GENERAL REEVALUATION REPORT AND

SUPPLEMENTAL ENVIRONMENTAL

IMPACT STATEMENT II:

RIO GRANDE FLOODWAY,

SAN ACACIA TO BOSQUE DEL APACHE UNIT,

SOCORRO COUNTY, NEW MEXICO

APPENDIX C

ENDANGERED SPECIES

ACT CONSULTATION

BIOLOGICAL

ASSESSMENT

DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
4101 JEFFERSON PLAZA NE
ALBUQUERQUE NM 87109-3435

May 8, 2012

Planning, Projects and Program Management Division
Planning Branch

Mr. Wally Murphy
U.S. Fish and Wildlife Service
Ecological Services Field Office
2105 Osuna NE
Albuquerque, New Mexico 87113

Dear Mr. Murphy:

As a follow-up to your office's comments dated January 26, 2012, the U.S. Army Corps of Engineers, Albuquerque District (Corps) is providing clarifying background information for the ongoing consultation with the U.S. Fish and Wildlife Service (Service) on the San Acacia to Bosque del Apache Unit of the Rio Grande Floodway Project. To this end, enclosed is the updated *Programmatic Biological Assessment of U.S. Army Corps of Engineers' Rio Grande Floodway, San Acacia to Bosque del Apache Unit, Socorro County, New Mexico.*

The Biological Assessment (BA) provides supplemental information to clarify project design and the Corps' effects determination of the proposed action on federally listed species and designated and/or proposed critical habitat occurring from the San Acacia Diversion Dam downstream along the Rio Grande to San Marcial.

The Corps appreciates the Service's discussion on our BA provided during our meeting on January 31, 2012. We concur that a programmatic Biological Opinion (BO) is appropriate for the proposed action to provide flexibility for project implementation and species protection over the approximately twenty-year construction period. The Corps has included sections for annual monitoring and reporting to support the programmatic BO, and addressed other comments to the extent possible in the updated BA.

Formal Section 7 consultation on the proposed action was initiated on December 7, 2011, with the submittal of a Biological Assessment. With the submittal of the enclosed clarifying information, the Corps agrees to extend the formal consultation period. The Corps requests that Service provide a draft programmatic Biological Opinion no later than June 11, 2012, in order to stay on schedule to award a construction contract for the project during next fiscal year.

If you have any questions, please contact me at 505-342-3281 or Mr. William DeRagon, Biologist, at 505-342-3358.

Sincerely,

Julie A. Alcon
Acting Chief, Planning Branch

Enclosure

Copies Furnished:

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January 26, 2011

COMMENTS & RECOMMENDATIONS
On the
U.S. ARMY CORPS OF ENGNEERS BIOLOGICAL ASSESSMENT
For the
SAN ACACIA TO BOSQUE DEL APACHE UNIT
SOCCORO COUNTY, NEW MEXICO

General information: The Corps has revised the BA to include the clarifying information requested; and we took the opportunity to edit it for general readability and clarity. The text within a given chapter (especially Chs. 1, 2, and 5) have been rearranged. We attempted to preserve all edits through MS-Word's track-change feature; however, the results quickly became more of a disservice to the reader than a help. Despite substantive revisions in the text, the effects determination regarding the proposed action remains the same. Appendix A has been updated with more detailed information; and Appendix B (floodplains) has been added.

May 4, 2012

1) The BA contains no executive summary. However, this is not a hard and fast requirement, and the introduction includes all of that information.

   Response: The Introduction and the summary of effects section provide a brief summary of the document. An executive summary was not considered in a document of this rather small size and pointed topic.

2) If there were and executive summary, it would include the table on page 86, so suggest adding a sentence to the end of the last paragraph in the introduction to let the reader know that it is there.

   Response: A sentence referring to the summary table was added to end of the Introduction.

3) The table on page 86 needs to be revised to be consistent with the NLAA conclusion on page 78.

   Response: The Table has been revised.

4) The conclusions on page 85 need to be revised consistent with the conclusions on page 78.

   Response: The text has been revised.

5) Maps of the 14 individual reaches would be helpful in supporting the mitigative value of staged construction, and give the reader a better understanding of the project.

