United States Department of the Interior

FISH AND WILDLIFE SERVICE
New Mexico Ecological Services Field Office
2105 Osuna Road NE
Albuquerque, New Mexico 87113
Phone: (505) 346-2525 Fax: (505) 346-2542

February 16, 2016

Cons. No. 02ENNM00-2016-F-0287

Memorandum

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

From: Field Supervisor, Fish and Wildlife Service, New Mexico Ecological Services Field Office, Albuquerque, New Mexico

Subject: Biological Opinion on the effects to Rio Grande silvery minnow and Yellow-billed Cuckoo during Reclamation's and the New Mexico Interstate Stream Commission's proposed construction activities to create five habitat restoration sites along the west bank of the Rio Grande in the San Acacia Reach between River Mile 116 and River Mile 99, in Socorro County, NM, during 2016 to 2019

Thank you for the January 14, 2016, Biological Assessment (BA; McMillan et al. 2016) for the New Mexico Interstate Stream Commission (NMISC) San Acacia Habitat Restoration Project (NMISC San Acacia Habitat Restoration Project) from River Mile 116 to River Mile 99, in Socorro County, New Mexico (Figure 1). The U.S. Bureau of Reclamation (Reclamation) is partnering with the NMISC on the proposed action to enhance riparian and aquatic habitat at five sites along the Rio Grande during 2016 through April 2019. Attached below is the U.S. Fish and Wildlife Service's (Service) Biological Opinion (BO), which analyzes the effects of the proposed action on endangered Rio Grande Silvery Minnow (*Hybognathus amarus*, silvery minnow), silvery minnow critical habitat, and threatened Yellow-billed Cuckoo (*Coccyzus americanus*; cuckoo).

Reclamation requested formal consultation on the proposed action for these species and we have prepared this BO on the effects to those species in accordance with section 7(a)(2) of the Endangered Species Act, as amended (ESA; 16 U.S.C. 1531, et seq.). This BO is based on information submitted in the BA; conversations and communications between Reclamation, the NMISC and its contractors, SWCA Environmental Consultants (SWCA) and GeoSystems Analysis, 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).

In October 2015, Reclamation decided to prioritize and conclude this ESA consultation on the NMISC San Acacia Habitat Restoration Project. The proposed action and its effects to federally listed species are similar to other habitat restoration projects and other actions conducted by Reclamation (U.S. Bureau of Reclamation (USBR 2014, 2015; Pueblo of Sandia 2008; SWCA 2008a,b; 2010a,b; Golder Associates 2012). Other related actions including those conducted by others (U.S. Army Corps of Engineers (USACE 2007, 2012a,b,c)) and other related BOs issued by the Service (U.S. Fish and Wildlife Service (USFWS) 2003a; 2009a,b,c; 2010a,b; 2011a,b; 2012; 2013a,b,c; 2014a; 2015). This BO incorporates all the information cited above and within it by reference as well as any references cited therein. Therefore, we have abbreviated the narrative extent of this BO's sections on the proposed action, status of the species, environmental baseline, cumulative effects, and conservation recommendations, and their associated analyses by depending upon cited information incorporated into this BO. The result is that this BO largely focuses on the effects of the proposed action and on reasonable and prudent measures.

The Service concurs with Reclamation that the proposed action "may affect, is not likely to adversely affect" endangered southwestern willow flycatcher (*Empidonax traillii extimus*) (flycatcher), flycatcher critical habitat, or cuckoo proposed critical habitat based on the rationales provided in the BA and supplemental information provided by Reclamation (GeoSystems Analysis 2015; or by electronic mail). Reclamation found that the proposed action "may affect, is likely to adversely affect" the silvery minnow and the cuckoo. The Service did not find adequate justification in the BA to support Reclamation's finding that the proposed action "may affect, not likely to adversely affect" silvery minnow critical habitat. The Service describes adverse effects to silvery minnow critical habitat, below. Reclamation also found that the proposed action would have "no effect" on New Mexico meadow jumping mouse (*Zapus hudsonius luteus*) or its proposed critical habitat (BA).

The Service reviewed the proposed action (the NMISC San Acacia Habitat Restoration Project) with its associated construction activities, including various conservation measures designed to offset environmental impacts. The proposed action will increase the amount of native riparian vegetation that will benefit foraging cuckoos. The proposed action will also result in the creation or enhancement of inundated floodplains that will benefit silvery minnows by increasing the amount and diversity of habitat, increase lateral connectivity, and increase the amount of aquatic habitat with reduced velocities during the spring.

During construction activities, the proposed action will cause some silvery minnows to flee the physical disturbance, noise, vibration, and alterations in water quality during earthwork conducted on or along the shoreline. Therefore, the proposed activities will harass silvery minnows and may temporarily impair their natural feeding or sheltering activities, or their ability to engage in such behaviors (50 CFR 17.3). Although temporary, some of the physical features of silvery minnow critical habitat (e.g., water quality) will be adversely affected by the proposed action. Also disposal of spoils will affect the physical topography and vegetation in the floodplain, although the magnitude of adverse effects of these spoils to silvery minnow critical habitat is uncertain. Therefore, the Service concluded that the proposed action "may affect, is likely to adversely affect" silvery minnows and the physical features of critical habitat.

However, the proposed action is not likely to jeopardize the continued existence of the silvery minnow, because the numbers of silvery minnows expected to be affected in relation to the population abundance is small. Nor will the proposed action destroy or adversely modify silvery minnow critical habitat because the areas physically affected are also small, and therefore, will not appreciably diminish their value for conservation of the silvery minnow. Our staff discussed the uncertainty of the magnitude of spoil disposal impacts to silvery minnow critical habitat and how the beneficial actions may compensate for some of those impacts. We agreed that the issue was complicated, should be evaluated on a larger scale, and will benefit from ongoing evaluations and modeling currently being conducted by Reclamation. Therefore, it is advisable that Federal agencies continue to coordinate closely with the Service on such actions on a case-by-case basis and not consider the evaluations in this BO as definitive. Reclamation identified measures that will further minimize impacts to silvery minnow and its critical habitat and the proposed habitat restoration does provide some relief from those adverse effects. Working with your staff, we agreed on reasonable and prudent measures as well as terms and conditions that will minimize the incidental take of silvery minnows associated with the proposed action.

Although seasonal restrictions are implemented to reduce effects to cuckoo from the proposed action, there will be adverse effects on cuckoos by a reduction in foraging habitat within a historically occupied territory. When native vegetation regenerates either by natural recruitment or by active planting, the function of the foraging habitat is anticipated to recover. The extent and duration of adverse effects to cuckoo are uncertain, but are likely short in duration (less than three years) and small (eight percent) compared to the size of cuckoo foraging habitat. We have provided reasonable and prudent measures as well as terms and conditions necessary to minimize the incidental take of cuckoos associated with the proposed NMISC San Acacia Habitat Restoration Project action. Therefore, the proposed action is not likely to jeopardize the continued existence of the cuckoo.

Thank you for working with us to address project concerns and partnering with the NMISC to enhance and create these habitat projects. If you have any questions regarding this BO, please contact David Campbell, Large River Recovery and Restoration Program Branch Chief, at the letterhead address, by email, at david_campbell@fws.gov, or by telephone at (505) 761-4745.

WALLY MURPHY
Digitally signed by WALLY MURPHY
Date: 2016.02.17 06:46:06 -07'00'

Wally Murphy

cc:
Director, New Mexico Department of Game and Fish, Santa Fe, New Mexico (electronic copy).
Director, New Mexico Office of the State Engineer, Interstate Stream Commission, Santa Fe, New Mexico (Attention: R. Schmidt-Peterson, Rio Grande Basin Manager) (electronic copy).
Administrative Record for Consultation Number 02ENNM00-2016-F-0287.

BIOLOGICAL OPINION

I. DESCRIPTION OF THE PROPOSED ACTION

The BA (McMillan et al. 2015) and GeoSystems Analysis (2015) describe the proposed NMISC San Acacia Habitat Restoration Project action in detail and these are incorporated by reference. In partnership with Reclamation, the NMISC proposes to create or improve a total of up to 13.6 acres Rio Grande Silvery Minnow (*Hybognathus amarus*, silvery minnow) habitat on the banks of the Rio Grande at five, off-channel sites (sites) at River Miles (RM) 114, 112, 100.5, 100 and 99.5, in Socorro County, New Mexico (see Figures 1-6). The goal of the proposed action is increase the area of inundation in silvery minnow critical habitat by flows ranging from 1,000 to 2,000 cubic feet per second (cfs) as measured at the U.S. Geological Survey (USGS) Gage 08354900 in the floodway at San Acacia, New Mexico. Woody riparian vegetation such as Goodding's willow (*Salix gooddingii*), coyote willow (*S. exigua*), and Rio Grande cottonwood (*Populus deltoides* spp. *wislizenii*) may become established at these sites through passive restoration and would benefit migratory birds, including providing feeding habitat for the Western Yellow-billed cuckoo (*Coccyzus americanus*; cuckoo). Construction will begin in February 2016 and will continue until April 15, 2019, though no work will be conducted in any year from April 15 to August 15, or through September 1, when cuckoos are present.

As a result of river management activities over the past 50 years, the Rio Grande in the San Acacia Reach, particularly near the project area, has continued to degrade, separating the river channel from its associated riparian floodplain, which has reduced the areas of inundation and overbanking even at modest flows (Parametrix 2008; Isaacson 2009; Gunning 2010; USACE 2007, 2012a,b, 2013; Shah-Fairbank et al. 2011; USFWS 2013; GeoSystems Analysis 2015). Within the last year (at these sites), up to six inches of sediment was deposited, which has decreased the area available for inundation by overbanking flows (GeoSystems Analysis 2015) that foster silvery minnow nursery habitat and larval recruitment and native riparian vegetation.

The proposed action (i.e., the final designs for sites RM114, RM112, RM100.5, RM100 and RM99.5) will result in enhancing the amount of low-velocity backwaters by approximately 13.6 acres (or more) at flows of 2,000 cfs (Table 1). The sites have features designed to begin to inundate at a flows as low as 800 cfs with some portions reaching depths of up to two feet or more at flows of 2,000 cfs and higher. All sites will slope into the river to facilitate silvery minnow movement onto these sites as well as to reduce the likelihood of silvery minnow entrapment during recession. The permanence of these five sites providing the physical features of critical habitat over time is unknown but monitoring of them was as described in the BA.

The proposed action involves earthwork and construction of shallow depressions in the landscape. Soil and some vegetation will be removed from each of the sites using heavy equipment (such as dozers, belly scrapers, excavators, backhoes, or trucks). Reclamation and NMISC propose that any increase in the amount of site inundation by flooding (as occurs during other actions – see Reclamation 2015) and the presence of nearby native vegetation to the project sites will encourage growth of native vegetation on and around the edges of those sites. As stated in the BA, however, if suitable flycatcher or cuckoo habitat is removed and is not replaced

naturally within three years, Reclamation (and NMISC) will further coordinate with the Service regarding a more active approach to revegetation in the Action Area.

Spoils from the earthwork will be deposited in nearby areas within the floodplain (also known as the floodway; BA, Figures 2-6; Table 1). Access roads and staging areas will be mowed or trimmed of vegetation within approximately 20 feet across or in height. After earthwork is completed, access roads and staging areas will be revegetated with native plants and seeds. In the BA, Reclamation identified various actions, such as pumping from the Rio Grande, which they may need to conduct in case of an emergency. However, for the proposed action, water used for dust abatement will *only* be pumped from areas outside the river floodway, especially during critical months of May or June.

Table 1. Site Name, Acreage of habitat enhanced at 2000 cfs, cubic feet of spoil, and location of spoil in the 100-year floodplain for the NMISC San Acacia Habitat Restoration Project. [cfs= cubic feet per second; CH=Critical Habitat; RGSM=Rio Grande Silvery Minnow; SWFL = Southwestern Willow Flycatcher; YBCU = Yellow-billed Cuckoo; PCH=Proposed CH)] [*the 100-year floodplain was estimated using USACE 2013 at a transect across or near the site]

Site Name (last row is a summary)	Acres of habitat at 2,000 cfs	Cubic feet of spoils	If spoils are placed 5 feet deep, then acreage =	Are spoils in* the 100-year floodplain?	Spoils in RGSM CH?	Spoils in YBCU CH?	Impact distance along shoreline (meters)
RM114	1.2	75,600	0.3	No	Yes	Yes	120
RM112	1.4	72,900	0.3	Yes	Yes	Yes	50
RM100.5	6.4	313,200	1.4	Yes	Yes	Yes	80
RM100	1.5	207,900	1.0	Yes	Yes	Yes	150
RM99.5	3.1	199,800	0.9	mostly No	Yes	Yes	110
Summary	13.6 acres	869,400 ft^3	4 acres	3/5 are yes	5/5 yes	5/5 yes	510 m

Action Area

This BO uses the term “Middle Rio Grande” (or MRG) to refer to the river channel and its floodplain (within the levees) in the Rio Grande-Albuquerque Watershed (USGS Hydrologic Cataloging Unit 13020203; Seaber et al. 1987) in central New Mexico. The MRG is often divided into river reaches identified by an upstream diversion dam (Reclamation 2015). Therefore, we refer to the San Acacia Reach as the channel and floodplain of the MRG between the San Acacia Diversion Dam and Elephant Butte Reservoir (USFWS 2013) and between the levee and high ground to the east. The proposed action all takes place in the San Acacia Reach.

