estimate of consumptive use is being developed for the Los Lunas Rio Grande Restoration Project, one of the prospective restoration sites. This estimate takes into account the best available data for the Middle Rio Grande Valley with respect to evaporation from sand bars with shallow groundwater conditions, evapotranspiration from rehabilitated cottonwood trees and willow tree stands, and evapotranspiration from non-native plant species, in addition to consumptive use from open water evaporation. Preliminary results indicate that restoration at that particular site may result in a net savings of water of between 30 and 64.5 acre-feet per year (Corps and Reclamation 2002).

(B) Impacts on flood control

Flood control was raised as an issue during scoping. The question is whether the designation of critical habitat for the silvery minnow will prevent actions necessary to protect communities from the risk of flood in the Middle Rio Grande Valley. The answer can be broken down into two parts. The first is whether Corps projects to rehabilitate levees in the Middle Rio Grande Valley will be precluded because of designation. The second is whether flood control authorities, in particular AMAFCA, will be precluded from taking actions to protect the Albuquerque metropolitan area from the risk of floods.

Levees

The Corps has rehabilitated the Corrales levee system since the silvery minnow was listed as an endangered species and critical habitat was first proposed. As noted in *Impacts on Agency Consultations*, the Service issued a Biological Opinion stating that the proposed action would not jeopardize the continued existence of the bald eagle, silvery minnow, or southwestern

³The RPA calls for 60-acre habitat restoration projects in each of six reaches from Cochiti to Elephant Butte. This estimate was developed for illustrative purposes only, by picking a location in each of the reaches and estimating the annual evaporation for each location using the NOAA Evaporation Atlas.

willow flycatcher, nor would it adversely modify proposed critical habitat for the silvery minnow (Cons.#2-22-92-I-373). A subsequent plan, involving the creation of backwater channels to benefit the silvery minnow, was also approved in Cons.#2-22-92-I-373.

In addition to the Corrales levee rehabilitation project, which has been completed, the Corps proposed to rehabilitate levees along the river in the Belen Division, or Isleta reach (Cons.# 2-22-95-F-158) and the Socorro Division, or San Acacia reach (Cons.#2-22-95-F-180). As described in *Impacts on Agency Consultations*, consultations on these proposed actions resulted in draft biological opinions stating that the projects as proposed would likely jeopardize the continued existence of the Rio Grande silvery minnow and the southwestern willow flycatcher, and result in destruction or adverse modification of proposed critical habitat for the silvery minnow. In each case, the Service offered a set of reasonable and prudent alternatives. Both projects were put on hold for a number of reasons, some or all of which independent of the consultation. The Corps will be moving forward with project planning and consultation again in the near future (T. Apodaca, Corps, pers. comm. 2002; F. Blake, Corps pers. comm 2002.).

Under Alternative B, proposed critical habitat extends to existing levees on either side of the Rio Grande or, if no levees are present, then within a lateral distance of 91.4 meters (300 feet) on each side of the stream width at bankfull discharge. The Service believes that the riparian corridors adjacent to the river channel provide an important function for the protection and maintenance of critical habitat, and that a lateral distance of 91.4 meters (300 feet) on each side of the stream to be appropriate for the protection of riparian and wetland habitat and the natural processes involved in the maintenance and improvement of water quality (Service 2002). Under this proposed designation, the Corps is likely to be able to propose a design and develop a plan for construction that would permit levees to be rehabilitated without adversely modifying critical habitat. As in the past, however, the consultation process will have to address the effects to the silvery minnow and the flycatcher as well as the effect on silvery minnow critical habitat.

AMAFCA

The Albuquerque Metropolitan Arroyo Flood Control Authority is the flood control authority for the Rio Grande Valley within Bernalillo County.⁴ Funded by property taxes, AMAFCA operates and maintains much of the infrastructure that carries storm runoff through Albuquerque to the Rio Grande. Structures include detention dams on intermittent tributaries to regulate sediment inflow and high flow events. AMAFCA also operates and maintains diversion channels and arroyos with outfalls to the river. The two main channels discharging into the Rio Grande are the North and South Diversion Channels, but AMAFCA operates and maintains, or relies on, several other outfalls as well. A feasibility study is underway to improve flood control

⁴The Southern Sandoval County Flood Control Authority has similar functions on the west side of the Rio Grande and south of Highway 44 and the Zia Pueblo in Sandoval County.

in Bernalillo County's South Valley, and additional outfalls may be needed (AMAFCA 2000; J. Kelly, AMAFCA, pers. comm. 2001).

AMAFCA works with a number of Federal agencies in furtherance of its flood control mandate. It obtains section 404 dredge-and-fill permits from the Corps when it does maintenance work in its channels. Much of AMAFCA's work at the detention dams, typically located some distance from the river, is done under a nationwide permit, and the process for obtaining approval for the work is relatively streamlined. To date, the Corps has not consulted with the Service regarding the permitting of AMAFCA activities and their effect, if any, on the silvery minnow.

The Corps may need to consult with the Service if AMAFCA were to apply for a section 404 permit for maintenance work at or near the confluence of its channels and arroyos with the Rio Grande. Such work is likely to be needed at or near the outfall for the North Diversion Channel in the near future. (J. Kelly, AMAFCA, pers. comm. 2002). As an applicant for a Corps permit, AMAFCA is likely to incur additional expense in the application process by virtue of section 7 consultation on the silvery minnow and its critical habitat. It is also possible that some project modifications will be required in connection with critical habitat. AMAFCA has worked successfully with the Corps and the Service on flycatcher issues at its San Antonio outfall in the Oxbow in Albuquerque.

Reclamation has worked with AMAFCA in the past on removal of sediment from the Rio Grande at the outfalls of diversion channels and arroyos. Reclamation has cleared sediment deposits when sediment has either reduced the channel capacity or caused flows to threaten a critical riverside facility on the opposite bank. Reclamation has performed sediment removal since the silvery minnow was listed and expects that, with appropriate habitat improvements, it can continue to do so under the current biological opinion. The agency is already engaging in ESA compliance activities and does not expect critical habitat designation to have additional effects on these actions (R. Padilla, Reclamation, memorandum, 2001).

AMAFCA could incur additional costs if it had to make major changes to its operations, or if it experienced delays in getting Federal approvals for its activities. Although AMAFCA's flood control functions could be impaired if Reclamation were to stop keeping the river channel free of debris where stormwater is discharged into the river, this appears unlikely. In the absence of a consultation history, it is difficult to predict when consultations involving AMAFCA will be required, and what the outcome of any particular consultation would be.

(B) Impacts on water quality

Designation under this alternative would be expected to have no impact on water quality. State and Pueblo water quality standards already limit adverse impacts on water quality throughout the Middle Rio Grande. In section 7 consultations on NPDES permitting, the

Service may continue to recommend additional toxicity testing at times to ensure that wastewater discharges do not jeopardize the silvery minnow.

The proposed rule designating critical habitat includes among the list of primary constituent elements considered essential for the primary physical and biological needs of the minnow: “Water of sufficient quality to maintain natural, daily, and seasonally variable water temperatures in the approximate range of greater than 1°C (35°F) and less than 30°C (85°F) and reduce degraded water quality conditions (decreased dissolved oxygen, increased p.H., etc.)” (Service 2002). While helping to clarify the needs of the species, this primary constituent element is unlikely to confer any higher standard of protection for water quality than that already established by State and Federal regulations and by virtue of the listing of the species. Thus, critical habitat designation is expected to have no significant water quality impacts on the Middle Rio Grande as a whole.

Irrespective of critical habitat designation, the water quality studies discussed in Chapter 3 will focus on identifying silvery minnow habitat needs (see *Water Quality* in Chapter 3). Preliminary indications are that the silvery minnow is not more sensitive to pollution than other fishes studied, or other aquatic forms generally. On the Rio Grande, it has continued to survive after sympatric native species have been extirpated, suggesting a general tolerance of the existing environment (J. Lusk, Service, pers. comm. 2001) The silvery minnow will most likely be protected by existing water quality standards, and changes to current EPA discharge permitting activities are expected to be minimal, although the possibility exists for EPA’s consultations with the Service to change as more becomes known about the water quality needs of the silvery minnow. It is even conceivable that the results of the upcoming studies could prompt changes in State or Pueblo water quality standards over time.

(B) Impacts on vegetation

The need for target flows such as those provided under the 2001 Programmatic Biological Opinion and RPA is expected to continue, and to be reflected in future biological opinions. Supplemental flows are likely to enhance efforts to restore native cottonwood/willow associations and wetland or moist riparian communities along the Middle Rio Grande. Benefits to vegetation may vary according to water release schedules. Enhanced springtime flows to achieve overbank flooding are most likely to help restore native vegetation. Such uses of water, however, may be precluded by the need to maintain flows during the summer months, when river drying is most likely to occur.

Overbank flooding in limited areas is expected to stimulate cottonwood regeneration and improve aspects of ecosystem functioning, including decomposition and nutrient cycling. Increased moisture in the bosque, whether from overbank flooding or hydrological connectivity with the river, will help slow or (to the extent that regeneration occurs) reverse the aging of the Rio Grande cottonwood gallery forest that currently extends along the river corridor (Service 2001b).

Benefits to vegetation and ecosystem health will also result from specific restoration and management projects intended to increase habitat for the silvery minnow and the flycatcher. Such restoration projects are being implemented in the absence of critical habitat designation, but may receive some additional support if designation occurs as proposed in this alternative. Restoration activities may include channel widening, creation of backwater and oxbow habitat, overbank flooding, removal of saltcedar and Russian olive from management areas, and the establishment of self-sustaining communities of native plant species.

Under the 2001 BO RPA, restoration efforts will be conducted at several sites on the Middle Rio Grande. Each restoration site will be situated at the river's edge, and consist of approximately 60 acres. Monitoring and assessment of each restoration project will be conducted at each site annually for a period of fifteen years. Additional benefits to native riparian communities may result from the RPA element requiring restoration to offset any direct impacts resulting from necessary river maintenance projects, in a 5:1 ratio of area restored to area adversely impacted. Over time, actions such as these are expected to benefit multiple species by promoting the conservation of biological diversity, protecting ecological function (Altieri 1999, Falkenmark 2000), and contributing to the ecosystem health (Rapport and Whitford 1999, Rapport 2000) of the Middle Rio Grande Valley (Crawford *et al.* 1993).

Managing flow regimes in accordance with the 2001 Programmatic Biological Opinion and RPA, and future biological opinions may require new strategies for water storage. One proposal was store up to 2000 ac-ft of water in existing ponds on Sevilleta NWR, La Joya Game Refuge, and Bosque del Apache NWR. Such storage, if conducted during periods of seed generation, may facilitate the proliferation of some noxious weeds, such as perennial pepperweed, which thrive in moist areas. The refuges and wildlife management areas currently employ various mechanical and chemical treatment methods to prevent the spread of the pepperweed and other harmful exotics (Socorro County Noxious Weed Committee 2001).

(B) Impacts on the Rio Grande silvery minnow_____

The purpose of designation is to protect habitat essential to the survival and recovery of the species. The Recovery Plan adopted in July 1999 recommends recovery goals for the silvery minnow and outlines the research and data collection activities that will identify measures to ensure the conservation of the silvery minnow in the wild. One of the primary goals of the Recovery Plan is to stabilize and enhance populations of silvery minnow and its habitat in the Middle Rio Grande Valley. Critical habitat designation under Alternative B is intended to further that goal.

The silvery minnow is adapted to a natural hydrological regime that includes low flows and, perhaps, occasional drying of some sections of the river. The severity and extent of dewatering has increased as a result of water operations over the past century, and this has contributed to a gradual decline in the silvery minnow population (Bestgen and Platania 1991).

Prior to the 20th century, any riverbed drying would have affected only a very small portion of the silvery minnow's total distributional range. With no barriers present in the river, minnows could easily move up or down stream from drying areas to areas of sufficient flowing water. The restricted range and mobility of the minnow today make riverbed drying far more significant. Also, with respect to past conditions, it should be noted that conditions 100 years ago do not represent a "natural" baseline for comparison. Irrigated acreage in the Middle Rio Grande reached a maximum in 1880, at a level nearly twice that of today. High demand for Rio Grande water in Colorado and New Mexico in the 1880s and 1890s resulted in water shortages and frequent drying of the river in downstream reaches. That the silvery minnow survived this and other periods of water scarcity does not imply that an ephemeral stream is the fish's optimal or preferred environment.

Under this alternative, the continuing need to avoid jeopardy to the silvery minnow and the need to avoid adverse modification to critical habitat will stimulate efforts aimed at securing river flows necessary for the fish's reproduction and survival. Under the terms of the 2001 BO RPA, the minnow will benefit from targeted flows as discussed above. The minnow will also benefit from pumping of water from the LFCC back into the river when intermittency is likely; from a springtime spike in flow to cue spawning; from captive propagation and egg collection activities designed to repopulate upper reaches of the Middle Rio Grande; from the planning and design of facilities to provide for fish passage at San Acacia Diversion Dam; and from habitat and ecosystem restoration projects on the Middle Rio Grande.

The 2001 RPA is not designed to ensure year-round flow or to exclude the possibility of intermittency in downstream reaches of the Middle Rio Grande. The Service anticipates that up to 25,000 adult silvery minnows and 75,000 silvery minnows under 30 millimeters (1.2 inches) in length may be "taken" (i.e., killed) in any year due to the Federal and non-Federal actions described in the 2001 Programmatic 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. Therefore, using the best scientific information and methodology available, if more than 250 adult silvery minnow or 750 silvery minnow under 30 millimeters (1.2 inches) in total length are found dead in any year, the level of anticipated take will have been exceeded (Service 2001b). This incidental take would consist largely of silvery minnows killed by the drying of isolated pools caused by water management that results in fluctuation in flows or intermittency, generally occurring in the San Acacia and Isleta reaches. Additionally, the Service anticipates that up to 100,000 silvery minnow eggs will be taken each year through entrainment at diversion facilities. The Service has determined that this level of take would not result in jeopardy if the 2001 BO RPA is implemented.

Current target flows being implemented under the 2001 Programmatic Biological Opinion and RPA are expected to be maintained under this alternative. They are subject to change, however. Reinitiation of consultation will be required where discretionary Federal

agency or involvement or control over the action has been retained (or authorized by law) and if: (1) the amount 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 the 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 the opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

Designation will also result in some additional protection to current silvery minnow habitat, by requiring consultation regarding agency actions that might result in adverse modification. Protections conferred under the standard of adverse modification often overlap, or are coterminous with, protections conferred under the standard of jeopardy. However, designation could have an impact on actions that would adversely modify critical habitat, but would not be expected to jeopardize the species. On the Middle Rio Grande, designation as proposed under this alternative may provide additional protections to portions of the river floodplain (i.e., the lateral width). Over the long term, designation may help ensure a consistent level of protection in reaches where the silvery minnow population is low or in which the presence of the species may become uncertain. To the extent that all five reaches of the Middle Rio Grande contain potential habitat for the minnow, and particularly to the extent that currently unpopulated sections of the river can and will be repopulated, the silvery minnow may benefit from the additional protections provided by designation.

(B) Impacts on other fish species

In general, native fish species in the Middle Rio Grande are expected to benefit, along with the silvery minnow, from designation of critical habitat. To the extent that actions as modified through section 7 consultation keep more water in the river, and result in conditions more similar to the natural hydrograph of the Middle Rio Grande valley, both native and non-native members of the Rio Grande's warm water fish community should benefit.

Fish in the smaller upstream reservoirs on the Rio Chama may potentially be affected by drawdowns intended to provide water for the minnow. Kokanee salmon and several species of trout are present in Heron Lake, and El Vado and Abiquiu Reservoirs. Fisheries in these lakes are supported by periodic hatchery stockings, not natural reproduction, and are present for recreational purposes. Depletions low enough to threaten fisheries are not anticipated and, in light of periodic stocking, no long-term damage to recreational fisheries would be expected.

(B) Impacts on other threatened, endangered and candidate species

Southwestern willow flycatcher

Listing and critical habitat designation for the silvery minnow will either have no effect or a positive effect on the flycatcher. The 2001 RPA included a number of actions intended to avoid jeopardy to the flycatcher, some of which were recommended in the draft recovery plan

for the species (Service 2001c).⁵ Implementation of the RPA or a similar future set of recommendations is likely to benefit the flycatcher by ensuring more constant river flows, considered to be an important habitat feature for successful breeding. The flycatcher is also expected to benefit from habitat restoration that results in a greater area and density of native vegetation in the riparian zone adjacent to the river channel, and from the creation of off-channel wetland areas.

Designation will further benefit the flycatcher through short-term and long-term improvements to breeding habitat. Designation may confer some additional protections resulting from the requirement that consultation precede any alteration of riverside habitat in the Middle Rio Grande.

Bald eagle, whooping crane, interior least tern

The whooping crane and least tern are not likely to be significantly affected by silvery minnow listing or critical habitat designation on the Middle Rio Grande. Only one individual whooping crane may remain in the Middle Rio Grande Valley, the result of previous efforts to re-establish a migratory wintering flock in the region. This whooping crane, like the sandhill cranes with which it feeds, may conceivably be affected by any possible reduction in winter forage brought about by a summer release of irrigation water from Bosque del Apache NWR (see *Impacts on other wildlife*, below). The interior least tern is present in the region only as an uncommon spring migrant, and few individuals would be affected by actions on the Middle Rio Grande. Target flows and river channel modifications to benefit the silvery minnow may help improve the availability of sandbar roosting habitat for this species.

The bald eagle may be slightly affected by designation, together with current and expected future Service recommendations for actions intended to avoid the likelihood of jeopardy to the silvery minnow and the flycatcher (Service 2001b). Habitat protections and restoration activities may benefit the eagle by conserving bosque vegetation used as roosting habitat. Water operations to benefit the silvery minnow would result in changing patterns of reservoir water storage and release, which may have some impact on the species. Limited negative impacts are possible if, for example, management actions alter the distribution or availability of fish or other species on which the eagles feed. Overall, however, a return to a more natural hydrograph on the Middle Rio Grande, as envisioned in the 2001 Programmatic Biological Opinion, is likely to produce net benefits for the species.

Western yellow-billed cuckoo, a candidate species

⁵ Like critical habitat designation for the silvery minnow, critical habitat designation for the flycatcher is being reconsidered as a result of a court decision. The Middle Rio Grande was not included in the original designation (62 FR 39129).

The cuckoo is a candidate species for Federal listing (66 FR 38611). The cuckoo has habitat requirements broadly similar to those of the flycatcher. It may benefit from riparian habitat restoration measures such as those that would be implemented as part of the 2001 RPA, and from additional protections to the riverside riparian zone resulting from designation. Efforts to restore wetlands can be expected to benefit this species.

(B) Impacts on other wildlife

Protections granted to listed species and designated critical habitat under the ESA may have important secondary beneficial effects, by helping to preserve natural communities and ecosystems. Habitat loss or degradation is the primary cause of species loss and population declines in the U.S. and globally (Wilcove *et al.* 1998; Sala *et al.* 2000). In the arid Southwest, riparian habitat is thought to be the most limited, most threatened, and most biologically valuable of all major habitat types. Many species restricted to this habitat, or dependent upon it for part of their life cycle, are declining (Finch *et al.* 1995; Cartron *et al.* 1999).

Riparian species should be favorably affected by efforts to simulate a more natural hydrological regime, and to restore the native mosaic of vegetation in the river corridor. Over time, such actions are expected to benefit multiple species by promoting the conservation of biological diversity, protecting ecological services (Altieri 1999, Falkenmark 2000), and contributing to the ecosystem health (Rapport and Whitford 1999, Rapport 2000) of the Middle Rio Grande Valley (Crawford *et al.* 1993).

Reptiles and amphibians that require moist, flooded, or wetland areas may see an increase in suitable habitat, as will some species of wading birds. Many neotropical migratory songbirds that use the Rio Grande Corridor as stopover or breeding habitat should also benefit. This group includes species such as the northern oriole, summer tanager, and the Bell's vireo, which have shown recent population declines in the state. Species that use irrigation ditches as their principal habitat could be affected if diversions from the river into the ditches were reduced to provide water for the silvery minnow. It could be expected, however, that such species would relocate to riparian areas by the river.

Migratory waterfowl and cranes may be adversely impacted if the fields and wetlands that they rely on as winter feeding grounds become non-productive, as a result of farmers voluntarily selling or leasing their water rights to benefit the minnow. Similarly, any decision on the part of the Service at Bosque del Apache NWR, or New Mexico Game and Fish at the State WMAs nearby, to forgo irrigation of grain crops or wetland areas could have an adverse impact on waterfowl that use those refuges for winter foraging. In 1998, Bosque del Apache contained roughly 324 hectares (800 acres) of alfalfa feeding habitat and 275 acres of corn feeding habitat. The four State WMAs contained roughly 304 hectares (750 acres) of alfalfa and 121 hectares (300 acres) of corn. Farming on private lands in the Middle Rio Grande Valley includes some 14,164 hectares (35,000 acres) of alfalfa, 607 hectares (1500 acres) of corn, and 405 hectares (1000 acres) of wheat (Taylor 1999).

Corn is the most important managed crop for migratory waterfowl and cranes. Corn production on private lands has dropped sharply since the 1980s, and has been accompanied by a decline in the use of these lands by light geese (snow and Ross' geese). The light goose population in the valley winters primarily on State and Federal refuge lands, which have steadily expanded production.

Alfalfa is also an important food resource for light geese and sandhill cranes in late fall and early winter. Alfalfa acreage is abundant in the valley, but may be the type of agricultural use most likely affected by voluntary leasing, forbearance, etc. to secure river flows for the silvery minnow and flycatcher. A reduction in irrigated alfalfa acreage of up to 26 percent is possible for the Middle Rio Grande (see *Social and economic impacts*, below), and the degree to which such a reduction might impact sandhill crane, light goose, or other waterfowl populations cannot be predicted. A reduction in corn acreage, particularly at Bosque del Apache and the State WMAs, is considered a less likely outcome, but would be more likely to affect wintering waterfowl.

Negative impacts on ducks and geese may also occur if less water is available for the management of wetland areas. Wetland vegetation provides an important component of the diet of migratory waterfowl. Production of this resource is managed by the refuge through the timing of draw downs and through irrigation in the summer months (J. Taylor, Service, pers. comm. 2002).

It should be noted that light goose populations have exploded over the past two decades, to the point that extensive damage has been caused to Arctic breeding areas. Sandhill crane numbers have also increased. Today's high numbers of wintering cranes and waterfowl in the valley have been achieved only through increased crop cultivation by management agencies, and coordinated efforts to concentrate bird distributions at refuge sites.

Not all potential impacts on migratory cranes and waterfowl are negative. River restoration projects resulting in a wider or more braided river channel, with the creation of more isolated sandbar habitat, would be beneficial to migratory waterfowl that require such habitat for roosting (J. Taylor, Service, pers. comm. 2002).

(B) Impacts on land ownership and use

The primary potential impacts on land use stem from the possibility that water rights may be purchased or leased from willing sellers, or forbearance agreements sought from the MRGCD or its members. This could result in irrigated cropland going out of production, temporarily or permanently. Acquisition of water rights sufficient to maintain the target flows described above in *Impacts on Federal Actions*, 95 years out of 100, could result in 3,680 hectares (9,094 acres) of land going out of production (Industrial Economics 2003; also see Appendix A to this FEIS). This represents roughly 15 percent of the irrigated crop acreage, and 26 percent of the alfalfa

acreage, of the four Middle Rio Grande counties (Sandoval, Bernalillo, Valencia, and Socorro) (NM Agricultural Statistics 2000, www.nass.usda.gov/NM/nmbulletin). If alternative methods of providing supplemental flows are pursued, these impacts may be lessened. Under a water banking or lease option system, lands may go temporarily out of production on an “as needed” basis, depending on annual patterns of precipitation.

Agricultural acreage that could be affected includes lands at Bosque del Apache NWR that are used to grow feed crops for migratory cranes and waterfowl. These lands could go out of production if the Service were to decide not to exercise its water rights for the refuge. The refuge has relied on two private farmers to grow crops for waterfowl, under cooperative agreements. During the 2000 irrigation season both “crop farmers” had to forgo their last cutting of alfalfa, after the Service decided not to irrigate in order to supplement river flows. The farmers were paid for their lost crop production; however, uncertainty over the possibility of future reimbursements has since caused one of the farmers to withdraw from the cooperative agreement with the refuge (J. Savery, Service, pers. comm. 2001).

New construction or other changes in land use within the proposed critical habitat boundary could be affected by designation, if there is Federal involvement. The impact in such cases would follow from the requirement that the agency and private applicant, if any, engage in section 7 consultation. Existing and future land use practices by private parties, where there is no Federal nexus, would not be affected. Aerial photography and vegetation maps based on GIS coverage indicate that there is little existing development in the floodplain area within the lateral critical habitat boundaries proposed by the Service. Structures and other developed areas, such as occur in limited locations in Sandoval and Socorro counties, are specifically excluded from designation as stated in the Service’s proposed rule (Service 2002).

MRGCD claims many of the areas of the bosque and other lands along the river between Cochiti Dam and Bosque del Apache NWR, and also holds a number of easements and rights of way on private and Pueblo lands. The land between Sandia and Isleta Pueblos is managed as part of the Rio Grande Valley State Park. These lands may be improved through habitat restoration projects by Federal agencies, such as those outlined in the Service’s 2001 Programmatic Biological Opinion (Service 2001b). Apart from this, the use and ownership status of these undeveloped bosque lands should not be affected by the listed status of the silvery minnow, nor by critical habitat designation.

Limited grazing occurs in the river floodplain in the northern and southern ends of the valley. Grazing on Pueblo and private lands will not be affected. Bosque vegetation is dominant in areas immediately adjacent the river across most of the valley, particularly from Santa Ana Pueblo to Socorro. This green belt of riparian vegetation represents the primary land use within the area proposed as silvery minnow critical habitat. The Middle Rio Grande bosque will be largely unaffected by designation, but in some locations the bosque’s scenic, recreational, and ecological values will likely be enhanced by conservation and restoration activities undertaken to benefit the silvery minnow and the flycatcher.

(B) Social and economic impacts

Economic costs associated with endangered species management and critical habitat designation for the silvery minnow are discussed in the Final Economic Analysis, which is incorporated into this FEIS by reference. The two documents are being distributed together, and it is important for the reader to review the Final Economic Analysis to understand the approach being taken and the assumptions being made. The analysis considers three categories of economic impact: 1) opportunity costs of maintaining sufficient instream flow for the silvery minnow; 2) secondary economic effects of water acquisition, including local and regional effects on production, employment, wages, and income; and 3) consultation and project modification costs. The latter set of costs is borne primarily by federal agencies, but some expenses may be incurred by third party applicants for Federal permits or funding. Tables summarizing impacts in the three cost categories for the Middle Rio Grande are presented in Appendix A.

It should be emphasized that the direct and indirect costs of maintaining stream flow, as discussed in the Final Economic Analysis and in the sections below, derive from actions taken to avoid jeopardy to the minnow (i.e., actions stemming from listing). Currently, these costs are based on the flow targets established in the 2001 BO RPA. They are discussed here as impacts arising from section 7 consultations, whether as a result of the listing of the species or critical habitat designation, or both.