   Response: Table 2.2 describes the s six segments of phased construction.

6) Habitat restoration proposed as a conservation measure is not described sufficiently to assess the aggregate effect after considering offsetting measures. A generalized location, total acreage and general habitat type is provided, but more detail is necessary to assess the adequacy in offsetting effects of the proposed action.

   Response: The descriptions of riparian vegetation effects and mitigative plantings has been revised.

7) Timing of construction needs to be clear. Not clear whether all construction activities except vegetation management will occur year-round.

   Response: The text has been revised accordingly.

8) Duration of the consultation is not clear. What is the life of the project? The non-federal O&M extends to perpetuity or when?

   Response: The following was added to Section 2.2.1: The Corps regularly considers 50 years as the functional life of flood control structures. Non-Federal operations and maintenance requirements extend to perpetuity.

9) How long will the temporary river crossing be deployed? Discussion of placing it is included but no discussion of how it will be removed.

   Response: See revised text in Sections 2.2.2 and 5.1.1.

10) The heart of the BA should be analysis of effects of the action on endangered species. Section 5 reads like a summary and covers some aspects of effects but is not comprehensive.

    Response: The text has been revised accordingly.

11) Why are 3 LFCC pumping stations going to be made permanent through the levee? Wouldn't it be better to say there is flexibility depending on the next Water Ops BO and/or future adaptive management?

    Response: Concur. See revised text in Section 2.2.7.

12) There still does not seem to be sufficient detail on some aspects to assess effects – how far are flycatcher territories from construction areas/ from habitat to be removed? Still no description of the effect on the side channel abuting the spoil levee in the refuge reach.

    Response: Additional detail on the location of flycatcher territories was included in Section 5.1.3, and in GIS shapefiles provided under separate cover. The ephemeral channel is discussed in Section 5.1.4.

13) No effect determinations were made for sunflower, falcon, and least tern. This is an action agency responsibility and we generally don't spend time on these species unless we have overwhelming reason to believe there are effects that should be considered.

    [No response necessary.]

14) Candidate species NM meadow jumping mouse and Yellow billed cuckoo were not assessed. This will be a trigger for reinitiation in the future when/if the species are listed. This may occur before construction is completed. While candidate species are not afforded protection under the ESA, and need not be included in the BA, it would be helpful to state that should they become listed species the project would re-initiate consultation for them, if necessary.

    Response: Section 2.2.13 mentions the criteria for reinitiation, including the listing of new species.

15) Difficult to understand if the San Marcial railroad bridge is a limiting factor on flood releases or not. First sentence Section 3.3.3 seems to mean that Corps flood operations are affected by the presence of the bridge but this is followed by lots of narrative of why the Corps did not replace it, and it contradicted by last sentence of this same section.

    Response: The text was revised to clarify that the bridge is a restriction to unregulated flood flows, but does not restrict the regulated flow from upstream reservoirs.

16) Table 2.2 on page 17 is hard to interpret. Does it mean that with the new levee that there will be almost ½ less overbanking flow?

    Response: This table (now Table 5.3) indicates that the new levee would eliminate inundation of lands west of the spoil bank / new levee alignment. The Corps refers to this area as the "floodplain", and uses "overbank" to refer to the out-of-channel area within the floodway.

17) There is no mention of the PCEs for the flycatcher. A discussion of their presence or absence in areas where woody vegetation is necessary in the analysis of effects.

    Response: Chapters 4 and 5 have been revised to include discussion of flycatcher PCEs.

18) There is no monitoring plan.

    Response: Monitoring is now described Section 2.2.13.

19) There is no reporting plan.

    Response: Annual reporting is now described Section 2.2.13.

20) The Collaborative Program deserves a discussion of its own.

    Response: As a long standing participant in the Collaborative Program, the Service is fully informed about the breadth of activities on the Middle Rio Grande. The BA references numerous reports funded by the Program that contribute directly to the baseline and analysis.

21) There is no mention of any coordination with the New Mexico Department of Game and Fish.

    Response: The NM Dept of Game and Fish has been requested to review and comment on the proposed plan, specifically the General Reevaluation Report / Supplemental EIS (GRR/SEIS). There was no specific coordination for Section 7 consultation.