The Action Area includes all areas that will be affected directly or indirectly by the proposed action (50 CFR 402.02). We find that the Action Area includes any areas of disturbance, areas of earthwork at the five sites, staging areas, access roads and haul routes, areas where vegetation is mowed or removed, fill material or sediment disposal areas, as well as areas where noise, disturbance, or water quality changes occur (often adjacent to the construction sites or downstream into a zone of mixing (dilution) occurs until those conditions are indistinguishable from conditions upstream (or prior to activities, far downstream, or across on other side of river).

II. STATUS OF THE SPECIES

The proposed NMISC San Acacia Habitat Restoration Project action may adversely affect endangered silvery minnow (USFWS 1994), its critical habitat (USFWS 2003b), and threatened cuckoo (USFWS 2013b) in the Action Area. The Service (USFWS 1994, 2003a,b, 2010, 2011, 2012, 2013a, 2013b, 2014a, 2014b, 2015) and Reclamation (USBR 2015) have both provided updates on the status of the silvery minnow, its critical habitat, and the cuckoo, including their descriptions, life history, genetics, demography, habitat, distribution, threats of extinction, goals for recovery, and the physical and biological features of their critical habitat, which are incorporated here by reference, including citations therein.

An updated status of these species specific to the San Acacia Reach, which is broader than but encompasses the Action Area, is provided below. This updated status of each species informs our effects analysis because it provides data on the abundance of the species during the period in which the proposed activities occur (that is, from September 1 through April 15). The Service assumes that the abundance of silvery minnows affected by the proposed NMISC San Acacia Habitat Restoration Project activities will be similar to the abundance of the silvery minnows found by silvery minnow population monitoring surveys conducted in the San Acacia Reach (Dudley et al. 2015, Dudley and Platania 2015).

Status of the Silvery Minnow and Abundance in the San Acacia Reach and Action Area

All life stages of silvery minnow currently inhabit the San Acacia Reach. Standard surveys of silvery minnows and silvery minnow eggs are routinely conducted at 10 discrete locations within the San Acacia Reach during long term monitoring (Dudley et al. 2015, Dudley and Platania 2015). Long-term, standardized monitoring of silvery minnows in the MRG began in 1993 and has continued annually, except for portions of 1998, 2009, and 2013 (Dudley et al. 2015). Long-term monitoring of silvery minnows has recorded substantial fluctuations within one year (orders of magnitude increases and decreases) in the overall (MRG) population densities (which is an index of abundance in the silvery minnow population; Figure 7). Silvery minnow abundance is highly correlated with hydrologic conditions, particularly the magnitude, duration and timing of spring runoff (Dudley et al. 2015). During these spring floods, inundated habitat in the floodplain is increased and, when sustained, provides additional areas for spawning adults, eggs, and larvae to nurse (grow, feed, shelter), such that annual silvery minnow abundance is observed to subsequently increase. There is also a negative relationship between low flow volumes and the distribution of silvery minnows (probability of occurrence of silvery minnow during sampling; that is, less water results in fewer occurrences of fish found during surveys). Thus, prolonged high flows during spring are most predictive of increased silvery minnow abundance and prolonged low flows during summer are most predictive of decreased silvery minnow occurrence at sites sampled over the 22-year study period (Dudley et al. 2015).

Dudley et al. (2015) also show that silvery minnows tend to exhibit a heterogeneous spatial distribution (i.e., they may shoal or swim in an aggregation) most likely indicative of different micro- and macro-habitat conditions (e.g., such as temperature, or velocities) throughout habitat in the river reach. Additionally, as silvery minnows move within and between locations in the San Acacia Reach, any silvery minnow has the potential to move into or near one of these sites

while work is conducted. Although habitat conditions (e.g., substrate, velocity, depth, fish community, etc.) at each of the five NMISC San Acacia Habitat Restoration Project sites may differ from habitat conditions at the standardized survey sites, we assume that silvery minnows occupy these sites at densities similar to those at the long-term survey sites. Therefore, for the period between September 2009 and December 2015, the Service summarized in Table 2 (Hobbs and Lusk 2016) the available data on silvery minnow densities in the San Acacia Reach collected during long term population monitoring (Dudley et al. 2015) by month (for those months occurring during the proposed NMISC San Acacia Habitat Restoration Project action from September through March).

Table 2. Estimated monthly densities of silvery minnows (RGSM/100m^2) during standard surveys in the San Acacia Reach, with average and 75th percentile RGSM densities, across all 9 survey sites, for the period between September 2009 and December 2015 (excluding non-construction months of April, May, June, July, and August) ["na" – data unavailable].

Data Source	RGSM / 100m^2 in Sept.	RGSM / 100m^2 in Oct.	RGSM / 100m^2 in Nov.	RGSM / 100m^2 in Dec.	RGSM / 100m^2 in Jan.	RGSM / 100m^2 in Feb.	RGSM / 100m^2 in Mar.	Average RGSM / 100m^2 from Sept to March
Dudley et al. 2009	22.3	14.7	10.7	7.7	na	na	na	13.9
Dudley et al. 2010	1.1	2.4	1.7	4.4	na	13.5	7.5	5.1
Dudley et al. 2011	3.5	na	5.0	3.7	na	2.7	na	3.7
Dudley et al. 2012	0.2	0.0	na	na	na	1.6	na	0.6
Dudley et al. 2013	0.3	0.2	0.2	2.8	na	na	na	0.9
Dudley et al. 2014	0.4	na	0.1	2.0	na	1.2	na	0.9
Dudley et al. 2015	1.1	0.0	na	na	na	1.3	na	0.8
Monthly Average	4.1	3.5	3.5	4.1	--	4.1	7.5	1.4
Monthly 75th %ile	3.5	8.6	7.9	6.1	--	8.1	--	**6.8**

For the purposes of this BO, we used the average of the monthly 75th percentile silvery minnow densities (expressed as "catch-per-unit effort" (CPUE) or number of RGSM per 100 square meters (RGSM/100m^2)) from the seven years of monitoring efforts in the San Acacia Reach (Table 2). That is, we used a density of 6.8 RGSM/100m^2 for all estimates of silvery minnow abundance within the NMISC San Acacia Habitat Restoration Project Action Area (Table 2; Hobbs and Lusk 2016). This density of 6.8 RGSM/100m^2 will be used to conservatively represent the status of the species for the duration of the proposed action across three years, despite population fluctuation. We used this density of silvery minnows times the area of impact to determine the number of silvery minnows that will be adversely affected by proposed action and in the Incidental Take Statement, below.

Status of Silvery Minnow Critical Habitat in the San Acacia Reach

From the San Acacia Diversion Dam to the utility line crossing the Rio Grande just east of the Bosque Well demarcated on USGS Paraje Well 7.5-minute quadrangle (1980) with UTM coordinates of UTM Zone 13: 311474 E, 3719722 N is designated silvery minnow critical habitat (USFWS 2003b). The critical habitat designation defines the lateral extent (width) as those areas bounded by existing levees or, in areas without levees, 300 feet (ft) (91.4 meters (m)) of riparian zone adjacent to each side of the bank full stage of the middle Rio Grande. The Service (USFWS 2003b) found that the riparian zone adjacent to the river channel provided an important function for the protection and maintenance of the primary constituent elements and was essential to the conservation of the species.

Although silvery minnows cannot be found in these areas when they are dry, these areas likely provided backwater habitat and were sometimes flooded in the past (USFWS 2003b citing Middle Rio Grande Biological Interagency Team 1993); therefore, they may provide habitat during high-water periods. The Service (USFWS 2003b) selected the 300-ft (91.4-m) lateral extent for three reasons: (1) The biological integrity and natural dynamics of the river system are maintained within this area (i.e., the floodplain and its riparian vegetation provide space for natural flooding patterns and latitude for necessary natural channel adjustments to maintain appropriate channel morphology and geometry, store water for slow release to maintain base flows, provide protected side channels and other protected areas for larval and juvenile silvery minnow, allow the river to meander within its main channel in response to large flow events, and recreate the mosaic of habitats necessary for the conservation of the silvery minnow); (2) conservation of the adjacent riparian zone also helps provide essential nutrient recharge and protection from sediment and pollutants, which contributes to successful spawning and recruitment of silvery minnows; and (3) vegetated lateral zones are widely recognized as providing a variety of aquatic habitat functions and values (e.g., aquatic habitat for fish and other aquatic organisms, moderation of water temperature changes, and detritus for aquatic food webs) and help improve or maintain local water quality. The Service (USFWS 2003b) found that a relatively intact riparian area, along with periodic flooding in a relatively natural pattern, is important in maintaining the conditions necessary for conservation of the silvery minnow.

Approximately 16,002 acres of silvery minnow critical habitat occur within the San Acacia Reach. Of that, approximately 7,532 acres are part of the river channel. Using the report and spreadsheet developed by USACE (2010) (based on the FLO-2D analysis by Tetra Tech 2004, 2005), approximately 1,700 acres of floodplain is inundated by flows at approximately 2,000 cfs measured at the San Acacia Gage. Approximately 4,680 acres of floodplain is inundated by flows at approximately 3,500 cfs and approximately 8,393 acres of floodplain is inundated by flows at approximately 7,000 cfs measured at the San Acacia Gage (USACE 2010). Recent elevation profiles at river cross-sections (Varyu 2013) have not been further developed in relation to flow so as to update the status of critical habitat in the MRG or San Acacia Reach.

Status of the Yellow-Billed Cuckoo and Abundance in the San Acacia Reach

The terms "detection," "territory," "habitat," and "breeding habitat" are used below to help describe cuckoo population biology and breeding habitat. (Note that for this BO, the term "site" is used to identify one or more of the habitat restoration sites (BA)). A detection is an observation of cuckoo presence documented by a permitted biologist completing a formal presence/absence cuckoo survey. A territory is an area occupied by a single male, pair, or pair with an additional "helper male" of cuckoos throughout the breeding season. A territory is estimated based on the post processed and analyzed detections compiled over the course of the summer and is the centralized location for relevant detections within a 500-meter radius. Some detections may be dismissed as migratory individuals (Carstensen et al 2015). Territories are the unit of measurement used by the Service in estimating population numbers. When used alone, the term "habitat" is used to describe those areas that provide food, shelter, and protection from predators during long-distance migration, short-distance stopover habitat, as well as foraging areas adjacent to and sometimes within a cuckoo territory. The term "breeding habitat" is used to describe habitats that would be considered suitable for nesting activity. This would include large areas with dense, mature trees that would provide resources for nest support, extra food for raising young, and protection from nest predators.

Standardized monitoring surveys of the cuckoo by Reclamation began in 2006. The goal was to determine distribution and abundance of cuckoos along 33 river miles of the Middle Rio Grande. The survey area has increased since then and now encompasses 125 river miles from the south boundary of the Isleta Pueblo near Los Lunas, downstream to the US Highway 60 Bridge. The number of individual surveys has also increased since 2006, from a minimum of three surveys per breeding season to a minimum of four. Similar to the flycatcher, the largest breeding population of cuckoos occurs in the exposed pool of Elephant Butte Reservoir (56% of detections within the study area). Other areas have not been as productive but small patches of habitat have developed that are attractive to breeding cuckoos (Carstensen et al 2015).

Cuckoo surveys in 2015 near the Action Area indicate that there are estimated cuckoo territory center points within 750 meters of the RM 112 site (~650 m) and the RM 100.5 site (~50 m) (ISC 2015). The habitat at the RM 112 site consists of sparse, monotypic salt cedar and comprises an estimated 0.02% of this territory. There is breeding and foraging habitat within the RM 100.5 site area.

III. ENVIRONMENTAL BASELINE

Under section 7(a)(2) of the ESA, when considering the effects of the proposed action on federally listed species, we are required to take into consideration the environmental baseline (that is current and foreseeable conditions in the Action Area). 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 already undergone formal or early section 7 consultation; and the impact of State and private actions that are contemporaneous with the consultation in process. The environmental baseline defines the effects of these activities in the Action Area on the current status of the species and its habitat to provide a platform to assess the effects of the action now under consultation. The Service (USFWS 2003a,b, 2010a,b, 2010a,b; 2011a,b; 2012; 2013a,b,c; 2014a; 2015), the U.S. Army Corps of Engineers (USACE 2007, 2012a,b,c)), others (Crawford et al. 1993; Dudley et al. 2015; Geosystems Analysis 2015; Gunning 2010; Parametrix 2008; Posner 2011; Shah-Fairbank et al. 2011; Tetra Tech 2014), and Reclamation (Smith and Massong 2002; USBR 2003; Massong 2005; Varyu 2013; Makar 2015; USBR 2015; McMillan et al. 2016) have described the environmental baseline, which encompass the Action Area, and these are incorporated here by reference, as they inform the baseline, effects analyses, and the jeopardy analysis in this BO.

Summary of the Environmental Baseline of Aquatic Habitat in the Action Area

The remaining wild population of silvery minnow is restricted to approximately seven percent of its historical range in the Rio Grande (USFWS 2010a). Several conditions in the environmental baseline have contributed to the current status of the silvery minnow and its habitat in the Action Area, and are believed to affect the survival and recovery of silvery minnows in the wild. Many of these activities are broader than the Action Area but have effects that extend into the Action Area. These include past and present projects that affect Rio Grande streamflow and riparian habitat such as water management, flood regulation, channelization, diversions for agriculture and drinking water, climate change, land use changes, pollution, nonnative species invasion, ground water drainage, drought, salinization, and trans-basin diversions of water. The reduction in the magnitude, frequency, duration, and timing of flooding (particularly overbank inundation of the floodplain during high spring flows) has disrupted the functional integrity of aquatic and riparian habitats in the Rio Grande and reduced the abundance of silvery minnow. Additionally, except for 2008, every year since 1996 has exhibited at least one drying event that has desiccated the river channel and negatively affected silvery minnow distribution, including documented mortality. Silvery minnows in the MRG are unable to expand their distribution because of poor habitat quality, diversion dams, and reservoirs restrict significant movement (USFWS 2010a).

