United States Department of the Interior

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July 10, 2008

Cons. # 22420-2008-F-0125

Lt. Colonel Kimberly M. Colloton
(Attn: Julie A. Hall)
Environmental Resources
U.S. Army Corps of Engineers
4101 Jefferson Plaza NE
Albuquerque, New Mexico 87109-3435

Dear Lt. Colonel Colloton:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion (BO) on the effects of the action described in the Biological Assessment (BA) for the Bosque Revitalization at Route 66 project for the Albuquerque Reach of the Rio Grande in Bernalillo County, New Mexico. The duration of this action is from the issuance of this BO through April 2010. This BO concerns the effects of the action on the endangered Rio Grande silvery minnow (*Hybognathus amarus*) (silvery minnow), its designated critical habitat, and the endangered southwestern willow flycatcher, (*Empidonax traillii extimus*) (flycatcher). Your request for formal consultation, in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 531 *et seq.*), was received on May 30, 2008. The U.S. Army Corps of Engineers (Corps) is the lead Federal agency in this consultation.

This BO is based on information submitted in the draft BA dated March 14, 2008; the final BA dated May 30, 2008; conversations between the Corps and the Service; and other sources of information available to the Service. A complete administrative record of this consultation is on file at the Service's New Mexico Ecological Services Field Office (NMESFO).

You have determined that the proposed project may affect, is not likely to adversely affect, flycatcher and designated critical habitat for the silvery minnow. We concur with these determinations for the following reasons:

Flycatcher

1) Flycatcher surveys were conducted at the project location in 2002 and 2003 and no migrant or nesting flycatchers were observed. Surveys were conducted in 2004 and 2005, and migrant birds (observed only on the first survey occasion each year) were observed on the east side—across the river—from the project site. Since the observations, vegetation and potential habitat has been removed from the area. Surveys were not conducted in 2008 since flycatchers have never been observed at the project site, and vegetation has been removed.

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2) Suitable migrant habitat may be found within .25 miles of the construction area. Construction within .25 miles of potential migrant habitat shall take place outside of the migrant season (April 15 through September 15). Construction not within .25 miles of suitable habitat may take place April 30 through August 30.

3) The project includes planting of native riparian/wetland vegetation, which can be beneficial to the flycatcher.

Silvery Minnow Designated Critical Habitat
The proposed action is likely to have a positive long-term impact on three of the four primary constituent elements of critical habitat for the silvery minnow. These include backwaters, shallow side channels, pools, and runs of varying depth and velocity; substrates of primarily sand and silt; and the presence of eddies created by debris piles, pools or backwaters, or other refuge habitat 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. The proposed restoration project will create backwater embayments, and a side channel that will inundate at higher flows. These habitats provide critical nursery habitat for silvery minnow eggs and larvae and enhance opportunities for silvery minnow recruitment. Short-term habitat disturbance will occur during the construction phase of this project. However, these effects will be limited in size and duration and are therefore, insignificant and discountable.

The remainder of this biological opinion will deal with the effects of implementation of the proposed action on the silvery minnow.

Consultation History
A draft BA was provided to the Service to review on March 14, 2008. A final BA was received on May 30, 2008. This BO is tiered off the 2003 Biological and Conference Opinions on the Effects of the Bureau's Water and River Maintenance Operations, Army Corps of Engineers' Flood Control Operation, and Related Non-Federal Actions on the Middle Rio Grande (March 2003 BO).

BIOLOGICAL OPINION

I. DESCRIPTION OF THE PROPOSED ACTION

Overview
The Bosque Revitalization at Route 66 Project (Route 66 Project) feasibility study was conducted under the authority of Section 1135 of the Water Resources Development Act of 1986 (P.L. 99-662), as amended. The objective of this authority is to improve the quality of the environment through modification of the structure or operation of existing water resources

projects constructed by the Corps, provided such modifications are feasible and consistent with the original project purpose. Improvements in ecosystem structure or function in areas adversely affected by such projects are also included in the authority. The Route 66 Project will improve ecosystem structure and function and create habitat for the silvery minnow and flycatcher. This project will recreate three hi-flo channels that will create habitat for the silvery minnow. Non-native vegetation will be removed and native vegetation will be planted, facilitating the regeneration of native vegetation suitable for the flycatcher.

The Route 66 Project is intended to partially fulfill the requirement of habitat restoration under the March 2003 BO Reasonable and Prudent Alternative (RPA) Element S which proposes "to conduct habitat/ecosystem restoration projects in the Middle Rio Grande to increase backwaters and oxbows, widen the river channel, and/or lower river banks to produce shallow water habitats, overbank flooding, and regenerating stands of willows and cottonwood to benefit the silvery minnow and flycatcher or their habitats."

Project location

The proposed project is located in the bosque along approximately 3 river miles of the Rio Grande between Central Avenue and Bridge Blvd. with a portion of the project north of Central on both sides of the river. The project area is bounded on east and west sides by levees and riverside drains. The total project area includes approximately 121 acres in the bosque.

Project Description

The proposed action includes removal of jetty jacks and non-native vegetation across 121 acres of bosque north and south of Central on the west side of the river and north of Central on the east side of the river (Figure 2, attachment), Non-native vegetation to be removed will include salt cedar (*Tamarix ramosissima*), Russian olive (*Elaeagnus angustifolia*), Tree of Heaven (*Ailanthus altissima*) and Siberian elm (*Ulmus pumila*). The proposed action also includes recreating 3 hi-flo channels, and enhancing 1 outfall wetland at the Gonzales Drain. Further restoration features include planting of native vegetation throughout the project area (121 acres) and creation of a number of willow swales. A detail of the size and acreage of each of the features is shown in Table 1. Improvements of existing facilities for educational, interpretive and low-impact recreational uses have also been considered in the Route 66 Project.

Table 1. Proposed Action

	Location	Dimension/#	# of Acres
Non-native vegetation removal			121*
Jetty jack removal		1000	
Hi-flo channel	Central NW		2
	Central SW		2
	Bridge NW		2
Outfall Wetland			1
Willow Swale	Central SW	5	3
	Bridge NW	14	10
Revegetation			121

*Note: Non-native vegetation removal will take place first across all areas and then hi-flo channels, etc. will be constructed. Therefore, the overall acreage affected is still 121 but all features (hi-flo channels, outfall wetland and willow swales) will be constructed in the same areas where the non-native vegetation removal will take place first.

1. Removal Features

Approximately 144,000 cubic yards of debris (concrete, asphalt, garbage) will be removed from the area north of Central Avenue on the west side of the river (see Figure 2). Removal of the debris will create new areas for native revegetation and will improve the aesthetic quality of the bosque.

Approximately 1000 non-functional jetty jacks will be removed during this project. Bank-line jacks and tie-back jacks in narrow bank areas in the Project Area such as on the west side north of Bridge Blvd. will not be removed. Removal of non-native vegetation and retreatment of areas where jetty jacks are removed is described in Removal/Disposal of Exotic Vegetation below.

2. Water Related Features

The Route 66 Project includes construction of three hi-flo channels. Two channels are north and south of Central Ave. on the west side. The third channel is north of Bridge Blvd. on the west side of the river. In total, these channels constitute approximately 6 acres of new habitat. The high flow channels are designed to re-create the historic braided channels of the river during hi-flo events. Design of the channels will be coordinated with final alignments of trails to limit access and create potential refuge areas on the river-side of the channels. The design of the channels is also being done in relation to lessons learned at the Nature Center channel. The Nature Center channel has two interior embayments which help create additional potential habitat but also created areas for sediment to fall out during the recent (May-June 2008) high flows. This created additional maintenance to ensure that the Rio Grande silvery minnow and other fish species were not trapped in the embayments once the water receded. Therefore, the channels proposed in this project do not have interior embayments. They are also only about half the width of the Nature Center channel (based on the width of the existing channels and limited area within the bosque). Therefore, the issue of sediment swirling and falling out within the channel should be much less than it has been at the Nature Center and should reduce the chances of trapping and Rio Grande silvery minnow.

A single outfall wetland approximately an acre in size will be constructed at the Gonzales Wasteway Outfall on the west side of the river about half way between Central and Bridge. A pre-existing drain is located here and no excavation will occur.

The proposed action calls for 19 willow swales, each approximately .5-1 acre in size. In total, these areas will create approximately 13.5 acres of willow swale environments. As with other water related features, these features will become ephemerally wet when ground water is high (spring run-off period and monsoon periods), but will be drier during low ground water times (summer, fall and winter). Additionally, they will function as water harvesting features during major precipitation events. Cumulatively these effects should increase the water budget for the willow swale areas, enabling moisture loving plants such as reeds, rushes and willows to thrive.

On the edge of the depression, thick stands of coyote willows, peachleaf willow, and other bosque endemic shrubs will form with an occasional cottonwood creating diversity in height and structure.

Approximately 20 acres of new water related features will be created as part of the implementation of the proposed action. Moist soil areas, again, are key for catalyzing some of the native revegetation processes of the bosque and improving the overall habitat in the reach (Crawford et al, 1993).

3. Revegetation

All areas of the proposed action will receive initial fuel reduction/exotic thinning (if needed) and treatment of resprouts of non-native vegetation. All areas will be replanted with native vegetation.

Effort will be made to reconstitute the native understory of the bosque wooded areas, including mid-canopy trees and shrubs such as peachleaf willow, black willow, New Mexico locust and New Mexico olive, and lower canopy shrubs such as gooseberry, sumac, golden current and amorpha. Over time, the structure of these areas will be similar to Hink & Ohmart's classes I & III. Re-creation of the tiered bosque forest is important to sustaining a number of plants and animals in the bosque (Crawford et al, 1993; Hink & Ohmart, 1984). These areas will become the patchy groves described in many of the early accounts of the river valley near Albuquerque (Scurlock, 1998). The larger size of these patches will provide important core habitat, while maintenance of the fire breaks will provide key edge habitat, thereby maximizing potential species richness (Hink & Ohmart 1984).

Some areas are also intended to become denser stands of shrubs and small trees. These patches will correspond to Hink & Ohmart's structure V and over time depending on the success of cottonwoods could evolve into structure type III. Included in the mix of plants will be peachleaf willow, black willow, New Mexico olive, chamisa, New Mexico locust, sumac, golden current, seep willow and adjacent to the river and other wetter areas, coyote willow. Fire break meadows will be maintained between these patches to enhance the edge effect and keep the potential for catastrophic fire to a minimum. Edge effect and the creation of denser patches such as the proposed shrub thickets will be important increasing wildlife diversity within the bosque (Crawford et al, 1993; Hink & Ohmart, 1984).

4. Recreation and Interpretive Features

A suite of recreation and interpretive features have been proposed as part of the proposed action (see Figure 2). Sensitive design and implementation of these features will be of critical importance to maintaining the success of the restoration features. Approximately 40,000 linear feet of undesignated trails will be replaced by approximately 15,000 linear feet of designated and defined trails.