Economic effects on the four counties of the Middle Rio Grande—Sandoval, Bernalillo, Valencia, and Socorro Counties—stem primarily from the need for water to meet the requirements of the Service’s 2001 Programmatic Biological Opinion or any successor. It’s assumed that future biological opinions on Middle Rio Grande water operations will set forth provisions similar to those already in affect. The extent to which supplemental flows will be needed to maintain target flows will vary from year to year, according to climatic conditions. Thus, the purchase or lease of 40,427 ac-ft/yr of water rights, and retirement from agriculture of 3,680 hectares (9,094 acres) are assumed to be necessary to assure adequate instream flow as specified in the Service’s 2001 Biological Opinion. The 40,427 ac-ft/yr figure was calculated from gage readings for historical flows and reflects the amount of water needed to meet current flow targets 95 years out of 100, given normal climatic variability (Industrial Economics 2003).

Because the Final Economic Analysis considers impacts only at the regional level, it has been necessary to employ a method of disaggregating the impacts to estimate effects on each county. To allocate the economic effects among the counties, *New Mexico Agricultural Statistics* data were used to determine the number of irrigated acres planted to crops in each county as a percentage of the total number of irrigated acres in the region. For purposes of running the economic model IMPLAN, the Final Economic Analysis assumed that, when water rights were sold to provide necessary streamflows, alfalfa would be the crop taken out of production. Most of the irrigated acreage is in alfalfa, which is also a water intensive crop and

thus would require the purchase or lease of the fewest acres of water rights. **Table 4-3** shows the estimated economic effects by county.

Table 4-3: Estimated Economic Effects by County Based on Percentage of Region’s Total Irrigated Acreage¹

	Irrigated acres in production	Percent of irrigated acres in region ²	Acres possibly retired ³	Value of foregone production	Indirect and induced effects	Total economic impact
Sandoval	9350	15.1%	1377	\$ 905,616	\$ 362,246	\$ 1,267,862
Bernalillo	9010	14.6%	1327	\$ 872,684	\$ 349,074	\$ 1,221,758
Valencia	21833	35.4%	3216	\$2,114,686	\$ 845,874	\$ 2,960,560
Socorro	21541	34.9%	3173	\$2,086,404	\$ 834,561	\$ 2,920,965
Region	61734	100.0%	9094	\$5,979,390	\$ 2,391,756	\$ 8,371,146

Assumptions:

1. Values calculated based on 95th percentile scenario (see Final Economic Analysis).
2. Percentage of acres in production is a proxy for water use and thus the percentage of land that may be taken out of production if water rights are sold. This coefficient is also used here to distribute indirect and induced effects and job losses by county, in the absence of county-level IMPLAN data.
3. Acres retired are assumed to be planted to alfalfa.

As the table shows, if water rights were purchased from within each county according to the proportion of its current use in irrigation, the greatest dollar impacts would be felt in Valencia and Socorro Counties, which have the most irrigated acreage. For direct effects (losses based on the value of the crop), the figures here are likely to reflect the situation accurately. Secondary effects, however, may be distorted, because of the differences in the forces driving each county’s economy. Socorro County, in particular, is more dependent on agriculture than any of the other counties. The economic effects on Socorro County may be greater than those estimated by the simple linear application of the percentage of irrigated land used here. It is also possible that any effort to voluntarily acquire water would be concentrated in the locale where the water is needed to supplement flows. Valencia and Socorro Counties would be those locales.

It is worth noting that, during the 2001 irrigation season, 26,000 ac-ft/yr of water was provided through the Conservation Water Agreement without agricultural acreage being reduced. San Juan-Chama water has also been used to supplement native Rio Grande flows. However, the availability of these sources of supplemental water may be changing. If water is obtained instead from existing uses, the types of effects described here may be realized.

The regional economic analysis prepared by Industrial Economics estimates that 362 jobs would be lost in the Middle Rio Grande Valley as a result of the transfer of 40,427 ac-ft/yr of water rights from irrigation to river flow for the minnow. **Table 4-3** shows the distribution by county of these estimated losses, based on the ratio of each county’s irrigated land to the total irrigated acreage for the region. **Table 4-4** shows the breakdown, by county, of the regional impacts on employment as estimated in the Final Economic Analysis.

Table 4-4: Estimated Effects on Unemployment by County Based on Percentage of Irrigated Acreage

	Jobs lost	Civilian labor force	Projected increase in unemployment
Sandoval	55	44,689	0.12percent
Bernalillo	53	293,068	0.02percent
Valencia	128	30,187	0.42percent
Socorro	126	6,515	1.94percent
Region	362		

Again, the effect on Socorro County would be proportionally greater because the number of jobs lost is a higher proportion of the labor force than in the other three counties. As noted in *Impacts on Water Supply*, these estimated economic effects might be mitigated by use of a different strategy for securing water, such as the development of a system for voluntary leasing rights only when necessary, through a water bank or an option to lease. Any such approach would have to be designed in cooperation with MRGCD.

Most of the social and economic impacts identified above stem from the provision of supplemental flows needed to conserve and avoid jeopardy to the silvery minnow. In the future, management guidelines may change in response to new information, or changes in the distribution or biological status of the species. It is possible, though not foreseen, that future circumstances might result in a situation in which the standard of adverse modification would produce a greater demand for supplemental flows in some locations than that arising by virtue of the listed status of the species. Under such circumstances, some economic impacts of supplemental flow requirements for locations along the Middle Rio Grande may become directly attributable to critical habitat designation. It is not possible to predict if, when, and where such a circumstance might arise, or to what extent critical habitat designation might ever have any social or economic impacts associated with supplemental flow requirements in excess of those needed to avoid jeopardy.

Apart from impacts resulting from the voluntary reallocation of water, any existing farms, developed areas, and commercial facilities occurring within the proposed critical habitat boundary are not expected to be directly affected by designation. In the final rule, the Service states: "Some developed lands within the 300-foot lateral extent are not considered critical habitat because they do not contain the primary constituent elements and they are not essential to the conservation of the silvery minnow. Lands located within the exterior boundaries of the critical habitat designation, but not considered critical habitat include: developed flood control facilities, existing paved roads, bridges, parking lots, dikes, levees, diversion structures, railroad tracks, railroad trestles, water diversion and irrigation canals outside of natural stream channels, the low flow conveyance channel, active gravel pits, cultivated agricultural land, and residential, commercial, and industrial developments." However, activities occurring on such lands may be subject to section 7 consultation if they affect primary constituent elements in areas designated as critical habitat, and if there is a Federal nexus.

Because of the exclusions listed above, and because a Federal nexus must exist for section 7(a)(2) impacts to occur, it is not expected that designation will have a direct effect on any existing economic or commercial activities within the lateral boundary. It is conceivable that designation might affect (through consultation requirements) the future development of economic or commercial activities on lands that would be included within the boundaries of critical habitat, if such development required Federal involvement. The Service is currently not aware of any such plans or circumstances.

Environmental protections associated with the Federal listing of threatened or endangered species, and with critical habitat designation, may produce a number of tangible and intangible social and economic benefits (Niemi 2002). Present and expected future actions taken on behalf of the silvery minnow are expected over time to help conserve biological diversity, protect ecological services, and contribute to the ecosystem health of the Middle Rio Grande Valley. Although it remains difficult to assign precise economic values to these functions, the potential exists for such values to help offset the more easily calculated costs associated with endangered species protection. The added protections of critical habitat designation may increase these benefits to some unknowable degree.

The City of Albuquerque, for example, may receive substantial benefits from the presence of a flowing river and healthy riparian corridor. Such benefits include ecological services—such as water delivery, aquifer recharge, wastewater disposal, and nutrient cycling—and the potential positive impacts of a healthy Rio Grande and restored bosque in such areas as employment (in restoration and recreational services, for example), regional tourism, property values, civic pride, and quality of life. The recent \$11.2 million appropriation by Congress to fund the conservation efforts of the Middle Rio Grande Endangered Species Act Collaborative Program will provide jobs and other benefits to communities in the region. As noted in the Final Economic Analysis, the existence value of the silvery minnow itself may also be considered. People place value on knowing that a particular species exists, particularly when its existence signals the preservation of a wider set of conditions valued by society. According to a study conducted in 1995, an average New Mexico household would be willing to pay \$28 annually for the maintenance of instream flows and the preservation of the silvery minnow, which translates to \$14 million annually statewide (Berrens *et al.* 1996; Industrial Economics 2003).

(B) Impacts on Indian trust resources

The Service recognizes that Federal Indian water rights are generally senior water rights and that they are not: (1) impaired by the Rio Grande Compact, (2) subject to State law restrictions, or (3) administered by the State of New Mexico. Federal action agencies and non-Federal water users assume the risk that the future development of such senior rights may result in shortages of water to junior users (Service 2001b). Nothing in the proposed rule or this FEIS is intended to preclude new depletions resulting from the exercise of senior Indian water rights, and the Service believes that nothing in this rulemaking impairs Indian Pueblo or Tribal trust resources.

Impairment of Federal Indian water rights is not the only concern the Middle Rio Grande Pueblos have expressed. In his comments on alternatives for critical habitat designation, the Governor of San Felipe Pueblo explained that any impacts go well beyond the economic, they go to the heart of the Pueblo's culture. Most if not all of the Pueblos along the Middle Rio Grande use the waters of the Rio Grande to carry out their traditional religious and cultural ceremonies.

Review of the Pueblos' scoping comments for this EIS reveal several common issues, each of which may receive a different emphasis in the different communities:

- The need to ensure that the final decision supports tribal self-determination and economic self-sufficiency and does not harm the Pueblos' economic interests;
- The need to consider potential impacts on the Pueblos' culture, tradition, heritage, family life and spirituality;
- Respect for each Pueblo's sovereignty and the inherent power to "manage its lands and resources according to its own goals and objectives";
- The need to ensure that Pueblos do not bear the burden of past impacts (caused by non-Indian water management practices) on the conservation of listed species;
- Recognition of each Pueblo's option to undertake its own conservation measures if it elects to do so;
- The need for the Service to rely on regulating non-Indian activities for proposed conservation measures.

Tribal comments refer to the Service's trust responsibility and to specific provisions of Secretarial Order No. 3206, "American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act" (June 5, 1997). Most of the comments do not assume that designation in this case will inevitably have a detrimental impact on tribal trust lands and resources, or fail to promote tribal control and self-determination over their trust assets. The comments do, however, ask that these issues be explicitly addressed. Santa Ana Pueblo's comments go further, suggesting that designation of the river through Santa Ana would "exert an additional legal constraint" on the Pueblo without benefitting the silvery minnow, even as the Pueblo is undertaking its own "successful management of essential silvery minnow habitat". The summaries below includes various points and views individual Pueblos have expressed to the Service.

Pueblo de Cochiti, the northernmost of the Middle Rio Grande Pueblos, is situated on Cochiti Lake and the Rio Grande just below Cochiti Dam. Tourism and recreation centering on

Cochiti Lake play a major role in the Pueblo's economy, and could be adversely affected if changes in water operations on the Rio Grande were to result in a reduction in the quality of recreation on the lake. This is unlikely, however, if the only discretion that the Corps has with regard to the recreation pool in Cochiti Lake is the timing of the delivery of San Juan-Chama replacement water (Service 2001b). With regard to the use of the Rio Grande for ceremonial purposes, it is unlikely that such use would involve Federal funding, authorization or activity and it should not be affected.

The **Pueblo of Santo Domingo** has the largest population of any of the Pueblos and is considered one of the most traditional. Farming and ranching remain major sources of income and the Pueblo's economic self-sufficiency depends, in part, on a reliable water supply. Traditional and ceremonial uses of the river should not be affected by critical habitat designation.

_____The **Pueblo of San Felipe** emphasized in its comments during scoping that any effect that critical habitat designation would have on the ability of Pueblo members to farm "go to the very heart of San Felipe's culture." It is not expected, however, that designation would affect San Felipe's Federal Indian water rights.

San Felipe stated in a comment letter that it is absolutely vital that water be available to the Pueblo so that it may carry out its ancient religious and cultural ceremonies. These ceremonies should not be affected by critical habitat designation, both because they are unlikely to affect the habitat and because Federal involvement is unlikely.

_____The **Pueblo of Santa Ana** is known for its bosque restoration efforts and its work in integrating habitat preservation and restoration with economic development activities such as the Tamaya Resort. If Federal funding or approval is involved in a Pueblo action that may affect the silvery minnow or designated critical habitat, the Federal agency will have to consult. Informal consultations have taken place on Santa Ana restoration efforts in the past. The history of consultations on the minnow does not include any formal consultations.

The Pueblo of Sandia, situated just north of Albuquerque, has both adopted its own water quality standards and undertaken restoration work along the river. The Pueblo has stated that critical habitat designation in its reach of the Rio Grande would further reinforce its efforts to improve water quality and undertake habitat conservation. The Service agrees and anticipates that critical habitat designation will have a positive impact on restoration activity in designated reaches. Consultation would be required, however, for actions for which there is Federal funding, authorization, or activity.

The **Pueblo of Isleta** has the largest land base of any of the Pueblos on the Middle Rio Grande. Isleta was also the first tribe in the country to adopt its own water quality standards and have them approved by EPA. As the southernmost of the Middle Rio Grande Pueblos, it is most proximate to the reaches below the Isleta Diversion Dam that experience intermittency. By

emphasizing the importance of maintaining quality habitat below the Dam, it is likely that the designation of critical habitat in those reaches would have a beneficial impact on the Pueblo. However, the need to leave water in the river to provide flows will likely be greatest in the Isleta and San Acacia reaches.

Both Isleta's and Sandia's water quality standards identify primary contact-ceremonial use as a designated use of the Rio Grande through the Pueblo. Critical habitat designation is not expected to interfere with ceremonial uses of the river. Only Federal agencies need consult with the Service over actions that may affect a species or its critical habitat.

(B) Environmental justice effects

The fact that critical habitat designation may involve several counties, and that the specific sources of water for the silvery minnow cannot be predicted with certainty, make it difficult to identify particular communities or neighborhoods requiring special attention for environmental justice considerations. It is safe to say that some economic costs associated with the listing of the silvery minnow, and the designation of critical habitat on the Middle Rio Grande, are likely to be borne disproportionately by low-income people and minorities as water is voluntarily transferred from irrigated agriculture.

However, some counties in the region are poorer than others, have higher Hispanic and/or American Indian populations, and/or are more dependent on agriculture as the basis for the local economy. This section spells out these differences for the counties of the Middle Rio Grande region, as does **Table 3-5** in the section on socioeconomic conditions.

Of the four counties in the Middle Rio Grande region, Socorro County stands as the economy most dependent on farming, at more than six percent of total earnings. Though it occupies the largest land area, it has the smallest population, less than 2.5 percent of the region's people. Its per capita personal income is the lowest, 73 percent of the State average, and it ranks sixth from the bottom of all New Mexico's counties. Over 31 percent of its people, and 41 percent of its children, are officially in poverty. Persons of Hispanic heritage constitute nearly half (48.7 percent) of the county's people, while American Indians (mostly of the Alamo Navajo Chapter⁶) are another 10.3 percent. Unemployment, at 5.5 percent in 2000, is the highest among the region's counties, and could increase if economic impacts are distributed among counties in proportion to their irrigated acreage. At least in the short term, the reach of the Rio Grande likely to be most in need of additional water for the silvery minnow is in Socorro County, and greater efficiency (i.e. lower conveyance losses) might be gained by supplying water to the river from sources within the county. This in turn could exacerbate the secondary economic impacts on Socorro County residents.

⁶ The Alamo Navajo Reservation is in the northwestern part of the county, and its economy is not particularly tied to irrigated agriculture. However, secondary effects affecting job opportunities, services, etc. in Socorro County as a whole could have an impact on members of this community.

After Socorro, the next most likely affected county is Valencia. With nine percent of the region's people, it is the second most rural county in the region. Per capita personal income (PCPI) is 87 percent of New Mexico's average, and more than 18 percent of its residents (and 24 percent of its children) fall below the poverty line. At 55 percent, it has the largest proportion of Hispanics of all counties in the region. Because agriculture constitutes a smaller slice of Valencia County's economy (2.4 percent of total earnings), impacts on employment from withdrawing an amount of water proportionate to the county's irrigated acreage would likely be smaller, raising unemployment by 0.4 percent. However, it should be remembered (as noted elsewhere) that in New Mexico agricultural statistics do not account for an appreciable number of small landholders who may supplement their food supply or even their income by irrigated agriculture, but whose activities are "off the books."

Bernalillo and Sandoval County are still less dependent on irrigated agriculture (one- and two-tenths of total earnings, respectively), but even in these counties there may be economic effects on those whose subsistence-level farming is not included in official agricultural statistics. Also, five of the six Pueblos on the Middle Rio Grande, all but Isleta, are located in Sandoval County. Isleta lands are split between Bernalillo and Valencia Counties. The Pueblos are discussed in the section entitled *Indian Trust Resources* above.

(B) Impacts on cultural resources

Impacts on archeological sites and historical features

The principal Federal law addressing cultural resources is the National Historic Preservation Act (NHPA) which, together with its implementing regulations (36 CFR 800), describes, the process for identifying and evaluating historic properties, for assessing the effects of Federal actions on historic properties, and for seeking consultation to avoid, reduce, or minimize adverse effects. Section 106 of the NHPA provides for consultations between Federal agencies and State Historic Preservation Officers whenever a Federal action is undertaken that encompasses sites that are either listed or eligible for the National Register of Historic Places.

The listing of a species under the ESA is not considered an undertaking under section 106. Similarly, critical habitat designation is not a ground-breaking project and hence is not an undertaking, and formal review and analysis under the NHPA is not required (D. Siegel, Service, pers. comm. 2001).

Designation by itself will produce no significant impact on historical or archeological sites, though the consultation requirement to avoid adverse modification might give some sites some additional protection from disturbance. Changes in water operations and river maintenance activities already underway to benefit the silvery minnow, and expected to continue under this alternative, may result in some limited negative impacts on archaeological and historical sites located in the river floodplain. It should be noted that any such prehistoric or

early historic sites have likely experienced scouring floods on a regular basis for centuries prior to the era of modern river management. Sites in some areas have also been subject to heavy disturbance, such as by construction of the LFCC. Nevertheless, under Alternative B, it is possible that some remaining sites may be indirectly affected by actions carried out to conserve and/or avoid jeopardy to the silvery minnow. Conceivable impacts include inundation during deliberate overbank flooding, or disturbance during vegetation removal carried out as part of habitat restoration efforts.

As noted in Chapter 3, a number of existing irrigation and diversion facilities in the Middle Rio Grande are over 50 years old, and may be considered historic features. Maintenance operations have been and will continue to be subject to consultation, and avoidance or minimization measures may be recommended in some cases, but adverse impacts to these facilities are not expected. The proposed relocation of the LFCC, itself a borderline historic feature, will be subject to consultation; impacts of this project on cultural resources in the San Acacia reach are being analyzed elsewhere (Reclamation 2000). Relocating the San Marcial Railroad Bridge to increase channel capacity in the lower reach of the river could impact the bridge as an historical feature, although plans are being made to preserve it by placing it at another location (T. Apodaca, Corps, pers. comm. 2002). More detailed analysis in compliance with the NHPA may be required for this and other specific projects.

Impacts on traditional cultural properties and Native American sacred sites

Executive Order 13007 requires that Federal agencies accommodate the access and use of sacred sites on Federal lands by Indians, and avoid adverse impacts to the physical integrity of sacred sites (61 FR 26771). Designation of critical habitat is not expected to have an impact on Pueblo sacred sites, nor on Pueblo access or use of such sites on Federal lands.

Pueblo religious or ceremonial activities involving sites within the proposed designation should not be affected, administratively or otherwise, both because there is no Federal nexus and because such activities would not be expected to affect primary constituent elements. For the same reasons, continuing efforts to voluntarily secure water to maintain downstream flows, as discussed in sections above, are not expected to interfere with Pueblo use of sacred sites or the ability of the Pueblos to use the river for ceremonial purposes. Some Pueblos have already embarked on extensive bosque restoration projects, including the use of overbank flooding to stimulate the growth of native vegetation. As these projects are carried out under Pueblo authority and control, no negative impacts on sacred sites are anticipated.

While the Service believes that the Pueblos' access to their sacred sites and use of the river for ceremonial purposes will not be affected by critical habitat designation, it also acknowledges the Pueblos' concern. Since the nature of these sites and their locations are generally confidential, any further discussions of these concerns are best addressed in government-to-government consultations with individual Pueblos.

(B) Impacts on recreation

Facilities and opportunities for recreation will not be directly impacted by the designation of critical habitat under this alternative. Implementation of critical habitat should not require any changes in allowable recreational uses of the Middle Rio Grande, its upstream and downstream reservoirs, or public lands along the river corridor.

Recreational opportunities may be indirectly impacted by some possible but not certain consequences of listing, designation, and endangered species management as proposed in this alternative. Several such scenarios will be considered:

- Fishing and boating opportunities may be lost if drawdowns at reservoirs (e.g., at Heron or El Vado) to maintain river flows, or to achieve overbank flooding, result in a loss of access (boat ramps no longer reaching the water) or otherwise decrease the suitability of reservoirs for these recreational activities. If drought conditions require extensive drawdowns, stocked fish populations may be adversely impacted, although restocking could be expected. The recreational pool at Cochiti Lake should not be adversely affected by water operations foreseen under this alternative. Any negative effects on upstream and tributary reservoirs should be temporary; the frequency and duration of these effects will depend largely on climatic conditions.
- Hunting and wildlife viewing opportunities may be gained because of habitat restoration, or possibly lost if State and/or Federal refuges choose to forego irrigation of crops as a winter food supply for migratory cranes and waterfowl, in order to keep more water in the river. In any given year, however, such decisions may also result in no (or virtually no) impact on waterfowl numbers, and related recreational opportunities. If foraging sites and roosting sites shifted from public to private lands, private farms may be affected while some recreational opportunities could be lost. However, the mandates and management plans of the NWRs and WMAs require these facilities to maintain suitable winter habitat for migratory waterfowl. It is not expected that designation will interfere with existing management to such an extent that goose, duck, and crane populations, or opportunities to enjoy these resources, would be greatly affected.
- Opportunities for the enjoyment of one of the valley's principal natural resources, the Rio Grande bosque, may be maintained or enhanced if restoration and habitat management actions as considered in this alternative result in the creation of new or improved riparian habitat, or in the renewed health and vigor of Rio Grande cottonwood forests. Wildlife viewing opportunities (particularly bird watching) will increase to the extent that improved habitat for resident and migratory species is created. As a scenic and biological resource, the bosque plays a large role in determining the overall environmental character of the middle valley, and must be considered a source of both tourism dollars and recreational opportunities for the region. Although some efforts to "save the bosque" originated outside of the context of endangered species management, riparian restoration is now being strongly

addressed in consultations regarding the minnow and the flycatcher. This will likely continue or increase if critical habitat is designated.

Summary of Adverse Effects of Alternative B

Alternative B proposes to designate as critical habitat all of the areas occupied currently by the Rio Grande silvery minnow. Because of the extensive Federal activities that take place on the Middle Rio Grande, obligations imposed primarily by the endangered status of the minnow but occurring co-extensively with critical habitat designation are substantial. A number of Federal agencies must consult with the Service on a range of activities, as described early in this chapter. Over time, agencies such as Reclamation and the Corps have been modifying their activities in response to ESA concerns such that by now the actions over which they consult include a combination of traditional and species-protective actions. The “single reasonable and prudent alternative” described in the 2001 Programmatic Biological Opinion, or any comparable approach taken in a later consultation, will continue to reshape Federal actions to benefit endangered species.

Among the actions of the Bureau of Reclamation, in particular, are efforts to secure supplemental water through purchase, lease, or with forbearance agreements to provide flows in reaches susceptible to drying (Reclamation 2001b). While these are actions considered protective of the environment, in the long run there may be unintended socio-economic consequences. Much less San Juan-Chama water is available for lease than previously, and water may be increasingly sought from other sources. To the extent that water rights are purchased or leased from the agricultural sector and the lands are retired from farming, there would be ripple effects on the communities that have provided goods and services for the support of agriculture. These have been modeled in the Final Economic Analysis at the regional level and described on the county level in *Social and Economic Impacts* above.

Some of the actions on which Federal agencies must consult are the permitting and/or funding of private or agency activities. In such cases, private parties and non-Federal entities are affected when the Federal decision-maker undergoes consultation. They may be affected by a slower, possibly more costly review process as well as by possible modifications to their activities.

Comparing Short-Term Uses and Long-Term Productivity

_____ In the short term, the Middle Rio Grande will continue to be managed under the RPA in the 2001 Programmatic Biological Opinion. Given the presence of the minnow in the Middle Rio Grande and the river management agencies’ awareness of its presence, the minnow will continue to receive protections under the ESA. Short-term commitments of resources would consist largely of the time and financial cost of additional Section 7 compliance requirements for Federal agency actions that might affect critical habitat. Additional protections resulting from designation will help ensure that habitat essential for the recovery and possible future de-listing

of the Rio Grande silvery minnow will remain available, in accordance with the recommendations of the Recovery Plan.

Irreversible and Irretrievable Commitments of Resources

Given the precarious status of the Rio Grande silvery minnow, the most irreversible and irretrievable loss would be the extinction of the species, if it were to be extirpated from the remaining reaches it inhabits. Possibly irretrievable commitments in counties such as Socorro or De Baca would be the loss of the farming-related businesses and agricultural way of life that could be a consequence of the purchase, lease, or forbearance agreement used by entities trying to keep water in the river for such co-extensive causes as endangered species protection and compact delivery requirements.

Cumulative Effects

“Cumulative impact” is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of the agency or person undertaking the actions (40 CFR 1508.7). Other actions affecting the Middle Rio Grande include the completion and operation of Cochiti Dam in 1975, the operation of diversion structures for irrigation, the channelization of the Rio Grande to improve deliveries to Texas under the Rio Grande Compact, and the gradual modification of floodplain vegetation. Population growth in urban centers, the mining of groundwater in the Albuquerque metropolitan area, the forthcoming diversion of San Juan-Chama waters for municipal contract holders, and future development of Pueblo water rights all put pressure on an already scarce resource, the Rio Grande.

Other significant actions include the listing of the Rio Grande silvery minnow and the southwestern willow flycatcher as endangered species, together with the legal obligations resulting from the listings. Most of the social and economic impacts on the Middle Rio Grande discussed in this chapter are the direct result of listing, and subsequent modification of actions undertaken to avoid jeopardy. Critical habitat designation for the minnow will have the effect of increasing the scope of and number of consultations by Federal agencies in the Middle Rio Grande Valley, and could require some project modifications. For the most part, however, designation will impose few additional obligations, and the impact on the environment should be a beneficial one.

As noted above, this FEIS does not provide detailed analyses for the reintroduction of the silvery minnow because any future recovery efforts, including repatriation of the species to areas of its historic range using the authorities of section 10(j) of the ESA must be conducted in accordance with NEPA and the ESA. The reasons for not conducting a detailed analyses were described above.