Augmentation of silvery minnows with captive-reared fish has been ongoing, and monitoring and evaluation of these fish provide information regarding the survival and movement of individuals including those affected by river desiccation (Archdeacon 2014; Archdeacon et al. 2015). Habitat conservation and restoration, captive propagation and augmentation, genetics management, salvage and relocation, and research activities have been ongoing to reduce the risk of extirpation of silvery minnow in the wild and monitor critical habitat in the Action Area.

Summary of the Environmental Baseline of Riparian Habitat in the Action Area

Riparian vegetation in the MRG between San Acacia Diversion Dam and Elephant Butte Reservoir has historically been classified using the Hink and Ohmart classification system (Hink and Ohmart 1984). This system identifies vegetation polygons based on dominant species and structure. Plant community types are classified according to the dominant or co-dominant plant species in the canopy and shrub layers. During the summer and fall of 2002, as part of the ESA Collaborative Program, Reclamation personnel updated vegetation maps from Belen to San Marcial using a combination of ground-truthing and aerial photo analysis (Callahan and White 2004). These areas were ground-truthed again in 2008 (Ahlers et al. 2010). In 2012, riparian vegetation within the Action Area was mapped and ground-truthed again using the Hink and Ohmart classification system by Reclamation staff (Siegle et al. 2013).

Riparian habitat within the MRG includes dense stands of willows and cottonwoods adjacent to or near the river channel, or the Low Flow Conveyance Channel (LFCC) (Siegle et al. 2013). The area from Cochiti Reservoir to Albuquerque in the Middle Rio Grande support local areas of suitable riparian habitat for cuckoos. Cuckoos (and many other species of neotropical migrant landbirds) use the MRG riparian corridor as stop-over habitat during migration. During migration, cuckoos use a greater variety and distribution of habitats, including non-riparian vegetation than during breeding (Siegle et al. 2013). Stopover habitats may lack some of the components important for breeding such as suitable riparian patch size and structure. Breeding cuckoos are riparian obligates and nest in low to moderate elevation riparian woodlands with dense vegetation providing a thick canopy cover.

Recent presence/absence surveys have detected migrating and foraging cuckoos throughout the MRG riparian corridor in vegetation types that are classified as “low suitability” for breeding habitat (Siegle et al. 2013). It is important to note that “suitability” qualifiers associated with this report were assigned based on flycatcher habitat requirements. However, these data were used as a surrogate for cuckoos since areas used by the flycatcher and cuckoo overlap in several areas in the southwestern United States (79 FR 48547).

Since 2012, the abundance of cuckoos within the San Acacia Reach have been consistent and represented five percent of the detections and four percent of the territories in the MRG during 2014 (Carstensen et al. 2015). Territories are typically 200 acres or more (79 FR 48547). Nesting activity typically occurs between late June and late July and nest clutch size is typically between two and four eggs (Halterman *et al.* 2015). There is more to learn about cuckoo site fidelity, but where banding studies have taken place, returning cuckoos one or more years after initial capture were typically recaptured within 80 feet to 50 miles from their original banding location (McNeil et al. 2013, Halterman 2009, Halterman *et al.* 2015). Breeding pairs of banded cuckoos along the Lower Colorado River were found occupying the same territory for up to three years (Laymon 1998, Halterman *et al*. 2015).

Arid conditions (reduced area and frequency of flooding) on the floodplains in this degraded reach are limiting the potential for greater abundance of cuckoos. Habitat restoration is needed to reduce the risk of loss of cuckoos in this reach and maintain the conservation value of its critical habitat.

IV. EFFECTS OF THE ACTION

Regulations implementing the ESA (50 FR 402.02) define the *effects of the action* as the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or 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. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification; interdependent actions are those that have no independent utility apart from the action under consideration. Species adversely affected include the silvery minnow, silvery minnow critical habitat, and the cuckoo.

Effects on Silvery Minnow

Beneficial Effects of the Habitat Enhancement

The proposed action is anticipated to have beneficial effects on silvery minnows in the long-term by increasing the amount and frequency of floodplain inundation (BA; GeoSystems Analysis 2015). The amount of floodplain inundation at these five sites without the proposed action is approximately 5 acres and with the proposed action are 8.8 acres (when flows at San Acacia Gage are at 1,000 cfs). This resulted in approximately a 43 percent increase compared to the baseline. At 2,000 cfs, the benefits are expected to be greater, 13.6 acres, and vary with time.

Adult silvery minnows use habitat with slow velocities (Bovee et al. 2008). When flows inundate the floodplain, low velocity conditions also promote silvery minnow egg retention in the floodplain and foster larval food, cover, and survival (Porter and Massong 2004). At the San Acacia Gage (Gage 08354900), during the runoff season (May-June), the percent exceedance (from 1993 to 2013; Bui 2014) for flows approximately 750 cfs was 60 percent; for flows approximately 1,250 cfs was 53 percent; for flows approximately 1,750 cfs was 47 percent; for flows approximately 2,250 cfs was 39 percent; and for flows approximately 2,750 cfs was 32 percent. For high flows there was a negligible chance of flow at or above approximately 7,250 cfs from this historical record. This analysis suggests that these five sites should be inundated between 40 to 60 percent of the time when high flows (historically) occur during spring runoff.

Effects of Mechanical Activities, Noise, and Water Quality Alterations

During the NMISC San Acacia Habitat Restoration Project, major construction activities will begin to the west of the river, but may affect those silvery minnows that remain in the area immediately proximate in the Rio Grande. We expect silvery minnows will be directly harassed by human activities, heavy equipment operations, and any ancillary activities described in the BA. Short-term adverse effects on silvery minnows may occur due to physical disturbance of the water column and bed substrate during the earthwork along the shoreline and during removal of berms, silt fences, and other activities. Avoidance behavior, or fleeing from the disturbance, represents a disruption in normal behaviors and an expenditure of energy that an individual silvery minnow would not have experienced in the absence of the proposed action. However, this form of harassment is expected to be short in duration, with pre-exposure behaviors to resume after fleeing the disturbance.

Heavy equipment operations will generate noise and vibration. There is no information provided in the BA on the amounts of noise or the vibration frequencies of actions taken near the Rio Grande channel. Therefore, we assumed noise levels associated with the proposed action could range from 54 decibels equivalents (dBeq) to perhaps 78 dBeq (based on Nedwell et al. 2007 and Popper et al. 2014). Ambient noise levels in the Action Area are likely to be lower than observed in urbanized areas. The level at which fish can detect noise from construction activities sound depends upon the level of ambient noise. We assumed that ambient noise near the Rio Grande could have characteristic noise similar to other rural or unpopulated areas (perhaps 35 dBeq on average, with peak noise perhaps as high as 55 dBeq). There are several factors used to estimate the conductance of noise over distance in air and its transfer to the water column (Nedwell et al. 2007). We assumed that construction activities nearest the channel could generate noise levels over 65 dBeq and that would enter the water column and would startle silvery minnows from their normal feeding and sheltering behaviors.

Using Nedwell et al. (2007), and injury guidelines developed by Popper et al. (2014), we determined that silvery minnows would likely have behavioral effects (that is, startle and briefly flee) associated with noise (within its hearing and vibrational frequencies), when noise levels increased 5 to 30 dBeq above ambient noise levels in water column (> 15 to 60 dBeq). Longer term behavioral avoidance and physical injury can occur when noise becomes unbearably loud (> 90 dBeq) within silvery minnow acoustic habitat, but those high levels of noise area not anticipated with the proposed action. Therefore, while harassment of silvery minnows will occur, perhaps up to 5 to 15 meters into the water column (that is, approximately 10 percent of the linear areas associated with heavy equipment use near 510 meters of the shoreline; Figures 2-6), we do not anticipate any mortality or direct injuries to be attributable to the proposed action.

Where there is a pathway of exposure, sediment disturbance during construction activities may affect water quality, causing localized increases in turbidity and suspended sediments and alterations in the oxygen saturation (caused by oxygen demand in sediments and in other materials when released into the water column). Effects from excess suspended sediments and reduced oxygen saturation on a variety of fish species have included alarm reactions, abandonment of cover, avoidance responses, reduced feeding rates, increased respiration, gill damage, physiological stress, reduced growth, increased susceptibility to disease and other stressors, or mortality (Davis 1975; Fillos and Molof 1972; Kreutzberger et al. 1980; Wang 1980; Walker and Snodgrass 1986; Kramer 1987; Veenstra and Nolen 1991; Caldwell and Doyle 1995; Newcombe and Jensen 1996; BCME 1997; Buhl 2010, 2011).

In addition, indirect effects from sediment mobilization are possible, including potential smothering of silvery minnow prey such as algae and aquatic invertebrates, or oxygen stress, which can result in depressed rates of growth, and reduced physiological function of some silvery minnows. Under unusual conditions, low oxygen saturation may also cause a wide range of additional chronic effects and behavior responses in fish (Downing and Merkens 1957; Kramer 1987; Breitburg 1992), which are averse to silvery minnow (Lusk et al. 2012; USFWS 2011, 2013). However, it is not known what sublethal effects, if any, occur to silvery minnows as a result of exposures to increased turbidity, suspended sediments, and lower oxygen saturation associated with activities at these five sites other than harassment. We expect silvery minnows to flee any water quality alterations that occur until those conditions return to baseline levels.

Those silvery minnows that are startled and flee the noise, vibrations, and water quality alterations associated with the proposed construction activities will be adversely affected. We assumed, as described in the BA, that approximately 10 percent of the impact area could be affected by mechanical disturbance, noise, and water quality alterations when such activities occurred along or near the shoreline. However, the BA describes activities across different sites for differing numbers of days in which activities, noise, or water quality alterations would occur. Therefore, we estimated the number of silvery minnows adversely affected by the length of activities near the site, the width of impact area (assumed to be 10 percent of the length), the number of days the impact would occur for each site times the density of silvery minnows for the proposed action (Table 3). The total number of silvery minnows that would be adversely affected by mechanical activities, noise and water quality alterations numbered 1,544 using the assumptions stated above and in Table 3. These silvery minnows are those incidentally taken.

Table 3. Areas and days of impact, assumed density of silvery minnows used, and number of silvery minnows affected by disturbance, noise, and water quality alterations for proposed action.

Site Name	Approximate linear impact area near the shoreline (in meters)	Width of Impact area (10% of length in meters)	Days of Impact	Density of Silvery Minnows per 100 m^2 (see Table 2)	Number of silvery minnows affected per site
RM114	120	12	2	6.8	196
RM112	50	5	3	6.8	51
RM100.5	80	8	10	6.8	426
RM100	150	15	3	6.8	459
RM99.5	110	11	5	6.8	412
summary	510	51	23	34	1,544

Effects to Silvery Minnow Critical Habitat

The purpose of the proposed action is to remove sediment deposited at these sites so they will more readily inundate under high spring flows. Sediment accumulation at these sites has occurred recently (BA) and is expected to continue to accumulate sediment (USACE 2012 a,b,c; USFWS 2013) which reduces their value for silvery minnow habitat. The proposed action occurs within silvery minnow critical habitat. We used the elevations of the water surface during the 100-year flood flows (USACE 2013) as a surrogate for evaluating whether critical habitat would be adversely affected. The locations, volume, elevation, height of spoils, or spoil placement designs within critical habitat were not fully detailed within the BA, by supporting analyses (GeoSystems Analysis 2015), or subsequent communications. We identified that four of five sites appear to place the spoils within the 100-year floodplain (Table 1). Therefore, based on the Service's definition (USFWS 2003b) of the role of the lateral extent of silvery minnow critical habitat, spoil placement within the 100-year floodplain would adversely affect critical habitat.

However, the proposed action includes the excavation of sediment from these floodplain sites in addition to the disposal of spoils elsewhere in critical habitat. We attempted to evaluate whether the proposed action would have a significant benefit to silvery minnow critical habitat by comparing the acreages of habitat restored (8.8 acres at 1,000 cfs, and 13.6 or more acreage at

2,000 cfs) (Table 1) with the placement of spoils (13.3 acres, if spoils were 1.5 feet deep; or 4 acres if spoils were placed 5 feet deep (Table 1)). An important part of this type of analysis is the duration of habitat benefits provided. The proposed habitat restoration action was not designed to provide all the physical features of critical habitat at these five sites for an extended duration (that is, pages 16-35 in the BA identified three to five years of monitoring; also the proposed action is not required to provide 10 years of functionality (USFWS 2003a)). Therefore, we were unable to compare the duration of habitat restoration benefits with those of the spoil placement within silvery minnow critical habitat over time in order to evaluate the benefit.

The 300-feet of lateral floodplain within silvery minnow critical habitat was identified as essential for energy and nutrient cycling, filtering runoff, absorbing and gradually releasing floodwaters, recharging groundwater, maintaining stream flows, protecting from erosion, and providing shade and cover to help ensure the river channel maintains the habitat components essential to silvery minnow (USFWS 2003b). However, one of the more critical roles the floodplain plays is to provide aquatic habitats which when flooded during late spring and summer, provide areas for spawning behaviors, quality egg habitat, and optimal conditions for larval fish development, growth, and survival. Conditions in those flooded areas during spring runoff may provide, food, shelter, cover, and water quality conditions that are optimal for the survival, growth, and development silvery minnow eggs, embryos, and larval silvery minnows that then may recruit into the main stem after flows subside. During formal consultation, it became evident that the FLO-2D floodplain inundation model (USACE 2010) was outdated by recent changes in the channel (it has deepened – Reclamation 2014, 2015) and the elevation of the floodplain has and will continue to increase (USACE 2010; Shah-Fairbank and others 2011; USACE 2012a,b,c; USFWS 2013; Varyu 2013; GeoSystems Analysis 2015). While several sources of information were exchanged between Reclamation and the Service, we were unable to model the elevation of spring flows within the San Acacia Reach and determine the flood elevations, areas flooded, and duration of inundation in the Action Area sufficient to assess whether the spoil disposal locations would or would not have an insignificant effect on the function and role of floodplain within silvery minnow critical habitat.