Equipment, staging and access

Sequencing of the construction is proposed to reduce the amount of potential sediment moving

into the river and reduce impacts to the river bank edge. The bosque between the levee and the river (the 121 acre project area), willow swale areas, the hi-flo channel areas and outfall wetland will be thinned first in order to remove the non-native woody vegetation (Removal Features). The hi-flo channels, willow swales and outfall wetland will be constructed separately after fuel reduction has been performed in these areas (Water Related Features). The hi-flo channels will be constructed so that the opening at the south end will be excavated first and the opening at the north end will be excavated last (similar to the Rio Grande Nature Center project). Flows in the river during construction of these high flow channels are anticipated to be about 300-400 cfs. The exact device used to divert the flow of water during construction will be at the discretion of the construction contractor and approved by the Corps. If flows are low enough, it is preferred that the contractor leave the edge of the berm for each end of the channel in place during construction until opening the channel at the very end. The berm could serve as the 'dam' itself. Therefore, a coffer dam or silt curtain may not be needed. If one is needed, the silt curtain or coffer dam will be placed along the bank line and then pushed out into the channel to expand the bankline, under the supervision of Corps' Biologists, in order to minimize disturbance to the flows. It will go out into the river approximately 10-20 feet from the bank. It will take approximately one day to install. If needed, it will be similar to what was proposed for the Rio Grande Nature Center project (though it was not used at the Nature Center since leaving the berm in place as described above was successful) (Figure 3). Since each channel and the outfall wetland have not been fully designed, the exact construction sequence is yet to be determined but these 'best management practices' discussed above will be implemented. Areas will be revegetated as described in Revegetation. Recreation and Interpretive Features will be constructed last.

The sites are located between the levee and the river channel. Access from the levee through the riparian forest to the river edge is available. A temporary access road off of the levee/paved trail will be constructed to access proposed construction areas if one does not exist. These temporary access roads will be removed and reseeded once construction is complete or left in place if so desired by AOSD. Any additional disturbance caused by equipment accessing the site will be reseeded with native vegetation and mulched once complete. Equipment will access proposed construction areas from the nearest river crossing (ie: Central and Bridge Blvd.'s). If needed, equipment will be stored overnight in a designated staging area (currently proposed at Central NW on the west side of the levee (see Figure 2). The staging areas will be reseeded once the project is complete. Staging will not take place in the bosque.

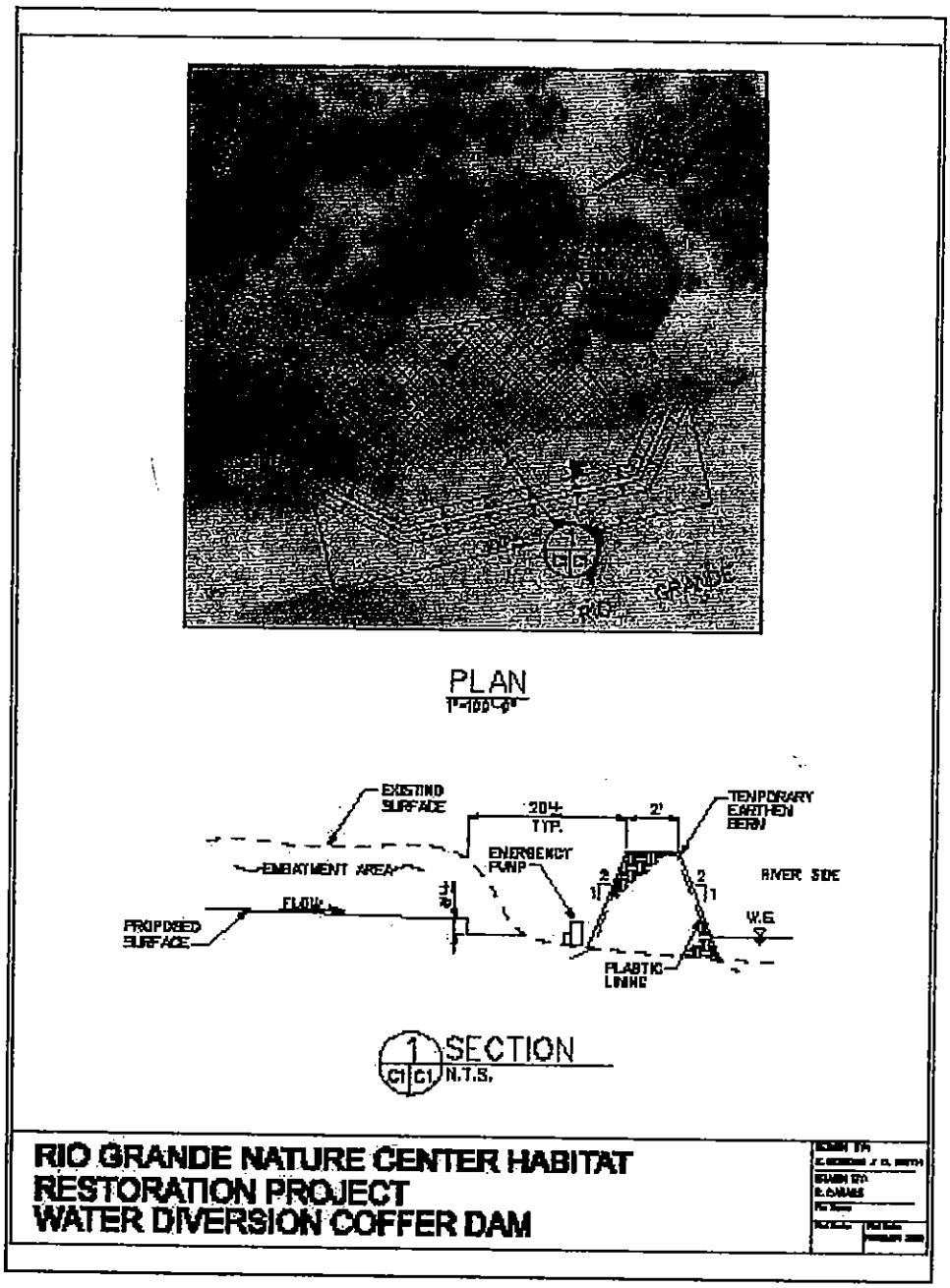


Figure 3. Example of potential coffer dam and/or silt curtain for use during construction of channel openings.

Conservation Measures

1) Silt fence will be installed adjacent to the riverbank to prevent erosion to the river.

2) Fueling of vehicles will not take place in the bosque.

3) Cleaning of all equipment is required prior to entering the site.

4) A Corps' biologist will monitor the project during construction at the bank of the river in order to detect any potential silvery minnow in the area. Findings of injured or dead silvery minnows will be reported to the Service. Water quality measurements will be taken before, during and after construction activity.

5) In coordination with the Service, a protocol to monitor presence/absence of silvery minnows in the channels following high flows, and to determine whether channel maintenance is warranted, will be developed.

6) Construction activities will take place in designated areas only, avoiding any unnecessary damage to the riparian area.

7) Work inside of the bosque will not occur between May 1 and August 30. Surveys will be conducted for the presence/absence of Southwestern Willow Flycatchers during their breeding season throughout the project area immediately prior to construction. If such surveys indicate breeding season occupation in areas not considered in this BA, the avoidance procedures outlined above will be applied to newly discovered areas.

Action Area

The action area is defined as the entire width of the 100 year floodplain within the reach from the Angostura Diversion Dam to the Isleta Diversion Dam. Silvery minnows that are present in the Action Area during the construction of ephemeral side channels and embayments are likely to be affected by the presence of construction equipment, the deployment of the coffer dam/porta dam, and by the mobilization of sediment into the Rio Grande.

II. STATUS OF THE SPECIES

RIO GRANDE SILVERY MINNOW

Description

The silvery minnow currently occupies a 170 mi (275 kilometer [km]) reach of the Middle Rio Grande, New Mexico, from Cochiti Dam, Sandoval County, to the headwaters of Elephant Butte Reservoir, Socorro County (U.S. Fish and Wildlife Service 1994). The silvery minnow is a stout minnow, with moderately small eyes, a small, sub-terminal mouth, and a pointed snout that projects beyond the upper lip (Sublette *et al.* 1990). The back and upper sides of the silvery minnow are silvery to olive, the broad mid-dorsal stripe is greenish, and the lower sides and abdomen are silver. Maximum length attained is about 3.5 in (90 millimeters [mm]). The only readily apparent sexual dimorphism is the expanded body cavity of ripe females during spawning (Bestgen and Propst 1994).

In the past, the silvery minnow was included with other species of the genus *Hybognathus* due to morphological similarities. Phenetic and phylogenetic analyses corroborate the hypothesis that it is a valid taxon, distinctive from other species of *Hybognathus* (Cook *et al.* 1992, Bestgen and Propst 1994). It is now recognized as one of seven species in the genus *Hybognathus* in the United States and was formerly one of the most widespread and abundant minnow species in the Rio Grande basin of New Mexico, Texas, and Mexico (Pflieger 1980, Bestgen and Platania 1991). Currently, *Hybognathus amarus* is the only remaining endemic pelagic spawning minnow in the Middle Rio Grande. The speckled chub (*Extrarius aestivalus*), Rio Grande shiner (*Notropis jemezanus*), phantom shiner (*Notropis orca*), and bluntnose shiner (*Notropis simus simus*) are either extinct or have been extirpated from the Middle Rio Grande (Bestgen and Platania 1991).

Legal Status

The silvery minnow was federally listed as endangered under the ESA on July 20, 1994 (U.S. Fish and Wildlife Service 1994). The species is also listed as an endangered species by the state of New Mexico. Primary reasons for listing the silvery minnow are described below in the Reasons for Listing section.

Critical habitat for the silvery minnow was designated on February 19, 2003 (68 FR 8088). The critical habitat designation extends approximately 157 mi (252 km) from Cochiti Dam, Sandoval County, New Mexico downstream to the utility line crossing the Rio Grande, a permanent identified landmark in 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, 300 ft (91.4 meters) or riparian zone adjacent to each side of the bankfull stage of the Middle Rio Grande. Some developed lands within the 300 ft lateral extent are not considered critical habitat because they do not contain the primary constituent elements of critical habitat and are not essential to the conservation of the silvery minnow. Lands located within the lateral 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. The Pueblo lands of Santo Domingo, Santa Ana, Sandia, and Isleta within this area are not included in the critical habitat designation. Except for these Pueblo lands, the remaining portion of the silvery minnow's occupied range in the Middle Rio Grande in New Mexico is designated as critical habitat (68 FR 8088).