Sub-Alternative B-2 - Exclusion of Four Pueblo Lands in the Middle Rio Grande (Preferred Alternative)

As stated in Chapter 2, after a review of public comments received on the proposed designation, the draft economic analysis, and the DEIS and a re-evaluation of lands proposed as critical habitat, the Service has determined that changes to the proposed rule and the proposed action (Alternative B) presented in the DEIS were necessary. These changes are reflected in the final rule for the designation of critical habitat and are described in this sub-alternative. This alternative is not a new alternative, but rather a subset or “sub-alternative” of Alternative B. Instead of merely revising Alternative B to reflect the information received, the Service opted to develop this sub-alternative, so as to provide the reviewer with an opportunity to compare this revised proposal for the designation of critical habitat with the proposal (Alternative B-2) put forth in the DEIS. The critical habitat designation under this sub-alternative differs from Alternative B in two ways:

1. The southern boundary of critical habitat is the utility line crossing the Rio Grande at UTM 13–311474E, 3719722 N, just east of the Bosque Well demarcated on USGS Paraje Well 7.5 minute quadrangle (1980).
2. The Pueblo lands of Santo Doming, Santa Ana, Sandia and Isleta have been excluded from the designation in accordance with section 4(b)(2) of the ESA.

It is estimated that the impacts associated with this sub-alternative will be very similar to those described in Alternative B above. Therefore, the impact analysis will tier off of the information provided above. If impacts to a given resource are not detailed in this section, it is assumed that the impacts to this resource remain as described in Alternative B and do not warrant additional discussion in this section. Because this sub-alternative represents a subset of the designation described in Alternative B, it is not anticipated that any of the socio-economic impacts related to this sub-alternative would be greater than those described in Alternative B. Because the extent of the critical habitat designation is reduced under this sub-alternative, many of the impacts will be reduced as well.

Under this sub-alternative, the silvery minnow critical habitat designation in the Middle Rio Grande extends from Cochiti Dam, Sandoval County, downstream to the utility line crossing the Rio Grande at UTM 13–311474E, 3719722 N, a permanent identified landmark in Socorro County, New Mexico. The designation also includes the tributary Jemez River from Jemez Canyon Dam to the upstream boundary of Santa Ana Pueblo. The critical habitat designation defines the lateral extent (width) as those areas bounded by existing levees or, in areas without levees, 91.4 meters (300 feet) of riparian zone adjacent to each side of the bankfull stage of the middle Rio Grande. The Pueblo lands of Santo Domingo, Santa Ana, Sandia, and Isleta within this area are excluded under this sub-alternative. As discussed in Chapter 2, these four Pueblos

submitted special management plans during the comment period and based on the Services analysis under section 4(b)(2) of the ESA, it was determined that the benefits of excluding these Pueblo lands in the critical habitat designation outweighed the benefits of including them. For the purposes of our effects analysis, the excluded lands will be referred to as Pueblo Management Areas (PMAs). Except for these excluded lands, the last remaining portion of the silvery minnow's occupied range in the Middle Rio Grande in New Mexico is designated as critical habitat.

Designation as proposed in this alternative would not include the ephemeral or perennial irrigation canals and ditches outside of natural stream channels, including the Low Flow Conveyance Channel (LFCC), which is adjacent to a portion of the stream reach within the Middle Rio Grande downstream of the southern boundary of Bosque del Apache NWR to Elephant Butte Reservoir.

Certain lands located within the exterior boundaries of the proposed critical habitat designation (i.e., within the existing levees, or if no levees are present, then within a lateral distance of 91.4 m (300 ft) on each side of the stream width at bankfull discharge), are not considered critical habitat and are therefore excluded by definition. Lands located within the exterior boundaries of the critical habitat designation, but not considered critical habitat include: developed flood control facilities, existing paved roads, bridges, parking lots, dikes, levees, diversion structures, railroad tracks, railroad trestles, water diversion and irrigation canals outside of natural stream channels, the low flow conveyance channel, active gravel pits, cultivated agricultural land, and residential, commercial, and industrial developments (Service 2003).

(B-2) Impacts on Federal Agency Consultations

Exclusion of the PMAs from silvery minnow critical habitat may decrease the number of Federal agency consultations expected to occur as a result of designation on the Middle Rio Grande. The critical habitat designation under Sub-alternative B-2 represents approximately 73 percent of the Middle Rio Grande area proposed for designation under Alternative B (a 27 percent decrease in total area designated). Assuming that the likelihood of future consultations for critical habitat is evenly distributed across all designated areas, it can be estimated that exclusion of PMAs will result in a 27 percent reduction in the number of future consultations on the Middle Rio Grande attributable to designation. Thus 3-4 fewer formal and 9-10 fewer informal consultations would be expected to occur under this sub-alternative than under Alternative B. This reduction in consultation requirements is due to the decrease in the total area that would be designated as critical habitat under this sub-alternative. For those areas excluded under this sub-alternative, the need for consultations that solely address modifications to critical habitat would not exist. The Service, Reclamation, and the Corps would be the principal agencies affected by this reduction. The costs of Federal agency consultations pertaining to critical habitat on the Middle Rio Grande may also be reduced due to the reduction of area designated as critical habitat under this sub-alternative. For this reason, it is not expected that

the number of consultations, or the consultation and project modification costs would exceed those anticipated under Alternative B.

As discussed in Alternative B, the BIA, to date, has not consulted with the Service regarding activities affecting the silvery minnow. There is no baseline for BIA consultations, however, it is expected that the likelihood of future BIA consultations (discussed in Alternative B) would be reduced under this sub-alternative, due to the exclusion of the PMAs which are located on Pueblo lands. For Alternative B, the Final Economic Analysis estimates 0 formal and 6 informal consultations with the Service because of critical habitat designation on the Middle Rio Grande over the next 20 years (Industrial Economics 2003). Under this sub-alternative, the number of future BIA consultations related solely to critical habitat would likely be reduced since four of the six Pueblos located within the Middle Rio Grande would be excluded from the designation.

The PMAs excluded under this sub-alternative are considered occupied by the silvery minnow, and Federal agencies will continue to consult to ensure that the actions they authorize, fund, or carry out in these areas do not jeopardize the species. Thus, the number and cost of future section 7 consultations regarding jeopardy under this sub-alternative will be the same as those described for Alternative B. If conditions change in the future and these PMAs are not occupied by the species, Federal agencies may still have to engage in section 7 consultation on the silvery minnow because, for example, of indirect effect to the silvery minnow in downstream reaches. As described in Alternative B, section 7 consultation requirements for other species such as the flycatcher, would also continue.

Additionally, as Tribes and Pueblos become involved in water leasing or trading, future consultation with the Service is likely to occur, although consultations so far have originated with Reclamation rather than the BIA. Reclamation consulted in 2001 on leases with the Jicarilla Apache Nation and San Juan Pueblo for San Juan-Chama water. Tribal participation in the water market is likely to benefit the Rio Grande silvery minnow, and consultations are likely to remain informal. These consultations would occur regardless of whether critical habitat is designated in the PMAs because the species occupies the four areas that are excluded in this sub-alternative.

(B-2) Impacts on Federal Agency Actions

It is difficult to predict the extent to which Federal agencies would be impacted by the elimination of a consultation requirement for silvery minnow critical habitat in the excluded areas. As discussed in Alternative B, Federal actions have been affected and will continue to be affected by the consultation process undertaken by Reclamation and the Corps, stemming from the listing of the silvery minnow and the flycatcher. These impacts will continue to be felt in the excluded PMAs, regardless of designation. Actions undertaken to secure supplemental water to maintain flows in downstream reaches will be unaffected by the inclusion or exclusion of the PMAs lands in the critical habitat designation.

Future Federal agency projects in the excluded PMAs could be shaped differently through section 7 consultation since they would not be designated as critical habitat. As noted in Alternative B, designation could result in some added modification to projects in the river floodplain within the 91.4-meter (300-foot) lateral boundary. It is estimated that the estimated project modification costs associated solely with the designation of critical habitat as discussed under Alternative B would likely be reduced under this sub-alternative due to the exclusion of the PMAs. Because the exclusion of the PMAs result in a decreased area of designation, the project modification costs for 20 years on the Middle Rio Grande are expected to be less than or equal to those costs anticipated under Alternative B.

Although the project modification costs associated solely with the designation of critical habitat would be reduced under this sub-alternative, it is expected that project modifications associated with section 7 consultations for affects to the silvery minnow would remain the same as those anticipated under Alternative B. The excluded PMAs are considered occupied by the silvery minnow, and Federal agency actions in these areas will continue to be subject to modification through section 7 consultation to avoid causing jeopardy to the species.

(B-2) Impacts on water supply and use

Critical habitat designation as proposed in this sub-alternative would have no direct impact on existing water operations. Consultations on Middle Rio Grande Water Operations will continue to guide Federal actions on the river such that jeopardy to the silvery minnow is avoided. Target flows, sources of water to meet target flows, the pumping program, and habitat restoration programs are expected to be similar to those described for Alternative B. Thus, the impacts on water supply and use under this sub-alternative are anticipated to be the same as those described for Alternative B.

(B-2) Impacts on water rights

Regardless of the exclusion of the PMAs, Pueblo water rights may be affected if the Pueblos choose to develop a means of leasing water to Federal management agencies to provide downstream flows. As described in Alternative B, any such impact would come about solely through voluntary agreements on the part of the Pueblos. Otherwise, there should be no impact on Federal Indian water rights held by the Pueblos, which are recognized as senior to other claims to Rio Grande waters. Because water operations and management would not differ significantly between this sub-alternative and Alternative B, concerns the Middle Rio Grande Pueblos may have over development and maintenance of their water rights would apply equally to both alternatives.

(B-2) Impacts on water quality

State and Pueblo water quality standards already limit adverse impacts on water quality within the Middle Rio Grande. The management plans for the PMAs address water quality and include provisions for continued monitoring of water quality within these areas. Therefore, it is likely that water quality protections will continue in the excluded areas, regardless of designation.

(B-2) Impacts on vegetation

In the absence of designation, there will continue to be considerable management activity aimed at restoring native vegetation in the PMAs. Such activities have been identified in all of the special management plans submitted by the Pueblos. Therefore, it is expected that similar management attention and protections will be provided under this sub-alternative as described under Alternative B.

Although Federal agencies will continue to consult to avoid jeopardy to the silvery minnow and flycatcher, consultations related to projects that are undertaken in the PMAs would not be required to analyze the potential for adverse modification of critical habitat. Therefore, under this sub-alternative, the scope of section 7 consultations on riparian restoration projects within the PMAs would be the same as that described under Alternative A (No-Action).

(B-2) Impacts on the Rio Grande silvery minnow

It is anticipated that the special management plans developed by the Pueblos will provide conservation benefits to the silvery minnow and its habitat in the excluded PMAs. The special management plans (described in Appendix F), and comments submitted by the four Pueblos documents that meaningful collaborative and cooperative scientific studies will begin or continue within their lands. These commitments demonstrate the willingness of each Pueblo to work cooperatively with us toward landscape-scale conservation efforts that will benefit the silvery minnow. The four Pueblos have committed to several ongoing or future management, restoration, enhancement, and survey activities that would not occur as a result of critical habitat designation. The Service has also determined that the exclusion of the PMAs as described in this sub-alternative and the Final Rule will not affect the recovery and future delisting of the species. Therefore, the Service has determined that the benefits of excluding these areas from the critical habitat designation, as described in this sub-alternative, outweigh the benefits of including these areas as described in Alternative B.

(B-2) Impacts on other fish species

As described in Alternative B, efforts taken on behalf of the conservation of the silvery minnow are likely to benefit other native fish species as well. Although the PMAs would be excluded under this sub-alternative, the special management plans developed by the Pueblos will likely provide similar benefits to other fish species as those described under Alternative B.

Therefore, the potential benefits to other fish species is expected to be the same as described under Alternative B.

Potential impacts to fish in the smaller upstream reservoirs described in Alternative B should also remain the same since the special management plans and the excluded PMAs will not affect reservoir operations on the Rio Chama or the Rio Grande.

(B-2) Impacts on Other Threatened, Endangered and Candidate Species

Southwestern willow flycatcher

Impacts to the flycatcher are expected to be similar to those described under Alternative B. In all Middle Rio Grande reaches, including the Pueblo lands, the flycatcher is likely to benefit from water operations, river maintenance, and restoration activities by Federal management agencies intended to avoid the likelihood of jeopardy to the species (Service 2001b).

Although the special management plans focus on conservation needs of the minnow, it is anticipated that many of the conservation activities in these plans will also benefit flycatchers and flycatcher habitat within the excluded Pueblo lands. As with the designation of critical habitat, the special management plans will also further benefit the flycatcher through short-term and long-term improvements to breeding habitat. Under Alternative B, the critical habitat designation may confer some protections resulting from the requirement that consultation on affects to silvery minnow critical habitat would precede any alteration of riverside habitat in the Middle Rio Grande. Any protections resulting from this consultation requirements would be reduced under this sub-alternative due to the exclusion of the PMAs. In contrast, this reduction in consultation requirements may also reduce the administrative burden that could be associated with riparian habitat restoration projects within the excluded areas. Because the special management plans developed for the PMAs include riparian habitat restoration actions that may benefit the flycatcher, it anticipated that the impacts of this sub-alternative will be similar to those described in Alternative B.

Bald eagle, whooping crane, interior least tern, piping plover

The whooping crane and least tern are not likely to be significantly affected by silvery minnow listing or critical habitat designation on the Middle Rio Grande, and therefore it is unlikely that they will be significantly affected by the special management plans that have been developed for the PMAs. Only the bald eagle is likely to be present in the excluded areas and the potential impacts on the bald eagle are expected to be the same as those described under Alternative B.

Western yellow-billed cuckoo, a candidate species

To the extent that this sub-alternative results in any decrease in riparian habitat in the excluded areas, due to the reduced scope of consultation for actions in these areas, the cuckoo may fail to receive some benefits present under Alternative B. However, as noted above, restoration efforts by the Pueblos and by State and Federal agencies are expected to continue within the excluded areas and the special management plans developed for the Pueblo lands include riparian habitat restoration actions that may benefit the cuckoo. Therefore, it is anticipated that the impacts related to this sub-alternative will be the same as those described in Alternative B.

(B-2) Impacts on other wildlife

As stated above, protections granted to listed species and designated critical habitat under the ESA may have important secondary beneficial effects, by helping to preserve natural communities and ecosystems. It is expected that the implementation of the special management plans will provide similar secondary benefits to other wildlife in the excluded PMAs as those described under Alternative B. Therefore, it is anticipated that the impacts to other wildlife under this sub-alternative as will be the same as those described in Alternative B.

(B-2) Impacts on land use

Under Alternative B, the primary potential impacts on land use stem from the possibility that water rights may be purchased or leased from willing sellers, or forbearance agreements sought from the MRGCD or its members. Excluding the PMAs would not significantly reduce the impact of critical habitat designation on land use in the Middle Rio Grande. The need for supplemental water downstream would be the same as in Alternative B. If any of the Pueblos in the Middle Rio Grande choose to lease their water rights or participate in a forbearance program, the same acreage could potentially be taken out of agricultural production. Under designation, new construction or other new development of land uses within the 300-foot lateral boundary of critical habitat could be affected, if there is Federal involvement. Pueblo plans are not known, but based on the virtual absence of residential or commercial development within the 91.4-meter (300-foot) boundary along the Middle Rio Grande, such an impact is not considered likely. Under this sub-alternative any such impact arising from section 7 consultation regarding critical habitat would not be realized in the excluded Pueblo lands. Designation is not otherwise expected to affect the land use practices of those Pueblos included in the designation, or private parties next to the river. Therefore the impacts associated with this sub-alternative are not expected to differ from those described in Alternative B.

(B-2) Social and economic impacts

Potential social and economic impacts of listing and/or critical habitat designation arise largely from the efforts of Federal water managers to leave water in the river, or deliver water to specific river reaches, for the benefit of listed species. As discussed in Alternative B, there may be economic and social impacts associated with voluntarily acquiring water sufficient to

maintain target flows for the Isleta and San Acacia reaches. These impacts include the cost of voluntarily acquiring supplemental water and the secondary social and economic impacts of retiring land from agricultural production. These impacts will remain regardless of the inclusion or exclusion of the PMAs in the designation.

Because the Final Economic Analysis assesses economic impacts within a reach on a county-by-county basis, it is impossible to truly estimate the economic impacts of this sub-alternative. In general, the economic impact may be reduced for those Pueblos that have developed special management plans and are thus excluded in this sub-alternative. This sub-alternative may also reduce the overall economic impact of critical habitat designation that is described under Alternative B. It is not anticipated that this sub-alternative would result in economic impacts greater than those described under Alternative B. A reduced economic impact to those Pueblos that are excluded from the designation may also result in a lower economic impact within the counties and river reaches in which they are located. It is not anticipated that this sub-alternative would result in greater economic impacts at the county or reach level as those described under Alternative B.

It is possible that, at some point in the future, water rights held by one of the excluded Pueblos could be offered for sale or lease to a management agency seeking to secure river flows for listed species downstream. It may be expected that the market value of water rights will increase to the extent that management for listed species creates increased demand for water and water rights on the Middle Rio Grande. The degree to which the excluded Pueblos would participate in this market cannot be predicted. Secondary economic impacts of any such sales or leases will occur regardless of whether or not the Pueblos are included in the critical habitat designation.

(B-2) Impacts on Indian trust resources

Although significant impacts of critical habitat designation on the six Middle Rio Grande Pueblos and Indian trust resources are not expected, principles of tribal sovereignty and self-government may be furthered for those four Pueblos that are excluded from designation. Specifically, excluding the Pueblos of Santo Domingo, Santa Ana, Sandia, and Isleta may have the positive effect of assuring these four Pueblos that they have the relative freedom to manage their own river and riparian restoration efforts. Therefore, it is expected that this sub-alternative would have less of an impact on Indian Trust Resources than Alternative B. It is not anticipated that this sub-alternative would have any effects on tribal trust resources greater than those described under Alternative B.

Regardless of the critical habitat designation, Pueblo water rights may be affected if the Pueblos choose to develop a means of leasing water to Federal management agencies to provide downstream flows. Any such impact would come about solely through voluntary agreements on the part of the Pueblos. Otherwise, there would be no impact on Federal Indian water rights held by the Pueblos, which are recognized as senior to other claims to Rio Grande waters. Because

water operations and management would not differ significantly between this sub-alternative and Alternative B, concerns the six Middle Rio Grande Pueblos may have over development and maintenance of their water rights would apply equally to both alternatives (B and B-2).

Federal agencies funding, authorizing, or carrying out actions on Tribal lands included in the designation will be subject to the section 7 consultation process if the action may affect the silvery minnow or critical habitat. For those Pueblos that are excluded from the designation, Federal agencies funding, authorizing, or carrying out actions on those excluded lands would still be subject to the section 7 consultation process if the action may affect the silvery minnow. Section 7 requirements could be seen as placing an additional administrative burden on the future development of Pueblo water rights, to the extent that such development might occur through projects with Federal agency involvement (necessitating consultation). Exclusion of the PMAs could reduce this administrative burden for four of the Pueblos (Santo Domingo, Santa Ana, Sandia, and Isleta) in that future consultations would only have to address jeopardy to the species and not adverse modification of critical habitat. Potential impacts to the two Pueblos included in this designation (Pueblos of Cochiti and San Felipe) would be the same as described under Alternative B.

(B-2) Environmental justice effects

Some of the Pueblos commented during the scoping process that they should not bear the burden of conservation measures to remedy problems that are not of their making. Others have commented that they should not be constrained in the development of their water rights just because they have not had the opportunity to develop them. Concerns of this nature may be reduced for those Pueblos whose lands would be excluded from designation under this sub-alternative. No other unique environmental justice issues are expected to arise due to the exclusion of these Pueblos from designation. Environmental justice effects associated with the acquisition and supply of supplemental water are expected to remain as described in Alternative B, regardless of critical habitat designation on the Middle Rio Grande and regardless of the inclusion or exclusion of the PMAs in the designation.

(B-2) Impacts on cultural resources

As noted in Chapter 3, the NMHPD database contains little or no information on archeological sites that may be located on the Pueblo lands that are excluded from designation under this sub-alternative. Knowledge of such sites may reside with the Pueblos. No unique impacts on cultural resources are expected due to the exclusion of the PMAs from designation. Impacts of this alternative on cultural resources are unlikely to differ from the impacts described in Alternative B. It is possible that some archeological sites could be affected by actions taken to conserve and/or avoid jeopardy to the silvery minnow. Conceivable impacts include inundation during deliberate overbank flooding, or disturbance during vegetation removal carried out as part of habitat restoration efforts.

Some Pueblos (including three of the four Pueblos excluded from the designation) have already embarked on bosque restoration projects, including the use of overbank flooding to stimulate the growth of native vegetation. As these projects are carried out under Pueblo authority and control, no negative impacts on any known sacred or archeological sites are anticipated. The ability of the six Middle Rio Grande Pueblos to conserve, protect, and have access to sacred sites should remain the same whether critical habitat is designated or not. The reasoning for this is that there is no Federal nexus associated with such actions, and such activities would not be expected to affect the primary constituent elements. (See the discussion in Alternative B for the general approach being taken with regard to cultural resources in this FEIS).

(B-2) Impacts on recreation

Recreational activities on or near the river in the reach are unlikely to be directly affected by critical habitat designation, due to the absence of a Federal nexus. Therefore, no unique impacts are expected to result from the exclusion of the PMAs from the designation and potential recreation impacts associated with this sub-alternative will be similar to those described in Alternative B.

Summary of Adverse Effects of Sub-alternative B-2

Sub-alternative B-2 is the Preferred Alternative and proposes to designate as critical habitat all of the areas currently occupied by the Rio Grande silvery minnow, with the exception of the four Pueblos (Santo Domingo, Santa Ana, Sandia, and Isleta) that submitted special management plans directed towards the conservation of the silvery minnow and its habitats within their lands. The designation under Sub-alternative B-2 also differs from Alternative B in the location of the southern boundary. Changing the southern boundary of the critical habitat designation from Elephant Butte Dam to the utility line crossing the Rio Grande at UTM 13–311474E, 3719722 N, would not significantly decrease or change the southern extent of the designation because most of the area south of the utility line was excluded by definition in the Proposed Rule. Any areas below the southern terminus (67 FR 39206) would still be subject to consultation under section 7 of the ESA for jeopardy analysis. Adverse impacts of listing and critical habitat designation in areas outside of the PMAs largely mirror those anticipated under Alternative B. Although the lands of four Pueblos would be excluded from the critical habitat designation, it is anticipated that the benefits to the silvery minnow that are associated with the exclusion of these lands from the critical habitat designation will outweigh the benefits associated with the inclusion of these lands as part of the designation (See discussion in Chapter 2). Consultation would still be required for projects undertaken in the PMAs due to the federally listed status of the silvery minnow, but adverse modification of critical habitat would not have to be considered. It is possible that some Federal actions on the river floodplain in the PMAs would be affected differently by the consultation process under this sub-alternative than under Alternative B.

Although the critical habitat designation may help Federal agencies and others prioritize or guide their efforts to restore the river corridor, it is not expected that less attention or funding would be provided for river and riparian habitat restoration projects in the PMAs. The special management plans developed for the PMAs will continue to guide the implementation of restoration activities within the excluded areas. In addition, exclusion of the PMAs could relieve the Pueblos of Santo Domingo, Santa Ana, Sandia and Isleta of some administrative burden regarding actions on or near the Rio Grande, and would be consistent with the principles of tribal sovereignty and self-government.

Comparing Short-term Uses and Long-term Productivity

In the short term, management of the Rio Grande, including the PMAs, will continue to be guided by consultations on Middle Rio Grande water operations, regardless of critical habitat designation. Depending on the outcome of ongoing ESA Work Group and Upper Rio Grande Water Operations (URGWOP) studies, future programmatic section 7 consultation by Reclamation and the Corps would likely result in a comparable set of management actions due to the ongoing need to avoid jeopardy to the silvery minnow.

Short-term commitments of resources, in the form of Federal agency and third party expenses associated with the section 7 consultation process, would be reduced under this sub-alternative because impacts to critical habitat would not have to be considered for activities undertaken in the excluded PMAs. The special management plans and critical habitat designation, in conjunction with listing, should provide additional and immediate protection to physical and biological features considered essential for the conservation of the silvery minnow. Therefore, Sub-alternative B-2, should provide similar or additional conservation benefits to silvery minnow habitat as those described in Alternative B. In the long term, the critical habitat designation and special management plans may also provide some added degree of consistency to habitat protection, regardless of the potentially changing biological status of the silvery minnow. In the long term, the likelihood that habitat essential for the conservation and recovery of the silvery minnow will be preserved is the same for both Sub-alternative B-2 and Alternative B. Other short-term and long-term consequences of this sub-alternative are generally the same as those described for Alternative B.

Irreversible and Irretrievable Commitment of Resources

As discussed in Alternative B, due to the precarious status of the silvery minnow, the most irreversible and irretrievable loss would be the extinction of the species, if it were to be extirpated from the remaining reaches it inhabits. Possibly irretrievable commitments in counties such as Socorro County would be the loss of the farming-related businesses and agricultural way of life that could be a consequence of the purchase, lease, or forbearance agreement used by entities trying to keep water in the river for such co-extensive causes as endangered species protection and compact delivery requirements. Therefore, the potential

irreversible and irretrievable commitment of resources under this sub-alternative are anticipated to be the same as those described in Alternative B.

Cumulative Effects

“Cumulative impact” is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of the agency or person undertaking the actions (40 CFR 1508.7). The set of cumulative effects impacting the environment on the Middle Rio Grande, and influencing management decisions and practices regarding the river and its floodplain, were described in Alternative B. It is anticipated that cumulative effects would be the same under this sub-alternative.

Alternative C – The Middle Rio Grande from Cochiti Dam to Elephant Butte Dam, and the lower Jemez River, excluding the Cochiti reach

Under this alternative the reach proposed for designation as critical habitat under Alternative B would be designated, with the exception of the Cochiti reach. The Cochiti reach consists of 34 kilometers (21 miles) of river immediately downstream of Cochiti Reservoir to the Angostura Diversion Dam. Most of the lands in the Cochiti reach belong to the Pueblos of Cochiti, Santo Domingo, and San Felipe.

Because designation under this alternative closely mirrors that proposed under Alternative B, similar or identical impacts are expected for reaches included in both alternatives. The following sections highlight those unique impacts that may occur owing to the exclusion of Cochiti reach from critical habitat designation.

(C) Impacts on Federal Agency Consultations

At least three consultations since 1994 have taken place on agency activities exclusively within the Cochiti reach. In all cases the activities in question—the stocking of sport fish in Cochiti Reservoir, bridge improvements north of Peña Blanca, and a subsurface drainage project at Pena Blanca—were determined not to affect the silvery minnow. In addition, activities in the Cochiti reach have been considered in broader consultations regarding water operations, including programmatic consultations by Reclamation and the Corps regarding actions across the entire Middle Rio Grande.

Exclusion of the Cochiti reach from silvery minnow critical habitat may decrease the number of Federal agency consultations expected to occur as a result of designation on the Middle Rio Grande. Cochiti reach includes roughly 12 percent of the Middle Rio Grande area proposed for designation under Alternative B. Assuming that the likelihood of future

consultations for critical habitat is evenly distributed across all designated areas, it can be estimated that exclusion of Cochiti reach will result in a 12 percent reduction in the number of future consultations on the Middle Rio Grande attributable to designation. Thus 1-2 fewer formal and 4-5 fewer informal consultations would be expected to occur under this alternative than under Alternative B. The Service, Reclamation, and the Corps would be the principal agencies affected by this reduction. The likelihood of future BIA consultations (discussed in Alternative B) may also be reduced, due to the reduction in the number of Pueblos affected by the designation.