As the physical features, including temporary oxygen alterations, and the function and role of the floodplain would be affected by placement of spoils, and providing the benefit of the doubt to the species, the Service concluded that the NMISC San Acacia Habitat Restoration Project “may affect, is likely to adversely affect” silvery minnow critical habitat. Based on the limited volume of spoils within the floodplain (Table 1), the addition of measures to minimize the areal impact of spoil placement on silvery minnows, we found that silvery minnow critical habitat throughout its extent within the MRG would not be destroyed or adversely modified (that is, 4 to 13.3 acres of spoils disposal is not significant to 16,002 acres of critical habitat available in the San Acacia Reach). The functionality of the floodplain within critical habitat requires additional information on flood elevations in the Action Area to determine which areas may still play a critical role during the formation of silvery minnow nursery habitats in spring). Based on the ongoing conservation commitments of Reclamation (USBR 2015) to reduce the impact of spoils, through the implementation of minimization measures, the proposed action will not preclude future development of essential features in the floodplain of critical habitat within the Action Area.

Effects on Cuckoo

The proposed action is anticipated to have beneficial effects on cuckoos in the long-term by increasing the amount and frequency of floodplain inundation, which is expected to result in an increased amount and quality of cuckoo habitat (BA). In its current state, flows at or higher than 2,500 cfs are needed to inundate cuckoo habitat at the five sites (GeoSystems Analysis 2015).

We do not expect there to be direct, adverse effects to cuckoos based on the conservation measures to implement seasonal restrictions of activities from April 15 until September 1 (BA). However, there may be indirect effects to cuckoo suitable and foraging habitat at RMs 112 and 100.5 since there are estimated territory center points within 750 m of these sites. The Service expects that the effects at RM 112 will not be meaningfully measureable, and therefore insignificant, because the vegetation there is sparse, monotypic salt cedar and only comprises 0.02% of the territory. At RM100.5, on the other hand, the Service expects 0.8 acres of suitable and 8.0 acres of foraging habitat to be adversely affected by the project actions. Any effects to the cuckoo population, however, are expected to be small in scale and short in duration because native vegetation will be avoided, will regenerate, or will be replanted. The project, as proposed, is expected to result in more inundation and thus more native vegetation growth in the future, which would benefit cuckoos.

Although seasonal restrictions are implemented to reduce effects to cuckoo from the proposed action, there will be adverse effects on cuckoos by a reduction in foraging habitat near active territories. Preliminary cuckoo survey data (since 2013, described in the BA; or available to the Service) indicated that all five of these sites are within 2 miles of a cuckoo territory. Although work will not occur when cuckoos are present (April 15 through September 1) the removal of riparian vegetation from these sites will adversely affect the function of cuckoo foraging habitat within a historically occupied territory. The extent and duration of adverse effects to cuckoo are uncertain, but are likely short in duration (less than three years) and small (eight percent) compared to the size of cuckoo foraging habitat. When native vegetation is replanted and regeneration occurs, we expect that cuckoo foraging habitat function will be restored near these territories as a result of the proposed action.

Summary of Effects to Silvery Minnows, Silvery Minnow Critical Habitat, and Cuckoos

The proposed action will eventually increase the amount of native riparian vegetation that will benefit foraging cuckoos and silvery minnows. The proposed action will result in the creation or enhancement of inundated floodplains that will have beneficial effects to silvery minnow by increasing the amount and diversity of habitat, increase lateral connectivity, and increase the amount of aquatic habitat with reduced velocities during spring. However, during construction activities, the proposed action will harass silvery minnows by physical disturbance, noise, vibration, and alterations in water quality during earthwork conducted on or along the shoreline.

The Service has defined take by harassment as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering (see 50 CFR 17.3). The Service estimated no more than 1,544 juvenile or adult silvery

minnows would be harassed by the proposed action. No silvery eggs or larvae will be affected.

The maintenance of these restored habitats in providing the physical features of silvery critical habitat, over time, are uncertain. The long term maintenance of the physical features in these inundated floodplain habitats may affect the quantity (area and depth of inundation) and qualities of water (e.g., temperature, oxygen saturation) are uncertain and monitoring of these physical features in these habitats was limited. Additionally, the role of riparian vegetation in the floodplain will be altered by spoils disposal and water quality will be temporarily altered within silvery minnow critical habitat. The issue of spoils disposal within the floodplain was complicated and was evaluated on a case-by-case basis. The Service concluded that the NMISC San Acacia Habitat Restoration Project "may affect, is likely to adversely affect" silvery minnows as well as silvery minnow critical habitat.

We have provided reasonable and prudent measures as well as terms and conditions necessary to minimize the incidental take of silvery minnows associated with the proposed NMISC San Acacia Habitat Restoration Project action. It is the Service's opinion that the proposed NMISC San Acacia Habitat Restoration Project action is not likely to jeopardize the continued existence of the silvery minnow, because the numbers of silvery minnows expected to be affected (1,544) is small (0.07 percent) compared to a similar estimate of silvery minnow abundance in the San Acacia Reach (6.8/100m^2 x 7,532 acres of river channel is over 2 million) and those effects are temporary. Nor will the proposed action destroy or adversely modify silvery minnow critical habitat because the areas affected are small in relation to the area of critical habitat, and measures will be implemented to minimize impacts, and the benefits of the habitat restoration provide some relief from those adverse effects.

Although seasonal restrictions are implemented to reduce effects to cuckoo from the proposed action, there will be adverse effects on cuckoos by a reduction in foraging habitat near a historically occupied territory. When native vegetation that is replanted and its regeneration occur, the function of the foraging habitat should recover. The extent and duration of adverse effects to cuckoo are uncertain, but are likely short in duration (less than three years) and small (eight percent) compared to the size of cuckoo foraging habitat within the historically occupied territory. We have provided reasonable and prudent measures as well as terms and conditions necessary to minimize the incidental take of cuckoos associated with the proposed NMISC San Acacia Habitat Restoration Project action. Therefore, the proposed action is not likely to jeopardize the continued existence of the threatened cuckoo.

Cuckoos are not expected to be present during construction activities (August 15, or September 1, if cuckoos are present, to April 15) and therefore we expect no direct effects. While removal of native vegetation will be minimized, some removal of it, as well as nonnative vegetation, is expected due to construction, which would adversely affect cuckoos returning to these sites for food and shelter. At the RM 100.5 site, there will be adverse effects to 0.8 acres of suitable habitat and 8.0 acres of foraging habitat for the cuckoo. It is expected that there will be an increase in the amount of suitable cuckoo habitat in the years following construction due to the increased frequency of inundation at these sites. If regeneration of native vegetation is not occurring or is not occurring at an appropriate density at the RM 100.5 site within three years, more active revegetation may be necessary and Reclamation will coordinate with the Service.

V. CUMULATIVE EFFECTS

Cumulative effects are those effects of future State or private activities, not involving Federal activities, which are reasonably certain to occur within the Action Area of the Federal action subject to consultation (50 FR 402.02). Cumulative effects include the effects of future State, Tribal, local or private actions that are reasonably certain to occur within the Action Area considered in this BO. 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. The Service (USFWS 2003a, 2010, 2011, 2013, 2014, 2016) and Reclamation (USBR 2015) have described cumulative effects, which are incorporated here by reference, along with a summary of the cumulative effects below, which inform the jeopardy analysis for the proposed NMISC San Acacia Habitat Restoration Project.

Based on Ellis (2015), the Service expects that cumulative human activities will continue to affect these species' (silvery minnow, flycatcher, and cuckoo) habitat, the quality, availability, and timing of these species' prey, their predator and competitor relationships, the incidence of disease, the conditions that exceed their physiological tolerances, or that alter their rates of metabolic and biochemical processes, to continue to occur either individually or in combination, in the Action Area and to affect the status of these species in the San Acacia Reach. The Service considered these cumulative impacts as well as the effects of climate change and determined that cumulative effects would not be measurable at the scale of NMISC San Acacia Habitat Restoration Project activities (about eight months to 3 years). These cumulative effects will continue to reduce the quality and quantity of these species' habitat and continue to threaten the survival and recovery of these species.

VI. CONCLUSION

After reviewing the status of the silvery minnow, silvery minnow critical habitat, and the cuckoo, the analysis of effects of the proposed action, along with the environmental baseline, it is the Service's opinion that the proposed NMISC San Acacia Habitat Restoration Project action does not jeopardize the continued existence of the silvery minnow or the cuckoo. The Service expects the amount and type of takeoff silvery minnows by the proposed action is unlikely to appreciably diminish its abundance in the San Acacia Reach, nor for the species as a whole in the MRG. The proposed action will not destroy or adversely modify silvery minnow critical habitat because the areas affected are small, measures will be implemented to minimize impacts, and the benefits of the habitat restoration provide some relief from adverse effects. The extent and duration of adverse effects to cuckoo are uncertain, but are likely short in duration (less than three years) and small (eight percent) compared to the size of cuckoo foraging habitat. We expect loss of a small amount of cuckoo habitat to be lost, with some replacement of it with the revegetation and regeneration of native riparian species in cuckoo 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 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 Reclamation so that they become binding conditions of any grant or permit issued, as appropriate, for the exemption in section 7(o)(2) to apply. Reclamation has a continuing duty to regulate the activity covered by this Incidental Take Statement. If Reclamation fails to assume and implement the terms and conditions or fails to require adherence to the terms and conditions of this Incidental Take Statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, Reclamation must report the progress of the proposed action and its impact on the species to the Service (annually) as specified in this Incidental Take Statement (50 CFR §402.14(i)(3)).

Amount or Extent of Take Anticipated

The Service has developed this Incidental Take Statement based on the premise that the NMISC San Acacia Habitat Restoration Project action will be implemented as proposed in the BA. Take of silvery minnows is expected in the form of harassment, due to mechanical activities, noise, vibration, disturbance, and temporary water quality degradation in the Action Area. We estimated that as many as 1,544 silvery minnows would be harassed by the proposed action. If scientific evidence is provided to the Service that indicates that actual incidental take of harassed silvery minnows exceeds 1,544 individuals for the duration of the proposed action, or should any silvery minnows, eggs, or larvae be documented as having been killed by the proposed action, then Reclamation contact the Service within 48 hours and reinitiate formal consultation after.

We base the estimates of silvery minnows harassed on the best available information on a high (75^{th} percentile) density expected to be encountered during any year during the implementation of the proposed action in the Action Area. The Service notes that this represents a best estimate of the extent of take of silvery minnows that is likely during the proposed action. Project specific monitoring of silvery minnows near the areas of impact associated with construction activities along or near the shoreline was not proposed in the BA. However, Reclamation has an active silvery minnow population monitoring program for the MRG and San Acacia Reach, including survey sites near the Action Area (Dudley et al. 2015). Based on the summary of

relevant population monitoring results (Dudley et al. 2009, 2010, 2011, 2012, 2013, 2014, 2015; and see Table 2), the likelihood of higher densities of silvery minnows should be quite rare. Additionally, using the survey methods for population monitoring, estimated densities are significant when the differences in silvery minnow population abundance, by year, are large (Dudley et al. 2015). Therefore, as densities of silvery minnows were most often below 15.2 silvery minnows/100m^2 in the Action Area (Table 2; Hobbs and Lusk 2016), then incidental take will be exceeded if the estimated densities of silvery minnow reported by the silvery minnow population monitoring program (Dudley et al. 2015) in the San Acacia Reach are equal to or greater than 15.2 fish/100m^2 only. Therefore, population monitoring program results should be monitored frequently, and if the San Acacia Reach silvery minnow density is equal to or greater than 15.2 fish/100m^2, then incidental take may be exceeded and consultation must be reinitiated.

The best available scientific information for the cuckoo indicates that there will be incidental take as a result of the proposed action. The Service anticipates incidental take in the form of harassment where habitat loss would occur as a result of project activities. In 2015, one pair of cuckoos occupied a territory near RM 100.5. This pair could be taken due to displacement as a result of partial loss of habitat within the territory at this site. These figures are based on the best available information for the cuckoo.

Effect of Take

The Service has determined that this level of anticipated take is not likely to result in jeopardy to the silvery minnow or cuckoo. The NMISC San Acacia Habitat Restoration Project may affect, is likely to adversely affect, silvery minnow and cuckoos by harassment and cuckoos. Incidental take will result from harassment of minnows during mechanical activities, disturbance, noise, vibration, and water quality degradation. Harassment or harm of cuckoo habitat will occur from the removal of breeding and foraging cuckoo habitat at the RM 100.5 site, which would lead to displacement of the historically occupied territory.

Reasonable and Prudent Measures

The following reasonable and prudent measures are necessary and appropriate to minimize incidental takes of silvery minnows and cuckoos from the proposed action:

1. Minimize take of silvery minnows and reduce impacts to their habitat.

Minimizing the extent and duration during construction or other activities near or along the shoreline may reduce the adverse effects to silvery minnows from disturbance, noise, vibration, and water quality alterations. Where practicable, reasonable, and prudent, seek alternative strategies to minimize the impacts of spoil disposal in silvery minnow habitat.

2. Minimize take of suitable and foraging cuckoo habitat due to NMISC San Acacia Habitat Restoration Project activities.

Minimize construction impacts by avoiding the removal of native vegetation. If native vegetation must be removed, then it must be replaced at the proposed 10:1 ratio as described

within the Conservation Measures section of the BA. Monitor the success of reseeding and replanted vegetation and the inundation levels during spring runoff for the duration of the proposed action. Replacement can be in the form of passive restoration, but adequate results must be achieved within three years or more active forms of revegetation must be undertaken.