Habitat

The silvery minnow travels in schools and tolerates a wide range of habitats (Sublette *et al.* 1990); yet, generally prefers low velocity (<0.33 ft per second, 10 centimeters/second [cm/sec]) areas over silt or sand substrate that are associated with shallow (< 15.8 in, 40 cm) braided runs, backwaters or pools (Dudley and Platania 1997). Habitat for the silvery minnow includes stream margins, side channels, and off-channel pools where water velocities are low or reduced from main-channel velocities. Stream reaches dominated by straight, narrow, incised channels with

rapid flows are not typically occupied by silvery minnow (Sublette *et al.* 1990, Bestgen and Platania 1991).

Adult silvery minnow are most commonly found in backwaters, pools, and habitats associated with debris piles; whereas, young of year (YOY) occupy shallow, low velocity backwaters with silt substrates (Dudley and Platania 1997). A study conducted between 1994 and 1996 characterized habitat availability and use at two sites in the Middle Rio Grande at Rio Rancho and Socorro. From this study Dudley and Platania (1997) reported that the silvery minnow was most commonly found in habitats with depths less than 19.7 in (50 cm). Over 85 percent were collected from low-velocity habitats (<0.33 ft/sec, 10 cm/sec) (Dudley and Platania 1997, Watts *et al.* 2002).

Critical Habitat

The Service has determined the primary constituent elements (PCEs) of silvery minnow critical habitat based on studies on silvery minnow habitat and population biology (68 FR 8088). They include:

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 the following: 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), and runs (flowing water in the river channel without obstructions) of varying depth and velocity – all of which are necessary for each of the particular silvery minnow life-history stages in appropriate seasons (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 relatively constant winter flow (November through February));

2. The presence of eddies created by debris piles, pools, or backwaters, or other refuge habitat 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 conditions (e.g., decreased dissolved oxygen, increased pH).

These PCEs provide for the physiological, behavioral, and ecological requirements essential to the conservation of the silvery minnow.

Life History

The species is a pelagic spawner that produces 3,000 to 6,000 semi-buoyant, non-adhesive eggs during a spawning event (Platania 1995, Platania and Altenbach 1998). The majority of adults spawn in about a one-month period in late spring to early summer (May to June) in association with spring runoff. Platania and Dudley (2000, 2001) found that the highest collections of silvery minnow eggs occurred in mid- to late May. In 1997, Smith (1999) collected the highest number of eggs in mid-May, with lower frequency of eggs being collected in late May and June. These data suggest multiple silvery minnow spawning events during the spring and summer, perhaps concurrent with flow spikes. Artificial spikes have apparently induced silvery minnows to spawn (Platania and Hoagstrom 1996). It is unknown if individual silvery minnows spawn more than once a year or if some spawn earlier and some later in the year.

Platania (2000) found that development and hatching of eggs are correlated with water temperature. Eggs of the silvery minnow raised in 30°C water hatched in approximately 24 hours while eggs reared in 20-24°C water hatched within 50 hours. Eggs were 0.06 inches (1.6 mm) in size upon fertilization, but quickly swelled to 0.12 inches (3 mm). Recently hatched larval fish are about 0.15 inches (3.7 mm) in standard length and grow about 0.005 inches (0.15 mm) in size per day during the larval stages. Eggs and larvae have been estimated to remain in the drift for 3-5 days, and could be transported from 134 to 223 miles (216 to 359 km) downstream depending on river flows (Platania 2000). Approximately three days after hatching the larvae move to low velocity habitats where food (mainly phytoplankton and zooplankton) is abundant and predators are scarce. YOY attain lengths of 1.5 to 1.6 inches (39 to 41 mm) by late autumn (U.S. Fish and Wildlife Service 1999). Age-1 fish are 1.8 to 1.9 inches (45 to 49 mm) by the start of the spawning season. Most growth occurs between June (post spawning) and October, but there is some growth in the winter months. In the wild, maximum longevity is about 25 months, but very few survive more than 13 months (U.S. Fish and Wildlife Service 1999). Captive fish have lived up to four years (C. Altenbach, City of Albuquerque, *pers. comm.* 2003).

Platania (1995) suggested that historically the downstream transport of eggs and larvae of the silvery minnow over long distances was likely beneficial to the survival of their populations. This behavior may have promoted recolonization of reaches impacted during periods of natural drought (Platania 1995). The spawning strategy of releasing floating eggs allows the silvery minnow to replenish populations downstream, but the current presence of diversion dams (Angostura, Isleta, and San Acacia Diversion Dams) prevents recolonization of upstream habitats (Platania 1995). As populations are depleted upstream and diversion structures prevent upstream movements, isolated extirpations of the species through fragmentation may occur (U.S. Fish and Wildlife Service 1999). Adults, eggs and larvae are also transported downstream to Elephant Butte Reservoir. It is believed that none of these fish survive because of poor habitat and predation from reservoir fishes (U.S. Fish and Wildlife Service 1999).

The silvery minnow is herbivorous (feeding primarily on algae); this is indicated indirectly by the elongated and coiled gastrointestinal tract (Sublette *et al.* 1990). Additionally, detritus,

including sand and silt, is filtered from the bottom (Sublette *et al.* 1990, U.S. Fish and Wildlife Service 1999).

Population Dynamics

Generally, a population of silvery minnows consists of only two age classes: YOY and Age-1 (U.S. Fish and Wildlife Service 1999). The majority of spawning silvery minnows are one year old. Two year old fish comprise less than 10 percent of the spawning population. High silvery minnow mortality occurs during or subsequent to spawning, consequently very few adults are found in late summer. By December, the majority (greater than 98 percent) of individuals are YOY (Age 0). This population ratio does not change appreciably between January and June, as Age 1 fish usually constitute over 95 percent of the population just prior to spawning.

Platania (1995) found that a single female in captivity could broadcast 3,000 eggs in eight hours. Females produce 3 to 18 clutches of eggs in a 12-hour period. The mean number of eggs in a clutch is approximately 270 (Platania and Altenbach 1998). In captivity, silvery minnows have been induced to spawn as many as four times in a year (C. Altenbach, City of Albuquerque, *pers. comm.* 2000). It is not known if they spawn multiple times in the wild. The high reproductive potential of this fish appears to be one of the primary reasons that it has not been extirpated from the Middle Rio Grande. However, the short life span of the silvery minnow increases the population instability. When two below-average flow years occur consecutively, a short-lived species such as the silvery minnow can be impacted, if not completely eliminated from dry reaches of the river (U.S. Fish and Wildlife Service 1999).

Distribution and Abundance

Historically, the silvery minnow occurred in 2,465 mi (3,967 km) of rivers in New Mexico and Texas. They were known to have occurred from Española upstream from Cochiti Lake; in the downstream portions of the Chama and Jemez Rivers; throughout the Middle and Lower Rio Grande to the Gulf of Mexico; and in the Pecos River from Sumner Reservoir downstream to the confluence with the Rio Grande (Sublette *et al.* 1990, Bestgen and Platania 1991). The current distribution of the silvery minnow is limited to the Rio Grande between Cochiti Dam and Elephant Butte Reservoir, which amounts to approximately 5 percent of its historic range.

The construction of mainstem dams, such as Cochiti Dam and irrigation diversion dams have contributed to the decline of the silvery minnow. The construction of Cochiti Dam in particular has affected the silvery minnow by reducing the magnitude and frequency of flooding events that help to create and maintain habitat for the species. In addition, the construction of Cochiti Dam has resulted in degradation of silvery minnow habitat within the Cochiti Reach. Flow in the river at Cochiti Dam is now generally clear, cool, and free of sediment. 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 in) 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 (U.S. Fish and Wildlife Service 2001, 1999). The Rio Grande

below Angostura Dam becomes a predominately sand bed river with low, sandy banks in the downstream portion of the reach. The construction of Cochiti Dam also created a barrier between silvery minnow populations (U.S. Fish and Wildlife Service 1999). As recently as 1978, the silvery minnow was collected upstream of Cochiti Lake; however surveys since 1983 suggest that the fish is now extirpated from this area (U.S. Fish and Wildlife Service 1999).

Silvery minnow catch rates declined two to three orders of magnitude between 1993 and 2004. Additionally, relative abundance of silvery minnows declined from approximately 50 percent of the total fish community in 1995 to about 5 percent in 2004. However, in 2004, the October density of silvery minnows was significantly higher ($p<0.05$) than in 2003 and autumnal catch rates increased by over an order of magnitude between those years. Silvery minnow catch rates in 2004 were comparable to those in 2001. Catch rates in 2005 were even higher. October catch rates in 2005 (3,899) increased nearly 50 times over catch rates for 2004 (78) (Dudley *et al.* 2005).

Augmentation, throughout this period, likely sustained the silvery minnow population. Nearly 900,000 silvery minnows have been released (primarily in the Angostura Reach) since 2000 (see Environmental Baseline). Captively propagated and released fish supplemented the native adult population and most likely also took advantage of the good spawning conditions of 2004 and 2005.

The silvery minnow was the most abundant taxon in October 2005 captures; it comprised about 72 percent of the total catch (Dudley *et al.* 2005). The species was nearly twice as abundant as the next most-abundant taxon (western mosquitofish). The increase in abundance of silvery minnow in 2005 has been comparable to previous years with above average precipitation (e.g., mid-1990s) (Dudley *et al.* 2005). These monitoring results from 2005 indicate that the status of the species has improved markedly compared to Fall of 2004.

Increased discharge in the Rio Grande during 2004 contrasted with the extended low-flow conditions observed throughout the Middle Rio Grande during 2003 and 2002. The timing of the 2004 runoff flow was typical of a flow increase that would normally occur at the onset of the spring runoff period. Elevated and extended flows during 2004 likely resulted in more favorable conditions for the growth and survivorship of newly hatched silvery minnow larvae. It is possible that even low numbers of eggs and larvae could have resulted in greatly increased recruitment success because of the inundation of shoreline habitats, abandoned side channels, and backwaters. Low velocity and shallow areas provide the warm and productive habitats required by larval fishes to successfully complete their early life history.

Spring runoff in 2005 was also above average, leading to a peak of over 6,000 cfs at Albuquerque and sustained high flows (> 3,000 cfs) for more than 2 months. These flows improved conditions for both spawning and recruitment. October monitoring indicated a significant increase in silvery minnows in the Middle Rio Grande, increasing to 3,899 total silvery minnows captured from 2 and 78 in 2003 and 2004, respectively. In 2006, however, October numbers declined to 166 after an extremely low Spring runoff and channel drying in

June and July (Dudley et al. 2006). October samples yielded no small silvery minnows, indicating poor recruitment in the spring.

Middle Rio Grande Distribution

Since the early 1990s, the density of silvery minnows generally increased from upstream (Angostura Reach) to downstream (San Acacia Reach). During surveys in 1999, over 98 percent of the silvery minnows captured were downstream of San Acacia Diversion Dam (Dudley and Platania 2002). This distributional pattern has been observed since 1994 (Dudley and Platania 2002) and is attributed to downstream drift of eggs and larvae and the inability of adults to repopulate upstream reaches because of diversion dams.