The costs of Federal agency consultations pertaining to critical habitat on the Middle Rio Grande may also be reduced. Using the figures presented in Appendix D of the Final Economic Analysis, excluding the Cochiti reach would result in total consultation costs over 20 years on the Middle Rio Grande ranging from \$832,600 to \$2,083,700 , a savings of \$376,800 - \$578,800 over Alternative B (Industrial Economics 2003).

The Cochiti reach is considered occupied by the silvery minnow, and Federal agencies will continue to consult to ensure that the actions they authorize, fund, or carry out do not jeopardize the species. Thus the number and cost of future section 7 consultations regarding jeopardy will be the same under this alternative as Alternative B. If conditions change in the future and the Cochiti reach is not occupied by the species, Federal agencies may still have to engage in section 7 consultation on the silvery minnow because, for example, of indirect effect to the silvery minnow in downstream reaches. However, section 7 consultation requirements for other species such as the flycatcher, would continue.

(C) Impacts on Federal agency actions

It is difficult to predict the extent to which Federal agencies would be impacted by the elimination of a consultation requirement for silvery minnow critical habitat in the Cochiti reach. As discussed in Alternative B, Federal actions have been affected and will continue to be affected by the consultation process undertaken by Reclamation and the Corps, stemming from the listing of the silvery minnow and the flycatcher. These impacts will continue to be felt in the Cochiti reach, regardless of designation. Actions undertaken to secure supplemental water to maintain flows in downstream reaches will be unaffected by the inclusion or exclusion of Cochiti reach in the critical habitat designation.

One possible result of designation is to focus management attention on the habitat requirements of the silvery minnow, and to increase support for habitat restoration efforts. Habitat restoration projects for the Cochiti reach may receive less agency support if the reach is not designated critical habitat. On the other hand, given the Federal government's trust responsibilities, it may be unlikely that habitat restoration on Pueblo lands would receive less management attention or Federal funding.

Future Federal agency projects in the Cochiti reach could be shaped differently through section 7 consultation if the reach is not designated as critical habitat. As noted in Alternative B, designation could result in some added modification to projects in the river floodplain within the 91.4-meter (300-foot) lateral boundary. Consequently, it may be estimated that Middle Rio Grande project modification costs will be reduced due to exclusion of the Cochiti reach as proposed in this alternative. Using the cost figures in the Final Economic Analysis, excluding the Cochiti reach would result in project modification costs for 20 years on the Middle Rio Grande ranging from \$3.5 million to \$6.4 million, a savings of \$1.0 million - \$1.7 million over Alternative B (Industrial Economics 2003).

The Cochiti reach is considered occupied by the silvery minnow, and Federal agency actions will continue to be subject to modification through section 7 consultation to avoid causing jeopardy to the species. Thus the number and cost of future project modifications undertaken to avoid jeopardy will be the same in this alternative as Alternative B.

(C) Impacts on water supply and use

No supplemental water is needed to maintain river flows in the Cochiti reach. Regardless of designation, the river in the Cochiti reach will continue to be affected by Cochiti Dam operations, as carried out by the Corps in consultation with the Service. At times the Cochiti reach will carry supplemental flows released from Cochiti Reservoir to avoid drying conditions in downstream reaches that might jeopardize the silvery minnow. Impacts resulting from target flow provisions of the RPA in the Service's 2001 Programmatic Biological Opinion, or subsequent biological opinions, will be as described in Alternative B.

As discussed in Alternative B, habitat restoration and bioengineering projects intended to benefit listed species may increase or decrease net depletions, although this is likely contingent upon project design. The OSE requires that any increase in non-Indian net depletions of water be offset in the Middle Rio Grande Project area. General improvements to the river and riparian areas by habitat restoration include restoring connectivity between the river and its floodplain with overbank flows; removing non-native and reintroducing native vegetation; and widening the river channel to allow more natural river conditions with aquatic habitats conducive to native fish. Such restoration projects are already under way, and are expected to continue in response to both listing (e.g. Service 2001b) and critical habitat designation. Exclusion of the Cochiti reach from designation may result in some decreased focus on restoration projects in this reach, and hence some reduction in the potential for any additional net depletions that such projects may cause.

(C) Impacts on water rights

Regardless of designation in the Cochiti reach, Pueblo water rights may be affected if the Pueblos choose to develop a means of leasing water to Federal management agencies to provide downstream flows. Any such impact would come about solely through voluntary agreements on

the part of the Pueblos. Otherwise, there should be no impact on Federal Indian water rights held by the Pueblos, which are recognized as senior to other claims to Rio Grande waters. Because water operations and management would not differ significantly between this alternative and Alternative B, concerns the Middle Rio Grande Pueblos may have over development and maintenance of their water rights would apply equally to both alternatives.

Federal agencies funding, authorizing, or carrying out actions on Pueblo and Tribal lands will be subject to the section 7 consultation process if the action may affect the silvery minnow or critical habitat. Thus section 7 requirements may be seen as placing an additional administrative burden on the future development of Pueblo water rights, to the extent that such development might occur through projects with Federal agency involvement. Exclusion of the Cochiti reach would reduce this administrative burden somewhat for the three Pueblos within the reach (Cochiti, Santo Domingo, and San Felipe) in that future consultations would only have to address jeopardy and not adverse modification of critical habitat.

(C) Impacts on water quality

State and Pueblo water quality standards already limit adverse impacts on water quality within the Middle Rio Grande. In section 7 consultations on NPDES permitting, the Service may continue to recommend additional toxicity testing at times to ensure that wastewater discharges do not jeopardize the silvery minnow. These protections will likely continue in the Cochiti reach regardless of designation.

As discussed in Alternative B, the list of primary constituent elements considered essential for the primary biological needs of the silvery minnow are: “Water of sufficient quality to maintain natural, daily, and seasonally variable water temperatures in the approximate range of greater than 1°C (35°F) and less than 30°C (85°F) and reduce degraded water quality conditions (decreased dissolved oxygen, increased p.H., etc.)” (Service 2002). While helping to clarify the needs of the species, this primary constituent element is unlikely to confer any higher standard of protection for water quality than that already established by State and Federal regulations and by virtue of the listing of the species. Thus critical habitat designation is expected to have no significant water quality impacts on the Middle Rio Grande as a whole, and exclusion of the Cochiti reach is expected to have no unique effects.

(C) Impacts on vegetation

In the absence of designation, there will still be considerable management activity aimed at restoring native vegetation in the Cochiti reach. Restoration projects will be undertaken largely by the Pueblos within the reach, with assistance from Reclamation and other State and Federal agencies, and are intended primarily to preserve and stimulate regeneration of the native riparian forest. Although such projects are expected to continue, it is possible that, lacking the additional focus provided by designation, restoration efforts in the Cochiti reach will receive less

management attention under this alternative than under Alternative B. Here, as in other reaches, it should be noted that riparian restoration projects may originate from multiple sources, including Federal agency conservation efforts and section 7 consultations under the ESA, and from bosque preservation initiatives outside of the context of endangered species management.

Although Federal agencies will continue to consult to avoid jeopardy to the silvery minnow and flycatcher, exclusion of the Cochiti reach would eliminate the requirement that consultation address possible adverse modification of critical habitat in this reach. This may result in a somewhat lower level of protection (relative to Alternative B) for riparian vegetation within the 300-foot lateral boundary of critical habitat. On the other hand, section 7 consultations on restoration projects themselves may be simplified if silvery minnow critical habitat does not have to be considered.

All impacts on vegetation downstream from Angostura Diversion Dam will be identical to those described under Alternative B. Native vegetation in all Middle Rio Grande reaches including Cochiti is expected to benefit from water operations, river maintenance, and restoration activities by Federal management agencies intended to avoid the likelihood of jeopardy to the silvery minnow and flycatcher (Service 2001b). Over time, such actions are expected to benefit multiple species by promoting the conservation of biological diversity, protecting ecological services (Altieri 1999, Falkenmark 2000), and contributing to the ecosystem health (Rapport and Whitford 1999, Rapport 2000) of the Middle Rio Grande Valley (Crawford *et al.* 1993).

(C) Impacts on the Rio Grande silvery minnow

Because the silvery minnow population in the Cochiti reach is low, excluding this reach is not likely to change the total size or percentage of the species population occurring within the boundaries of critical habitat. The silvery minnow, to the extent it is present in the Cochiti reach, would continue to receive protection from jeopardy and “take” under the ESA. The species would continue to benefit from habitat restoration provisions in the Service’s 2001 Programmatic Biological Opinion, and likely to be continued in future biological opinions. Exclusion of the Cochiti reach from the area of designated critical habitat does not preclude implementation of the Recovery Plan in this reach.

It is possible that some areas of existing or potential silvery minnow habitat in the Cochiti reach may be adversely modified or destroyed as a result of Federal actions that would have been avoided or changed as a result of section 7 consultation under Alternative B. There may also be some negative impacts on the silvery minnow if exclusion of this reach results in decreased management attention, or slows efforts to restore or create more areas of suitable habitat in the reach. In that case, current river flow and channel characteristics unfavorable to the silvery minnow will be more likely to persist for a longer time and/or over a wider area.

All impacts on the silvery minnow downstream from Angostura Diversion Dam will be identical to those described under Alternative B. In all Middle Rio Grande reaches, including Cochiti, the silvery minnow is likely to benefit from water operations, river maintenance, and restoration activities by Federal management agencies intended to avoid the likelihood of jeopardy to the species (Service 2001b).

(C) Impacts on other fish species

As described in Alternative B, efforts taken on behalf of the conservation of the silvery minnow to create a more natural hydrograph on the Middle Rio Grande, and to restore aquatic and riparian habitat, are likely to benefit other native fish species as well. Under this alternative native fish species in the Cochiti reach would continue to benefit from habitat restoration provisions in the Service's 2001 Programmatic Biological Opinion specific to that reach. Impacts on Middle Rio Grande fish species and communities downstream from Angostura Diversion Dam will be identical to those described under Alternative B. In all Middle Rio Grande reaches, including Cochiti, native fish species and communities are likely to benefit from water operations, river maintenance, and restoration activities by Federal management agencies intended to avoid the likelihood of jeopardy to the silvery minnow and flycatcher (Service 2001b).

It is possible that some areas of existing or potential silvery minnow habitat in the Cochiti reach may be adversely modified or destroyed as a result of Federal actions that would have been avoided or changed as a result of section 7 consultation under Alternative B. This might have a negative impact on other fish species with similar habitat requirements. There may also be some negative impacts on native fish if exclusion of the Cochiti reach from designation results in decreased management attention to the habitat requirements of the silvery minnow, or slows efforts to restore or create more areas of suitable habitat in the reach.

(C) Impacts on other threatened, endangered and candidate species

Southwestern willow flycatcher

It is unclear to what extent the available suitable habitat for the flycatcher has been surveyed within the Cochiti reach. Flycatcher surveys have been conducted within this reach, however the results have not been made available to the Service and therefore the Service is unaware of any occupied habitats within this reach. Efforts to restore native vegetation may create more suitable breeding habitat, and lead to flycatcher occupancy of this area in the future. To the extent that this alternative results in any decreased attention to riparian habitat restoration in the Cochiti reach, the flycatcher may fail to receive some benefits present under Alternative B. However, as noted above, restoration efforts by the Pueblos and by State and Federal agencies are expected to continue.

Impacts on the flycatcher in reaches downstream from Angostura Diversion Dam will be identical to those described under Alternative B. In all Middle Rio Grande reaches, including Cochiti, the flycatcher is likely to benefit from water operations, river maintenance, and restoration activities by Federal management agencies intended to avoid the likelihood of jeopardy to the species (Service 2001b).

Bald eagle, whooping crane, interior least tern, piping plover

Only the bald eagle is likely to be present in the Cochiti reach. As discussed in Alternative B, the whooping crane, least tern, and piping plover are not likely to be affected by critical habitat designation on the Middle Rio Grande. Exclusion of the Cochiti reach from designation is not expected to affect these species. Exclusion of the Cochiti reach may possibly result in some lower degree of protection to vegetation that may be used for roosting by the bald eagle; otherwise no unique impacts on the bald eagle are expected.

Impacts on all four threatened or endangered bird species in reaches downstream from Angostura Diversion Dam will be identical to those described under Alternative B. In all Middle Rio Grande reaches, including Cochiti, the bald eagle may receive some benefit from water operations, river maintenance, and restoration activities by Federal management agencies intended to avoid the likelihood of jeopardy to the silvery minnow and flycatcher (Service 2001b).

Western yellow-billed cuckoo, a candidate species

To the extent that this alternative results in any decreased attention to riparian habitat restoration in the Cochiti reach, the cuckoo may fail to receive some benefits present under Alternative B. However, as noted above, restoration efforts by the Pueblos and by State and Federal agencies are expected to continue.

Impacts on the cuckoo in reaches downstream from Angostura Diversion Dam will be identical to those described under Alternative B. In all Middle Rio Grande reaches, including Cochiti, the cuckoo is likely to benefit from water operations, river maintenance, and restoration activities by Federal management agencies intended to avoid the likelihood of jeopardy to the silvery minnow and the flycatcher (Service 2001b).

(C) Impacts on other wildlife

To the extent that this alternative results in any decreased attention to riparian habitat restoration in the Cochiti reach, some species may fail to receive some benefits present under Alternative B. However, as noted above, restoration efforts by the Pueblos and by State and Federal agencies are expected to continue.

Wildlife impacts in reaches downstream from Angostura Diversion Dam will be identical to those described under Alternative B. Some negative impacts on migratory cranes and waterfowl are possible, if water is diverted from the irrigation of crops used as forage at Bosque del Apache NWR in order to help provide supplemental flows, as described in Alternative B. In all Middle Rio Grande reaches, including Cochiti, a variety of wildlife species may receive some benefit from water operations, river maintenance, and restoration activities by Federal management agencies intended to avoid the likelihood of jeopardy to the silvery minnow and the flycatcher (Service 2001b). Over time, such actions are expected to benefit multiple species by promoting the conservation of biological diversity, protecting ecological services (Altieri 1999, Falkenmark 2000), and contributing to the ecosystem health (Rapport and Whitford 1999, Rapport 2000) of the Middle Rio Grande Valley (Crawford *et al.* 1993). Wildlife species that may benefit from this management approach include reptiles and amphibians, small mammals inhabiting the riparian corridor, and a large number of migratory songbirds that use the Rio Grande bosque as breeding or migratory stopover habitat.

(C) Impacts on land use

Excluding the Cochiti reach would not significantly reduce the impact of critical habitat designation on land use in the Middle Rio Grande. The need for supplemental water downstream would be the same as in Alternative B. If the Pueblos choose to lease their water rights or participate in a forbearance program, the same acreage could potentially be taken out of agricultural production. Under designation, new construction or other new development of land uses within the 300-foot lateral boundary could be affected, if there is Federal involvement. Pueblo plans are not known, but based on the virtual absence of residential or commercial development with the 91.4-meter (300-foot) boundary along the Middle Rio Grande, such an impact is not considered likely. Under this alternative any such impact arising from section 7 consultation regarding critical habitat would not be realized in the Cochiti reach. Designation is not otherwise expected to affect the land use practices of the Pueblos or of private parties next to the river, so no unique impacts of excluding the Cochiti reach from designation are expected.

(C) Social and economic impacts_____

Potential social and economic impacts of listing and/or critical habitat designation arise largely from the efforts of Federal water managers to leave water in the river, or deliver water to specific river reaches, for the benefit of listed species. As discussed in Alternative B, there may be economic and social impacts associated with voluntarily acquiring water sufficient to maintain target flows for the Isleta and San Acacia reaches. These impacts include the cost of voluntarily acquiring supplemental water and the secondary social and economic impacts of retiring land from agricultural production. These impacts will remain regardless of the inclusion or exclusion of Cochiti reach in the designation.

There is no need for supplemental water in the Cochiti reach, and therefore the Final Economic Analysis estimates no opportunity costs for maintaining flows in this reach. As a result, the Final Economic Analysis also estimates no secondary economic effects resulting from the management of river flows within the Cochiti reach. The Final Economic Analysis does not consider secondary social and economic impacts that might occur as a result of reallocating water from use within the Cochiti reach to maintain target flows downstream; again, such impacts are not affected by designation. Economic impacts are considered on a county-by-county basis in Alternative B.

It is possible that, at some point in the future, water rights held by one of the Pueblos, or another party in the Cochiti reach, could be offered for sale or lease to a management agency seeking to secure river flows for listed species downstream. It may be expected that the market value of water rights will increase to the extent that management for listed species creates increased demand for water and water rights on the Middle Rio Grande. The degree to which water rights holders in the Cochiti reach would participate in this market cannot be predicted. Secondary economic impacts of any such sales or leases will occur regardless of whether or not Cochiti reach is included in the critical habitat designation.

Any existing farms, developed areas, and commercial facilities occurring within the 91.4-meter (300-foot) lateral boundary are not expected to be directly affected by designation. Such areas are specifically excluded from the definition of critical habitat (Service 2002). It is conceivable that designation might affect (through consultation requirements) the future development of economic or commercial activities on lands that would be included within the boundaries of critical habitat, if such development required Federal involvement. The Service is currently not aware of any such plans or circumstances. Any such possible future impact would not occur on the Cochiti reach under this alternative. Otherwise, exclusion of the Cochiti reach from designation is expected to result in no direct economic savings or costs to any private party.

As discussed in Alternative B, a number of tangible and intangible social and economic benefits may be associated with the protections given the silvery minnow under Federal listing, and with critical habitat designation. Present and expected future actions taken on behalf of the silvery minnow are expected over time to help conserve biological diversity, protect ecological services, and contribute to the ecosystem health of the Middle Rio Grande Valley. Although it remains difficult to assign precise economic values to these functions, the potential exists for such values to help offset the more easily calculated costs associated with endangered species protection. The added protections of critical habitat designation may increase these benefits to some unknowable degree. To the same degree, exclusion of Cochiti reach from designation may result in a lower net benefit to the Middle Rio Grande Valley than would be present under Alternative B.

(C) Impacts on Indian trust resources

Although significant impacts of critical habitat designation on the Pueblos and Indian trust resources are not expected, principles of tribal sovereignty and self-government may be furthered if the reach is excluded from designation. Specifically, excluding the Cochiti reach may have the positive effect of assuring the three Pueblos within the reach—Cochiti, Santo Domingo, and San Felipe—that they have relative freedom to manage their own river and riparian restoration efforts. On the other hand, a possible reduced focus on this reach by Federal and State agencies could result in less support for those efforts.

Regardless of designation in the Cochiti reach, Pueblo water rights may be affected if the Pueblos choose to develop a means of leasing water to Federal management agencies to provide downstream flows. Any such impact would come about solely through voluntary agreements on the part of the Pueblos. Otherwise, there would be no impact on Federal Indian water rights held by the Pueblos, which are recognized as senior to other claims to Rio Grande waters. Because water operations and management would not differ significantly between this alternative and Alternative B, concerns the Middle Rio Grande Pueblos may have over development and maintenance of their water rights would apply equally to both alternatives.

Federal agencies funding, authorizing, or carrying out actions on Indian Pueblo and Tribal lands will be subject to the section 7 consultation process if the action may affect the silvery minnow or critical habitat. Thus section 7 requirements could be seen as placing an additional administrative burden on the future development of Pueblo water rights, to the extent that such development might occur through projects with Federal agency involvement (necessitating consultation). Exclusion of the Cochiti reach could reduce this administrative burden somewhat for the three Pueblos within the reach (Cochiti, Santo Domingo, and San Felipe) in that future consultations would only have to address jeopardy to the species and not adverse modification of critical habitat.

(C) Environmental justice effects

Some of the Pueblos commented during the scoping process that they should not bear the burden of conservation measures to remedy problems that are not of their making. Others have commented that they should not be constrained in the development of their water rights just because they have not had the opportunity to develop them. Concerns of this nature may be reduced for those Pueblos whose lands would be excluded from designation under this alternative. No other unique environmental justice issues are expected to arise due to the exclusion of Cochiti reach from designation. Environmental justice effects associated with the acquisition and supply of supplemental water to downstream reaches are expected to remain as described in Alternative B, regardless of critical habitat designation on the Middle Rio Grande and regardless of the inclusion or exclusion of Cochiti reach in that designation.

(C) Impacts on cultural resources

As noted in Chapter 3, the NMHPD database contains little or no information on archeological sites that may be located on Pueblo lands in the Cochiti reach. Knowledge of such sites may reside with the Pueblos. No unique impacts on cultural resources are expected due to the exclusion of Cochiti reach from designation. Impacts of this alternative on cultural resources are unlikely to differ from the impacts of Alternative B. It is possible that some archeological sites could be affected by actions taken to conserve and/or avoid jeopardy to the silvery minnow. Conceivable impacts include inundation during deliberate overbank flooding, or disturbance during vegetation removal carried out as part of habitat restoration efforts.

Some Pueblos have already embarked on extensive bosque restoration projects, including the use of overbank flooding to stimulate the growth of native vegetation. As these projects are carried out under Pueblo authority and control, no negative impacts on any known sacred or archeological sites are anticipated. The ability of the Pueblos in the Cochiti reach to conserve, protect, and have access to sacred sites should remain the same whether critical habitat is designated or not, both because there is no Federal nexus and because such activities would not be expected to affect the primary constituent elements. (See the discussion in Alternative B for the general approach being taken with regard to cultural resources in this FEIS).

(C) Impacts on recreation

Recreational activities on or near the river in the reach are unlikely to be directly affected by critical habitat designation, due to the absence of a Federal nexus. Therefore no unique impacts are expected to result from the exclusion of the Cochiti reach from designation. Recreational activities on Cochiti Reservoir may be affected by water releases as described in Alternative B, regardless of designation. The scope of consultations regarding the stocking of sport fish in Cochiti Reservoir may be slightly reduced if critical habitat is not designated in the Cochiti reach, but stocking operations would probably not be affected.

Summary of Adverse Effects of Alternative C

Alternative C differs from Alternative B only in the exclusion of the Cochiti reach from critical habitat designation. Adverse impacts of listing and critical habitat designation in areas outside of the Cochiti reach largely mirror those anticipated under Alternative B. The principal unique adverse effect of Alternative C is that the Cochiti reach would not be accorded the increased level of protection that designation may provide. Consultation would still be required due to the federally listed status of the silvery minnow, but adverse modification of critical habitat would not have to be considered. It is possible that some Federal actions on the river floodplain in the Cochiti reach would be affected differently by the consultation process under this alternative than Alternative B.

Federal agencies and others would not have critical habitat designation to help them prioritize or guide their efforts to restore the river corridor, and less attention may be paid to providing funding and assistance for river and riparian habitat restoration projects in the reach.

On the other hand, exclusion of the reach could relieve the Pueblos of Cochiti, Santo Domingo, and San Felipe of some administrative burden regarding actions on or near the Rio Grande, and would be consistent with the principles of tribal sovereignty and self-government.

Comparing Short-term Uses and Long-term Productivity

In the short term, management of the Rio Grande, including the Cochiti reach, will continue to be guided by the Service's 2001 Programmatic Biological Opinion and RPA, regardless of critical habitat designation. Depending on the outcome of ongoing ESA Work Group and Upper Rio Grande Water Operations (URGWOP) studies, future programmatic section 7 consultation by Reclamation and the Corps would likely result in a comparable set of management recommendations due to the ongoing need to avoid jeopardy to the silvery minnow.

Short-term commitments of resources, in the form of Federal agency and third party expenses associated with the section 7 consultation process, would be reduced under this alternative because impacts on critical habitat in the Cochiti reach would not have to be considered. On the other hand, in conjunction with listing, designation may provide additional and immediate protection to physical and biological features considered essential for the conservation of the silvery minnow. Under Alternative C, this added protection would not extend to the Cochiti reach. In the long term, designation may also provide some added degree of consistency to habitat protection, regardless of the potentially changing biological status of the species; this benefit likewise would not extend to the Cochiti reach. For these reasons, in the long run this alternative may result in a somewhat lower likelihood that habitat essential for the conservation and recovery of the silvery minnow will be preserved. Other short-term and long-term consequences of this alternative outside of the Cochiti reach are largely as described for Alternative B.

Irreversible and Irrecoverable Commitment of Resources

Under historical river management practices, the Rio Grande in the Cochiti reach has become narrower, incised in its bed, and disconnected from the floodplain. To the extent such practices are continued, it becomes increasingly difficult to restore the natural functioning of the river and to create more favorable conditions for the silvery minnow in this reach. Designation would add support to restoration and other management efforts aimed at preventing the permanent loss of this reach from the already short list of river segments that may potentially sustain silvery minnow populations. Excluding the Cochiti reach from designation could have the opposite effect. Extirpation of the silvery minnow from the Cochiti reach would be an irreversible and irretrievable loss of a biological resource.

Cumulative Effects

“Cumulative impact” is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable

future actions regardless of the agency or person undertaking the actions (40 CFR 1508.7). The set of cumulative effects impacting the environment on the Middle Rio Grande, and influencing management decisions and practices regarding the river and its floodplain, were described in Alternative B. Cumulative effects are the same under this alternative.

Alternative D – The Middle Rio Grande from Cochiti Dam to Elephant Butte Dam, and the lower Jemez River, Excluding the San Acacia Reach

Under this alternative the reach proposed for designation as critical habitat under Alternative B would be designated, with the exception of the San Acacia reach. The San Acacia reach extends 148 kilometers (92 miles), from San Acacia Diversion Dam to Elephant Butte Dam, with the waters of Elephant Butte Reservoir specifically excluded from designation. Depending on reservoir levels, this reach includes approximately 97 kilometers (60 miles) of the Rio Grande below San Acacia Diversion Dam. This reach has been the site of river drying in recent years, and is thought to contain up to 95 percent of the existing silvery minnow population.

Because designation under this alternative closely mirrors that proposed under Alternative B, similar or identical impacts are expected for reaches included in both alternatives. The following sections highlight those unique impacts that may occur owing to the exclusion of San Acacia reach from critical habitat designation.

(D) Impacts on Federal Agency Consultations

Since 1994, a number of consultations have taken place on agency activities exclusively within the San Acacia reach. Subjects of past consultations include levee reconstruction (Corps); LFCC operational studies, sediment removal operations, construction of a temporary channel to Elephant Butte Reservoir, and repair of eroding river banks (Reclamation); NPDES permitting for a Socorro wastewater treatment facility (EPA); and habitat restoration at Bosque del Apache NWR and silvery minnow rescue and relocation efforts (Service). In addition, as the site of the most frequent and extensive river drying in recent years, the San Acacia reach has figured largely in broader consultations regarding water operations, including programmatic consultations by Reclamation and the Corps regarding actions across the entire Middle Rio Grande.

Exclusion of the San Acacia reach from silvery minnow critical habitat may decrease the number of Federal agency consultations expected to occur as a result of designation on the Middle Rio Grande. The San Acacia reach includes roughly 33 percent of the Middle Rio Grande area proposed for designation under Alternative B. Assuming that the likelihood of future consultations for critical habitat is evenly distributed across all designated areas, it can be estimated that exclusion of the San Acacia reach will result in a 33 percent reduction in the

number of future consultations on the Middle Rio Grande attributable to designation. Thus 4-5 fewer formal and 11-12 fewer informal consultations would be expected to occur under this alternative than under Alternative B. The Service, Reclamation, and the Corps would be the principal agencies affected by this reduction.