Terms and Conditions

Compliance with the following terms and conditions must be achieved in order to be exempt from the prohibitions of section 9 of the ESA. These terms and conditions implement the Reasonable and Prudent Measures described above. These terms and conditions are non-discretionary. Reclamation has already begun to implement these measures into the project.

To implement RPM 1 Reclamation shall:

a. To the extent practicable, minimize the area and duration of construction activities near or along the shoreline of the MRG in the Action Area.

b. Estimate and report the elevations of floods within the Action Area that may be affected by spoils placement, other sediment accumulation, or channel incision

c. To the extent practicable, reasonable, and prudent, reduce the impact of spoil placement in silvery minnow habitat in the Action Area:
    i. Actively seek alternatives for spoil disposal outside the floodway.
    ii. Where alternatives for spoil placement or usage are infeasible, seek to minimize the impacts of spoil placement through design considerations:
        1. At Site RM99.5 and reduce the amounts of spoils deposited on the east or north of the existing road (that is within the floodway).
        2. Place spoils at areas of higher elevation that are sparsely vegetated.
        3. Reduce the size of spoil disposal areas by maximizing their height.
        4. Shape the spoil disposal areas into forms that are streamlined and that will minimize impedance of flood flows in the Action Area.
        5. Discourage recreation vehicle use of the spoil disposal areas.

d. Routinely review the Rio Grande Silvery Minnow Population Monitoring Program reports (e.g., Dudley et al. 2015) to determine if the estimated densities of silvery minnows in the San Acacia Reach are at or above 15.2 fish/100m^2.

To implement RPM 2 Reclamation shall:

1. Ensure that all NMISC San Acacia Habitat Restoration Project activities are conducted within the timeframes described in the BA and this biological opinion (that is, not between April 15 through September 1).

2. Coordinate with the Service regarding revegetation at all sites to determine effectiveness of passive revegetation efforts within three years of construction.

For all RPMs, Reclamation shall monitor the implementation of the RPMs and their associated terms and conditions, and provide a report of their status of implementation to the Service's New Mexico Ecological Services Field Office annually, no later than January 30th, for any proposed action activities conducted during the previous calendar year, until the proposed project activities, including restoration success, are complete. Report to the Service's New Mexico Ecological Services Field Office the discovery of any silvery minnow mortalities near or associated with the proposed action within 48 hours. Ensure that the Service receives electronic copies of all reports and plans related to implementation of these RPMs and terms and conditions, including but not limited to, species monitoring or survey results, and any habitat and water quality monitoring activities or formal Adaptive Management Plans involving these sites. In years where no project activities occur, the annual report may be abbreviated. These annual reports should reference Consultation # 02ENNM00-2016-F-0287 and be sent to the email address nmesfo@fws.gov or by mail to the New Mexico Ecological Services Field Office, 2105 Osuna Road NE, Albuquerque, New Mexico 87113.

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 (USFWS 2011, 2012, 2014) provided conservation recommendations in previous BOs incorporated here by reference. In addition, the following conservation measure is provided:

- Complete a biological study (e.g., telemetry) on the timing and frequency of cuckoo use of different habitat types within their territories to better understand the importance of lower quality foraging areas in relation to the nesting areas and average territory size that are specific to the San Acacia Reach.

- Work with the Service, and others, to identify and implement cost-effective ways to address sediment disposal for future habitat restoration projects and that will minimize impacts to critical habitats.

- Use a formal Adaptive Management process to determine which methods and techniques are most effective at creating optimal habitat conditions for listed species and also that seek to minimize (or constrain) costs.

RE-INITIATION NOTICE

This concludes formal consultation on the action described in Reclamation's BA (McMillan et al. 2016). 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 BO; (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 BO; 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.

LITERATURE CITED

Archdeacon, T. P. 2014. Rio Grande Silvery Minnow augmentation in the Middle Rio Grande, New Mexico. U.S. Fish and Wildlife Service 2014 Annual Report to U. S. Bureau of Reclamation, Albuquerque, New Mexico.

Archdeacon, T. P., K. R. Henderson, R. L. Cook, and T. J. Austring. 2015. Rio Grande Silvery Minnow salvage and rescue 2014 annual report. U.S. Fish and Wildlife Service 2014 Annual Report to U. S. Bureau of Reclamation, Albuquerque, New Mexico.

Breitburg, D. L. 1992. Episodic hypoxia in Chesapeake Bay: interacting effects of recruitment, behavior, and physical disturbance. Ecological Monographs 62:525–546.

BCME (British Columbia Ministry of the Environment). 1997. Water Quality: Ambient water quality criteria for dissolved oxygen. Technical Appendix. Government of British Columbia, British Columbia, Canada. Available online at the website link: http://www.env.gov.bc.ca/wat/wq/BCguidelines/do/index.html. Accessed 9/23/15.

Bovee, K. D., T. J. Waddle, and J. M. Spears. 2008. Streamflow and Endangered Species Habitat in the Lower Isleta Reach of the Middle Rio Grande. USGS Open File Report 2008-1323, Reston, Virginia.

Buhl, K. J. 2010. Toxicity of adverse water quality conditions of low dissolved oxygen, high temperatures, and pulses of high ammonia concentrations to different life stages of the Rio Grande Silvery Minnow. USGS Columbia Environmental Research Center 2008 Annual Administrative Progress Report for the Collaborative Program, Yankton, South Dakota.

Buhl, K. J. 2011. On-site evaluation of the suitability of a wetted instream habitat in the Middle Rio Grande, New Mexico, for the Rio Grande Silvery Minnow (*Hybognathus amarus*). USGS Scientific Investigations Report 2011-5061, Reston, Virginia.

Bui, C. 2014. Flow Duration Curve Analysis from Cochiti Dam to Elephant Butte Reservoir. U.S. Department of the Interior, Bureau of Reclamation, Upper Colorado Region, Albuquerque, NM. 51 pp.

Caldwell, J. M., and M. C. Doyle. 1995 Sediment Oxygen Demand in the Lower Willamette River, Oregon, 1994. USGS Water-Resources Investigations Report 95–4196, Portland, Oregon.

Callahan, D. and L. White. 2004. Vegetation Mapping of the Rio Grande Flood Plain 2002–2004. U.S. Bureau of Reclamation, Technical Service Center, Denver, Colorado.

Carstensen, D., S. D. Moore, and D. Ahlers. 2015. Yellow-billed Cuckoo Study Results – 2014 Middle Rio Grande from Los Lunas to Elephant Butte Reservoir, New Mexico. Bureau of Reclamation, Technical Service Center, Fisheries and Wildlife Resources. Denver, CO.

Crawford, C., et al. 1993. Middle Rio Grande ecosystem: Bosque biological management plan. Middle Rio Grande Biological Interagency Team, Albuquerque, New Mexico. http://www.fws.gov/southwest/mrgbi/Resources/BBMP/Bbmp.pdf. Accessed September 9, 2011.

Dahm, C. and R. Candelaria-Ley. 2012. Continuous Water Quality Monitoring Network for the Middle Rio Grande, Final Report, University of New Mexico, Albuquerque, New Mexico.

D'Antonio, J. R. 2006. The impacts of climate change on New Mexico's water supply and ability to manage water resources.

Davis, J. C. 1975. Minimal dissolved oxygen requirements of aquatic life with emphasis on Canadian species: A review. Journal of the Fishery Research Board of Canada 32:2295-2332.

Dittrich, J., J. D. Dias, C. C. Bonecker, F. A. Lansac-Toha, and A. A. Padial. 2016. Importance of temporal variability at different spatial scales for diversity of floodplain aquatic communities. Freshwater Biology 61:316-327.

Downing, K. M. and J. C. Merkens. 1957. The influence of temperature on the survival of several species of fish in low tensions of dissolved oxygen. Annals of Applied Biology 45:261–267.

Dudley et al. 2009. Summary of the Rio Grande Silvery Minnow Population Estimation Program Results from October 2009. Report to the U.S. Bureau of Reclamation, Albuquerque.

Dudley et al. 2011. Rio Grande Silvery Minnow Population Monitoring Results from September 2009 to October 2010. Albuquerque: American Southwest Ichthyological Researchers.

Dudley et al. 2012. Rio Grande Silvery Minnow Population Monitoring Results from December 2010 to October 2011. Albuquerque: American Southwest Ichthyological Researchers.

Dudley et al. 2013. Rio Grande Silvery Minnow Population Monitoring Results from December 2011 to October 2012. Albuquerque: American Southwest Ichthyological Researchers.

Dudley et al. 2014. Rio Grande Silvery Minnow Population Monitoring Results from May 2013 to October 2013. Albuquerque: American Southwest Ichthyological Researchers.

Dudley, R. K., S. P. Platania, and G. C. White. 2015. Rio Grande silvery minnow population monitoring program results from February to December 2014. Report prepared for the Middle Rio Grande Endangered Species Collaborative Program by American Southwest Ichthyological Researchers, L.L.C., Albuquerque, New Mexico.

Dudley, R. K. and S. P. Platania. 2015. Summary of the Rio Grande Silvery Minnow Population Estimation Program Results from August 2015. Report prepared for the Middle Rio Grande Endangered Species Collaborative Program by American Southwest Ichthyological Researchers, L.L.C., Albuquerque, New Mexico.

Ellis, E. C. 2015. Ecology in an anthropogenic biosphere. Ecological Monographs 85:287-331.

Fillos, J., and A. H. Molof. 1972. Effect of benthal deposits on oxygen and nutrient economy of flowing waters. Journal of the Water Pollution and Control Federation 44:644–662.

Geosystems Analysis. 2015. Habitat Restoration Analysis and Design, River Mile 130-99: Final Conceptual Design, Phase 1. GeoSystems Analysis, Inc., Work Order Report RG-15-2 to New Mexico Interstate Stream Commission, Albuquerque, New Mexico.

Golder Associates, Inc. 2012. Middle Rio Grande Rio Rancho Open Space Habitat Restoration Project Biological Assessment. Golder Associates Report prepared for U.S. Bureau of Reclamation on behalf of New Mexico Interstate Stream Commission, Albuquerque, New Mexico. 51 pp.

Gunning, C. 2010. Estimating phreatophyte evapotranspiration from diel groundwater fluctuations in the Middle Rio Grande bosque. Master of Science Thesis, University of New Mexico, Albuquerque, New Mexico.

Halterman, M. D. 2009. Sexual dimorphism, detection probability, home range, and parental care in the yellow-billed cuckoo. Ph.D. Dissertation, University of Nevada, Reno, Nevada.

Halterman, M., M.J. Johnson, J.A. Holmes and S.A. Laymon. 2015. A Natural History Summary and Survey Protocol for the Western Distinct Population Segment of the Yellow-billed Cuckoo: U.S. Fish and Wildlife Techniques and Methods, Sacramento, California. 45 p.

Heath, A. G. 1995. Water pollution and fish physiology. CRC Press, Boca Raton, Florida.

Hink, V.C. and R.D. Ohmart. 1984. Middle Rio Grande Biological Survey. U.S. Army Corps of Engineers Contract No. DACW47-81-C-0015 Report by the Center for Environmental Studies, Arizona State University, Tempe, Arizona.

Hobbs, B. H and J. Lusk. 2016. Microsoft Excel spreadsheet titled: Hobbs and Lusk 2016 identifying ITS ranges for ISC-SanAcacia_BO table.xlsx. U.S. Bureau of Reclamation, Albuquerque Area Office, Albuquerque, New Mexico.

Isaacson, K. 2009. Modeling riparian groundwater depth as a function of river flow for the Rio Grande at Albuquerque, NM. Master of Science Thesis, University of New Mexico, Albquerque, New Mexico. Available at: http://repository.unm.edu/handle/1928/9346.

Kramer, D. L. 1987. Dissolved oxygen and fish behavior. Environmental Biology of Fishes 18:81–92.

Kreutzberger, W. A., R. A. Race, T. L. Meinholz, M. Harper and J. Ibach. 1980. Impact of sediments on dissolved oxygen concentrations following combined sewer overflows. Journal of the Water Pollution Control Federation 52:192–201.

Laymon, S.A. 1998. Partners in Flight Bird Conservation Plan: Yellow-billed Cuckoo (Coccyzus americanus). (http://www.prbo.org/calpif/htmldocs/species/riparian/yellow-billed_cuckoo.htm)

Lusk, J. D., A. P. Davis, M. J. Osborne, D. M. Papoulias, J. E. Woodland, and W.J. Remshardt. 2012. Rio Grande Silvery Minnow Health Study. U.S. Fish and Wildlife Service, New Mexico Ecological Services, Albuquerque, New Mexico.

Massong, T. M. 2005. San Acacia River Mile 111 Priority Site Bend Migration Assessment Final Report. U. S. Bureau of Reclamation, Albuquerque, New Mexico. Available at http://www.usbr.gov/uc/albuq/envdocs/techreports/BendEvolution/BendEvol-RM111-2005.pdf.

McMillan, M., E. Gonzales, and B. Bader. 2016. Biological Assessment for the New Mexico Interstate Stream Commission San Acacia Habitat Restoration Project from River Mile 116 to 99, Socorro County, New Mexico. SWCA Environmental Consultants Project 34090 for U.S. Bureau of Reclamation on behalf of New Mexico Interstate Stream Commission, Albuquerque, New Mexico. 57 pp.