However, in 2004 and 2005, Dudley *et al.* (2005 and 2006) found that this pattern reversed. Catch rates were highest in the Angostura Reach and approximately equal in the Isleta and San Acacia reaches. The Angostura Reach yielded the most silvery minnow (n=2,226) in 2004, followed by the Isleta Reach (n=442), and San Acacia Reach (n=371). Routine augmentation of silvery minnow in the Angostura Reach (nearly 900,000 since 2000), and the transplanting of silvery minnow rescued from drying reaches (approximately 770,000 since 2003) explains this change in pattern. Additionally, good spawning conditions (i.e., high and sustained spring runoff) throughout the Middle Rio Grande during April and May followed by wide-scale drying in the Isleta and San Acacia reaches from June-September, exacerbated the skew. High spring runoff and perennial flow in the Angostura Reach appeared to result in relatively high survival and recruitment of larval and juvenile silvery minnow compared to previous drought years (2002-2003). In contrast, large portions of the Rio Grande south of Isleta Diversion Dam were dewatered in 2004 and young silvery minnow in these areas were either subjected to poor recruitment conditions (i.e., lack of nursery habitats during low-flows) or they were trapped in drying pools where they perished.

Sampling in early 2006 indicates populations are again higher downstream. Of the 6,143 silvery minnows caught in March 2006, 33 were found in the Angostura Reach, 2,445 were found in the Isleta Reach, and 3,665 were caught in the San Acacia Reach. Silvery minnow catch rates were an average of 2.53 per 100 m^2 in the Angostura Reach.

Reasons for Listing/Threats to Survival

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

1. Regulation of stream waters, which has led to severe flow reductions, often to the point of dewatering extended lengths of stream channel;

2. Alteration of the natural hydrograph, which impacts the species by disrupting the environmental cues the fish receives for a variety of life functions, including spawning;

3. Both the stream flow reductions and other alterations of the natural hydrograph throughout the year can severely impact habitat availability and quality, including the temporal availability of habitats;

4. Actions such as channelization, bank stabilization, levee construction, and dredging result in both direct and indirect impacts to the silvery minnow and its habitat by severely disrupting natural fluvial processes throughout the floodplain;

5. Construction of diversion dams fragment the habitat and prevent upstream migration;

6. Introduction of nonnative fishes that directly compete with, and can totally replace the silvery minnow, as was the case in the Pecos River, where the species was totally replaced in a time frame of 10 years by its congener the plains minnow (*Hybognathus placitus*); and

7. Discharge of contaminants into the stream system from industrial, municipal, and agricultural sources also impact the species (U.S. Fish and Wildlife Service 1993b, 1994).

These reasons for listing continue to threaten the species throughout its currently occupied range in the Middle Rio Grande.

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

III. ENVIRONMENTAL BASELINE

Under section 7(a)(2) of the ESA, when considering the effects of the action on federally listed species, we are required to take into consideration the environmental baseline. Regulations implementing the ESA (50 FR 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area; the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation; and the impacts of State and private actions that are contemporaneous with the consultation in progress. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

Drought, as an overriding condition of the last decade in the southwest, is an important factor in the environmental baseline. However, stream conditions in 2004 and 2005 improved over previous years. The United States Geological Survey (USGS) in Albuquerque, New Mexico

reported that stream flow conditions in 2005 were well above average to significantly above average statewide leading to a peak of over 6,000 cfs at Albuquerque and sustained high flows (> 3,000 cfs) for more than 2 months. These flows improved conditions for both spawning and recruitment. Despite good runoff, reservoir levels continue to be below average across the state. It will take a least another year or two of well above average precipitation to reach pre-drought reservoir conditions.

The 2006 spring runoff was well below average because of lower than normal snowpack. In May 2006, year to date precipitation was well below average with the snow pack at 20 percent of average in the Rio Grande Basin. Fortunately, a strong monsoon season led to the wettest period of record in July and August. Consequently, only 26.5 miles of river dried in the summer of 2006 the lowest amount since 2001.

Status of the Species within the Action Area

Past actions have eliminated and severely altered habitat conditions for the silvery minnow. These actions can be broadly categorized as changes to the natural hydrology of the Rio Grande and changes to the morphology of the channel and floodplain. Other factors that influence the environmental baseline are water quality, the release of captively propagated silvery minnows, silvery minnow rescue efforts, on-going research efforts, and past projects in the Middle Rio Grande. Also of importance is the current drought, the expected weather pattern for the near future, and how it may affect flow in the Rio Grande. Each of these topics is discussed below.

Changes in Hydrology

There have been two primary changes in hydrology as a result of the construction of dams on the Rio Chama and Rio Grande that affect the silvery minnow: Loss of water and changes to the magnitude and duration of peak flows.

Loss of Water

Prior to measurable human influence on the system, up to the fourteenth century, the Rio Grande was a perennially flowing, aggrading river with a shifting sand substrate (Biella and Chapman 1977). There is now strong evidence that the Middle Rio Grande first began drying up periodically after the development of Colorado's San Luis Valley in the mid to late 1800s (Scurlock 1998). After humans began exerting more influence on the river, there are two documented occasions when the river became intermittent; during prolonged, severe droughts in 1752 and 1861 (Scurlock 1998). The silvery minnow historically survived low-flow periods because such events were infrequent and of lesser magnitude than they are today. There were also no diversion dams to block repopulation of upstream areas, the fish had a much greater geographical distribution, and there were oxbow lakes, cienegas, and sloughs associated with the Rio Grande that supported fish until the river became connected again.

Water management and use has resulted in a large reduction of suitable habitat for the silvery minnow. Agriculture accounts for 90 percent of surface water consumption in the Middle Rio Grande (Bullard and Wells 1992). The average annual diversion of water in the Middle Rio Grande by the MRGCD was 535,280 af (65,839 hectare-meters) for the period from 1975 to

1989 (Reclamation 1993). In 1990, total water withdrawal (groundwater and surface water) from the Rio Grande Basin in New Mexico was 1,830,628 af, significantly exceeding a sustainable rate (Schmandt 1993). Water withdrawals have not only reduced overall flow quantities, but also caused the river to become locally intermittent and/or dry for extended reaches. Irrigation diversions and drains significantly reduce water volumes in the river. However, the total water use (surface and groundwater) in the Middle Rio Grande by the MRGCD may range from 28 – 37 percent (S.S. Papadopulos & Associates, Inc. 2000; U.S. Geological Survey 2002). A portion of the water diverted by the MRGCD returns to the river and may be re-diverted (in some cases more than once) (Bullard and Wells 1992; MRGCD, *in litt.* 2003).

River reaches particularly susceptible to drying are immediately downstream of the Isleta Diversion Dam (river mile 169), a 5 mile (8 km) reach near Tome (river miles 150-155), a 5 mile (8 km) reach near the U.S. Highway 60 Bridge (river miles 127-132), and an extended 36 mile (58 km) reach from near Brown's Arroyo (downstream of Socorro) to Elephant Butte Reservoir. Extensive fish kills, including tens of thousands of silvery minnows, have occurred in these lower reaches when the river has dried (C. Shroeder, Service, *pers. comm.* 2002). Since 1996, an average of 32 miles of the Rio Grande has dried, mostly in the San Acacia Reach. The most extensive drying occurred in 2003 and 2004 when 60 and 68.7 miles, respectively, were dewatered. Most documented drying events lasted an average of two weeks, before flows returned.

Predatory birds have been observed hunting and consuming fish from isolated pools during river intermittence (J. Smith, NMESFO, *pers. comm.* 2003). Although the number of fish present in any pool is unknown, it must be assumed that many of the fish preyed upon in these pools are silvery minnows. Thus, while some dead silvery minnows were collected during the shorter drying events, it is assumed that many more mortalities occurred than were documented.

Changes to Size and Duration of Peak Flows

Water management has also resulted in a loss of peak flows that historically initiated spawning. The reproductive cycle of the silvery minnow is tied to the natural river hydrograph. A reduction in peak flows and/or altered timing of flows may inhibit reproduction. Since completion of Elephant Butte Dam in 1916, four additional dams have been constructed on the Middle Rio Grande, and two have been constructed on one of its major tributaries, the Rio Chama (Scurlock 1998). Construction and operation of these dams, which are either irrigation diversion dams (Angostura, Isleta, San Acacia) or flood control and water storage dams (Elephant Butte, Cochiti, Abiquiu, El Vado), have modified the natural flow of the river. Mainstem dams store spring runoff and summer inflow, which would normally cause flooding, and release this water back into the river channel over a prolonged period of time. These releases are often made during the winter months, when low-flows would normally occur. The releases depart significantly from natural conditions, and can substantially alter the habitat. In spring and summer, artificially low-flows may limit the amount of habitat available to the species and may also limit dispersal of the species (U.S. Fish and Wildlife Service 1999).

In the spring of 2002 and 2003, there was concern that silvery minnow would not spawn because of a lack of spring runoff due to an extended drought. River discharge was artificially elevated through short duration reservoir releases during May to induce silvery minnow spawning. In response to the releases, significant silvery minnow spawning occurred and was documented in all reaches except the Cochiti Reach (S. Gottlieb, UNM, *in litt.* 2002; Dudley *et al.* 2005). Fall populations in 2003 and 2004 continued to decrease despite large spawning events, indicating a lack of recruitment.

Mainstem dams and the altered flows they create can affect habitat by preventing overbank flooding, trapping nutrients, altering sediment transport regimes, prolonging summer base flows, modifying or eliminating native riparian vegetation, and creating reservoirs that favor non-native fish species. These changes may affect the silvery minnow by reducing its food supply, altering its preferred habitat, preventing dispersal, and providing a continual supply of non-native fish that may compete with or prey upon them. Altered flow regimes may also result in improved conditions for other native fish species that occupy the same habitat, causing those populations to expand at the expense of the silvery minnow (U.S. Fish and Wildlife Service 1999).

In addition to providing a cue for spawning, flood flows also maintain a channel morphology to which the silvery minnow is adapted. The changes in channel morphology that have occurred from the loss of flood flows are discussed below.

Changes in Channel Morphology

Historically, the Rio Grande was sinuous, braided, and freely migrated across the floodplain. Changes in natural flow regimes, narrowing and deepening of the channel, and restraints to channel migration (i.e., jetty jacks) adversely affected the silvery minnow. These effects result directly from constraints placed on channel capacity by structures built in the floodplain. These anthropogenic changes have and continue to degrade and eliminate spawning, nursery, feeding, resting, and refugia areas required for species' survival and recovery (U.S. Fish and Wildlife Service 1993a).