The costs of Federal agency consultations pertaining to critical habitat on the Middle Rio Grande may also be reduced. Using the figures presented in Appendix D of the Final Economic Analysis, excluding the San Acacia reach could result in total estimated consultation costs over 20 years on the Middle Rio Grande ranging from \$792,800 to \$2,018,400 a savings of \$259,400 - \$644,100 over Alternative B (Industrial Economics 2003).

The San Acacia reach is occupied by the silvery minnow, and has been the site of silvery minnow rescue and relocation operations. Federal agencies will continue to consult to ensure that the actions they authorize, fund, or carry out do not jeopardize the species. Thus the number and cost of future section 7 consultations regarding jeopardy will be the same under this alternative as Alternative B.

(D) Impacts on Federal Agency Actions

It is difficult to predict the extent to which Federal agencies would be impacted by the elimination of a consultation requirement for silvery minnow critical habitat in the San Acacia reach. As discussed in Alternative B, Federal actions have been affected and will continue to be affected by the consultation process undertaken by Reclamation and the Corps, stemming from the listing of the silvery minnow and the flycatcher. These impacts will continue to be felt in the reach, regardless of designation. As long as the silvery minnow is present, it appears certain that actions undertaken to voluntarily secure supplemental water for the San Acacia reach will be unaffected by the inclusion or exclusion of the reach in the critical habitat designation. Nothing in the proposed rule indicates that target flows established to avoid jeopardy would be altered as a consequence of designation, and thus there is no expected difference in water operations between this alternative and alternative B.

Future Federal agency projects in the San Acacia reach, including Reclamation's proposed relocation of the river channel and LFCC, could be shaped differently through section 7 consultation depending on whether the reach is or is not designated as critical habitat. As noted in Alternative B, designation could result in some added modification to projects in the river floodplain within the 91.4-meter (300-foot) lateral boundary. Results of future consultations cannot be prejudged, however, and it is difficult to predict the extent and manner to which application of the standards of adverse modification and jeopardy together may result in impacts different than those resulting from the jeopardy standard alone. It may be safely estimated, however, that corresponding to the reduction in consultation costs mentioned above, there will be some reduction in project modification costs due to the exclusion of the San Acacia reach from designation as proposed in this alternative. Using the figures presented in Appendix D of the Final Economic Analysis, excluding the San Acacia reach could result in an estimated

total project modification costs over 20 years on the Middle Rio Grande ranging from \$2.7 million to \$4.3 million, a savings of \$1.8 million - \$3.8 million over Alternative B (Industrial Economics 2003).

(D) Impacts on water supply and use

Designation as proposed in this alternative would have no direct impact on existing water operations. The current RPA, or its successor, would continue to guide Federal actions on the river such that jeopardy to the silvery minnow is avoided. Thus most impacts on water supply and use under this alternative are similar or identical to those described for Alternative B. Unless the status or distribution of the silvery minnow in the river change dramatically, Service guidelines are likely to continue to recommend target flows at San Acacia Diversion Dam and San Marcial.

As discussed in Alternative B, management guidelines may change in response to new information, or changes in the distribution or biological status of the silvery minnow. It is possible though not foreseen that future circumstances might result in a situation in which the standard of adverse modification would produce a greater demand for supplemental flows in some locations than that arising by virtue of the listed status of the species. Under such circumstances, flow requirements for locations in the San Acacia reach might differ under this alternative, owing to lack of designation, than under Alternative B. The nature and extent of any such differences, however, cannot be predicted.

The San Acacia reach is heavily affected by saltcedar infestation. Eradication of saltcedar has the potential to reduce evapotranspiration, which is one of the ways water may be lost to the drainage system and stream flows reduced. Currently however there is no consensus on the degree to which saltcedar removal may help increase stream flows—see the discussion under *Evapotranspiration* in Chapter 3. The need to carry out restoration efforts for the silvery minnow and flycatcher, and the need to maintain river flows, are likely to result in increased management attention to saltcedar eradication on the San Acacia reach. Such efforts may receive some added support from designation, which would be lacking under this alternative.

Some habitat restoration and bioengineering projects intended to benefit listed species may increase or decrease net depletions, although this is likely contingent upon project design. The OSE requires that any increase in non-Indian net depletions of water be offset in the Middle Rio Grande Project area. General improvements to the river and riparian areas by habitat restoration include restoring connectivity between the river and its floodplain with overbank flows; removing non-native and reintroducing native vegetation; and widening the river channel to allow more natural river conditions with aquatic habitats conducive to native fish. Such restoration projects are already under way, and are expected to continue in response to both listing (e.g. Service 2001b) and critical habitat designation. Exclusion of the San Acacia reach from designation may result in some decreased focus on river channel restoration projects in this reach, and hence some reduction in the potential for any additional net depletions that such

projects may cause. Restoration work carried out to benefit the flycatcher will not be affected by lack of designation.

(D) Impacts on water rights

No existing water rights would be affected by the designation of the San Acacia reach, nor by its exclusion from designation. Because of the presence of the silvery minnow in the San Acacia reach, it will continue to be important to maintain river flows in a manner consistent with current agency initiatives and with the Service's current and future biological opinions. As in Alternative B, provision of this water is expected to result in a substantial impact on the exercise of some existing water rights, if through voluntary sale or lease of such rights, or through forbearance, rights holder choose to forego use of water.

(D) Impacts on water quality

State and Pueblo water quality standards already limit adverse impacts on water quality across the Middle Rio Grande. In section 7 consultations on NPDES permitting, the Service may continue to recommend additional toxicity testing at times to ensure that wastewater discharges do not jeopardize the silvery minnow. These protections will continue in the San Acacia reach regardless of designation.

As discussed in Alternative B, the proposed rule designating critical habitat includes among the list of primary constituent elements considered essential for the primary biological needs of the silvery minnow: "Water of sufficient quality to maintain natural, daily, and seasonally variable water temperatures in the approximate range of greater than 1°C (35°F) and less than 30°C (85°F) and reduce degraded water quality conditions (decreased dissolved oxygen, increased p.H., etc.)." (Service 2002). While helping to clarify the needs of the species, this primary constituent element is unlikely to confer any higher standard of protection for water quality than that already established by State water quality standards and by virtue of the listing of the species. Thus critical habitat designation is expected to have no significant water quality impacts on the Middle Rio Grande as a whole, and exclusion of the San Acacia reach is expected to have no unique effects.

(D) Impacts on vegetation

San Acacia is the most affected reach of all Middle Rio Grande reaches by saltcedar infestation. In the absence of designation, there would still be considerable management activity aimed at eradicating saltcedar and restoring native vegetation in the San Acacia reach, particularly at Bosque del Apache NWR. However, attention and funding for such projects may potentially be slightly lower under this alternative than if the reach is designated as critical habitat. Here, as in other reaches, it should be noted that riparian restoration projects may originate from multiple sources, including Federal agency conservation efforts and section 7

consultations under the ESA, for the flycatcher and the silvery minnow, and from bosque preservation initiatives outside of the context of endangered species management.

Vegetation can be affected by changes in water operations on the river, and by direct manipulation occurring during construction, channel maintenance, or habitat restoration activities. Although Federal agencies will continue to consult to avoid jeopardy to the silvery minnow and flycatcher, exclusion of the San Acacia reach would eliminate the requirement that consultation address possible adverse modification of critical habitat in this reach. This may result in a somewhat lower level of protection (relative to Alternative B) for riparian vegetation within the 91.4-meter (300-foot) lateral boundary of critical habitat.

As discussed in Alternative B, temporary storage of supplemental water in existing ponds at Sevilleta NWR and Bosque del Apache NWR, should it occur, could have adverse impacts in some areas by furthering the propagation of noxious weeds such as perennial pepperweed. Such storage is one water management option considered in the Reclamation's Supplemental Water Program (Reclamation 2001a) and the Service's 2001 Programmatic Biological Opinion (Service 2001b). Any use of the refuges for supplemental water storage would not be affected by the exclusion of the San Acacia reach from critical habitat designation. The provision of supplemental water results from the presence of the listed species and the need to avoid jeopardy.

All impacts on vegetation upstream of San Acacia Diversion Dam would be identical to those described under Alternative B. Native vegetation in all Middle Rio Grande reaches including San Acacia is expected to benefit from water operations, river maintenance, and restoration activities by Federal management agencies intended to avoid the likelihood of jeopardy to the silvery minnow and the flycatcher (Service 2001b). Over time, such actions are expected to benefit multiple species by promoting the conservation of biological diversity, protecting ecological services (Altieri 1999, Falkenmark 2000), and contributing to the ecosystem health (Rapport and Whitford 1999, Rapport 2000) of the Middle Rio Grande Valley (Crawford et al. 1993).

It is possible that in the future the biological status of the silvery minnow may change, in which case consultation over river operations may result in a different set of management recommendations than those present in the Service's 2001 Programmatic Biological Opinion. One possible benefit of critical habitat designation, as opposed to listing alone, is that it may result in more consistent and long-term protections to physical and biological features essential to the future conservation and recovery of the species. If, for example, the silvery minnow were to become extirpated from an area of presently occupied habitat, some degree of protection might be maintained owing to critical habitat designation that would not be maintained otherwise. Thus continued future benefits to vegetation of management actions taken on behalf of the silvery minnow may be somewhat less secure under this alternative than under Alternative B.

(D) Impacts on the Rio Grande silvery minnow

In the San Acacia reach the silvery minnow would continue to receive protection as a result of consultation requirements (the jeopardy standard) and “take” under the ESA. The species would continue to benefit from the river management, habitat restoration, and target flow provisions in the Service’s 2001 Programmatic Biological Opinion, as well as whatever similar provisions may result from future programmatic consultations regarding river management activities of Reclamation and the Corps. Exclusion of the San Acacia reach from the area designated as critical habitat would not preclude implementation of the Recovery Plan in this reach. However, because habitat in this reach has been identified as being important to the survival of the species, exclusion of the San Acacia reach as proposed under this alternative could hinder efforts to meet the goals of the Recovery Plan.

Adequate stream length is recognized in the Service’s 2001 Programmatic Biological Opinion and Recovery Plan as essential for the survival and/or recovery of the silvery minnow. For example, silvery minnow eggs and larvae drift for 3-5 days, and may be transported from 216 to 359 kilometers (134 to 223 mi) downstream depending on river flows and habitat conditions (e.g., debris piles, low velocity backwaters, etc.) (Platania and Altenbach 1998). Because eggs and larvae can be swept downstream, where recruitment (individuals added to the breeding population) of fish may be poor in the current degraded condition of the middle Rio Grande (e.g., channelization, banks stabilization, levee construction, and disruption of natural processes throughout the floodplain, etc.), adequate stream length appears to be an important determinant of reproductive success, and subsequent persistence of the species. Thus, under this alternative, if the San Acacia reach was excluded from the middle Rio Grande, the remaining stream reaches (i.e., Jemez, Cochiti, Angostura, and Isleta) would only provide approximately 120 miles of stream length. Consequently, it appears unlikely that this amount of stream length could ensure the survival and/or recovery of the species.

It is possible that some areas of existing or potential silvery minnow habitat in the San Acacia reach may be adversely modified or destroyed as a result of Federal actions that would have been avoided or changed as a result of section 7 consultation under Alternative B. There may also be some negative impacts on the silvery minnow if exclusion of this reach results in decreased management attention, or slows efforts to restore or create more areas of suitable habitat in the reach. In that case, current river flow and channel characteristics unfavorable to the silvery minnow may be more likely to persist for a longer time and/or over a wider area. In the unforeseen event that, at some point in the future, the silvery minnow is eliminated from this reach, continuing habitat protection might be more secure under Alternative B (owing to designation) than under this alternative.

All impacts on the silvery minnow upstream of the San Acacia Diversion Dam will be identical to those described under Alternative B. In all Middle Rio Grande reaches, including San Acacia, the silvery minnow is likely to benefit from water operations, river maintenance,

and restoration activities by Federal management agencies intended to avoid the likelihood of jeopardy to the species (Service 2001b).

(D) Impacts on other fish species

As described in Alternative B, efforts made on behalf of the silvery minnow to create a more natural hydrograph on the Middle Rio Grande, and to restore aquatic and riparian habitat, are likely to benefit other native fish species as well. Under this alternative native fish species in the San Acacia reach would continue to benefit from habitat restoration provisions in the Service's 2001 Programmatic Biological Opinion specific to that reach. In all Middle Rio Grande reaches, including San Acacia, native fish species and communities are likely to benefit from water operations, river maintenance, and restoration activities by Federal management agencies intended to avoid the likelihood of jeopardy to the silvery minnow and willow flycatcher (Service 2001b).

It is possible that some habitat features essential to the conservation of the silvery minnow in the San Acacia reach may be adversely modified or destroyed as a result of Federal actions that would have been avoided or changed as a result of section 7 consultation under Alternative B. This might have a negative impact on other native fish species—such as red shiner, flathead chub and fathead minnow—with similar habitat requirements. There may also be some negative impacts on native fish if exclusion of the San Acacia reach from designation results in decreased management attention to the habitat requirements of the silvery minnow, or slows efforts to restore or create more areas of suitable aquatic habitat in the reach.

(D) Impacts on other threatened, endangered and candidate species

Southwestern willow flycatcher

The flycatcher is more abundant in the San Acacia reach than elsewhere on the Middle Rio Grande. Habitat restoration projects currently planned or underway as a result of programmatic section 7 consultation involving Reclamation and the Corps are intended to reduce the likelihood of jeopardy to both the flycatcher and the silvery minnow. River management activities in the San Acacia reach will continue to address the needs of the flycatcher, with or without critical habitat designation for the silvery minnow. Any Federal agency actions affecting riparian habitat in the San Acacia reach will continue to require consultation. Thus no impacts on the flycatcher resulting from the exclusion of the San Acacia reach are anticipated.

Impacts on the flycatcher in reaches upstream from San Acacia Diversion Dam will be identical to those described under Alternative B. In all Middle Rio Grande reaches the flycatcher is likely to benefit from water operations, river maintenance, and restoration activities by Federal management agencies intended to avoid the likelihood of jeopardy to the species (Service 2001b).

Bald eagle, whooping crane, interior least tern, piping plover

The whooping crane, least tern, and piping plover are not likely to be affected by critical habitat designation on the Middle Rio Grande. Exclusion of the San Acacia reach from designation is not expected to affect these species. Exclusion of the San Acacia reach may possibly result in some lower degree of protection to vegetation in the reach that may be used for roosting by the bald eagle; otherwise no unique impacts on the bald eagle are expected.

Impacts on all four threatened or endangered bird species in reaches upstream from San Acacia Diversion Dam will be identical to those described under Alternative B. In all Middle Rio Grande reaches, including San Acacia, the bald eagle may receive some incidental benefit from water operations, river maintenance, and restoration activities by Federal management agencies intended to avoid the likelihood of jeopardy to the silvery minnow and the flycatcher (Service 2001b).

Western yellow-billed cuckoo, a candidate species

Because the cuckoo has habitat requirements broadly similar to those of the flycatcher, impacts on the cuckoo will be similar to those discussed for that species above. The cuckoo appear favor native vegetation over stands dominated by exotic species. Efforts to restore wetlands can be expected to benefit this species. If lack of designation results in any less support for riparian restoration than would be present under Alternative B, the cuckoo may fail to receive some benefits under this alternative.

(C) Impacts on other wildlife

To the extent that this alternative results in any decreased attention to riparian habitat restoration in the San Acacia reach, some species may fail to receive some benefits present under Alternative B. However, as noted above, restoration efforts in the San Acacia reach are expected to continue. Because water operations are expected to be maintained as described in Alternative B, some negative impacts on migratory cranes and waterfowl are possible if, as described in that alternative, water currently used to irrigate crops used as forage at Bosque del Apache NWR is instead used to help maintain target flows. The likelihood of such an impact would not be affected by designation.

In all Middle Rio Grande reaches, regardless of designation, a variety of wildlife species may receive some benefit from water operations, river maintenance, and restoration activities by Federal management agencies intended to avoid the likelihood of jeopardy to the silvery minnow and willow flycatcher (Service 2001b). Over time, such actions are expected to benefit multiple species by promoting the conservation of biological diversity, protecting ecological services (Altieri 1999, Falkenmark 2000), and contributing to the ecosystem health (Rapport and Whitford 1999, Rapport 2000) of the Middle Rio Grande Valley (Crawford *et al.* 1993).

Wildlife species that may benefit from this management approach include reptiles and amphibians, small mammals inhabiting the riparian corridor, and a large number of migratory songbirds that use the Rio Grande bosque as breeding or migratory stopover habitat.

(D) Impacts on land use

Excluding the San Acacia reach would not significantly reduce the impact of critical habitat designation on land use in the Middle Rio Grande. The need for supplemental water in the reach would be the same as in Alternative B, and the same acreage could potentially be taken out of agricultural production. Designation is not otherwise expected to affect the land use practices of farmers or other private parties on or near the river, so no unique impacts of excluding the San Acacia reach from designation are expected.

(D) Social and economic impacts

Potential social and economic impacts of listing and/or critical habitat designation arise largely from the efforts of water managers to leave water in the river, or deliver water to specific river reaches, for the benefit of listed species. As discussed in Alternative B, there may be economic and social impacts associated with voluntarily acquiring water sufficient to maintain target flows in the San Acacia reach. These impacts include the cost of voluntarily acquiring supplemental water and the secondary social and economic impacts associated with retiring land from agricultural production. They will remain regardless of the inclusion or exclusion of the San Acacia reach in the critical habitat designation. The Final Economic Analysis describes opportunity costs and secondary economic impacts associated with supplying supplemental water to the San Acacia reach; these are described in Alternative B.

It is likely that, at some point in the future, water rights held by parties on the San Acacia reach or upstream will be offered for sale or lease to a management agency seeking to secure river flows for listed species. Alternatively, flows may be secured through a voluntary forbearance program instituted through MRGCD. The degree to which water rights holders in the San Acacia reach would participate in such a market or forbearance program cannot be predicted. Secondary economic impacts of any such sales or leases will occur regardless of whether or not the San Acacia reach is included in the critical habitat designation.

It is unknown if habitat restoration efforts may result in increased net depletions. However, if additional water is needed to offset these depletions, such an impact might be slightly reduced if, owing to its exclusion from critical habitat designation, less restoration activity were to occur in the San Acacia reach under this alternative.

As discussed in Alternative B, existing farms, developed areas, and commercial facilities occurring within the 91.4-meter (300-foot) lateral boundary are not expected to be affected by designation. Such areas are specifically excluded from the definition of critical habitat (Service 2002). Designation might affect (through consultation requirements) the future development of

economic or commercial activities on lands that would be included within the boundaries of critical habitat, if such development required Federal involvement. The Service is currently not aware of any such plans or circumstances. Any such possible future impact would not occur on the San Acacia reach under this alternative. Otherwise, exclusion of the San Acacia reach from designation is expected to result in no direct economic savings or costs to any private party.

As discussed in Alternative B, a number of tangible and intangible social and economic benefits may be associated with the protections given the silvery minnow under Federal listing, and with critical habitat designation. Present and expected future actions taken on behalf of the silvery minnow are expected over time to help conserve biological diversity, protect ecological services, and contribute to the ecosystem health of the Middle Rio Grande Valley. Although it remains difficult to assign precise economic values to these functions, the potential exists for such values to help offset the more easily calculated costs associated with endangered species protection. The added protections of critical habitat designation may increase these benefits to some unknowable degree. To the same degree, exclusion of the San Acacia reach from designation may result in a lower net benefit to the Middle Rio Grande Valley than would be present under Alternative B.

As discussed in Alternative B, management guidelines may change in response to new information, or changes in the distribution or biological status of the silvery minnow. It is possible, though not foreseen, that future circumstances might result in a situation in which the standard of adverse modification would produce a greater demand for supplemental flows in some locations than that arising by virtue of the listed status of the species. Under such circumstances, any economic impacts of supplemental flow requirements for locations in the San Acacia reach might differ under this alternative, owing to lack of designation, than under Alternative B. The nature and extent of any such differences, however, cannot be predicted.

(D) Impacts on Indian trust resources

No tribal lands are present in the San Acacia reach. Regardless of designation, Pueblo water rights may be affected if the Pueblos choose to develop a means of leasing water to Federal management agencies to provide downstream flows, including target flows in the San Acacia reach. Any such impact would come about solely through voluntary agreements on the part of the Pueblos. Otherwise, there would be no impact on Federal Indian water rights held by the Pueblos, which are recognized as senior to other claims to Rio Grande waters. Because water operations and management would not differ significantly between this alternative and Alternative B, concerns that the Middle Rio Grande Pueblos may have about the development and maintenance of their water rights would apply equally to both alternatives.

(D) Environmental justice effects

The same environmental justice impacts are anticipated under this alternative as under Alternative B. See also the discussion of *Social and Economic Impacts*, above.

(D) Impacts on cultural resources

Archeological sites and historic features present in the San Acacia reach were discussed in Chapter 3. Effects on cultural resources are largely as described under Alternative B, and no adverse impacts are anticipated. Archeological sites may be impacted by deliberate overbank flooding intended to restore riparian habitat, or by uncontrolled flooding. To the extent that restoration work in the San Acacia reach may receive any less attention owing to lack of designation, there may be some slightly lower risk of disturbance to sites present in the reach. Lack of any consultation requirement for critical habitat in the San Acacia reach may take away some incidental added protection for archeological sites within the 91.4-meter (300-foot) lateral boundary that would be present under Alternative B. Excluding the San Acacia reach from designation may simplify section 7 consultations regarding projects affecting historical features, such as the proposed relocation of the San Marcial Railroad Bridge.

(D) Impacts on recreation

Recreational activities on or near the river are unlikely to be directly affected by critical habitat designation, or by the exclusion of the San Acacia reach from designation. The likelihood of those hypothetical negative impacts discussed under Alternative B—loss of fishing, boating, hunting, and wildlife viewing opportunities due to the effects of water operations on reservoirs and refuges—would remain the same.

Summary of Adverse Effects of Alternative D

Alternative D differs from Alternative B in the exclusion of the San Acacia reach from critical habitat designation. Adverse impacts of listing and designation on the Middle Rio Grande, in all areas outside of the San Acacia reach, largely mirror those anticipated under Alternative B.

Within the San Acacia reach, it is important to note that current policies regarding the provision of supplemental water to achieve flow targets set by the Service at San Acacia Diversion Dam and San Marcial are not expected to change by virtue of the exclusion of the reach from designation. These policies were set through programmatic consultation by Reclamation and the Corps in the absence of critical habitat designation. A management regime as outlined in the “single reasonable and prudent alternative” of the Service’s 2001 Programmatic Biological Opinion, or one similar, is expected to be maintained for as long as necessary to avoid jeopardy to the silvery minnow.

The principal unique adverse effect of Alternative D is that the San Acacia reach would not be accorded the increased level of protection that designation provides. Consultation would still be required due to the federally listed status of the silvery minnow, but adverse modification of critical

habitat would not have to be considered. It is possible that some Federal actions on the river floodplain in the San Acacia reach would be affected differently by the consultation process under this alternative than Alternative B. In addition, Federal agencies and others will not have designation to help them prioritize or guide their efforts to restore the river corridor, and less attention may be paid to river and riparian habitat restoration projects.

Comparing Short-term Uses and Long-term Productivity

In the short term, management of the Rio Grande, including the San Acacia reach, will continue to be guided by the Service's 2001 Biological Opinion and RPA, regardless of critical habitat designation. That document is expected to remain in effect until 2003, after which time it may be expected that new programmatic section 7 consultation by Reclamation and the Corps will result in a similar set of management recommendations due to the ongoing need to avoid jeopardy to the silvery minnow.

Short-term commitments of resources, in the form of Federal agency and third party expenses associated with the section 7 consultation process, would be reduced under this alternative because impacts on critical habitat in the San Acacia reach would not have to be considered. In the long term, however, designation may provide some added degree of consistency to habitat protection, regardless of the potentially changing biological status of the species; this benefit would not extend to the San Acacia reach. For these reasons, in the long run this alternative may result in a somewhat lower likelihood that habitat essential for the conservation and recovery of the silvery minnow will be preserved. Other short-term and long-term consequences of this alternative outside of the San Acacia reach are largely as described for Alternative B.

Irreversible and Irrecoverable Commitment of Resources

The San Acacia reach has become, in recent years, the last holdout of the silvery minnow on the Middle Rio Grande. Up to 95 percent of the remaining population is thought to occur in this reach. Under recent and historical river management practices, the Rio Grande in the San Acacia reach has at times experienced drying and the formation of isolated pools, particularly in years of below-average precipitation. The river channel has been highly modified by water depletions from agricultural and municipal use, dams and water diversion structures, bank stabilization, and the infrastructure for water delivery (e.g., irrigation ditches). These modifications have led to the loss of sediment, channel drying, separation of the river from the floodplain, and changes in river dynamics and resulting channel morphology. To the extent such practices are continued, it may become increasingly difficult to restore the natural functioning of the river and to create more favorable conditions for the silvery minnow in this reach. Designation would add support to restoration and other management efforts aimed at preventing the permanent loss of this reach from the already short list of river segments that may potentially sustain silvery minnow populations. Excluding the San Acacia reach from designation would have the opposite effect. Extirpation of the silvery minnow from the San Acacia reach—or from

the entire Middle Rio Grande—would be an irreversible and irretrievable loss of a biological resource.

Other irreversible and irretrievable commitments of resources are as described for Alternative B. Possibly irretrievable commitments in counties such as Socorro County would be the loss of the farming-related businesses, and agricultural way of life, that could be a consequence of the voluntary purchase, lease, or forbearance agreement used by entities trying to keep water in the river for endangered species protection and compact delivery requirements. The likelihood of such losses occurring is not affected by critical habitat designation.

Cumulative Effects

“Cumulative impact” is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of the agency or person undertaking the actions (40 CFR 1508.7). The set of cumulative effects impacting the environment on the Middle Rio Grande, and influencing management decisions and practices regarding the river and its floodplain, were described in Alternative B. Cumulative effects are the same under this alternative.

As noted above, this FEIS does not provide detailed analyses for the reintroduction of the silvery minnow because any future recovery efforts, including repatriation of the species to areas of its historic range using the authorities of section 10(j) of the ESA must be conducted in accordance with NEPA and the ESA. The reasons for not conducting a detailed analyses were described in alternative A above.

Alternative E - Designation of Selected Reaches of the Middle Rio Grande, Lower Rio Grande, and Middle Pecos River

Under this alternative, river reaches in the Middle Rio Grande, Lower Rio Grande and the Pecos River would be designated as critical habitat for the silvery minnow. In each reach, proposed critical habitat includes the stream channels within the reach and the area within the reach which is included within the existing levees, or if no levees are present, then within a lateral distance of 91.4 meters (300 feet) on each side of the stream width at bankfull discharge. Bankfull discharge is the flow at which water begins to leave the channel and move into the floodplain (Rosgen 1996). The river reaches that are included in this alternative are as follows:

- (1) Middle Rio Grande, from Cochiti Reservoir downstream to the Elephant Butte Reservoir Dam, in Sandoval, Bernalillo, Valencia, and Socorro Counties, New Mexico. This reach is identical to the reach described in Alternative B, the preferred alternative and a detailed description of this reach is located under Alternative B.