McNeil, S.E., D. Tracy, J.R. Stanek, and J.E. Stanek. 2013. Yellow-billed cuckoo distribution, abundance and habitat use on the lower Colorado River and tributaries, 2008-2012 summary report. Bureau of Reclamation, Multi-Species Conservation Program, Boulder City Nevada.

Makar, P. 2015. Lower Reach Conditions and Strategies (Report No. SRH-2015-30). U.S. Bureau of Reclamation, Technical Service Center, Denver, Colorado.

Merritt, D. M., and H. L. Bateman. 2012. Linking stream flow and groundwater to avian habitat in a desert riparian system. Ecological Applications 22:1973-1988.

Moore, S. D. 2015. Microsoft Word table titled: WIFL Survey Site Summary Table all sites 2015.docx. Bureau of Reclamation, Technical Service Center, Fisheries and Wildlife Resources. Denver, Colorado.

Moore, D. and D. Ahlers. 2015. 2014 Southwestern Willow Flycatcher Study Results – Selected Sites Along the Rio Grande From Bandelier National Monument to Elephant Butte Reservoir, New Mexico. U.S. Bureau of Reclamation, Technical Service Center, Denver, Colorado.

Nedwell, J. R., A. W. H. Turnpeny, J. Lovell, and others. 2007. A validation of the dB_{ht} as a measure of the behavioral and auditory effects of underwater noise. Subacoustech Report No. 534R1231, Hampshire, United Kingdom.

Newcombe, C. P., and J. O. T. 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.

Parametrix. 2008. Restoration analysis and recommendations for the San Acacia Reach of the Middle Rio Grande, NM. Report prepared for Middle Rio Grande Endangered Species Collaborative Program, Parametrix, Albuquerque, New Mexico.

Paxton, E. H., M. K. Sogge, S. L. Durst, T. C. Theimer, and J. R. Hatten. 2007a. The ecology of the southwestern willow flycatcher in central Arizona—a 10-year synthesis report. U.S. Geological Survey Open-File Report 2007-1381, Reston, Virginia. 143 p.

Popper, A. N., A. D. Hawkins, R. R. Fay, and others. 2014. Sound exposure guidelines for fishes and sea turtles: A technical report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. Springer, New York, New York.

Porter, M.D. and T.M. Massong. 2004. Contributions to Delisting Rio Grande Silvery Minnow: Egg Habitat Identification. U.S. Bureau of Reclamation, Albuquerque, New Mexico.

Posner, A. J. 2011. River hydro- and morphodynamics: Restoration, modeling, and uncertainty. University of Arizona, Dissertation, Tucson, Arizona.

Pueblo of Sandia. 2008. Pueblo of Sandia Rio Grande Bosque Rehabilitation Project Biological Assessment. Pueblo of Sandia Biological Assessment prepared for U.S. Bureau of Reclamation, Bernalillo, New Mexico. 32 pp.

Rocky Mountain Ecology, LLc. and Forest Fitness, LLc. 2013. Biological Assessment for Proposed State Trust Land Bosque Riparian Restoration and Associated Swale Construction. Prepared for New Mexico State Land Office, Santa Fe, New Mexico.

Seaber, P. R., F. P. Kapinos, and G. L. Knapp. 1987. Hydrologic Unit Maps. USGS Water-Supply Paper No. 2294, Denver, Colorado. http://pubs.usgs.gov/wsp/wsp2294/.

Sechrist, J.D., V. Johanson and D. Ahlers. 2009. Western Yellow-billed Cuckoo radio telemetry study results Middle Rio Grande, NM 2007-2008. U.S. Bureau of Reclamation, Denver Technical Service Center, Denver, Colorado.

Siegle, R., D. Ahlers, and V. Ryan. 2013. Southwestern Willow Flycatcher Habitat Suitability 2012, Middle Rio Grande, New Mexico. U.S. Bureau of Reclamation, Technical Service Center, Denver, Colorado.

Shah-Fairbank, S. C., J. Kim, and P. Julien. 2011. San Acacia Reach San Acacia Dam to Escondida Bridge Hydraulic Modeling Analysis – 1918-2006. Colorado State University Final Report to U.S. Bureau of Reclamation, Fort Collins, Colorado.

Smith, T. and T. Massong. 2004. San Acacia River Mile 114 and 113 Priority Sites Bend Migration Estimates. U.S. Bureau of Reclamation, Albuquerque, New Mexico. (Online at http://www.usbr.gov/uc/albuq/envdocs/techreports/BendEvolution/BendEvol-RM114-2004.pdf).

Sogge, M. K., D. Ahlers, and S. J. Sferra. 2010. A Natural History Summary and Survey Protocol for the Southwestern Willow Flycatcher; U.S. Geological survey Techniques and Methods 2A-10. 38 pp.

SWCA (SWCA Environmental Consultants). 2008a. Middle Rio Grande Isleta Reach Riverine Habitat Restoration Project Biological Assessment. SWCA Project No. 14614 prepared for U.S. Bureau of Reclamation on behalf of New Mexico Interstate Stream Commission, Albuquerque, New Mexico. 127 pp.

SWCA (SWCA Environmental Consultants). 2008b. Middle Rio Grande Riverine Habitat Restoration Project Phase IIa Biological Assessment. SWCA Project No. 14918 prepared for U.S. Bureau of Reclamation on behalf of New Mexico Interstate Stream Commission, Albuquerque, New Mexico. 103 pp.

SWCA (SWCA Environmental Consultants). 2010a. Middle Rio Grande, Isleta Reach Phase II Riverine Habitat Restoration Project Biological Assessment. SWCA Project No. 15690 prepared for U.S. Bureau of Reclamation on behalf of New Mexico Interstate Stream Commission, Albuquerque, New Mexico. 150 pp.

SWCA (SWCA Environmental Consultants). 2010b. Pueblo of Sandia River Riverine Habitat Restoration Project Biological Assessment. SWCA Project No. 16090 prepared for U.S. Bureau of Reclamation on behalf of Pueblo of Sandia Environment Department, Albuquerque, New Mexico. 100 pp.

Tetra Tech, Inc., 2004. Development of the Middle Rio Grande FLO-2D Flood Routing Model Cochiti Dam to Elephant Butte Reservoir. Tetra Tech Report prepared for the U.S. Fish and Wildlife Service and the U.S. Army Corps of Engineers, Albuquerque, New Mexico.

Tetra Tech, Inc., 2005. Middle Rio Grande Hydrographic Data Collection Report, Overbank Monitoring of the 2005 High Flow Spring Release from Cochiti Dam. Tetra Tech Report prepared for the USACE Albuquerque District, Albuquerque, New Mexico.

Tetra Tech. 2014. Ecohydrological Relationships along the Middle Rio Grande of New Mexico for the Endangered Rio Grande Silvery Minnow. Contract Report WP912PP-08-D-0009-0-20 for U.S. Army Corps of Engineers, Albuquerque, New Mexico.

USACE (U.S. Army Corps of Engineers) and others. 2007. Upper Rio Grande Basin Water Operations Review Final Environmental Impact Statement. U.S. Army Corps of Engineers FES-07-05, Albuquerque, New Mexico.

USACE (U.S. Army Corps of Engineers). 2010. Historic inundation analysis along the Middle Rio Grande for the period 1990 to 2009. U.S. Army Corps of Engineers, Albuquerque District, Albuquerque, New Mexico.

USACE (U.S. Army Corps of Engineers). 2012a. Programmatic biological assessment of U.S. Army Corps of Engineers Rio Grande Floodway, San Acacia to Bosque del Apache Unit, Socorro, New Mexico. U.S. Army Corps of Engineers, Albuquerque District, Albuquerque, New Mexico.

USACE (U.S. Army Corps of Engineers). 2012b. Draft general reevaluation report / supplemental environmental impact statement II. Rio Grande Floodway, San Acacia to Bosque del Apache Unit, Socorro, New Mexico. U.S. Army Corps of Engineers, Albuquerque District, Albuquerque, New Mexico.

USACE (U.S. Army Corps of Engineers). 2012c. Recommended flood plan, elevations, and water surface elevations at cross sections. USACE, Albuquerque District Flood Plan, Albuquerque, New Mexico.

USBR (U.S. Bureau of Reclamation). 2003. Geomorphologic Assessment of the Rio Grande San Acacia Reach. U.S. Bureau of Reclamation, Albuquerque Area Office, Albuquerque, New Mexico

USBR (U.S. Bureau of Reclamation). 2012. Southwestern Willow Flycatcher Management Plan for the Rio Grande Project. U.S. Bureau of Reclamation, Albuquerque Area Office, Albuquerque, New Mexico.

USBR (U.S. Bureau of Reclamation). 2014. Biological Assessment for the River Maintenance Program – Delta Channel Maintenance Project, Middle Rio Grande. U.S. Bureau of Reclamation, Albuquerque Area Office, Albuquerque, New Mexico.

USBR (U.S. Bureau of Reclamation). 2015. Joint Biological Assessment. Bureau of Reclamation, Bureau of Indian Affairs, and Non-Federal Water Management and Maintenance Activities on the Middle Rio Grande, New Mexico. U.S. Bureau of Reclamation, Albuquerque New Mexico.

USFWS (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.

USFWS (U.S. Fish and Wildlife Service). 1995. Endangered and threatened wildlife and plants; final rule determining endangered status for the southwestern willow flycatcher. Federal Register 60: 10693-10715.

USFWS (U.S. Fish and Wildlife Service). 2002. Final Southwestern Willow Flycatcher recovery plan. U.S. Fish and Wildlife Service, Albuquerque, N. M. 210 pp. +appendices.

USFWS (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. As amended on August 15, 2005, and June 15, 2006. U.S Fish and Wildlife Service, New Mexico Ecological Services Office, Albuquerque, New Mexico. http://www.fws.gov/southwest/es/NewMexico/ES_bio_op.cfm.

USFWS (U.S. Fish and Wildlife Service). 2003b. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Rio Grande Silvery Minnow; Final Rule. Federal Register 68: 8088-8135.

USFWS (U.S. Fish and Wildlife Service). 2009a. Biological Opinion on the Effects of the Middle Rio Grande Isleta Reach Riverine Habitat Restoration Project. U.S. Fish and Wildlife Service Consultation No. 02ENNM00-2009-F-0002, New Mexico Ecological Services, Albuquerque, New Mexico. 46 pp. (Spoils placed for river dilution)

USFWS (U.S. Fish and Wildlife Service). 2009b. Biological Opinion on the Effects of the Middle Rio Grande Riverine Habitat Restoration Phase IIa Project. U.S. Fish and Wildlife Service Consultation No. 02ENNM00-2009-F-0016, New Mexico Ecological Services, Albuquerque, New Mexico. 49 pp. (Spoils transferred to I-40 Bridge Project)

USFWS (U.S. Fish and Wildlife Service). 2009c. Biological Opinion on the Effects of the Pueblo of Sandia Bosque Rehabilitation Project. U.S. Fish and Wildlife Service Consultation No. 02ENNM00-2009-F-0022, New Mexico Ecological Services, Albuquerque, New Mexico. 38 pp. (Spoils used for levees and roads)

USFWS (U.S. Fish and Wildlife Service). 2010a. Biological Opinion on the Effects of the Middle Rio Grande Isleta Reach Phase II Riverine Habitat Restoration Project. U.S. Fish and Wildlife Service Consultation No. 02ENNM00-2010-F-0060, New Mexico Ecological Services, Albuquerque, New Mexico. 51 pp. (Spoils placed on bankline for river dilution)

USFWS (U.S. Fish and Wildlife Service). 2010b. Revised Rio Grande Silvery Minnow (*Hybognathus amarus*) Recovery Plan. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. http://ecos.fws.gov/docs/recovery_plan/022210_v2.pdf.

USFWS (U.S. Fish and Wildlife Service). 2011a. Biological Opinion on the Effects of the Middle Rio Grande Bosque Restoration Project, Bernalillo and Sandoval Counties, New Mexico. U.S. Fish and Wildlife Service Consultation No. 02ENNM00-2010-F-0077, New Mexico Ecological Services, Albuquerque, New Mexico. 62 pp. (Spoils placed on bankline for river dilution or terraced into the bosque/floodway)

USFWS (U.S. Fish and Wildlife Service). 2011b. Biological opinion on U.S. Environmental Protection Agency's action authorizing the discharge of pollutants in stormwater and certain nonstormwater discharges from the Large Municipal Stormwater Sewer Systems (MS4) in the Albuquerque urbanized area in Bernalillo County, New Mexico, USFWS Consultation No. 02ENNM00-2011-F-0024-R001, Albuquerque, New Mexico.

USFWS (U.S. Fish and Wildlife Service). 2012. Biological Opinion on the effects of the Albuquerque Metropolitan Arroyo Flood Control Authority permit application to U.S. Army Corps of Engineers (Action Number SPA-2010-00435-ABQ; Corps 2011) authorization to discharge fill material, widen, regrade, and stabilize the westernmost portion of the North Diversion Channel from its outfall with the Rio Grande to the Equipment Crossing (NMISC San Acacia Habitat Restoration Project) on endangered Rio Grande silvery minnow and endangered southwestern willow flycatcher. USFWS Consultation No. 02ENNM00-2012-F-0005, Albuquerque, New Mexico.

USFWS (U.S. Fish and Wildlife Service). 2013a. Biological Opinion on the effects of the U.S. Department of the Army, Corps of Engineers proposed action of construction, operation and maintenance of the Rio Grande Floodway, San Acacia to Bosque del Apache Unit, in Socorro County, New Mexico. USFWS Consultation No. 02ENNM00-2012-F-0015, New Mexico Ecological Services, Albuquerque, New Mexico. 172 pp.