The active river channel within occupied habitat is being narrowed by the encroachment of vegetation, resulting from continued low-flows and the lack of overbank flooding. The lack of flood flows has allowed non-native riparian vegetation such as salt cedar and Russian olive to encroach on the river channel (Reclamation 2001). These non-native plants are very resistant to erosion, resulting in narrowing of the channel. When water is confined to a narrower cross-section, its velocity increases. Fine sediments such as silt and sand are carried away leaving coarser bed materials such as gravel and cobble. Habitat studies during the winter of 1995 and 1996 (Dudley and Platania 1996), demonstrated that a wide, braided river channel with low velocities resulted in higher catch rates of silvery minnows, and narrower channels resulted in fewer fish captured. The availability of wide, shallow habitats that are important to the silvery minnow is decreasing. Narrow channels have few backwater habitats with low velocities that are important for silvery minnow fry and YOY.

Within the current range of the silvery minnow, human development and use of the floodplain have greatly restricted the width available to the active river channel. A comparison of river area between 1935 and 1989 shows a 52 percent reduction, from 26,598 acres (10,764 ha) to 13,901 acres (5,626 ha) (Crawford *et al.* 1993). These data refer to the Rio Grande from Cochiti Dam downstream to the "Narrows" in Elephant Butte Reservoir. Within the same stretch, 234.6 mi (378 km) of levees occur, including levees on both sides of the river. Analysis of aerial photography taken by Reclamation in February 1992, for the same river reach, shows that of the 180 mi (290 km) of river, only 1 mi (1.6 km), or 0.6 percent of the floodplain has remained undeveloped.

Development in the floodplain, makes it difficult, if not impossible, to send large quantities of water downstream that would create low velocity side channels that the silvery minnow prefers. As a result, reduced releases have decreased available habitat for the silvery minnow and allowed encroachment of non-native species into the floodplain.

Water Quality

Both point (pollution discharges from a pipe) and non-point (diffuse sources of pollution) sources affect the Middle Rio Grande. Major point sources are waste water treatment plants (WWTPs) and feedlots. Major non-point sources include agricultural activities (e.g., fertilizer and pesticide application, livestock grazing), storm water run off, and mining activities.

Effluents from WWTPs contain contaminants that may affect the water quality of the river. It is anticipated that WWTP effluent may be the primary source of perennial flow in the lower portion of the Angostura Reach during extended periods of intermittency. For that reason the water quality of the effluent is extremely important. In the project area, the largest WWTP discharges are from Albuquerque, followed by Rio Rancho (2 WWTP) and Bernalillo (mean annual discharge flows are 80.4, 2.5, 0.9, and 0.7 cfs, respectively) (Bartolino and Cole 2002). Since 1998, total residual chlorine (chlorine) and ammonia, as nitrogen (ammonia), have been discharged unintentionally at concentrations that exceed protective levels for the silvery minnow.

Albuquerque WWTP effluent discharge records show that during November 1999, the monthly maximum chlorine concentration in the outfall was 0.49 milligrams per liter (mg/L). Additionally, on February 23, 2003, the concentration of chlorine in the outfall was reported to be 0.70 mg/L (C. Abeyta, Service, *in litt.* 2003; D.S. Dailey, City, *in litt.* 2003). Chlorine concentrations of 0.013 mg/L can be harmful to the silvery minnow. Records also show that the monthly maximum concentration of ammonia during July 2001 was 14 mg/L. At pH 8 and water temperature of 25 °C, ammonia concentrations as low of 3.1 mg/L can be harmful to larval fathead minnow (U. S. Environmental Protection Agency 1999). The fathead minnow has been suggested as a surrogate to evaluate the effects of various chemicals on the silvery minnow (Buhl 2002).

Although we do not have complete records for the other WWTPs, in the summer of 2000, the Rio Rancho WWTP released approximately one million gallons of raw sewage into the Rio Grande. Chlorine treatment was maximized in an attempt to reduce the public health risk.

Ammonia was reported at 37 mg/L on July 13, 2000, and at 17.1 mg/L on July 27, 2000 (City of Rio Rancho, *in litt.* 2000). Nonetheless, no violations of chlorine or ammonia effluent limits were recorded. This suggests that averaging measurements and/or the frequency of water quality measurements is insufficient to detect water quality situations that would be toxic to silvery minnow. The Rio Rancho WWTP now uses ultraviolet disinfection (Dee Fuerst, City of Rio Rancho, *pers. comm.* 2003). However, high concentrations of ammonia could still be discharged during an upset. Spills from the Rio Rancho City sewage system are treated with chlorine, which may lead to chlorine being flushed to the Rio Grande.

In addition to chlorine and ammonia, WWTP effluents may also include cyanide, chloroform, organophosphate pesticides, semi-volatile compounds, volatile compounds, heavy metals, and pharmaceuticals and their derivatives, which can pose a health risk to silvery minnow when discharged in concentrations that exceed the protective water quality criteria (J. Lusk, Service, *in litt.* 2003). Even if the concentration of a single element or compound is not harmful by itself, chemical mixtures may be more than additive in their toxicity to silvery minnow (Buhl 2002). The long-term effects and overall impacts of chemicals on the silvery minnow are not known.

Large precipitation events wash sediments and pollutants into the river from surrounding lands through storm drains and intermittent tributaries. Contaminants of concern to the silvery minnow that are frequently found in storm water include the metals aluminum, cadmium, lead, mercury, and zinc, organics such as oils, the industrial solvents trichloroethene and tetracholoroethene (TCE), and the gasoline additive methyl tert-butyl ether (U.S. Geological Survey 2001).

Harwood (1995) studied the North Floodway Channel (Floodway) of Albuquerque, which drains an urban area of about 90 square miles and crosses Pueblo of Sandia lands. He found that storm water contributions of dissolved lead, zinc, and aluminum were significant and posed a threat to the water quality of the Rio Grande. Because the Floodway crosses lands of the Pueblo of Sandia and enters their portion of the Rio Grande, they requested that the Environmental Protection Agency conduct toxicity tests on water in the Rio Grande collected below the Floodway. Aquatic crustaceans exposed to this water were found to have significant reproductive impairment and mortality when compared with controls. Additionally, larval fish also experienced significant mortality and/or narcosis when exposed to water and bed sediment collected from this same area on April 22, 2002 (http://oaspub.epa.gov/enviro/pcs det_reports. detail_report?npdesid=NM0022250). This study indicates that storm water runoff can impact the water quality of the Rio Grande and the aquatic organisms that live in the river.

In a cooperative study, the New Mexico Environment Department (NMED) detected elevated polychlorinated biphenyl (PCBs) contamination of the San Jose Drain (NMED DOE Oversight Bureau Correspondence and Transmittal Letter, signed S. Yanicak, to G. Turner, DOE, Subject: 2002 – 2003 Cooperative Polychlorinated Biphenyl (PCB) Study Data, Dated June 6, 2006). The San Jose Drain empties into an area near the confluence of the Tijeras Arroyo (and SDC) with the Rio Grande. The PCB pollution was detected in sediment and storm water runoff and in fish tissue collected downstream. Concentrations of PCBs in fish tissues were elevated above

the threshold by which fish consumption advisories would recommend that no fish be eaten by people (R. Ford-Schmid, NMED, electronic communication, June 24, 2004). The San Jose Drain empties into the Rio Grande in close proximity of the SDC Island Site increasing the probability that sediment forming the island may be contaminated with PCBs as well.

Sediment is the sand, silt, organic matter, and clay portion of the river bed, or the same material suspended in the water column. Ong *et al.* (1991) recorded the concentrations of trace elements and organochlorine pesticides in suspended sediment and bed sediment samples collected from the Middle Rio Grande between 1978 and 1988. These data were compared to numerical sediment quality criteria (Probable Effects Criteria [PEC]) proposed by MacDonald *et al.* (2000). According to MacDonald *et al.* (2000) most of the PEC provide an accurate basis for predicting sediment toxicity to aquatic life and a reliable basis for assessing sediment quality in freshwater ecosystems. Although the PEC were developed to assess bed (bottom) sediments, they also provide some indication of the potential adverse effects to organisms consuming these same sediments when suspended in the water column.

Semi-volatile organic compounds are a large group of environmentally important organic compounds. Three groups of compounds, polycyclic aromatic hydrocarbons (PAHs), phenols, and phthalate esters, were included in the analysis of bed sediment collected by the USGS (Levings *et al.* 1998). These compounds were abundant in the environment, are toxic and often carcinogenic to organisms, and could represent a long-term source of contamination. The analysis of the PAH data by Levings *et al.* (1998) show one or more PAH compounds were detected at 14 sites along the Rio Grande with the highest concentrations found below Albuquerque and Santa Fe. Polycyclic aromatic hydrocarbons and other semi-volatile compounds affect the sediment quality of the Rio Grande and may affect silvery minnow behavior, habitat, feeding, and health.

Pesticide contamination occurs from agricultural activities, as well as from the cumulative impact of residential and commercial landscaping activities. The presence of pesticides in surface water depends on the amount applied, timing, location, and method of application. Water quality standards have not been set for many pesticides, and existing standards do not consider cumulative effects of several pesticides in the water at the same time. Roy *et al.* (1992) reported that DDE, a degradation product of DDT, was detected most frequently in whole body fish collected throughout the Rio Grande. He suggested that fish in the lower Rio Grande may be accumulating DDE in concentrations that may be harmful to fish and their predators.

In addition to the compounds discussed above, several other constituents are present and affect the water quality of the Rio Grande. These include nutrients such as nitrates and phosphorus, total dissolved solids (salinity), and radionuclides. Each of these also has the potential to affect the aquatic ecosystem and health of the silvery minnow. As the river dries, pollutants will be concentrated in the isolated pools. Even though these pollutants do not cause the immediate death of silvery minnows, the evidence suggests that the amount and variety of pollutants present in the Rio Grande, could compromise their health and fitness (Rand and Petrocelli 1985).

Silvery Minnow Propagation and Augmentation

In 2000, the Service identified captive propagation as an appropriate strategy to assist in the recovery of the silvery minnow. Captive propagation is conducted in a manner that will, to the maximum extent possible, preserve the genetic and ecological distinctiveness of the silvery minnow and minimize risks to existing wild populations.

Silvery minnow are currently housed at four facilities in New Mexico including: the Dexter Fish Hatchery; New Mexico State University Coop Unit (Las Cruces); the Service's New Mexico Fishery Resources Office (NMFRO), and the City of Albuquerque's propagation facilities. These facilities are actively propagating and rearing silvery minnow. Silvery minnow are also held in South Dakota at the U.S. Geological Survey, Biological Resources Division Lab, but there is no active spawning program at this facility.