- (2) Lower Rio Grande, Big Bend Reach—378 kilometers (236 miles) of river from the upstream boundary of Big Bend National Park (3.2 kilometers, or 2 miles, downstream of Lajitas), Brewster County, Texas, to the southern boundary of the Rio Grande Wild and Scenic River designation at the Terrell/Val Verde County line, Texas. Since critical habitat cannot be designated outside the United States' jurisdiction (50 CFR 424.12), the Service would propose that the lateral width of critical habitat designation in this stream reach extend from the U.S./Mexico International Boundary in the middle of the deepest channel to the edge of the 91.4-meter (300-foot) lateral width (see discussion above) on the United States' side.
- (3) Pecos River, Middle Pecos River Reach—359 kilometers (223 miles) of river immediately downstream of Lake Sumner to the Brantley Reservoir Dam in De Baca, Chaves, and Eddy Counties, New Mexico.

Designation as proposed in this alternative would not include the ephemeral or perennial irrigation canals and ditches outside of natural stream channels, including the Low Flow Conveyance Channel (LFCC), which is adjacent to a portion of the stream reach within the Middle Rio Grande downstream of the southern boundary of Bosque del Apache NWR to Elephant Butte Reservoir.

The areas inundated by Elephant Butte and Brantley Reservoirs are specifically excluded from critical habitat designation under this alternative. The Service has determined that these areas do not provide those physical or biological features essential to the conservation of the species. It defines the reservoir as that part of the body of water impounded by the dam where the storage waters are lentic (relatively still waters) and not part of the lotic (flowing water) river channel (Service 2002).

Certain lands located within the exterior boundaries of the proposed critical habitat designation (i.e., within the existing levees, or if no levees are present, then within a lateral distance of 91.4 meters (300 feet) on each side of the stream width at bankfull discharge), are not considered critical habitat and are therefore excluded by definition. Lands located within the exterior boundaries of the critical habitat designation, but not considered critical habitat include: developed flood control facilities, existing paved roads, bridges, parking lots, dikes, levees, diversion structures, railroad tracks, railroad trestles, water diversion and irrigation canals outside of natural stream channels, the low flow conveyance channel, active gravel pits, cultivated agricultural land, and residential, commercial, and industrial developments. (Service 2003).

Impacts on the Middle Rio Grande (MRG) in New Mexico

Whereas Sub-alternative B-2 and Alternatives C and D represented reductions of the proposed critical habitat described in Alternative B, this alternative is an expansion of Alternative B that includes two additional river reaches outside of the Middle Rio Grande. The

Middle Rio Grande portion of this alternative is identical to the area proposed under Alternative B. Therefore, the same impacts discussed under Alternative B would be expected for the Middle Rio Grande portion of this alternative.

Impacts on the Lower Rio Grande (LRG) through Big Bend National Park and the Rio Grande Wild and Scenic River

Designation as proposed in this alternative includes formerly occupied reaches of the Lower Rio Grande and the Pecos, from which the silvery minnow has been extirpated. These areas are included because the Service has determined that they are essential to the conservation of the silvery minnow. One of the goals of this alternative would be to ensure that potential habitat for recovery is protected, and that future management actions are not precluded in these currently unoccupied areas.

The Big Bend reach of the Lower Rio Grande extends from the upstream boundary of Big Bend National Park (the Park) to the downstream boundary of the Rio Grande Wild and Scenic River (RGWSR) at the Terrell/Val Verde County line. Impacts of designation in areas where the silvery minnow is not currently present would be somewhat different than impacts on the Middle Rio Grande. On the Big Bend reach, impacts of critical habitat designation would occur apart from and in the absence of any impacts that are attributable to the listing of the species. In these areas, Federal agencies that have not previously engaged in consultations regarding the minnow would be required to consult on actions that may affect critical habitat. In consultation, the standard of adverse modification will be applied to actions which may appreciably diminish the value of critical habitat for the survival and recovery of the species.

(E) Impacts on Federal Agency Consultations, LRG

1) NPS Consultations

The primary Federal agency that would be impacted under this alternative of the Rio Grande in the Big Bend reach is the NPS. The types of activities that might be subject to consultation are addressed in the Park's GMP of 1981, the Recreational River Use Management Plan of 1997, and new GMP and RGWSR Management Plan currently under development. In the recent past, the Park has engaged in informal section 7 consultations with the Service in conjunction with proposed general and river management scenarios, and for specific development and restoration projects.

Past consultations have involved several listed species present in the Park, including the peregrine falcon (now delisted), Big Bend gambusia, Mexican long-nosed bat, black-capped vireo, bunched cory cactus, and Chisos Mountain hedgehog cactus. Currently no federally threatened or endangered species inhabit the Big Bend reach, so there is no history of consultations directly relevant to this alternative.

Under this alternative, current or foreseeable Park actions for which consultation would be required include:

- Water diversions from the Rio Grande at Castolon and Rio Grande Village. The Park diverts about 600 ac-ft annually for campground irrigation at two locations (C. Purchase, NPS, pers. comm. 2001). Although they do not appreciably reduce net flows of the Rio Grande through the Park, under designation the timing and magnitude of these diversions might be subject to consultation to ensure that impacts on aquatic habitat are minimized. It is not expected that present policies would have to be altered if critical habitat were designated.
- Saltcedar removal. The Park engages in saltcedar removal by both mechanical and chemical means at various locations. Saltcedar control efforts have been focused on upland springs and seeps that drain into the Rio Grande. Some removal also takes place in the river corridor. Removal of non-native vegetation is consistent with Park mandates to preserve intact the natural character of ecosystems and biotic communities within Park boundaries. Saltcedar removal is generally considered beneficial for wildlife, especially when accompanied by restoration of native vegetation. Under existing Park policies vegetation removal is carried out in such a way as to minimize any unintended adverse ecological consequences. Under this alternative, consultations may take place to give special consideration to possible impacts on critical habitat. Current and foreseeable saltcedar removal activities would be likely to have no effect, or a slight beneficial effect, on the critical habitat. These actions do not extend below Park boundaries in the RGWSR segment. Thus, it is not expected that present policies would be altered due to designation of critical habitat.
- Recreational river use management. The Park's 1997 Recreational River Use Management Plan establishes guidelines regarding issues of zoning, motor use, fishing, river access, human waste, and recreational use limits. These guidelines were implemented to preserve both the recreational and natural values of the river corridor. Consultations would take place to ensure that none of the provisions specified in the plan result in adverse effects on critical habitat. Provisions that place restrictions on the use of motorized watercraft, limit the number of recreational users on the river, and require the removal of human waste from the river corridor may produce a slight beneficial effect on water quality, improving the overall quality of the habitat for native fish species. It is not foreseen that any aspects of the Recreational River Use Management Plan would be modified due to designation of critical habitat.

Recreational river use of the RGWSR segment below Park boundaries is being addressed in the forthcoming RGWSR Management Plan (see below). Currently, no recreational use limits are in place, but such limits are under discussion.

- GMP and RGWSR Management Plan. Under designation, the Park's existing and proposed management plans would be subject to review to ensure that no actions or initiatives are specified that might adversely affect critical habitat. In addition to the specific activities discussed above, any other actions specified that might affect critical habitat would be subject to consultation. The Park is currently considering several alternative concepts for its new GMP. Specific elements under consideration that would have impacts on the river corridor include the development of a new campground at Castolon, relocation of facilities at Rio Grande Village to locations outside of the 100-year or 500-year floodplain, and reduction of irrigation of the campground and associated areas at Rio Grande Village. These potential management actions would likely have no effect, or a slight beneficial effect, on silvery minnow habitat. Thus it is not foreseen that any aspects of the new GMP, or the RGWSR Management Plan, would be modified due to designation of critical habitat.

The Park is currently developing a RGWSR Management Plan that protects the outstanding scenic, geological, ecological, and recreational values of the RGWSR. This plan is expected to address and clarify jurisdictional issues between the Park and the State of Texas, and management boundary issues between the Park and private landowners. Like the GMP, the RGWSR Management Plan would be subject to consultation. It is not expected that actions specified in the plan would be modified due to designation of critical habitat.

Under this alternative, the Final Economic Analysis estimates an additional one formal and two informal NPS consultations because of designation of critical habitat in the Big Bend reach over the next 20 years (Industrial Economics 2003).

2) USIBWC Consultations

The USIBWC is a Federal agency with jurisdiction over the Rio Grande channel from Percha Diversion Dam, Sierra County, New Mexico to the Gulf of Mexico. The USIBWC is charged with administering and enforcing treaty obligations with Mexico, and with maintaining the river channel as an international boundary. Current or foreseeable USIBWC actions for which consultation might be required include:

- Boundary maintenance activities in the Park and RGWSR. No routine channel maintenance takes place in the Presidio to Amistad Dam reach of the Rio Grande. Occasionally, natural erosional and depositional processes result in a shift in the main channel of the Rio Grande. These channel shifts, or avulsions, are significant because they may alter the location of the international boundary between the U.S. and Mexico. In such cases, the U.S. and Mexican sections of the IBWC reach a determination as to whether or not to carry out construction activities designed to restore the river to its original position. Such actions have been relatively infrequent along the international stretch of the Rio Grande, and have never occurred within the boundaries of the Park and the RGWSR.

Much of the river corridor within the Park and the RGWSR segment consists of fairly narrow and steep-walled canyons, in which a significant channel shift is unlikely. It is possible however that a future channel shift in this area would necessitate action by the USIBWC, in cooperation with Mexico. This alternative would require USIBWC to consult before undertaking channel relocation or rectification projects in critical habitat.

- Boundary maintenance and flood control activities upstream from the Big Bend reach. Upstream channel improvement or maintenance activities may at times influence the character and quality of waters flowing through the Park and RGWSR. The USIBWC operates and periodically carries out maintenance activities on the Presidio-Ojinaga Valley Flood Control Project, a system of levees and cleared areas on each side of the river that form a floodway about 24 kilometers (15 miles) in length through the Presidio border area. It is possible that future USIBWC actions on the Presidio-Ojinaga Valley Flood Control Project might at least temporarily have an impact on water flow and quality through the Big Bend reach. In such a case, consultation would be required.

In the future, upstream channel improvements in the reach between Fort Quitman and Presidio may result in more water reaching Big Bend. The river channel in this area is badly deteriorated and overgrown with saltcedar, resulting in a loss of water. The Park's 1997 Recreational River Use Management Plan notes that in 1995, when surplus waters were released from New Mexico reservoirs, "the deteriorated river channel between Fort Quitman and Presidio caused more than 65 percent of the water that reached Fort Quitman to spill from the river's channel and form shallow lakes before reaching Presidio." (NPS 1997). The USIBWC has long considered channel rectification in this area, and in 1978 completed an EIS for its proposed Rio Grande Boundary Preservation Project. Work was initiated in the mid-1980s but less than 50 percent was completed, and improvements made at that time have since deteriorated. A resumption of this work would likely require consultation if critical habitat were designated in the Big Bend reach.

Maintaining the international boundary may over time require channel maintenance and other activities that may require consultation if the Big Bend reach were designated critical habitat for the silvery minnow. The Final Economic Analysis estimates no informal and four formal USIBWC consultations if critical habitat were designated within the reach over the next 20 years (Industrial Economics 2003).

3) EPA Consultations

Various entities typically engage with the Service and EPA in section 7 consultations regarding NPDES permitting. In the State of Texas, NPDES permitting and enforcement responsibilities have been granted by EPA to the TNRCC, and are under State jurisdiction. Because this jurisdiction has been granted under Federal authority, TNRCC typically engages

with the Service as EPA's representative in situations calling for section 7 consultation (K. Baskin, EPA, pers. comm. 2001).

Presidio holds an NPDES permit for its wastewater treatment facility. The town of Lajitas, just upstream from the Park, has recently applied for a new NPDES permit for an expanded wastewater treatment plant, to serve the needs of this rapidly expanding resort area. The Park commented that proposed wastewater discharge and sludge disposal in or near the river floodplain may potentially add to water quality problems in the Rio Grande. Issuance or renewal of this and potentially other NPDES permits, in areas upstream from the Park, could require EPA/TNRCC consultation if critical habitat were designated.

The Final Economic Analysis estimates seven formal EPA consultations if critical habitat was designated within this reach (Industrial Economics 2003).

4) Service Internal Consultations

If the silvery minnow is reintroduced to the Big Bend reach at some point in the future, management for the species could require internal consultations by the Service. Such consultations may take place with regard to minnow rescue or relocation efforts, fish stocking, and vegetation management. Any future reintroduction or habitat restoration efforts conducted by the Service or other Federal agencies in the Big Bend reach will be analyzed through NEPA and will be conducted in accordance with the ESA.

The Final Economic Analysis estimates 4 such internal consultations if critical habitat were designated within this reach over the next 20 years (Industrial Economics 2003). The economic costs associated with consultation requirements are discussed under *Social and Economic Impacts* below.

(E) Impacts on Federal Agency Actions, LRG

The section above identified various scenarios in which Federal agencies would be required to consult with the Service regarding actions in the Big Bend reach. The outcome of these possible future consultations cannot be predicted or pre-judged, particularly if the consultations arise due to unforeseen or unusual events such as a river channel avulsion along the international border. However, impacts on Federal agencies in this reach appear to be minimal. Given the information at hand, no significant modifications to specific and foreseeable agency actions would be expected. It is possible however that some future Federal agency actions could be modified as a consequence of designation under this alternative. Possible indirect effects of such modified actions are examined briefly in the sections below.

(E) Impacts on water supply and resources, LRG

No direct impacts on stream flow or the availability of water for any use are anticipated under this alternative. No alteration of naturally occurring hydrological processes would result

from the proposed designation. Flow conditions in this reach may be slightly improved if, as a result of consultation stemming from the proposed rule, actions are implemented under section 7(a)(1), discretionary conservation measures, or as part of a reasonable and prudent alternative identified during formal consultation, that would avoid the destruction or adverse modification of critical habitat.

(E) Impacts on water rights and management, LRG

There would be no direct effects of designation of critical habitat on existing water rights and management arrangements. The TNRCC's Rio Grande Watermaster Office retains authority over the allocation and control of Rio Grande water south of Fort Quitman. There is no Federal nexus affecting the delivery of water in this region, and no privately or municipally held water rights would be affected. The exercise of rights held by the Park is not expected to be affected.

(E) Impacts on water quality, LRG

No direct impacts on water quality are anticipated under this alternative. Water quality in this reach may be slightly improved if, as a result of consultation stemming from the proposed rule, actions are implemented under section 7(a)(1), discretionary conservation measures, or as part of a reasonable and prudent alternative identified during formal consultation, that would avoid the destruction or adverse modification of critical habitat.

(E) Impacts on vegetation, LRG

No adverse impacts to vegetation in the Park and RGWSR are anticipated. No alteration of habitat, biological communities, or ecological processes would result from this alternative. By focusing management attention on the needs of the Rio Grande silvery minnow, this alternative would provide further justification for the allocation of Park resources towards saltcedar removal in the river floodplain. Removal of saltcedar from areas where it has become dominant would benefit native riparian vegetation.

(E) Impacts on the Rio Grande silvery minnow, LRG

Designation of critical habitat in the Big Bend reach would have no direct or immediate effects on the silvery minnow, which is not currently present in this reach. Designation could benefit the silvery minnow, by helping to ensure that habitat suitable for reintroduction at some future date is preserved, and further by drawing attention to the habitat requirements of the species. Designation may be beneficial to the recovery and long term survival of the silvery minnow if actions are implemented under section 7(a)(1), discretionary conservation measures, or as part of a reasonable and prudent alternative identified during formal consultation, that would avoid the destruction or adverse modification of critical habitat.

(E) Impacts on fish communities, LRG

Designation of critical habitat in the Big Bend reach would have no direct or immediate effects on fish species in the Lower Rio Grande. To the extent that designation would focus management attention on habitat preservation, and result in additional protections not already present due to the area's protected status, the it may benefit certain other species whose habitat overlaps that of the Rio Grande silvery minnow. The area currently supports two members of the Rio Grande silvery minnow's reproductive guild (pelagic spawners), the speckled chub and Rio Grande shiner. The reach also includes other minnow species, which have been extirpated from upstream and downstream sections of the Rio Grande. All of these species would likely receive some benefit from designation of this reach if actions are implemented under section 7(a)(1), discretionary conservation measures, or as part of a reasonable and prudent alternative identified during formal consultation, that would avoid the destruction or adverse modification of critical habitat.

(E) Impacts on threatened and endangered species, LRG

The federally endangered Big Bend gambusia, which inhabits pools bordering the river floodplain including two within the lateral boundaries of this alternative, would be unaffected. The gambusia is affected by the Rio Grande only during peak flow events at roughly decadal intervals, when river waters flood the lowermost pool in which the fish lives. Such flooding, which may introduce exotic competitors into the gambusia habitat, is a normal part of the hydrological regime at Big Bend and would not be influenced by designation of critical habitat.

The Texas hornshell, a freshwater mussel recently declared a candidate species for Federal protection, is not known to occur in this reach, but its presence is considered possible. Any improvements to the hydrological regime or water quality resulting from designation under this alternative would likely improve the suitability of habitat for this species.

No other federally listed species in Brewster or Terrell Counties would likely be affected by designation of critical habitat in the Big Bend reach.

(E) Impacts on other wildlife, LRG

Non-aquatic species inhabiting the riparian corridor would likely be unaffected by, or receive slight benefit from, designation of critical habitat. Possible benefits to these species stem from the high degree of ecological connectedness between the river and adjacent riparian zone habitats.

(E) Impacts on land use, LRG

The area proposed under this alternative consists of the river and a narrow strip of riparian habitat within an already protected area. Grazing and agriculture are not legal activities within the Park. Ranching and farming activities upstream of the Park, and downstream on

lands adjacent to the RGWSR, take place on private lands and use state-administered water rights with no Federal nexus. Thus existing land use patterns will be unaffected by the known and foreseeable impacts of this alternative. Private parties and land owners carrying out activities with no Federal involvement would be unaffected by critical habitat designation.

(E) Social and economic impacts, LRG

In the Big Bend region, no economic impacts associated with acquiring or reallocating water for instream flow would be anticipated. Because this alternative will not affect existing patterns of land and water use, no negative social impacts are expected. Any impacts that might follow from future reintroduction of the silvery minnow to this reach would be analyzed through the separate NEPA process required for such an action.

There would be some economic cost to Federal agencies associated with section 7 implementation if critical habitat were designated. The Final Economic Analysis estimates a total cost for this reach of formal and informal consultation, technical assistance, and project modifications over and above baseline of between \$3.9 million and \$8.4 million (Industrial Economics 2003). The high-end figure assumes the Service engages in project modifications associated with managing a restored minnow population. Impacts estimated from consultation and technical assistance alone are under \$600,000. See Appendix A.

(E) Impacts on Indian trust resources, LRG

No Indian trust resources are involved or would be affected by designation of this reach.

(E) Environmental justice effects, LRG

No environmental justice issues have been identified for this reach. The area proposed under this alternative consists largely of Federally owned and/or managed lands, and any costs resulting from designation would be borne by Federal agencies. No acquisition of supplemental water or secondary economic impacts would be anticipated.

(E) Impacts on cultural resources, LRG

Existing historical and archeological sites in the Park and the RGWSR would be unaffected by any known or foreseeable impacts of designation. Cultural sites in the river corridor, such as the Hot Springs Historical District, would probably continue to be impacted by periodic very high flow events. Flood control is non-existent in the Big Bend reach, and floods will continue to occasionally reach historic sites in the river floodplain regardless of designation. The potential for locating archeological sites in the floodplain zone is low, due to centuries of scouring and sedimentation. This alternative would not directly or indirectly cause changes in the character or use of any historic properties. No conflicts between designation of critical habitat and American Indian religious or cultural concerns have been identified.

(E) Impacts on recreation, LRG

This alternative would not significantly reduce or interfere with opportunities for recreation in the Big Bend reach. The NPS currently manages the river corridor in a manner that attempts to serve the needs of both recreation and preservation, and existing recreational management guidelines would remain in place if the region is designated as critical habitat.

No projections exist on general Park and RGWSR visitation, or use of the river corridor in the coming years. The former has remained relatively constant over the past decade, and the latter has declined somewhat in recent years due to low water levels reducing recreational opportunities on the Rio Grande (R. Skiles, NPS, pers. comm. 2001). Given the remoteness of the Big Bend region, it is unlikely that visitation and use rates will change dramatically in the near future.

Recreational use of the river and adjacent riparian areas, including number and size of float trip launches, will continue to be regulated by the Park under existing and/or forthcoming guidelines. There are no data which indicate that river use by rafters and campers would be likely to result in any adverse effect on critical habitat for the silvery minnow. Although human use of the Rio Grande corridor in the Park does represent one possible source of contamination of river water, this impact is indistinguishable from—and is likely far less than—impacts from other sources.

Under existing Park guidelines, anglers may use nets to capture minnows for use as bait. This rule will be unaffected by designation. Modification of this guideline will have to be evaluated if at some future point the silvery minnow is reintroduced to the Big Bend reach. To the extent that designation would focus management attention on habitat preservation, and results in any additional protections not already present due to the area's protected status, this alternative would result in enhanced opportunities for wildlife viewing and enjoyment of natural ecological processes.

Impacts on the Pecos River (Pecos) from Sumner Dam to Brantley Reservoir

The reach of the Pecos River considered for designation in this alternative begins immediately downstream from Sumner Dam in New Mexico and extends south to Brantley Dam in New Mexico, a length of 359 kilometers (223 miles). Critical habitat under this alternative would be designated to Brantley Dam, but would exclude by definition the waters of Brantley Reservoir.

The Middle Pecos River is part of the historic range of silvery minnow, but is not currently occupied by the species. Impacts of designation in areas where the silvery minnow is not present would be somewhat different than impacts on the Middle Rio Grande. On the Pecos reach, impacts of critical habitat designation would occur apart from, and in the absence of, any impacts that are attributable to the listing of the species. In section 7 consultation, the standard

of adverse modification would be applied to agency actions that may appreciably diminish the value of critical habitat for the survival and recovery of the species.

(E) Impacts on Federal Agency Consultations, Pecos

The Pecos River is not currently occupied by the silvery minnow. The reach from Sumner Dam to Brantley Reservoir is, however, occupied by the Pecos bluntnose shiner, a fish species listed in 1987 as threatened, with critical habitat designated. To identify the Federal agencies that engage in consultation on the Pecos, and the kinds of actions on which consultation takes place, the Service:

- reviewed the consultations that have taken place since 1994 between Federal agencies and the Service with respect to the bluntnose shiner;
- assumed that similar consultations will take place regarding silvery minnow critical habitat over the next 10 - 20 years;
- modified those assumptions based on any anticipated changes in Federal activity that may arise from designation of critical habitat for the silvery minnow.

Table 4-5: Summary of Consultations on the Pecos River between Sumner Dam and Brantley Reservoir, New Mexico

Current or Future Activities	Nexus	Anticipated Effects to Silvery Minnow Critical Habitat?	Potential Changes to Project Resulting from Consultation?
Energy Development	BLM	Yes	No
Water Operations - Dam Releases & Supplemental Water	Reclamation, Corps	Yes	Yes
River Channel Modifications	Corps	Yes	Yes
Wastewater Discharge	EPA	Yes	No
Construction Projects, including bridges	Reclamation, Corps	Yes	No
Habitat restoration/saltcedar	Service, Reclamation	No	No

The Final Economic Analysis estimates the total estimated consultation activity likely to occur because of designation on the Pecos over a twenty year period. For the Middle Rio Grande, which is occupied by the silvery minnow, the Final Economic Analysis identified both a “baseline” level of consultation that would continue because of the listed status of the species, and an “above baseline” level of additional consultations that would occur due to designation. On the Pecos River, all consultations considered in the Final Economic Analysis and in this

analysis are attributed solely to silvery minnow critical habitat (Industrial Economics 2003). In practice, section 7 consultations of the Pecos would likely address designated critical habitat for both the silvery minnow and the bluntnose shiner, as well as the listed status of the latter species.

Consultation rates on silvery minnow critical habitat were estimated for each agency by analyzing the number of section 7 consultations for the bluntnose shiner occurring from 1994 to mid-2001. At least 4 formal and 15 informal consultations took place on the Pecos reach during that period. For each agency the Final Economic Analysis assumes that, at minimum, twice as many consultations would occur annually on the Pecos if critical habitat is designated for the silvery minnow. This assumption is based on the fact that critical habitat proposed for the silvery minnow is roughly twice the length of that designated for the bluntnose shiner (Industrial Economics 2003). Critical habitat for the bluntnose shiner consists of two sections. The first begins at a point 10 miles south of Fort Sumner in De Baca County and extends downstream 103 kilometers (64 miles). The second begins near the town of Hagerman, in Chaves County, and extends downstream about 58 kilometers (36 miles) to a point near Artesia, in Eddy County. The city of Roswell in Chaves County lies between the two sections. The proposed designation for the silvery minnow extends continuously from Sumner Dam to Brantley Dam, encompassing both sections of bluntnose shiner critical habitat.

Table 4-6: Total historical and expected future consultations by Federal agency (Industrial Economics 2003)

Agency	Total Consultations for the Bluntnose Shiner, 1994 - 2001	Total Consultations Estimated for the Silvery Minnow, 20 yrs.
Service	0 formal, 2 informal	0 formal, 10 informal
Reclamation	3 formal, 4 informal	15 formal, 20 informal
Corps	1 formal, 4 informal	5 formal, 20 informal
BLM	0 formal, 2 informal	1 formal, 15 informal
EPA	0 formal, 3 informal	0 formal, 15 informal
FEMA	0 formal, 0 informal	1 formal, 2 informal

The following sections review the recent history of Federal agency consultations regarding the Pecos bluntnose shiner. This review is provided to identify and highlight the kinds of issues likely to be present under management of critical habitat for the silvery minnow. Additional consultation issues with respect to silvery minnow critical habitat have been identified where possible.

1) Internal Service Consultations

The Service is required to undertake section 7 consultations on its own actions to ensure that those actions do not jeopardize federally listed species or adversely modify critical habitat. On the Pecos, the Service has conducted intra-agency consultations for management activities at the Bitter Lake National Wildlife Refuge near Roswell, New Mexico. In 1999, the Service consulted regarding implementation of its Fire Management Plan for Bitter Lake NWR. The plan includes treatment with prescribed fire of an estimated 2,023 hectares (5,000 acres) per year to accomplish management objectives, including hazardous fuels reduction and saltcedar control. This consultation resulted in a finding of “may affect, not likely to adversely affect” the bluntnose shiner (Cons. #2-22-99-I-140). A current proposal to restore the Pecos River channel through the Bitter Lake NWR is under evaluation by the Service and Reclamation. In the last five years, Bitter Lake NWR has removed more than 347 acres of exotic salt cedar along the Pecos River (Pecos River Compact Commission 2001).

Internal Service consultations on restoration and wildlife management activities would be expected to continue, and additional consultations would be anticipated as a result of critical habitat designation. The Final Economic Analysis estimates that the Service would engage in no formal and 15 informal internal consultations on the Pecos River over the next 20 years, as a result of silvery minnow critical habitat designation (Industrial Economics 2003). Estimated costs associated with expected consultations are shown in Appendix A.