USFWS (U.S. Fish and Wildlife Service). 2013b. Biological Opinion on the Effects of the Rio Rancho Open Space Habitat Restoration Project within the Albuquerque Reach of the Middle Rio Grande. U.S. Fish and Wildlife Service Consultation No. 02ENNM00-2013-F-0029, New Mexico Ecological Services, Albuquerque, New Mexico 63 pp. (Spoils sold, hauled away, or placed at elevation above 6,000 cfs overbank flood)

USFWS (U.S. Fish and Wildlife Service). 2013c. Biological Opinion on the Effects of the State Trust Land Bosque Riparian Restoration and Associated Swale Construction Project. U.S. Fish and Wildlife Service Consultation No. 02ENNM00-2014-F-0010, New Mexico Ecological Services, Albuquerque, New Mexico 57 pp. (Spoils placed on Refuge, and placed adjacent to levee road on the river side)

USFWS (U.S. Fish and Wildlife Service). 2013d. Proposed Threatened Status for the Western Distinct Population Segment of the Yellow-Billed Cuckoo (*Coccyzus americanus*). Federal Register 78: 78321-78322.

USFWS (U.S. Fish and Wildlife Service). 2013e. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Southwestern Willow Flycatcher; Final Rule. Federal Register 78: 343-534.

USFWS (U.S. Fish and Wildlife Service). 2014a. Biological Opinion on U. S. Environmental Protection Agency issuance of General NPDES Permit No. NMR04A000 on endangered Rio Grande silvery minnow. USFWS Consultation No. 02ENNM00-2011-F-0024-R001, Albuquerque, New Mexico.

USFWS (U.S. Fish and Wildlife Service). 2014b. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Western Distinct Population Segment of the Yellow-Billed Cuckoo; Proposed Rule. Federal Register 79:48548-48652.

USFWS (U.S. Fish and Wildlife Service). 2014c. Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Western Distinct Population Segment of the Yellow-billed Cuckoo (Coccyzus americanus); Final Rule. Federal Register 79: 59991-60038.

USFWS (U.S. Fish and Wildlife Service). 2015. Concurrence with Determination for Pueblo of San Felipe Priority Sites: Phase 2 Upstream Project. USFWS Consultation No. 02ENNM00-2015-I-0357, Albuquerque, New Mexico.

USFWS (U.S. Fish and Wildlife Service). 2016. Biological Opinion on effects of actions associated with the proposed continuation of the Rio Grande Project Operating Agreement and storage of San Juan-Chama Project water in Elephant Butte Reservoir, New Mexico. USFWS Consultation No. 02ENNM00-2015-F-0734, Albuquerque, New Mexico.

Valett, H. M., et al. 2005. Biogeochemical and metabolic responses to the flood pulse in a semiarid floodplain. Ecology 86:220–234.

Van Cleave, M. 1935. Vegetative changes in the Middle Rio Grande Conservancy District. Master of Science Thesis, University of New Mexico, Albuquerque, New Mexico.

Van Horn, D. and C. N. Dahm. Water quality in the middle Rio Grande, September 2005-February 2008: Final Report. University of New Mexico, Albuquerque, New Mexico.

Varyu, D. 2013. Aggradation / Degradation Volume Calculations: 2002-2012. U.S. Bureau of Reclamation Technical Report No. SRH-2013-28, Technical Service Center, Denver, CO.

Veenstra, J. N., and S. L. Nolen. 1991. In-situ sediment oxygen demand in five Southwestern U.S. Lakes. Water Research 25:351–354.

Walker, R. R., and W. J. Snodgrass. 1986. Model for sediment oxygen demand in lakes. Journal of Environmental Engineering 112:25–43.

Wang, W. 1980. Fractionation of sediment oxygen demand. Water Research 14:603–612.

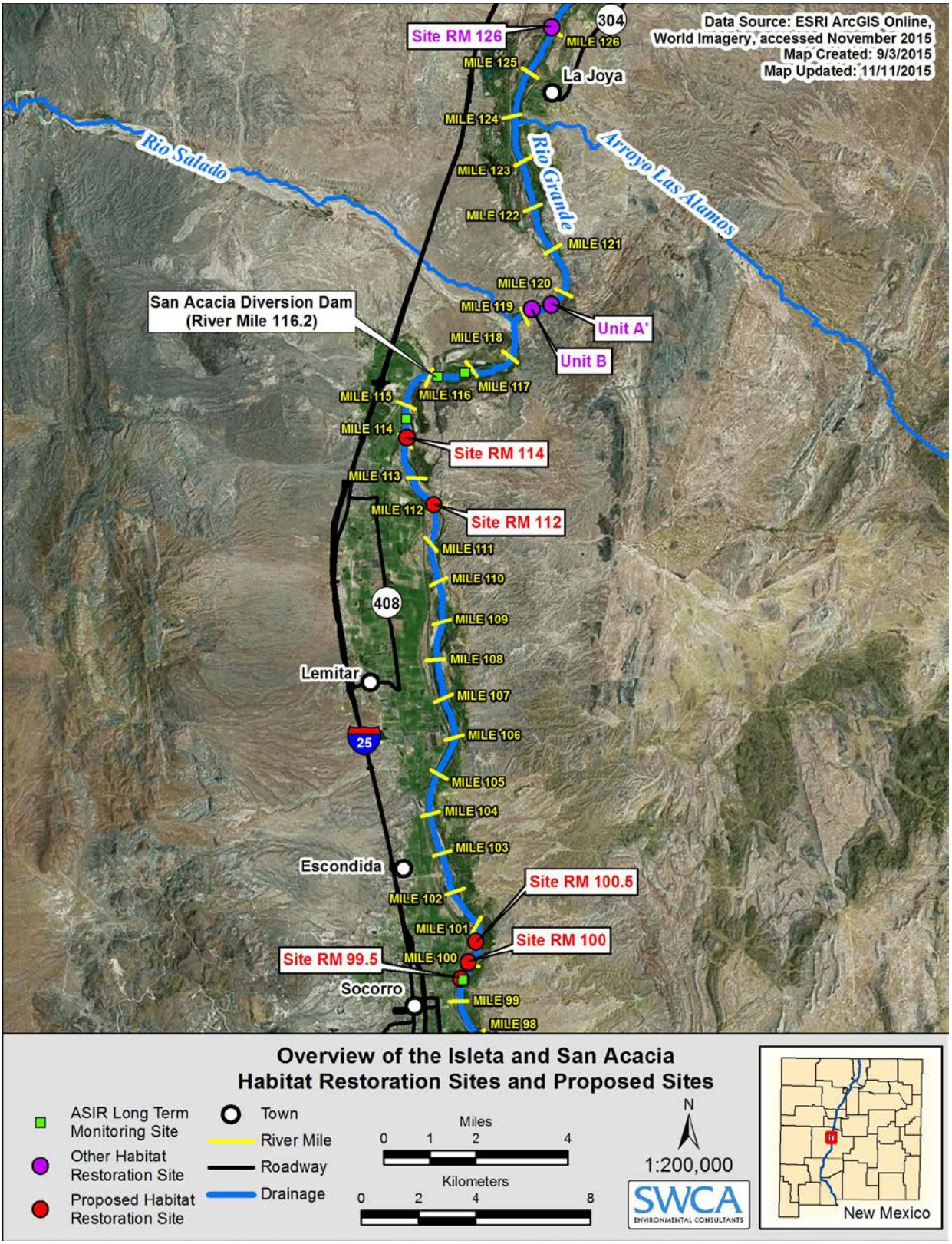

Figure 1. Overview of the five NMISC San Acacia Habitat Restoration Project sites (red letters). (Other Habitat Restoration sites are [shown in purple letters] not part of this BO).

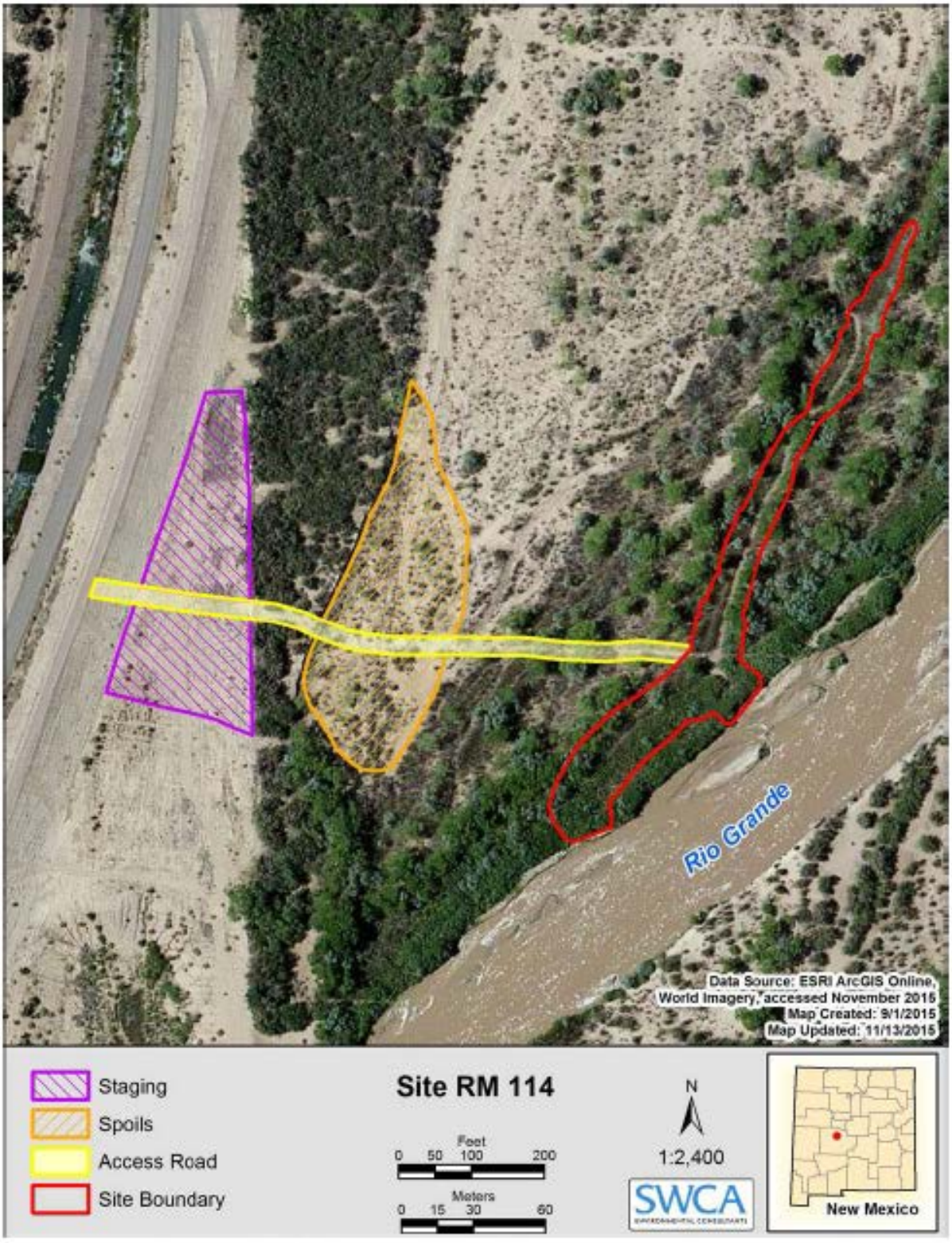

Figure 2. San Acacia Habitat Restoration Site RM 114 depicting excavated habitat site (red line), access road (yellow), spoils (orange crosshatch), and staging areas (purple).

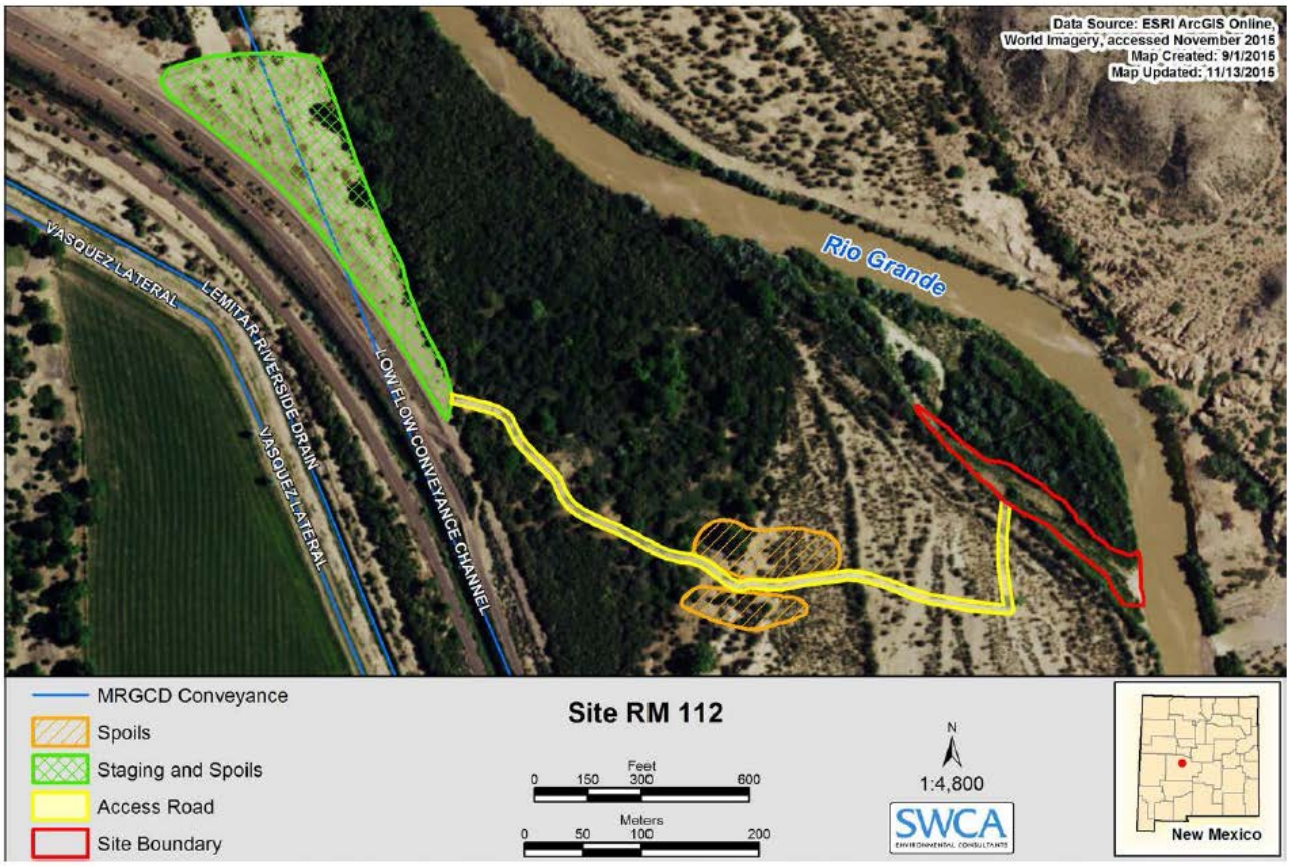

Figure 3. San Acacia Habitat Restoration Site RM 112, depicting excavated habitat site (red line), access road (yellow), spoils (orange crosshatch), and spoil and staging areas (green).