Since 2000 over 1,000,000 silvery minnow have been propagated using both adult wild silvery minnows and wild caught eggs and then released into the wild. Wild gravid adults are successfully spawned in captivity at the City's propagation facilities. Eggs are raised and released as larval fish. Marked fish have been released by the NMFRO since 2002 under a formal augmentation effort funded by the Collaborative Program. Silvery minnows are released into the Angostura Reach of the river near Alameda Bridge to ensure downstream repopulation. Eggs left in the wild have a very low survivorship and this ensures that an adequate number of spawning adults are present to repopulate the river each year. While hatcheries continue to successfully spawn silvery minnow, wild eggs are collected to ensure genetic diversity within the remaining population.

Ongoing Research

There is ongoing research by the NMFRO and University of New Mexico (UNM) to examine the movement of silvery minnow. Augmented fish are marked with a visible fluorescent elastomer tag and released in large numbers in a few locations. Crews sample upstream and downstream from the release site in an attempt to capture the marked fish. Preliminary results indicate that the majority of silvery minnows disperse a few miles downstream. One individual was captured 15.7 mi (25.3 km) upstream from its release site (Platania *et al.* 2003). Monitoring within 48 hours after the release of the 41,500 silvery minnows resulted in the capture of 937 fish. Of these, 928 were marked and 927 were collected downstream of the release point. The farthest downstream point of recapture was 9.4 mi (15.1 km).

In 2002, a hybridization study involving the plains minnow and silvery minnow was conducted to determine the genetic viability of hybrids. Plains minnow are found in the Pecos River where reintroduction of silvery minnow is being considered. The results are preliminary because the number of trials was low and because there is some question about the fitness of the females used in the experiments. The plains minnow and silvery minnow did spawn with each other and the hybrid eggs hatched. However, none of the larvae lived longer than 96 hours. The control larvae (non-hybrids) for both the plains minnow and silvery minnow lived until the end of the study (24 days) (Caldwell 2002).

Due to the increased efforts in captive propagation, recent studies by UNM have focused on the genetic composition of the silvery minnow. This research indicates that the net effective population size (Ne) (the number of individuals that contribute to maintaining the genetic variation of a population) of the silvery minnow in the wild is between 60-250 fish (T. Turner, UNM, *pers. comm.* 2003). It has been suggested that a Ne of 500 fish is needed to retain the long-term adaptive potential of a population (Franklin 1980). No significant genetic differences have been found in populations isolated in the different reaches of the Rio Grande (D. Alo UNM, *pers. comm.* 2002). Because the number of wild fish in the river appears to be low, the addition of thousands of silvery minnows raised in captivity could impact the genetic structure of the population. The propagation effort should be sufficient to maintain 100,000 to 1,000,000 fish in the wild (T. Turner, UNM, *pers. comm.* 2003). For instance if it were determined that 50,000 silvery minnow were in the wild, a minimum of 50,000 adult fish should be in propagation facilities. We do not know how many fish are in the wild so it is difficult at this time to determine the exact number needed in propagation facilities. However, to insure against a catastrophic event where most wild fish are lost, it is suggested that 100,000 to 1,000,000 silvery minnow should be kept in propagation facilities to maintain a sufficient amount of genetic variability for propagation efforts (T. Turner, UNM, *pers. comm.* 2003). Approximately 150,000 silvery minnows are currently being maintained in captivity (M. Ulibarri, Service, *pers. comm.* 2007).

Permitted and/or Authorized Take

Take is authorized by section 10, and incidental take is permitted under section 7. These permits and/or authorizations are issued by the Service. Applicants for section 10 permits must also acquire a permit from the State to "take" or collect silvery minnows. Many of the permits issued under section 10 allow take for the purpose of collection and salvage of silvery minnows and eggs for captive propagation. Eggs, larvae, and adults are also collected for scientific studies to further our knowledge about the species and how best to conserve the silvery minnow. Because of the population decline from 2002-2004, the Service has reduced the amount of take permitted for voucher specimens in the wild.

Incidental take of silvery minnows is authorized through section 7 consultation associated with the March 2003, programmatic biological opinion on water operations and maintenance in the Middle Rio Grande, the City of Albuquerque Drinking Water project, the Isleta Island Removal Project, the Tiffany Plug Removal Project, and the Interstate Stream Commission's (ISC) Habitat Restoration Project.

Factors Affecting Species Environment within the Action Area

On the Middle Rio Grande, the following past and present federal, state, private, and other human activities, in addition to those discussed above, have affected the silvery minnow and its critical habitat:

1. Release of Carryover Storage from Abiquiu Reservoir to Elephant Butte Reservoir: The Army Corps of Engineers (Corps) consulted with the Service on the release of water during the winter of 1995. Ninety-eight thousand af (12,054 hectare-meters) of water

was released from November 1, 1995 to March 31, 1996, at a rate of 325 cfs (9.8 cm). This discharge is above the historic winter flow rate. Substantial changes in the flow regime that do not mimic the historic hydrograph can be detrimental to the silvery minnow.

2. Corrales, Albuquerque, and Belen Levees: These levees contribute to floodplain constriction and habitat degradation for the silvery minnow. Levees at these sites result in a reduction in the amount and quality of suitable habitat for the silvery minnow.

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

4. Creation of a Conservation Pool for Storage of Native Water in Abiquiu and Jemez Canyon Reservoirs and Release of a Spike Flow: The City created space (100,000 af) in Abiquiu Reservoir and the Corps created space in Jemez Canyon Reservoir to store Rio Grande Compact credit water for use in 2001, 2002, and 2003 for the benefit of listed species. The conservation pool was created with the understanding that the management of this water would be decided in later settlement meetings or during water operations conference calls. In addition, a supplemental release (spike) occurred in May 2001 to accommodate movement of sediment as a part of habitat restoration and construction on the Rio Grande and Jemez River on the Santa Ana Pueblo.

5. Programmatic Biological Opinions on the Effects of Actions Associated with the U. S. Bureau of Reclamation's, U.S. Army Corps of Engineers', and non-federal Entities' Discretionary Actions Related to Water Management on the Middle Rio Grande: In 2001 and 2003, the Service issued jeopardy biological opinions on the effects of water operations and management activities in the Middle Rio Grande on the silvery minnow and flycatcher. In 2002, the Service issued a jeopardy biological opinion for the silvery

minnow. The current opinion, issued on March 17, 2003, contains one RPA with multiple elements. These elements set forth a flow regime in the Middle Rio Grande and describe habitat improvements necessary to alleviate jeopardy to both the silvery minnow and flycatcher.

6. Albuquerque Drinking Water Project: The Drinking Water Project, involves the construction and operation of: (1) A new surface diversion dam north of Paseo del Norte Bridge, (2), conveyance of raw water from the point of diversion to the new water treatment plant, (3) a new water treatment plant on Chappell Road NE, (4) transmission of treated (potable) water to residential and commercial customers throughout the Albuquerque metropolitan area, and (5) aquifer storage and recovery. During typical operations, the project will divert a total of 94,000 acre-feet per year (afy) of raw water from the Rio Grande (47,000 afy of City San Juan-Chama water and 47,000 afy of Rio Grande native water) at a near constant rate of about 130 cubic-feet per second (cfs) (3.68 cms). Peak diversion operations will consist of up to 103,000 afy being diverted at a rate of up to 142 cfs (4.02 cms). A new water treatment plant with a normal operating rate of 84 million gallons per day (mgd) (381.9 million liters per day [mld]) and a peak capacity of about 92 mgd (418.2 mld) or 142 cfs (4.02 cms) will be constructed as part of the proposed action. Consultation on this project was completed in October, 2003. Construction is currently underway.

7. Los Lunas Habitat Restoration Project: On February 6, 2002, the Service completed this consultation, which tiered from the programmatic biological opinion on water management on the Middle Rio Grande issued June 29, 2001. This project is intended to partially fill element J of the Reasonable and Prudent Alternative from the programmatic biological opinion to conduct habitat/ecosystem restoration projects in the Middle Rio Grande to benefit the silvery minnow and flycatcher. Approximately 37 acres of native riparian and 40 acres of aquatic habitat have been created by this project. This project includes side-channels resulting in increased inundation frequency and will result in inundation of the area at flows greater than or equal to 2,500 cfs. A variety of substrate elevations will also allow inundation of some areas when flows are less than 2,500 cfs.

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

9. Silvery minnow salvage and relocation: During river drying, the Service's silvery minnow salvage crew captures and relocates silvery minnow. Since 1996, approximately 770,000 silvery minnow have been rescued and relocated to wet reaches, the majority of which were released in the Angostura Reach. Studies are being conducted to determine survival rates for salvaged fish.

10. Habitat Restoration Projects: Several habitat restoration projects have been completed in the Albuquerque reach through the Collaborative Program. These projects include two woody debris installation projects to encourage the development of pools and wintering habitat, and a river bar modification project south of the I-40 Bridge designed to create side and backwater channels on an existing bar as well as modify the top surface of the bar to create habitat over a range of flows. Additionally, in 2005, the ISC started a multi-year habitat restoration program that implements several island, bar, and bank line modification techniques throughout the Albuquerque Reach. Approximately 24 acres of habitat were restored in the Phase I. Phase II is scheduled to begin in winter 2007.

Summary

The remaining population of the silvery minnow is restricted to approximately 5 percent of its historic range. Every year since 1996, there has been at least one drying event in the river that has negatively affected the silvery minnow population. The population is unable to expand its distribution because poor habitat quality and Cochiti Dam prevent upstream movement and Elephant Butte Reservoir blocks downstream movement (Service 1999). Augmentation of silvery minnows with captive-reared fish will continue, however, continued monitoring and evaluation of these fish is necessary to obtain information regarding the survival and movement of individuals.

Water withdrawals from the river and water releases from dams severely limit the survival of silvery minnows. The consumption of shallow groundwater and surface water for municipal, industrial, and irrigation uses continues to reduce the amount of flow in the Rio Grande and eliminate habitat for the silvery minnow (Reclamation 2003). However, under state law, the municipal and industrial users are required to offset the effects of groundwater pumping on the surface water system. The City for example, has been offsetting their surface water depletions with 60,000 af per year (Reclamation 2003). The effect of water withdrawals means that discharge from WWTPs and irrigation return flows will have greater importance to the silvery minnow and a greater impact on water quality. Lethal levels of chlorine and ammonia have been released from the WWTPs in the last several years. In addition, a variety of organic chemicals, heavy metals, nutrients, and pesticides have been documented in storm water channels feeding into the river and contribute to the overall degradation of water quality.

Various conservation efforts have been undertaken in the past and others are currently being carried out in the middle Rio Grande. Silvery minnow abundance has increased over 2002-2003 population levels. However, the threat of extinction for the silvery minnow continues because of increased reliance on captive propagation, the fragmented and isolated nature of currently occupied habitat, and the absence of silvery minnows in other parts of the historic range. The increased abundance of silvery minnow from 2004-2006 is a positive sign. Nevertheless, the threats that endanger this species are still present.