2) Reclamation Consultations

As on the Rio Grande, Reclamation’s activities are affected by section 7 consultation requirements. Since 1994, the administrative record indicates that Reclamation has entered into at least 3 formal and 4 informal section 7 consultations with the Service concerning the bluntnose shiner. Reclamation has undertaken water management effort on the Pecos River to improve habitat conditions for that species. Actions include changing the timing and duration of releases from Sumner Lake, instituting longer block release tailouts, and bypassing natural inflows from Sumner Dam to target an average baseflow of 35 cfs at the Near Acme gage (Cons.# 2-22-97-I-196; Cons.# 2-22-98-I-316; Cons.# 2-22-01-F-221). The Service does not expect management activities focused on providing consistent flows at the Near Acme gage to change if critical habitat for the Rio Grande silvery minnow were designated on the Pecos River (J. Brooks, Service, pers. comm.; E. Hein, Service, pers. comm. 2001).

In connection with the management regime for the bluntnose shiner, Reclamation is in the process of preparing a Pecos River Water Operations Plan and Programmatic EIS. The NMISC is serving as a joint lead agency in the EIS process. The process is directed primarily at the development of a plan for modified operations at Sumner Dam to benefit the bluntnose shiner, and the pursuit of water acquisition and management options. The EIS will also address the potential regional economic impact from the modified operations of Sumner Dam.

Reclamation is also funding the Pecos River Basin Water Salvage Project to control saltcedar growth along the river (<http://dataweb.usbr.gov/html/pecos.html>). Saltcedar has been targeted for clearing because of its high consumptive use of water and its encroachment onto croplands and pasture. The salvage project was authorized by Public Law 88-594 in 1964 to reduce nonbeneficial consumptive use of water in the basin by saltcedar and other targeted phreatophytes. The clearing program began in 1967 and continued until 1971 and extended from Sumner Lake to Pecos, Texas. The program was reinitiated in 1995, and 12,141 hectares (30,000 acres) have since been cleared in New Mexico.

Reclamation may also become increasingly involved in different types of habitat restoration projects, comparable to the bioengineering projects being undertaken in the Middle Rio Grande. These efforts may involve river channel modifications to facilitate the regeneration of native habitat and pre-dam geomorphological conditions. Portions of the Pecos are channelized, and not conducive to forming the diverse habitat conditions favored by the Rio Grande silvery minnow. Projects on the Rio Grande to widen the river and encourage braiding and the formation of oxbows may be duplicated on the Pecos.

The Final Economic Analysis estimates that Reclamation would engage in 15 formal and 20 informal consultations on the Pecos River over the next 20 years, if silvery minnow critical habitat were designated (Industrial Economics 2003). Estimated costs associated with consultations are shown in Appendix A.

3) Corps Consultations

Along the Pecos River, the Corps has been involved with bridge construction, bank stabilization projects to abate eroding stream banks, flood control activities, and issuance of section 404 permits for placement of dredged and fill materials. The consultation files indicate that, since 1994, the Corps has entered into at least 1 formal and 4 informal section 7 consultations with the Service concerning the bluntnose shiner.

During past consultations, the Service has evaluated such activities to ensure that they do not contribute to degradation of habitat for the shiner. Measures intended to lessen harmful impacts of certain activities may include avoiding construction activity or water diversion during spawning season, storage of petrochemicals outside of the 100-year floodplain to avoid impacts, and avoiding excessive siltation and erosion. For example, the Corps consulted on a nationwide section 404 permit for work including the construction of a gas well drilling pad, a reserve pit, a flare pit, and an access road. The site was 0.8 kilometers (.5 miles) from the Pecos River. The Service concluded that runoff from the site could degrade water quality in the Pecos River. The Service recommended, among other measures, that the permit be modified to include provisions for off-site storage of equipment and petrochemicals, containment of wastewater products, and the implementation of effective erosion control measure (Cons.# 2-22-95-I-192).

The Service developed similar recommendations on a Corps project to replace a bridge that crossed the Pecos River. The Service recommended that construction be avoided during April through September to avoid impact on the bluntnose shiner's reproduction cycle, and that the Corps take measures to prevent adverse impacts to water quality (Cons.# 2-22-94-I-434). The Service may also request that fish samples be taken from the river to identify the presence of the bluntnose shiner. For example, in a project proposed by the Corps to construct six jetties for bank stabilization purposes, the Service requested that the Corps perform fish surveys immediately prior to the planned onset of work, and avoid construction if bluntnose shiners were present (Cons.# 2-22-96-I-211).

The Final Economic Analysis estimates that the Corps would engage in 5 formal and 20 informal consultations on the Pecos River over the next 20 years, if silvery minnow critical habitat were designated (Industrial Economics 2003). Estimated costs associated with consultations are shown in Appendix A.

4) BLM Consultations

A considerable amount of oil and gas exploration occurs in the Pecos River basin. The BLM issues leases for oil and gas exploration and development activities within the Pecos River watershed. These activities are conducted primarily on Federal lands, but also on private lands to which the U.S. has retained the subsurface mineral rights.

Since 1994, the consultation files indicates that the BLM has entered into 0 formal and at least 2 informal section 7 consultations with the Service concerning the bluntnose shiner. Energy development in the floodplain may impact aquatic habitat in the event of a rupture or release from a drilling, transport, or storage facility. Habitat may also be affected by pollution occurring during project construction. Accidents occurring in upland facilities are less likely to impact aquatic habitat. In past consultations on BLM management plans, the Service has issued conservation recommendations concerning the potential impacts of oil and gas leasing and development activities on the bluntnose shiner. For example, the Service has requested that the BLM maintain a policy of selling no new oil and gas leases on lands within the 100-year floodplain (Cons.# 2-22-96-F-128).

The BLM also manages Federal lands and administers and issues permits for livestock grazing on the land. The Service believes that grazing may impact aquatic habitat by degrading watersheds. Degradation caused by livestock grazing results from alteration of the vegetative composition of the watershed, soil compaction and erosion, and alterations in soil chemistry. These conditions ultimately lead to increased erosion and increased runoff patterns. To evaluate the impacts of grazing, BLM recently engaged in consultation and completed a biological evaluation regarding the issuance of grazing on a number of threatened and endangered species in Chaves, Eddy, and Lea counties (Cons. # 2-22-99-I-132). In the past, the Service has required that detailed long-term studies be performed to evaluate the impacts of grazing in particular

areas (Cons.# 2-22-96-F-128). The BLM has taken measures in its resource management plans to protect the riparian areas along the Pecos.

The Final Economic Analysis estimates that the BLM would engage in 1 formal and 15 informal consultations on the Pecos River over the next 20 years, if silvery minnow critical habitat were designated (Industrial Economics 2003). Estimated costs associated with consultations are shown in Appendix A.

5) EPA Consultations

The EPA is responsible under the Clean Water Act for issuing NPDES permits to entities that discharge pollutants into U.S. waters. Dischargers commonly include companies that generate liquid waste and municipalities processing sewage. The Service evaluates applications to discharge waste to ensure that downstream aquatic habitat will not be degraded by a particular discharge scheme. Since 1994, the administrative record indicates that since 1994, the EPA has entered into 0 formal and at least 3 informal section 7 consultations concerning the bluntnose shiner.

Sometimes the analysis of NPDES permits by the Service will require further data on the amount and type of constituents in the discharge to evaluate the potential impact on fish habitat. In such cases dischargers may be asked to implement a monitoring plan to better understand the impacts of the action. For example, when the EPA was drafting the permit for the Roswell Wastewater Treatment Plant, the Service concluded that the EPA's public notice concerning the draft permit contained insufficient information to fully evaluate potential impacts to bluntnose shiner habitat. The Service recommended the development of a monitoring plan to aid in the analysis of effluent from the treatment plant (Cons.# 2-22-I-96-473). In 2001, the Service concurred with EPA's determination that reissuance of an NPDES permit for the Fort Sumner wastewater treatment facility would have no adverse effects on the bluntnose shiner or its critical habitat (Cons.# 2-22-01-I-195).

The Final Economic Analysis estimates that the EPA would engage in no formal and 15 informal consultations on the Pecos River over the next 20 years, if silvery minnow critical habitat were designated (Industrial Economics 2003). Estimated costs associated with consultations are shown in Appendix A.

6) FEMA Consultations

FEMA administers an emergency management program both to protect the national infrastructure and to prepare for effective response to emergencies. Another component of FEMA is the National Flood Insurance Program, which enables communities that enforce floodplain management ordinances to receive federally-backed flood insurance (<http://www.fema.gov>).

To date, FEMA has not consulted with the Service on the Pecos River concerning its issuance of flood insurance or its participation in disaster relief efforts. However, the agency is reviewing its operations in light of a lawsuit filed by Forest Guardians in New Mexico alleging a violation of the ESA for FEMA's failure to consult with the Service on the flood insurance program. If FEMA's policies change as a result of this review, the agency may consult with the Service on the Pecos.

The Final Economic Analysis estimates that FEMA would engage in 1 formal and 2 informal consultations annually on the Pecos River over the next 20 years, if silvery minnow critical habitat were designated (Industrial Economics 2003). Estimated costs associated with consultations are shown in Appendix A.

(E) Impacts on Federal Agency Actions, Pecos

Federal agencies are affected by the obligation to engage in section 7 consultation with the Service, and agency actions could also be affected by the outcome of the consultation process. In many cases such impacts consist of voluntary agency compliance in carrying out the proposed action, with guidelines or conservation recommendations issued by the Service during consultation.

As on the Middle Rio Grande, the most significant impacts arising from the presence of listed species and designated critical habitat on the Pecos River are on Federal water operations, river management activities, and the procurement of supplemental water. The most recent and comprehensive consultation on Pecos River water operations took place between Reclamation and the Service during the 2001 irrigation season. In its "Biological Assessment of Proposed Pecos River 2001 Interim Irrigation Season Operations on the Pecos Bluntnose Shiner" (Reclamation 2001a), Reclamation outlined a series of actions including measures intended to reduce adverse effects to the bluntnose shiner. The Service responded with a "Biological Opinion on Reclamation's 2001 Discretionary Actions Related to Water Management on the Pecos River, New Mexico" (Service 2001a). The Service concluded that the proposed operations were not likely to jeopardize the continued existence of the bluntnose shiner, and would not result in the destruction or adverse modification of bluntnose shiner critical habitat.

Through consultation, it was agreed that Reclamation would:

- Bypass natural inflows to Lake Sumner when available and necessary to improve base flows and meet the downstream target of 35 cfs at the Near Acme gage;
- Restrict the duration of block releases from Sumner Dam to a maximum of 15 days, and the cumulative duration during the 2001 calendar year to a maximum of 65 days;
- Target a minimum of 14 days between consecutive block releases from Sumner Dam;

- Try to achieve a 7 week period with no block releases from June 1 to August 31, to reduce adverse effects during the spawning season;
- Conduct weekly conference calls with the Service during the irrigation season, and support ongoing bluntnose shiner population monitoring.

In addition, Reclamation undertook a program for voluntarily leasing supplemental water, to make up depletions to the water supply caused by Sumner Dam bypass operations.

Federal agencies are expected to continue to modify their actions on the Pecos River to address reduce adverse effects to the bluntnose shiner, and to manage any designated silvery minnow critical habitat. The silvery minnow and the bluntnose shiner have similar life histories, and their habitat requirements are similar and compatible (D. Coleman, Service, pers. comm. 2001). Furthermore, it is not anticipated that management for critical habitat for the minnow would differ substantially from the management currently in place for the bluntnose shiner (E. Hein, Service, pers. comm. 2001) . Elements of current endangered species management activities by Federal agencies that would be expected to continue include:

- Management of the river, with particular attention paid to the effects on habitat of flow regimes and river drying events;
- A supplemental water program, whether through purchase or lease of water rights or a forbearance program; and possibly
- Review of discharges of pollutants in the river.

(E) Impacts on water supply and use, Pecos

The existing management regime on the Pecos, as outlined in Reclamation operation plans for the 2001 irrigation season, includes the requirement of bypasses of natural inflows to Sumner Lake as necessary to maintain downstream flow of 35 cfs at the Near Acme gage. This requirement has been in place for several years, and was established through consultation between Reclamation and the Service to meet the needs of the Pecos bluntnose shiner. Reclamation has engaged in efforts to acquire water to try to maintain these flows.

The NMISC reported recently that providing 35 cfs over the Near Acme gage could increase water depletions on the Pecos by 5,000 to 13,000 ac-ft/yr (NMISC 2001). The Final Economic Analysis estimates that 24,463 ac-ft/yr in supplemental flows would be needed to provide the higher amount of 50 cfs—which that documents associates with silvery minnow critical habitat designation—at the Near Acme gage 95 years out of 100). Based on the current market price of water on the Pecos River (about \$1,750 per ac-ft) the Final Economic Analysis

estimates the “total opportunity cost” of maintaining the 50 cfs flow at \$47.3 million, or an annualized cost of \$1.4 million to \$3.3 million (Industrial Economics 2003).

In the last several years, Reclamation has made adjustments in the way it sends water from Sumner Lake to Brantley Reservoir downstream. The 2001 Biological Opinion for the bluntnose shiner (Service 2001a) asked for more limited block releases, a ramping down at the end of block releases, and no block releases for seven weeks during the summer. These changes were intended to reduce the number of bluntnose shiner eggs washing into the inhospitable environment of Brantley Reservoir. However, limitations on block release and the institution of more continuous river flows may result in additional depletions from the Pecos River in New Mexico, and may potentially affect deliveries under the Pecos River Compact.

Reclamation has engaged in different means of acquiring water to offset the depletions caused by its bypasses to maintain target flows at the Near Acme gage, and by changes in reservoir operations on the Pecos. Through consultation with the Service in 2001, Reclamation agreed to lease approximately 2,000 ac-ft of river pumpers’ water rights, as well as roughly 350 ac-ft of Hagerman Canal water rights and 500 ac-ft of groundwater rights upstream from the Near Acme gage (Service 2001a). In recent years, Reclamation has entered into a forbearance program with FSID through which it has paid for crops forgone as a result of reduced water use by participating FSID members. Agreements reached in 2000 and 2001 resulted in water that would have been used to irrigate 703 hectares (1,738 acres) of farmland being kept in the river (N. Purdy, Reclamation, pers. comm. 2001). Participation in the forbearance program was voluntary on the part of individual irrigators.

So far, it appears that Reclamation’s efforts to provide water to the Pecos have resulted in a net gain to the river for purposes of the Pecos River Compact, rather a net depletion. Assuming that Reclamation continues its efforts to supplement flows as necessary on behalf of the bluntnose shiner, it can be expected that the change in flow regime will not result in net depletions for compact delivery purposes.

The water that would be required to maintain 50 cfs flows, as described under the 95 percent scenario in the Final Economic Analysis, is considerably higher than the amounts of supplemental water provided to date. Water acquired to maintain 50 cfs flows at the Near Acme gage would pass downstream (minus losses to evaporation and riparian vegetation) to the CID, and be available for delivery to Texas under the Pecos River Compact. However, it is by no means clear when or if such amounts of water would in fact be acquired to supplement Pecos River flows if silvery minnow critical habitat is designated on the Pecos reach.

(E) Impacts on water rights and management, Pecos

The State Engineer (OSE) considers the waters of the Pecos River in New Mexico to be fully appropriated, and no new appropriations may be made. The NMISC has been actively acquiring and leasing water rights to meet the state’s delivery obligations to Texas as specified in

the Pecos River Compact. Between 1991 and 1999, \$27.8 million was spent on the Pecos River water rights acquisition program. To date, at least 27,000 ac-ft/yr of Pecos water rights have been acquired by the NMISC.

New Mexico faced a shortfall in its Pecos River Compact delivery obligations for the year 2001 and the possibility of priority administration, when the State Engineer would order junior water rights holders not to use water (<http://www.seo.state.nm.us/water-info/pecos/index.html>). The NMISC formed a Pecos River Basin Ad Hoc Committee to work towards a solution to both the immediate crisis and the development of alternatives to address long term management strategies. The Committee passed a resolution in January 2002 recommending that certain steps be taken for the State to acquire water rights, with the cost of the program estimated at \$68 million.

(E) Impacts on water quality, Pecos

No direct impacts on water quality are anticipated under this alternative. Consultation on NPDES permit issuance may in some cases result in a higher standard for water quality than the permitting alone, although preliminary studies indicate that the silvery minnow is not more sensitive to pollution than other fishes, or aquatic life forms generally (J. Lusk, Service, pers. comm. 2001). Aquatic habitat in the Middle Pecos River would continue to be protected by State and Federal water quality standards, and by consultation requirements for the bluntnose shiner. No significant changes to current EPA discharge permitting activities are expected to result if silvery minnow critical habitat were designated.

(E) Impacts on vegetation, Pecos

No alteration of habitat, biological communities, or ecological processes would result directly from the proposed designation. The river management regime instituted to protect and conserve the bluntnose shiner would be expected to continue under designation as proposed in this alternative, results in a more steady flow of water through the Pecos reach than previous management practices. This will likely raise the water table in some areas adjacent to the stream, making more water available to native and non-native vegetation. In scattered locations this may stimulate the growth and reproduction of cottonwoods or other native riparian species. In other locations, a higher water table may fuel the growth and expansion of saltcedar thickets.

Native vegetation may benefit if, as on the Middle Rio Grande, management of river flows for endangered species is accompanied by an allocation of resources towards saltcedar eradication and riparian habitat restoration. At present, only a few such projects are under way. Designation could result in additional management attention to, and support for, restoration efforts on the Pecos.

(E) Impacts on the Rio Grande silvery minnow, Pecos

Under this alternative, designation of the Middle Pecos River would have no direct or immediate effects on the silvery minnow, which is not currently present in this reach. This alternative could benefit the silvery minnow by helping to ensure that habitat suitable for reintroduction at some future date is preserved, and further by drawing management attention to the status, past and present distribution, and habitat requirements of the species.

It should be noted that reintroduction of the silvery minnow to the Pecos River, although recommended by the RGSM Recovery Plan, would have to be preceded by additional studies to determine the suitability of the habitat (Service 1999). In addition, questions regarding the extent of hybridization between plains and silvery minnows need to be resolved in order to determine whether or not the two species can coexist. Currently, New Mexico State University is conducting research on interactions between the two species; preliminary results should be available by the summer of 2002.

(E) Impacts on other fish species, Pecos

Pecos bluntnose shiner. The Pecos bluntnose shiner is federally listed as threatened with critical habitat designated in the Pecos River (see *Water Management for the Pecos bluntnose shiner*, Chapter 3). Bluntnose shiner critical habitat includes a 103 kilometer (64 mile) reach of the Pecos River extending from a point 16 kilometers (10 miles) south of Fort Sumner downstream to the De Baca/Chaves County line and a 60 kilometers (37 miles) reach from near Hagerman to near Artesia (Service 2001a). The shiner population in the Pecos has remained relatively stable under the management regime of the last decade, since there was no intermittency in the 1990's. However, during 2001, an intermittency event occurred from July 10-14, effecting 23 to 45 kilometers (14 to 28 miles) of river. As long as releases from Sumner Dam are sufficient to meet the 35 cfs target flow at the Near Acme gage as recommended by the Service, no change is expected in the shiner's status. To the extent that these flows are not maintained and intermittency occurs, the shiner may experience increased habitat loss, disease, predation, and direct mortality.

Under this alternative, critical habitat for the silvery minnow would encompass a larger river area, extending continuously from Sumner Dam to Brantley Dam. The Service has stated that it believes the two fish are compatible with similar requirements (J. Brooks, Service, pers. comm. 2001). The shiner has benefitted and will continue to benefit from its listed status as a threatened species with critical habitat. It could receive some additional benefit, to the extent that this alternative would result in any additional critical habitat protection or restoration of river habitat.

Under this alternative, no adverse impacts would be anticipated for other fish species in the Pecos River. In general, fish species occupying the river channel have likely benefitted from efforts to maintain more continuous flow for the bluntnose shiner. These benefits would be

maintained, but probably will not be exceeded, if designation occurs. Additional benefits may be realized if designation were to result in any additional protection or restoration of river habitat.

(E) Impacts on other threatened and endangered species, Pecos

Bald eagle. The bald eagle could be slightly affected by designation, together with current and expected future water operations intended to avoid jeopardy to the bluntnose shiner. Habitat protections and restoration activities may benefit the eagle by conserving vegetation used as roosting habitat. No management actions that might come about as a result of designation are likely to result in any adverse impacts on the eagle. A return to a more natural hydrograph on the Middle Pecos River is likely to produce net benefits for the species.

Interior least tern. The tern uses isolated sandbars in rivers as nesting and roosting habitat. The creation of any additional areas of such habitat on the Pecos, as part of restoration efforts intended to benefit the bluntnose shiner and the silvery minnow, would benefit this species. The tern may also benefit from a more steady hydrograph that maintains continuous flows and restricts the duration and magnitude of block releases from Sumner Dam.

Western yellow-billed cuckoo. The cuckoo may benefit from riparian habitat restoration measures, which may or may not follow from designation. Efforts to reduce saltcedar and restore native plant associations can be expected to benefit this species. However, saltcedar eradication intended to reduce water losses, and not accompanied by habitat restoration, could have an adverse impact on the cuckoo.

(E) Impacts on other wildlife, Pecos

Protections granted to listed species and designated critical habitat under the ESA may have important secondary beneficial effects, by helping to preserve natural communities and ecosystems. Habitat loss or degradation is the primary cause of species loss and population declines globally. In the arid Southwest, riparian habitat is thought to be the most limited, most threatened, and most biologically valuable of all major habitat types. Many species restricted to this habitat, or dependent upon it for part of their life cycle, are declining.

It can be predicted that riparian species in general will be favorably affected by any efforts to simulate a more natural hydrological regime and, restore the native mosaic of vegetation in the river corridor. Reptiles and amphibians that require moist, flooded, or wetland areas may see an increase in suitable habitat, as will some species of wading birds. Many neotropical migratory songbirds that use the Pecos River Valley as stopover or breeding habitat should also benefit to some degree.

Wintering sandhill cranes and waterfowl may be adversely affected if water operations to benefit the shiner, and, under this alternative, maintain critical habitat for the silvery minnow,

result in any decrease in grain production at Bitter Lake NWR, W. S. Huey Waterfowl Area, or private farmlands. (See *Impacts on Other Wildlife* for the Middle Rio Grande.) Decreased production of corn, alfalfa, or other crops is a possible consequence of obtaining supplemental water.

(E) Impacts on land use, Pecos

The primary potential impacts on land use stem from the possibility that water rights may be purchased or leased from willing sellers, or forbearance agreements sought from the FSID or its members. This could result in irrigated cropland going out of production, temporarily or permanently.

Acquisition of water rights sufficient to maintain the target flows described above in *Impacts on Federal Actions*, 95 years out of 100, could result in 2,363 hectares (5,839 acres) of land going out of production (Industrial Economics 2003; also see Appendix A to this FEIS). This represents roughly 4 percent of the irrigated crop acreage, and 7 percent of the alfalfa acreage, of the three counties (De Baca, Chaves, and Eddy) in the Middle Pecos River Valley (NM Agricultural Statistics 2000, www.nass.usda.gov/NM/nmbulletin). If agricultural lands are retired only in De Baca and Chaves counties, the total represents roughly 9percent of the irrigated crop acreage, and 6percent of the alfalfa acreage, in this two-county region (*Id*). Retirement of the 2,363 hectares (5,839 acres) is based on the assumption of 50 cfs flows at the Near Acme gage. It is by no means certain when or if the establishment of such flows might follow from silvery minnow critical habitat designation.

Agricultural acreage that could be affected includes the 2,630 hectares (6,500 acres) of lands irrigated by the FSID, as well as the larger total of private lands irrigated by river and groundwater pumping. If alternative methods of providing supplemental flows are pursued, impacts such as those described above may be lessened. Under a water banking or lease option system, lands may go temporarily out of production on an “as needed” basis, depending on annual patterns of precipitation. In its efforts to benefit the bluntnose shiner, Reclamation has been leasing water rights, and has carried out a successful forbearance program with members of the FSID. Lands have been taken out of production through voluntary participation of irrigators.

In addition to impacts on existing agricultural lands, designation and endangered species management on the Pecos may affect land use in other ways. New construction or other changes in land use within the proposed critical habitat boundary could be affected by designation, if there is Federal involvement. The impact in such cases would follow from the requirement that the action agency and private applicant, if any, engage in section 7 consultation. Existing and future land use practices by private parties, where there is no Federal nexus, would not be affected. Existing development is minimal in the floodplain area within the lateral critical habitat boundaries proposed by the Service. Structures and other developed areas are specifically excluded from designation as stated above. Grazing occurs in some areas, but

grazing on private lands is not subject to section 7 requirements. Grazing on BLM allotments will be subject to consultation.

(E) Social and economic impacts, Pecos

Economic costs associated with endangered species management and critical habitat designation for the silvery minnow are discussed in the Final Economic Analysis. The analysis considers three categories of economic impact: 1) The opportunity cost of maintaining sufficient instream flow for the silvery minnow; 2) Secondary economic effects of water acquisition, including local and regional effects on production, employment, wages, and income; and 3) Consultation and project modification costs to Federal agencies. Tables summarizing impacts in the three cost categories for the Pecos are presented in Appendix A.

In considering the figures used in the Final Economic Analysis, and in the discussion below, it should be kept in mind that these figures describe hypothetical direct and indirect costs of managing and reallocating water in the Pecos River, under this alternative, to maintain critical habitat for the silvery minnow. Costs associated with the ongoing management and water reallocation program to benefit the Pecos bluntnose shiner are beyond the scope of this document. Any actual costs of silvery minnow management on the Pecos would occur together with current and future costs attributable to managing the river for the bluntnose shiner.

As with the Middle Rio Grande region analysis, economic effects have been assumed to be a function of the voluntary purchase and retirement of sufficient water rights to meet critical habitat requirements for the silvery minnow 95 years out of 100. In the Middle Pecos region this amounts to 24,463 ac-ft per year, sufficient to irrigate 2,363 hectares (5,839 acres) of alfalfa (Industrial Economics 2003), without identifying a way to get credit for the water delivered to CID or the Texas Stateline.

The data used in the analysis of regional effects on the Middle Pecos have been disaggregated to the county level in order to estimate effects on each county. New Mexico Agricultural Statistics 1999 provides the amount of irrigated land in each county planted to crops, which has been used to estimate each county's share as a percentage of the total irrigated acreage in the region. The value of foregone production in each county was calculated in the analysis assuming that alfalfa would be the crop voluntarily taken out of production as farmers' water rights were bought. The economic effects are shown in **Table 4-7**.