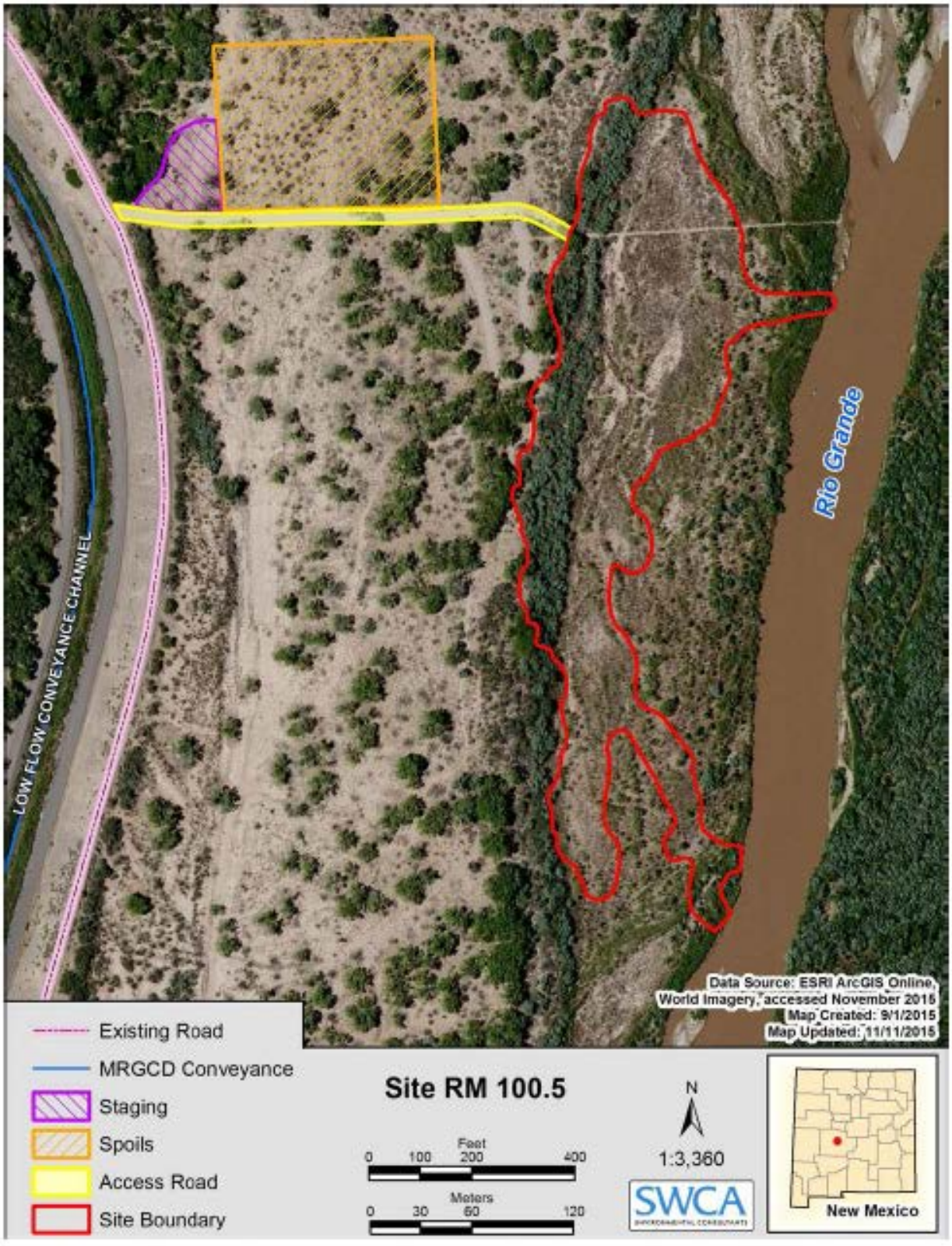

Figure 4. San Acacia Habitat Restoration Site RM 100.5, depicting excavated habitat site (red line), access road (yellow), spoils (orange crosshatch), and staging areas (purple).

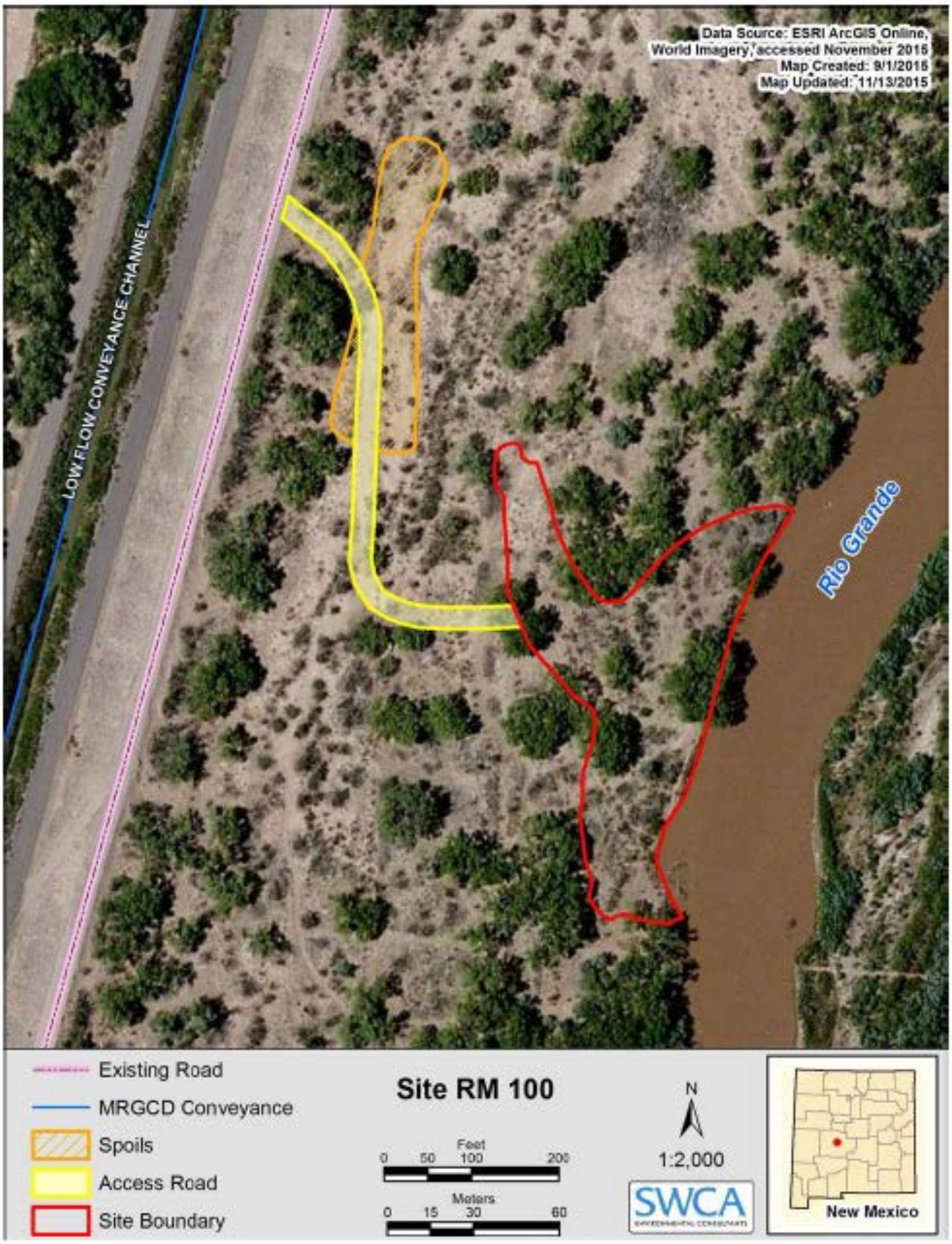

Figure 5. San Acacia Habitat Restoration Site RM 100, depicting excavated habitat site (red line), access road (yellow), and spoils areas (orange crosshatch).

Figure 6. San Acacia Habitat Restoration Site RM 112, depicting excavated habitat site (red line), access road (yellow), spoils (orange crosshatch), and spoil and staging areas (green).

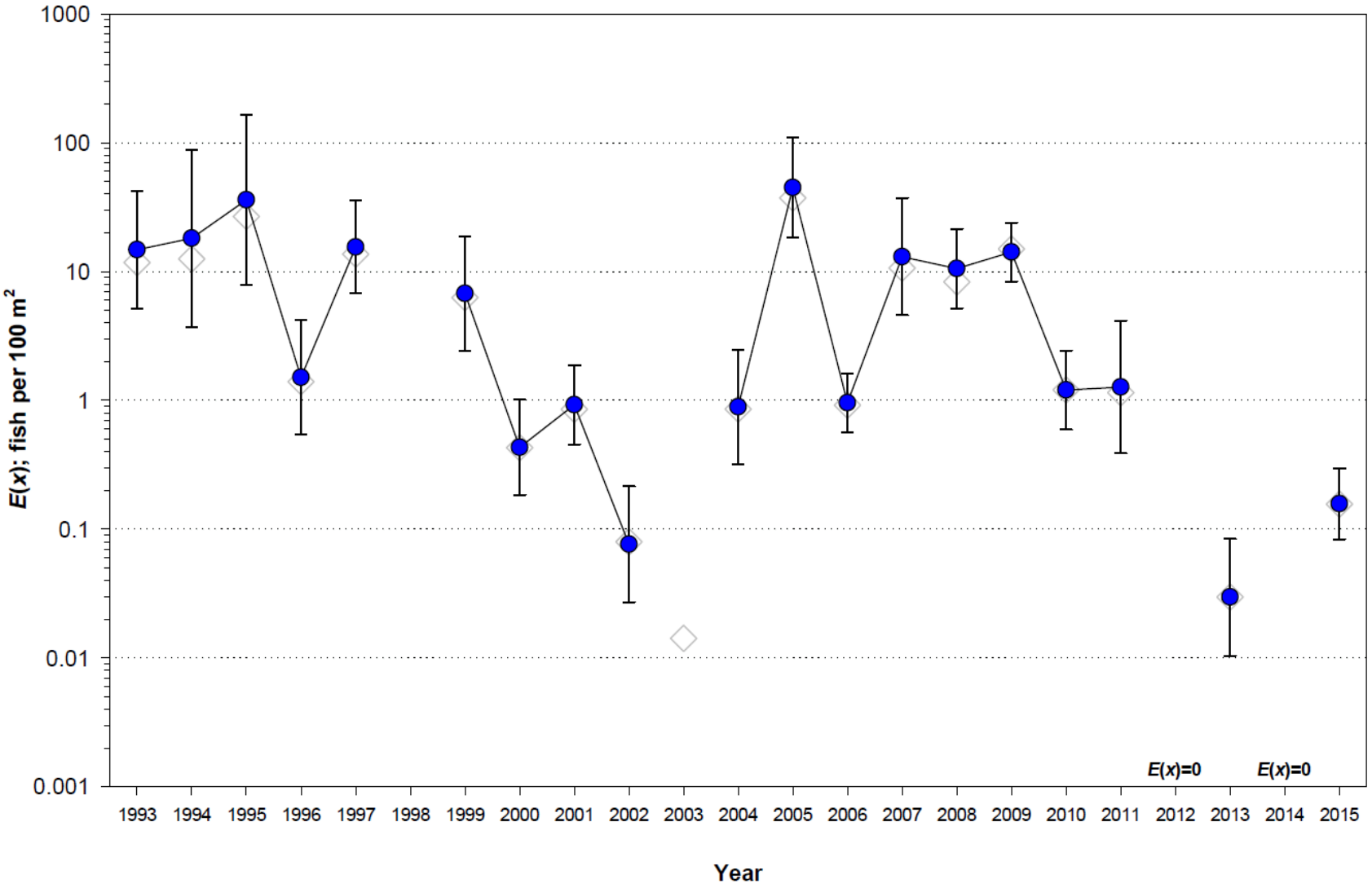

Figure 7. Yearly silvery minnow mixture model estimates of density (E(x)), using October sampling-site data (1993-2015). Solid circles indicate modeled estimates and bars represent 95% confidence intervals. Dotted horizontal lines represent orders of magnitude. Gray diamonds indicated simple estimated of mean densities using the method of moments. (Dudley et al. 2015).