IV. EFFECTS OF THE ACTION

'Effects of the Action' refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated and interdependent with that action, which will be added to the environmental baseline. Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur. Silvery minnows are present in the Albuquerque Reach (Dudley et al. 2006) and are expected to be present within the action area. The primary adverse effects of the proposed action on the silvery minnow will result from the placement of coffer dams around the channel openings and the mobilization of sediment during construction.

Direct Effects

The proposed action is likely to have direct short-term adverse effects on silvery minnows during final construction activities involved in creating the north and south embayments of the ephemeral channel. Silvery minnows may be harmed or harrassed as the coffer dam or porta dam is installed above the ordinary high water mark. Fleeing from disturbance represents an expenditure of energy that the fish would not have without the project. However, this form of harassment would be short in duration. The potential number of individuals within the immediate vicinity of the equipment affected will likely be relatively low.

Additionally, channel excavation will mobilize sediments and may expose contaminants, impairing water quality. Direct effects to the silvery minnow from excess suspended sediments include: alarm reaction, abandonment of cover, avoidance response, reduction in feeding rates, increase in coughing rate, increased respiration, physiological stress, poor condition, reduced growth, delayed hatching, and mortality (Newcombe and Jensen 1996).

Occasional adverse effects are still likely beyond the construction period. High flows may deposit sediment in or at the openings of constructed channels so that isolated pools containing silvery minnows would be formed. Silvery minnows may become stranded in these isolated pools and die. However, the Route 66 Project is incorporating lessons learned from the Rio Grande Nature Center Project to minimize the potential for isolated pools.

Indirect effects

Sediment disturbance may result in indirect effects to the silvery minnow including the potential smothering and mortality of algae and aquatic invertebrates, depressed rates of growth, reproduction, and recruitment or reduced physiological function of invertebrates. Decreases in primary production are associated with increases in sedimentation and turbidity and produce negative cascading effects through depleted food availability to zooplankton, insects, mollusks, and fish.

Beneficial Effects

The proposed action is expected to establish diverse mesohabitats that support the silvery minnow. Such habitat benefits the species through improved egg and larval retention, increased recruitment rates, and increased survival of both YOY and adult minnows. In the long term, the

project is anticipated to have a beneficial effect on the silvery minnow and its habitat, contributing to the improvement of the status of silvery minnow into the future.

Cumulative Effects

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

Cumulative effects include:

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

- Increased urban use of water, including municipal and private uses. Further use of surface water from the Rio Grande will reduce river flow and decrease available habitat for the silvery minnow.

- Contamination of the water (i.e., sewage treatment plants, runoff from small feed lots and dairies, and residential, industrial, and commercial development). A decrease in water quality and gradual changes in floodplain vegetation from native riparian species to non-native species (i.e., saltcedar) could adversely affect the silvery minnow and its habitat. Silvery minnow larvae require shallow, low velocity habitats for development. Therefore, encroachment of non-native species results in less habitat available for the silvery minnow.

- Human activities that may adversely impact the silvery minnow by decreasing the amount and suitability of habitat include dewatering the river for irrigation; increased water pollution from non-point sources; habitat disturbance from recreational use, suburban development, and removal of large woody debris.

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

V. CONCLUSION

After reviewing the current status of the silvery minnow, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the Route 66 Project, as proposed in the May 30 BA and additional correspondences, is not likely to jeopardize the continued existence of the silvery minnow.

Recent sampling data have shown significant increases in numbers of silvery minnow. The restoration project is likely to have a short-term adverse effect on individual silvery minnows, which may be present in the Action Area, but impacts will be minimal. In addition, the proposed action is anticipated to have a long-term positive impact on the species through improvements to quality and availability of suitable habitat.

INCIDENTAL TAKE STATEMENT

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

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

Amount or Extent of Take Anticipated

The Service has developed the following incidental take statement based on the premise that the Route 66 Project will be implemented as proposed. Take of silvery minnows is expected in the form of harm and harass during ephemeral channel restoration.

The Service anticipates that up to 394 silvery minnows may be taken during construction of the north and south embayments of the ephemeral side channel during the installation of coffer or porta dams. We base this figure on the assumptions that up to 1.5 acres (6070 m^2) of wetted area may be affected by the deployment of the coffer dams and that silvery minnows are present in the project area at a density of 6.50/100 m^2. Take is likely to occur in the form of harassment.

Additionally, the Service anticipates that up to 1577 silvery minnows may be taken in the channel that is created. Based on the project description we assume that 24,281 m^2 of channel will be constructed. In the event that up to 24,281 m^2 of isolated habitats form in the ephemeral channel, approximately 1577 silvery minnow could be trapped if high flows recontour these channels, block entrances or exits, and strand silvery minnows within the constructed channel. If more than 1577 silvery minnows are found dead in this channel, the level of anticipated take will have been exceeded.

Estimated incidental take may be modified from the above estimated number should other silvery minnow monitoring information, data from silvery minnow rescue operations, or other research indicate substantial deviations from estimated values. In this case, further consultation may be necessary.

Effect of Take

The Service has determined that this level of anticipated take is not likely to result in jeopardy to the silvery minnow. The restoration project is likely to have minimal short-term adverse effects on individual silvery minnows and beneficial long term effects to silvery minnow habitat.

Reasonable and Prudent Measures

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

1. Minimize take of silvery minnow due to habitat restoration activities.
2. Manage for the protection of water quality from activities associated with the restoration project.
3. Continue to work collaboratively with the Service on the Middle Rio Grande Endangered Species Act Collaborative Program.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Corps must comply with the following terms and conditions, which implement the RPMs described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

The following terms and conditions will implement RPM 1:

To implement RPM 1, the Corps shall:

1. Report observations of isolation or impending isolation to the Service.
2. Report findings of injured or dead silvery minnows to the Service.
3. The final restoration monitoring report (outlining the results and effectiveness of the side channel restoration and embayment creation) shall be provided to the Service.

To implement RPM 2, the Corps shall:

1. Report to the Service, water quality measurements taken before, during and after construction activity.

2. Schedule, to the extent possible, embayment construction during dry or frozen soil conditions.

To implement RPM 3, the Corps shall:

1. Work to further conduct habitat/ecosystem restoration projects in the Middle Rio Grande to benefit the silvery minnow.

CONSERVATION RECOMMENDATIONS

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

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

RE-INITIATION NOTICE

This concludes formal consultation on the actions described in the August 2006 biological assessment. As provided in 50 CFR § 402.16, re-initiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) The amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this biological opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this biological opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending re-initiation.

In future correspondence on this project, please refer to consultation number 22420-2008-F-0125. If you have any questions or would like to discuss any part of this biological opinion, please contact Michelle Cummer of my staff at (505) 761-4715.

Sincerely,

Wally Murphy
Field Supervisor

cc:
Assistant Regional Director (ES), Region 2, U.S. Fish and Wildlife Service, Albuquerque, NM
Regional Section 7 Coordinator (ES), Region 2, U.S. Fish and Wildlife Service, Albuquerque, NM

LITERATURE CITED

Bartolino, J.R. and J.C. Cole, 2002. Ground-Water Resources of the Middle Rio Grande Basin, New Mexico. U.S. Geological Survey Circular 1222. 132 pp.

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

Bestgen, K. and D.R. Propst. 1994. Redescription, Geographic Variation, and Taxonomic Status of the Rio Grande silvery minnow, *Hybognathus amarus* (Girard, 1856). Contribution 69. Larval Fish Laboratory, Colorado State University.

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

Buhl, K. J. 2002. The Relative Toxicity of Waterborne Inorganic Contaminants to the Rio Grande silvery minnow (*Hybognathus amarus*) and Fathead Minnow (*Pimephales promelas*) in a Water Quality Simulating that in the Rio Range, New Mexico. Final Report to the U.S. Fish and Wildlife Service, Study No. 2F33 9620003. U.S. Geological Survey, Columbia Environmental Research Center, Yankton Field Research Station, Yankton SD.

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

Caldwell, C. 2002. Hybridization Potential and Spawning Behavior of Rio Grande silvery minnow (*Hybognathus amarus*) and Plains Minnow (*Hybognathus palcitus*). Interim report submitted to U.S. Fish and Wildlife Service Ecological Services Field Office, September 2002. 18 pp.

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

Crawford, C., A. Cully, R. Leutheuser, M. Sifuentes, L. White, and J. Wilber. 1993. Middle Rio Grande Ecosystem; Bosque Biological Management Plan. Middle Rio Grande

Dudley, R.K., and S.P. Platania. 1996. Rio Grande silvery minnow Winter Population Habitat Use Monitoring Project, April 1996. Summary of four trips (December 1995–March 1996). Report to the U.S. Army Corps of Engineers, Albuquerque. 12 pp.

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

Dudley, R.K., and S.P. Platania. 2002. Summary of Population Monitoring of Rio Grande silvery minnow (1994–2002). Report to New Mexico Ecological Services Field Office, September 10, 2002, Albuquerque, New Mexico. 14pp.

Dudley, R.K., S.P. Platania, and S.J. Gottlieb. 2005. Summary of the Rio Grande Silvery Minnow Population Monitoring Program Results from September 2005. American Southwest Ichthyological Research Foundation, Albuquerque, New Mexico.

Dudley, R.K., S.P. Platania, and S.J. Gottlieb. 2006. Summary of the Rio Grande Silvery Minnow Population Monitoring Program Results from October 2006. American Southwest Ichthyological Research Foundation, Albuquerque, New Mexico.

Estes, J. R. 2005. Cultural Resources Survey for the Bosque Wildfire Project: Fire Prevention Phase in Bernalillo and Sandoval Counties, New Mexico. OCA/UNM Report No. 185-839 (NMCRIS No. 89833) Office of Contract Archaeology, University of New Mexico, Albuquerque.

Franklin, I. R. 1980. Evolutionary Change in Small Populations. Pages 135 – 148 in M. E. Soulé and B. A. Wilcox (editors) Conservation Biology: an evolutionary-ecological perspective. Sinauer Associates, Inc. Sunderland, Massachusetts.

Harwood, A.K. 1995. The Urban Stormwater Contribution of Dissolved Trace Metal from the North Floodway Channel, Albuquerque, NM, to the Rio Grande. University of New Mexico, Water Resources Program, Professional Project Report.

Hink, V.C., and R.D. Ohmart. 1984. Middle Rio Grande biological survey. U.S. Army Corps of Engineers, Albuquerque District, New Mexico. Contract No. DACW47-81-C-0015, Arizona State University. 193 pp.

Levings, G.W., D.F. Healy, S.F. Richey, and L.F. Carter. 1998. Water Quality in the Rio Grande Valley, Colorado, New Mexico, and Texas, 1992-95. U.S. Geological Survey Circular 1162. Http://water.usgs.gov/pubs/circ1162 (viewed on May 18, 1998).