Table 4-7. Pecos County Economic Effects Based on Percentage of Region's Total Irrigated Acreage¹

Lower Pecos Counties	Irrigated acres in production	Percent of irrigated acres in region ²	Acres possibly retired ³	Value of foregone production	Secondary (indirect and induced effects)	Total economic impact
De Baca	10,377	7.4percent	431	\$ 310,965	\$ 146,988	\$ 457,953
Chaves	87,036	61.9percent	3,615	\$ 2,608,186	\$ 1,232,848	\$ 3,841,034
Eddy	43,159	30.7percent	1,793	\$ 1,293,335	\$ 611,339	\$ 1,904,674
Region:	140,572	100.0percent	5,839	\$ 4,212,486	\$ 1,991,175	\$ 6,203,661

This table shows what might occur if water rights were purchased voluntarily from within each county in proportion to its use of irrigation water. Chaves County would experience the greatest dollar impacts, twice that of Eddy County. It is important to note, however, that both Chaves and Eddy counties have far more diversified economies than does De Baca, and that both of the larger counties may experience less in the way of secondary effects than shown in this table. De Baca County, where agricultural earnings constitute 24 percent of total earnings, may be subject to a higher level of indirect and induced effects than shown here. It is also reasonably certain that residents of Carlsbad and the lower half of Eddy County, being downstream from the Near Acme gage, where the river is most likely to go dry, are a less likely source of "wet water" than residents at or above the gage. De Baca County may be subject to yet higher impacts.

Table 4-8. Pecos, Effects on Unemployment by County Based on Percentage of Irrigated Acreage

Lower Pecos Counties	Effect on jobs	Civilian labor force	Projected increase in unemployment rate
De Baca	11.7	999	1.2percent
Chaves	97.8	24,560	0.4percent
Eddy	48.5	22,928	0.2percent
Region	158		

Although De Baca County would lose fewer than 12 jobs as a result of the voluntary transfer of irrigation water under this scenario, the effect on the small labor force would be an increase in unemployment of 1.2 percent.⁷ The effects in Chaves and Eddy counties would be proportionally smaller, but would be added to higher base levels of unemployment. Nearly 100 jobs might be lost in Chaves County, and 50 in Eddy County.

(E) Impacts on Indian trust resources, Pecos

No Indian trust resources are involved or would be affected under this alternative.

(E) Environmental justice effects, Pecos

De Baca County, the second to the last county in personal income in New Mexico, with an aging population and a high percentage of children in poverty, and Chaves County, with a substantial low-income population, will be affected economically if land is taken out of production.

(E) Impacts on cultural resources, Pecos

Water operations implemented on behalf on the bluntnose shiner, and expected to continue under this alternative, will likely have little or no effect on any cultural resources in the Pecos River Valley. The scattering of archeological sites present in the river floodplain will be largely unaffected by a regime that maintains minimum year-round flows and does not require overbank flooding. Some sites close to the river may be marginally affected by changes in the near-surface water table. No cultural resources other than archeological sites have been identified within the area proposed for designation under this alternative.

(E) Impacts on recreation, Pecos

Impacts of endangered species management on recreation in the Pecos Valley are largely the same as those described for the Middle Rio Grande. Under this alternative, facilities and opportunities for recreation would not be directly impacted by designation. Critical habitat for the silvery minnow would not require any changes in allowable recreational uses of the Middle Pecos River, its upstream or downstream reservoirs, or public lands along the river corridor. The Pecos is impacted by a loss of reservoir-based recreation for other reasons, namely the need to deliver water from Santa Rosa and Sumner Reservoirs to Brantley Reservoir for delivery to CID.

⁷While Industrial Economics ran a regional analysis using IMPLAN, an analysis was done for De Baca County using IMPLAN at the county-level. It was assumed, for the sake of analysis in the county-level run, that 20 percent of the irrigated acreage would be fallowed. This resulted in a loss of 60 jobs, as compared to the 12 jobs that are lost when 4.2 percent (431 out of 10,377) of the acreage is taken out of production. The results are comparable.

Recreational opportunities may be indirectly impacted by potential consequences of designation as proposed in this alternative. Fishing and boating opportunities may be lost if reservoir drawdowns to maintain river flows result in an even greater loss of access (boat ramps no longer reaching the water) than is the case when CID calls for water.

Hunting and wildlife viewing opportunities may be lost if State and/or Federal refuges choose to forego irrigation of crops as a winter food supply for migratory cranes and waterfowl, in order to keep more water in the river. This impact is probably less likely on the Pecos than in the Middle Rio Grande Valley. On the other hand, wildlife viewing and possibly hunting opportunities may increase to the extent that improved habitat for resident and migratory bird species is created.

Summary of Adverse Effects of Alternative E

Alternative E is the most comprehensive of the alternatives studied. It proposes to designate as critical habitat all of the areas occupied currently by the Rio Grande silvery minnow and offers protection to areas within the historical range of the species.

Because of the extensive Federal activities that take place on the Middle Rio Grande, obligations imposed primarily by the endangered status of the minnow but occurring co-extensively with critical habitat designation are substantial. A number of Federal agencies must consult with the Service on a range of activities, as described early in this chapter. Over time, agencies such as Reclamation and the Corps have been modifying their activities in response to ESA concerns such that by now the actions over which they consult include a combination of traditional and species-protective actions. The “single reasonable and prudent alternative” described in the 2001 Programmatic Biological Opinion, or any comparable approach taken in a later consultation, will continue to reshape Federal actions to benefit endangered species.

Among the actions of the Bureau of Reclamation, in particular, are efforts to voluntarily secure supplemental water through purchase, lease, or with forbearance agreements to provide flows in reaches susceptible to drying (Reclamation 2001b). While these are actions considered protective of the environment, in the long run there may be unintended socio-economic consequences. Much less San Juan-Chama water is available for lease than previously, and water may be increasingly sought from other sources. To the extent that water rights are voluntarily purchased or leased from the agricultural sector and the lands are retired from farming, there would be secondary effects – ripple effects – on the communities that have provided goods and services for the support of agriculture. These have been modeled in the Final Economic Analysis at the regional level and described on the county level in *Social and Economic Impacts* above.

Some of the actions on which Federal agencies must consult are the permitting and/or funding of private or agency activities. In such cases, private parties and non-Federal entities are affected when the Federal decision-maker undergoes consultation. They may be affected by a

slower, possibly more costly review process as well as by possible modifications to their activities.

There may be unintended consequences to the natural environment. Under certain scenarios, it is conceivable that wildlife refuges could be requested to forego the water rights they use to irrigate croplands for migratory birds in favor of letting the water flow downstream.

Similar impacts may be felt in De Baca, Chaves, and Eddy Counties as water managers may try to voluntarily lease or purchase water rights on the Pecos. While willing sellers or lessors may be compensated, the retail and service industries relying on their business are not. On a less tangible level, De Baca County is a sparsely populated farming and ranching area that may already be losing ground; changes in the community may accelerate as land is retired to meet the needs of the Pecos bluntnose shiner and silvery minnow critical habitat, as well as Pecos River Compact compliance.

In Big Bend National Park, no significant adverse impacts are likely to result from this alternative. Minor financial and administrative impacts could result from the burden placed upon Federal agencies to consult with the Service regarding any actions that might have an effect on the area designated as critical habitat. Section 7 consultation would be required by the NPS regarding a few ongoing or planned management actions, and some project modifications are possible for Park water diversions and saltcedar control projects. Beyond this, assessment of impacts becomes more speculative. Certain hypothetical impacts may take place only if particular events occur. For example, channel avulsion might require an IBWC boundary maintenance action, which in an area of critical habitat would require section 7 consultation.

The Rio Grande Wild and Scenic River in and south of the park to the Terrell/Val Verde county line is a remote area, with little Federal involvement and few private landowners. The only likely Federal actions on the river are the adoption of a new river management plan and the issuance of boating permits. As in the other reaches, however, there may be less tangible impacts. Landowner fear of endangered species issues could sideline the collaborative process underway to develop a management plan for the wild and scenic river.

Comparing Short-Term Uses and Long-Term Productivity

_____ In the short term, the Middle Rio Grande will continue to be managed under the RPA in the 2001 Programmatic Biological Opinion. Given the presence of the minnow in the Middle Rio Grande and the river management agencies' awareness of its presence, designation is likely to add little extra protection in the immediate future. It is possible, however, that if the status and distribution of the species were to change, designation might add a consistency to habitat protection that might not otherwise exist.

Designation of the Pecos between Sumner Dam and Brantley Reservoir and the Rio Grande through Big Bend and the Wild and Scenic River as critical habitat for the silvery minnow would have few immediate effects, either positive or negative. Short-term

commitments of resources would consist largely of the time and financial cost of section 7 compliance for the small number of Federal agency actions that might affect habitat. However, designation would carry with it a long-term commitment to sustainable management. On the Pecos, it should provide further impetus to hybridization studies and other work needed to prepare for possible reintroduction.

Additional protections resulting from designation would help ensure that habitat essential for the recovery and possible future de-listing of the Rio Grande silvery minnow would remain available, in accordance with the recommendations of the Recovery Plan. Designation would also help stimulate management efforts to preserve the physical and ecological character of the Rio Grande in southwest Texas, both for the benefit of wildlife and for the enjoyment of future generations of visitors to Big Bend National Park and the Rio Grande Wild and Scenic River. In so doing, this alternative is fully consistent with the mission and legislated management objectives of the NPS.

Irreversible and Irrecoverable Commitments of Resources

Given the precarious status of the Rio Grande silvery minnow, the most irreversible and irretrievable loss would be the extinction of the species, if it were to be extirpated from the few remaining reaches it inhabits. Possibly irretrievable commitments in counties such as Socorro or De Baca would be the loss of the farming-related businesses and agricultural way of life that could be a consequence of the voluntary purchase, lease, or forbearance agreement used by entities trying to keep water in the river for such co-extensive causes as endangered species protection and compact delivery requirements.

This alternative will not result in the irreversible commitment or loss of non-renewable resources in the Big Bend region. Waters of the Rio Grande are a renewable resource, and designation itself would not result in the loss of any existing or currently planned use of those waters.

Cumulative Effects

“Cumulative impact” is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of the agency or person undertaking the actions (40 CFR 1508.7). Other actions affecting the Middle Rio Grande include the completion and operation of Cochiti Dam in 1975, the operation of diversion structures for irrigation, the channelization of the Rio Grande to improve deliveries to Texas under the Rio Grande Compact, and the gradual modification of floodplain vegetation. Population growth in urban centers, the mining of groundwater in the Albuquerque metropolitan area, the forthcoming diversion of San Juan-Chama waters for municipal contract holders, and future development of Pueblo water rights all put pressure on an already scarce resource, the Rio Grande.

Other actions include the listing of the Rio Grande silvery minnow and the flycatcher as endangered species, together with the legal obligations resulting from the listings. Most of the social and economic impacts on the Middle Rio Grande discussed in this chapter are the direct result of listing, and subsequent modification of actions undertaken to avoid jeopardy. Critical habitat designation for the minnow would have the effect of increasing the scope of and number of consultations by Federal agencies in the Middle Rio Grande Valley, and could require some project modifications. For the most part, however, designation would impose few additional obligations, and the impact on the environment should be a beneficial one.

On the Pecos, over-appropriation of the water resource combined with the importance of making deliveries to Texas under the Pecos River Compact pose a great challenge for water resource managers. The OSE considers the waters of the Pecos River in New Mexico to be fully appropriated, and no new appropriations are being made. The NMISC has been actively acquiring and leasing water rights to meet the State's delivery obligations to Texas as specified in the Pecos River Compact. Between 1991 and 1999, \$27.8 million was spent on the Pecos River water rights acquisition program. To date, at least 27,000 ac-ft/yr of Pecos water rights have been acquired by the NMISC.

In 2001, New Mexico faced a potential shortfall in its Pecos River Compact delivery obligations and the possibility of priority administration, when the State Engineer would order junior water rights holders not to use water (<http://www.seo.state.nm.us/water-info/pecos/index.html>). The NMISC formed a Pecos River Basin Ad Hoc Committee to work towards a solution to both the immediate crisis and the development of alternatives to address long term management strategies. The Committee found that the economic impact of priority administration would exceed the cost of purchasing water rights to meet Compact obligations. As a result, the Committee developed a plan that includes the purchase of 2,428 hectares (6,000 acres) of irrigated farmland, the purchase of 12,000 ac-ft of water rights, and the pumping of roughly 20,000 ac-ft from the Roswell Artesia Basin artesian aquifer to augment downstream supplies.

Completion of Brantley Dam, infestation by saltcedar, and possibly the introduction of the plains minnow have contributed in different ways to a degraded river. The listing of the Pecos bluntnose shiner in 1987, with critical habitat, has caused water managers to try to reverse that trend. Adding critical habitat designation for the silvery minnow would increase the level and scope of consultations, but management of the Pecos for the silvery minnow would be, according to Service fisheries experts, compatible with management for the bluntnose shiner. It is foreseeable that the additional layer of ESA protection would be beneficial to the environment.

As noted above, this FEIS does not provide detailed analyses for the reintroduction of the silvery minnow because any future recovery efforts, including repatriation of the species to areas of its historic range using the authorities of section 10(j) of the ESA must be conducted in

accordance with NEPA and the ESA. The reasons for not conducting detailed analyses were described in alternative B above.

Chapter 5. Consultation and Coordination

Development of the DEIS and FEIS

The designation of critical habitat for the Rio Grande silvery minnow has a long and difficult history. On March 1, 1993, the Service proposed to list the Rio Grande silvery minnow as an endangered species, with critical habitat (58 FR 11821). On July 20, 1994, after a review of the comments received in response to the proposed rule, the Service published the final rule to list the Rio Grande silvery minnow as endangered, but concluded that critical habitat was not then determinable (59 FR 36988).

On February 22, 1999, in *Forest Guardians v. Babbitt*, Civ. No. 97- 0453 JC/DIS, the U.S. District Court for the District of New Mexico ordered the Service to publish a final determination with regard to critical habitat for the Rio Grande silvery minnow. On July 6, 1999, the Service published a final rule (64 FR 36274) designating as critical habitat the stretch of the Rio Grande in New Mexico from Cochiti Dam south to the San Marcial Railroad Bridge.

Several parties filed suit objecting to the designation. On November 21, 2000, in *Middle Rio Grande Conservancy District v. Babbitt*, Civ. No. 99-870, 99-872 and 99-1445M/RLP (consolidated), the U.S. District Court in New Mexico ordered the Service to issue within 120 days both an EIS under NEPA and a new proposed rule on critical habitat designation under the ESA. On April 25, 2001, the Court issued an order denying the Service an extension of time and instructing the agency to continue to work on a formal designation with the urgency the work deserves.

The Service published notice of its intent to prepare an EIS in the Federal Register on April 5, 2001 (66 FR 18107). It also mailed almost 500 letters to individuals, agencies, and organizations and placed notices in several newspapers of general circulation in New Mexico and Texas. The Federal Register announcement, letters, and newspaper notices announced public scoping meetings and also invited the public to submit written comments by June 4, 2001.

Public scoping meetings were held on April 17, 2001, in Albuquerque, on April 23, 2001, in Carlsbad, New Mexico and on April 24, 2001, in Fort Stockton, Texas. A meeting was also held on April 30, 2001 in Socorro, New Mexico. A total of one hundred and thirty five people attended these meetings, with some people attending more than one. Over thirty people made oral comments at the meetings and thirty sets of written comments were submitted, including comments from five of the six Indian Pueblos that are situated in the Middle Rio Grande Valley.

During the scoping process that took place in April, May, and early June, 2001, members of the public submitted comments on possible alternatives for the designation and raised a

number of issues. The Service, charged with overseeing the writing of this document, took these questions, comments, and suggestions into consideration as it developed alternative approaches to designation and identified potential impacts of the different alternatives for study in the DEIS.

At a meeting of the Rio Grande Silvery Minnow Recovery Team on September 12, 2001, Service and EIS contractor personnel briefed the Team on the status of the DEIS and discussed different possible alternatives for designation. Because of the nature of the topic and the historical range of the minnow, members of the Rio Grande Fishes Recovery Team, the six Indian Pueblos on the Middle Rio Grande, and irrigation districts on the Pecos were invited to the meeting. Fourteen individuals from outside the Service and EIS contractor staff attended; the events of September 11 prevented others from being present. Given time constraints, the Service could not schedule another meeting but distributed summaries of the September 12 discussion and invited comments and suggestions on alternative designations and the submission of information on possible biological, cultural, social, and economic impacts. The Service received 10 letters in response to this request for information.

The Service held a day-long meeting with its EIS contractor, UNM's Institute of Public Law, and its economic analysis contractor, Industrial Economics, Inc., early in the project. In subsequent months, available data and other information, including historical records on Section 7 consultations and scientific reports and analyses, were reviewed, written inquiries were made, and telephone interviews conducted. Weekly meetings were held between and among EIS contractor personnel and Service scientists and other staff.

In our continuing efforts as the lead the Federal agency for compliance with NEPA (40 CFR 1501.5; 40 CFR 1501.6), we requested the expert review of the preliminary predecisional draft EIS and preliminary predecisional draft economic analysis from our cooperating agencies or from others agencies that had jurisdiction by law or special expertise on matters relating to the conservation of the silvery minnow. This list of agencies included: the U.S. Bureau of Reclamation, U.S. Bureau of Indian Affairs, National Park Service, U.S. Army Corps of Engineers, New Mexico Department of Game and Fish, Texas Parks and Wildlife Department, New Mexico Interstate Stream Engineer, Chaves County, New Mexico, and the Middle Rio Grande Conservancy District.

Given the short amount of time that was available to prepare a proposed rule, a draft economic analysis, and a draft environmental impact statement, the Service is especially interested in receiving comments, corrections and suggestions from reviewers. The three documents are being distributed as widely as possible for this reason. Agencies, organizations, and individuals interested in, involved with, or possibly affected by critical habitat designation are encouraged to review the three documents carefully and send the Service their comments and any additional information that they would like the Service to consider. Among other things, the Service would appreciate copies of any data, reports, or other information that commentors believe would be helpful to the analysis of environmental impacts.

The proposed rule, DEIS and Draft Economic Analysis were released on June 6, 2002. We requested that all interested parties submit comments or information concerning the designation of critical habitat for the silvery minnow (67 FR 39206). During the comment period, we held public hearings in Socorro and Albuquerque on June 25, and 26, 2002, respectively. We published newspaper notices inviting public comment and announcing the public hearings in the following newspapers in New Mexico: Albuquerque Journal, Albuquerque Tribune, Socorro Defensor Chieftain, Sante Fe New Mexican, Las Cruces Sun. Transcripts of these hearings are available for inspection. The comment period originally scheduled to close on September 4, was extended until October 2, 2002 (67 FR 57783). We contacted all appropriate State and Federal agencies, Tribes, county governments, scientific organizations, and other interested parties and invited them to comment. On June 6, 2002, we hosted a teleconference to provide a short presentation and answer questions by reporters on all aspects of the proposed critical habitat designation, the draft economic analysis, and DEIS. We also provided notification of these documents through email, telephone calls, letters, and news releases faxed and/or mailed to affected elected officials, media outlets, local jurisdictions, Tribes, and interest groups. We also published all of the associated documents on our Region 2 Internet site following their release on June 6, 2002.

We solicited five independent experts who are familiar with this species to peer review the proposed critical habitat designation. Only one of the peer reviewers submitted comments, and these supported the proposed designation. We also received a total of 34 oral and 54 written comments. Of those oral comments, 10 supported critical habitat designation and 24 were opposed to designation. Of the written comments, 17 supported critical habitat designation, 22 were opposed to designation, and 15 were neutral or provided additional information. We reviewed all comments received for substantive issues and new data regarding critical habitat and the silvery minnow. We addressed and considered all comments received during the comment periods and public hearing testimony. Comments of a similar nature were grouped into issues and responses were provided. The comments and responses can be found in Appendix G.

Distribution of the FEIS

This FEIS is being sent to the following agencies, organizations, and individuals for their review and comment. It will also be sent to any other agencies, organizations or individuals requesting copies during the period for public comment. Because of the sheer volume of paper and the desire to circulate the documents widely, the Service will be distributing the Final Rule, Final EIS and Final Economic Analysis together on compact disc. It will also be available on the U.S. Fish and Wildlife's Region 2 Homepage (<http://southwest.fws.gov/>) under Hot Topics. Hard copies will be provided upon request.

Federal Agencies

Council on Environmental Quality

Department of Agriculture

Secretary of Agriculture

Natural Resource Conservation Service

United States Forest Service

Department of the Interior

Secretary of the Interior

Bureau of Indian Affairs

Bureau of Land Management

Bureau of Reclamation

Fish and Wildlife Service, including:

Bitter Lake National Wildlife Refuge

Bosque del Apache National Wildlife Refuge

Sevilleta National Wildlife Refuge

National Park Service, including:

Big Bend National Park

Environmental Protection Agency

International Boundary and Water Commission, U.S. Section

U.S. Army Corps of Engineers

Mexico

International Boundary and Water Commission, Mexican Section

Compact Commissions

Pecos River Compact Commission

Rio Grande Compact Commission

State of New Mexico

Office of the Governor

Bureau of Mines and Mineral Resources

Department of Agriculture

Department of Game and Fish

Energy, Minerals and Natural Resources Department

Environment Department

Game Commission

Historic Preservation Division

Interstate Stream Commission

New Mexico Institute of Mining and Technology

New Mexico State University

NMSU Cooperative Extension Service

Office of the Attorney General

Office of the State Engineer
State Land Office
University of New Mexico

State of Texas

Office of the Governor
Natural Resources Conservation Commission
Parks and Wildlife
Office of the Attorney General
Sul Ross State University
Texas A & M University
University of Texas
Water Commission

State of Colorado

Division of Water Resources
Office of the Attorney General

Tribal Governments

All Indian Pueblo Council
Jicarilla Apache Nation
Navajo Nation
Pueblo of Acoma
Pueblo of Cochiti
Pueblo of Isleta
Pueblo of Jemez
Pueblo of Laguna
Pueblo of Nambe
Navajo Nation
Pueblo of Picuris
Pueblo of Pojoaque
Pueblo of San Felipe
Pueblo of San Ildelfonso
Pueblo of San Juan
Pueblo of Sandia
Pueblo of Santa Ana
Pueblo of Santa Clara
Pueblo of Santo Domingo
Pueblo of Taos
Pueblo of Tesuque
Pueblo of Zia
Ysleta del Sur Pueblo

New Mexico Counties

Bernalillo County
Chaves County
De Baca County
Dona Ana County
Eddy County
Guadalupe County
Sandoval County
Santa Fe County
Sierra County
Socorro County
Valencia County

New Mexico Municipalities

Albuquerque
Artesia
Belen
Bernalillo
Bosque Farms
Carlsbad
Corrales
Española
Fort Sumner
Las Cruces
Los Lunas
Los Ranchos de Albuquerque
Rio Rancho
Roswell
Santa Fe
Santa Rosa
Socorro
Truth or Consequences

Texas Counties

Brewster County
Crane County
Crockett County
Hudspeth County
Loving County
Pecos County
Presidio County
Reeves County
Terrell County

Val Verde County
Ward County

Texas Municipalities

Alpine
Brownsville
Del Rio
El Paso
Fabens
Fort Stockton
Girvin
Grandfalls
Imperial
Langtry
Pandale
Pecos
Presidio

Other Public Authorities

Albuquerque Metropolitan Arroyo Flood Control Authority
Anthony Water and Sanitation District
Carlsbad Irrigation District
De Baca Soil and Water Conservation District
El Paso County Lower Valley Water District Authority
El Paso County Water Improvement District No. 1
Elephant Butte Irrigation District
Fort Sumner Irrigation District
Hagerman-Dexter Soil & Water Conservation District
Hudspeth County Conservation and Reclamation District No. 1
Middle Rio Grande Conservancy District
Middle Rio Grande Council of Governments
New Mexico Acequia Commission
Pecos Valley Artesian Conservancy District
Red Bluff Water Power Control District
Rio Chama Acequia Association
San Juan-Chama Contractors Association
Sierra Soil and Water Conservation District
Socorro Water and Conservation District
Southern Sandoval County Arroyo Flood Control Authority
Ward County Irrigation District No. 1

New Mexico Congressional Delegation

Senator Pete Domenici
Senator Jeff Bingaman
Representative Joe Skeen
Representative Tom Udall
Representative Heather Wilson

Texas Congressional Delegation

Senator Phil Gramm
Senator Kay Bailey Hutchison
Representative Bill Archer
Representative Dick Armev
Representative Joe Barton
Representative Ken Bentsen, Jr.
Representative Dick Armev
Representative Henry Bonilla
Representative Kevin Brady
Representative Larry Combest
Representative Tom DeLay
Representative Lloyd Doggett
Representative Chet Edwards
Representative Martin Frost
Representative Charles Gonzalez
Representative Kay Granger
Representative Gene Green
Representative Ralph Hall
Representative Ruben Hinojos
Representative Eddie Bernice Johnson
Representative Sam Johnson
Representative Nick Lampson
Representative Sheila Jackson Lee
Representative Solomon Ortiz
Representative Ron Paul
Representative Silvestre Reyes
Representative Ciro Rodriguez
Representative Max Sandlin
Representative Pete Sessions
Representative Lamar Smith
Representative Charles Stenholm
Representative William Thornberry
Representative Jim Turner

Organizations

Alliance for Rio Grande Heritage
Amigos Bravos
Carson Forest Watch
Center for Biological Diversity
Defenders of Wildlife
Economic Forum
Endangered Species Coalition
Forest Guardians
National Association for Commercial Real Estate
National Association of Industrial and Office Properties
National Parks Conservation Association
New Mexico Audubon Council
New Mexico Cattle Growers Association
New Mexico Farm and Livestock Bureau
New Mexico B.A.S.S. Federation
New Mexico Wool Growers, Inc.
Paso del Norte Water Task Force
Quivira Coalition
Rio Grande Restoration
Rio Grande/Rio Bravo Basin Coalition
Rio Grande Water Users Association
Sierra Club, Rio Grande Chapter
Southwest Environmental Center
Texas Center for Policy Studies
The Nature Conservancy of New Mexico
Trout Unlimited

Public Libraries

Albuquerque-Bernalillo County Public Library
Anthony-Valley Community Library
Artesia Public Library
Belen Public Library
Bernalillo Public Library, Town of
Bosque Farms Public Library
Carlsbad Public Library
Cochiti Lake Community Library
Corrales Community Library
Española Public Library
Fort Sumner Public Library
Las Cruces - Thomas Branigan Memorial Library
Los Lunas Community Library
Rio Rancho Public Library

Roswell Public Library
Santa Fe Public Library
Santa Rosa Public Library
Socorro Public Library
Truth or Consequences Public Library

Individuals

This FEIS will be sent to all individuals who have requested to receive a copy. The FEIS is also being sent to the members of the Rio Grande Silvery Minnow Recovery Team and the Rio Grande Fishes Recovery Team

List of Preparers

This FEIS was prepared by the U.S. Fish and Wildlife Service with the assistance of the Institute of Public Law at the University of New Mexico School of Law. People who contributed substantially to the writing, review or editing of this document are listed below. Others too numerous to list provided information on the different subjects covered.

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Preparers of Final Economic Analysis

The Draft Economic Analysis, incorporated into this DEIS by reference, was prepared for the Service’s Division of Economics by Industrial Economics, Incorporated, Cambridge, Massachusetts, with the assistance of Brookshire, McIntosh and Associates, Albuquerque, New Mexico and Michael Jones, consulting hydrologist, Albuquerque, New Mexico. Industrial Economics is an economic and environmental consulting firm founded in 1981 to provide expert analysis to government decision makers and regulators, corporate strategic planners, trade associations, and other clients. Its personnel offer expertise in environmental policy and regulatory analysis, health and ecological risk assessment, habitat restoration, business management, natural resource damage assessment, and financial and industrial analysis.