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Ecosystems. Archives of Environmental Toxicology and Chemistry 39:20–31.

Newcombe, C.P. and Jensen. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries management. 16:693-727.

Ong, K., T.F. O'Brien, and M.D. Rucker. 1991. Reconnaissance Investigation of Water Quality, Bottom Sediment, and Biota Associated with Irrigation Drainage in the Middle Rio Grande and Bosque del Apache National Wildlife Refuge in New Mexico 1988–89: U.S. Geological Survey Water-Resources Investigations Report 91-4036, Albuquerque, New Mexico.

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

Platania, S.P. 1995. Reproductive Biology and Early Life-history of Rio Grande silvery minnow, *Hybognathus amarus*. U.S. Army Corps of Engineers, Albuquerque, New Mexico. 23 pp.

Platania, S. P. 2000. Effects of Four Water Temperatures Treatments On Survival, Growth, and Developmental Rates of Rio Grande silvery minnows, *Hybognathus amarus*, Eggs and Larvae. Report to U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

Platania, S.P., and C. Altenbach. 1998. Reproductive Strategies and Egg Types of Seven Rio Grande Basin Cyprinids. Copeia 1998(3): 559–569.

Platania, S.P., and R. Dudley. 1999. Draft Summary of Aquatic Conditions in the Middle Rio Grande between San Acacia Diversion Dam and San Marcial Railroad Bridge Crossing for the period 14 through 26 April 1999. Prepared for the Bureau of Reclamation and New Mexico Ecological Services Field Office.

Platania, S.P., and R. Dudley. 2000. Spatial Spawning Periodicity of Rio Grande silvery minnow during 1999, http://www.uc.usbr.gov/progact/rg/RGSM2002/egg_salvage/wrg/aop/rgo/progact/rg/RGSM2002/progact/rg/RGSM2002/index.html.

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

Platania, S.P., and C.W. Hoagstrom. 1996. Response of Rio Grande Fish Community to and Artificial Flow Spike: Monitoring Report Rio Grande silvery minnow Spawning Peak Flow. New Mexico Ecological Services State Office, Albuquerque, New Mexico.

Platania, S.P., M.A. Farrington, W.H.Brandenburg, S.J. Gottlieb, and R.K. Dudley. 2003. Movement Patterns Of Rio Grande silvery minnow *Hybognathus amarus*, in the San Acacia Reach of the Rio Grande During 2002 Final Report. 38 pp.

Rand, G.M., and Petrocelli, S.R. 1985. Fundamentals of Aquatic Toxicology B Methods and Applications. Hemisphere Publishing Corporation, New York. 666 pp.

Roy, Richard, T.F. O'Brien, and M. Rusk-Maghini. 1992. Organochlorine and Trace Element Contaminant Investigation of the Rio Grande, New Mexico. U.S. Fish and Wildlife Service, New Mexico Ecological Services Office, Albuquerque, NM. 39 pp.

S.S. Papadopulos & Associates, Inc. 2000. Middle Rio Grande Water Supply Study. Boulder, CO: August 4, 2000.

Schmandt, J. 1993. Water and Development in the Rio Grande/Río Bravo Basin. University of Texas Press, Austin, Texas.

Scurlock, D. 1998. From the Rio to the Serria: An Environmental History of the Middle Rio Grande Basin. USDA Rocky Mountain Research Station, Fort Collins, Colorado, 80526.

Smith, J.R. 1999. Summary of Easy Egg Catching in the LFCC in the 9 Mile Study Reach during Spring 1998 Operation. U.S. Fish and Wildlife Service Report Submitted to the U.S. Bureau of Reclamation, Albuquerque, New Mexico on April 28, 1999.

Sogge, M.K., R.M. Marshall, S.J. Sferra, and T.J. Tibbitts. 1997. A Southwestern Willow Flycatcher Natural History Summary and Survey Protocol. Technical Report NPS/NAUCPRS/NRTR-97/12. USGS Colorado Plateau Research Station, Northern Arizona University, Flagstaff,Arizona.

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

Tetra Tech, Inc. 2004. Habitat restoration plan for the Middle Rio Grande. Prepared for Middle Rio Grande Endangered Species Act Collaborative Program, Habitat Restoration Subcommittee. Albuquerque.

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

U.S. Bureau of Reclamation. 2001. U.S. Bureau of Reclamation's Discretionary Actions Related to Water Management, U.S. Army Corps of Engineers Water Operations Rules, and Non-Federal Actions Related to Ordinary Operations on the Middle Rio Grande, New Mexico: June 30, 2001, through December 31, 2003. June 8, 2001.

U.S. Bureau of Reclamation. 2003. U.S. Bureau of Reclamation's Bureau of Reclamation's Water and River Maintenance Operations, Army Corps of Engineers' Flood Control Operation, and Non-Federal Actions on the Middle Rio Grande, New Mexico: March 1, 2003, through February 28, 2013. February 19, 2003.

U.S. Environmental Protection Agency. 1999. Update of Ambient Water Quality Criteria for Ammonia. Washington, D.C. 153pp.

U.S. Fish and Wildlife Service. 1993a. Proposal Rule to List the Rio Grande silvery minnow as Endangered, with Critical Habitat. 58 Federal Register 11821-11828.

U.S. Fish and Wildlife Service. 2003a. Biological and Conference Opinions on the Effects of Actions Associated with the Programmatic Biological Assessment of Bureau of Reclamation's Water and River Maintenance Operations, Army Corps of Engineers' Flood Control Operation, and Related Non-Federal Actions on the Middle Rio Grande, New Mexico. March 17, 2003.

U.S. Fish and Wildlife Service. 1993b. Notice of 12-month Petition Finding/Proposal to List *Empidonax traillii extimus* as an Endangered Species, and to Designate Critical Habitat. Federal Register 58:39495–39522..

U.S. Fish and Wildlife Service. 1994. Endangered and Threatened Wildlife and Plants; Final Rule to list the Rio Grande silvery minnow as an Endangered Species. Federal Register 59:36988–37001.

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

U.S. Fish and Wildlife Service. 2001. Programmatic Biological Opinion on the Effects of Actions Associated with the U.S. Bureau of Reclamation's, U.S. Army Corps of Engineers', and non-Federal Entities' Discretionary Actions Related to Water Management on the Middle Rio Grande, New Mexico, June 29, 2001.

U.S. Fish and Wildlife Service. 2002b. Report to the Rio Grande Compact Commission, U.S. Fish and Wildlife Service Activities in the Rio Grande Basin Calendar Year 2001. Prepared for the Rio Grande Compact Commission by the New Mexico Ecological Services Field Office, Albuquerque, New Mexico.

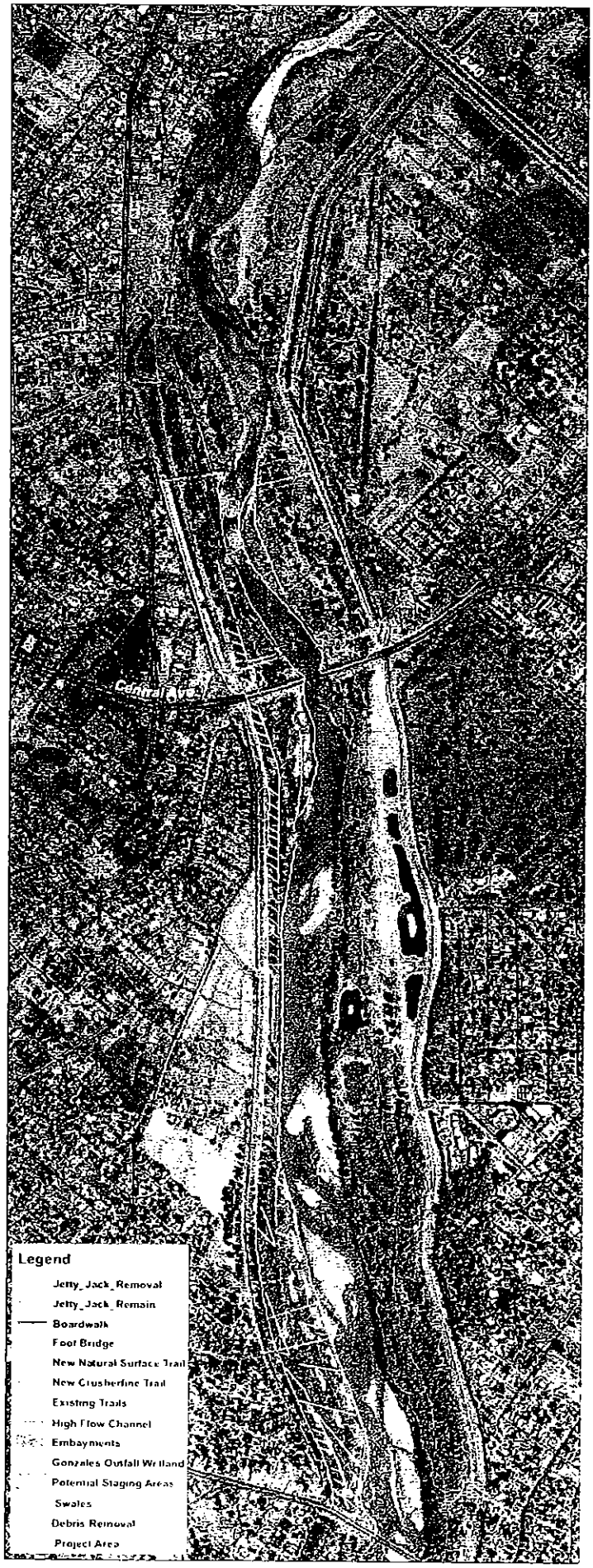
U.S. Fish and Wildlife Service. 2003. Endangered and Threatened Wildlife and Plants; Final rule for the Designation of Critical Habitat for the Rio Grande silvery minnow. Federal Register 68:8088–8135.

U.S. Geologic Survey. 2001. Selected Findings and Current Perspectives on Urban and Agricultural Water Quality by the National Water-Quality Assessment Program, FS-047-http://water.usgs.gov/pubs/FS/fs-047-01//pdf/fs047-01.pdf

U.S. Geologic Survey. 2002. Ground-water resources of the Middle Rio Grande basin, New Mexico. Circular 1222.

Watts, H.E., C.W. Hoagstrom, and J.R. Smith. 2002. Observations on Habitat Associated with Rio Grande silvery minnow, *Hybognathus amarus* (Girard). Submitted to U.S. Army Corps of Engineers, Albuquerque District and City of Albuquerque Water Resources Division, June 28, 2002.

ATTACHMENT
FIGURE 2



Ecosystem Revitalization @ Route 66 Project