22) The discussion on the placement of riprap states that it will be when the area is dry and should conclude NLAA or no effect to the minnow.

    Response: Concur. See revised text in Section 5.1.5.

23) Relocation of fish from construction areas is a form of take and is adverse.

    Response: Agree. The following text was added to Section 2.2.2: "Cofferdams and silt curtains would be deployed to minimize disturbance to fish in the immediate area. These barriers *would be deployed by Corps biologists from the shoreline into the current to exclude fish from the area where the temporary ramp is constructed. These barriers also would be deployed to exclude fish from the construction activities when the ramp is removed." Service determines effects and take.*

24) The analysis for the soils cement/riprap states that water velocities at SADD are too high for the minnow. The riprap would reduce the velocity of water and create some backwater refugia that could be used by the minnow at lower flows. Since some PCEs are lacking, why the adverse modification conclusion? [There are plenty of minnow near SADD, so perhaps that discussion was an oversimplification. Adverse modification could result from the soil cement and/or the temporary road placed in the river?]

    Response: PCEs for minnow habitat are described in Section 4.1.1. PCE iii is specific to substrate type. The text in Section 5.1.2 has been revised regarding loss of aquatic habitat area, conversion of sand substrate (PCE) to soil cement. Riprap will not be used at this site based on more recent design.

25) 2.1, p. 7: "Prior to LFCC construction, the channel into Elephant Butte Reservoir was obstructed with sediment and vegetation such that no surface flows entered the reservoir...". Does this mean no flows *ever*, or just under some or most conditions?

    Response: The latter condition is implied. The text in Section 1.2 was revised to read: "Prior to LFCC construction, the channel into Elephant Butte Reservoir was obstructed with sediment and vegetation such that surface flows entered the reservoir were reduced, resulting in an estimated water loss of 140,000 acre-feet per year."

26) 2.1, p. 8: "Average annual water salvage ranges from 35,000 to 66,000 acre-feet during full operation." We were told on the field trip that the LFCC and this is verified by other sources that the LFCC is no longer used to divert flows but only captures drainage. Please expand the description of the operation of the LFCC to clarify its current management. Are any of the water saving actually being achieved these days, perhaps consisting of water drained from the agricultural areas?

    Response: The text states accurately that the Bureau of Reclamation does not currently operate the LFCC for its intended purpose. The state water savings refer to the "when-operated" period between 1962 and 1985 (approximately). The LFCC does passively function as an riverside drain currently.

27) 2.1, p. 8: "Elephant Butte Reservoir storage increased in the early to mid-1980s, inundating and burying the last 15 miles of the channel above the reservoir with sediment." Clarify that this, along with difficulties with maintenance of alternate reentry points for the LFCC, are the reasons that diversions into the LDCC have largely or entirely stopped.

    Response: The text in Section 1.2 was revised accordingly.

28) 2.1.1, p. 9: "The new levee cross section is narrower than the existing non-engineered spoil bank...". This is mostly true but not always true. Also, should point out that the new levee is higher than spoil bank. New levee is expected to prevent the spoil bank overtopping or other failure issues that are expected without it.

    Response: The description of the proposed levee was revised accordingly.

29) 2.2.1, p. 11: Text states: “Error! Reference source not found”. Please provide reference.

Response: The erroneous links to tables and figures have been corrected.

30) 2.1.1, p. 12: Clarify vegetation and habitat characteristics of Tiffany Basin disposal site. These are not discussed elsewhere in the document. There needs to be a discussion of impacts, or lack thereof as the case may be, for this component of the project at the appropriate locations in the document. This is 300 acres that will receive spoil. It needs to be clear what habitat will be lost and restored or where nearest flycatcher territories are.

Response: The revised BA addresses these topics in Section 5.1.8.

31) 2.2.4, p. 14: Provide more information on the vegetation management zone and levee management. Mowing will be required once or twice a year, forbs will need to be controlled (see below), and rodents will be controlled which will probably mean using poison bait.

Response: More information has been provided within Section 2.2.6 for clarity and understanding.

32) 2.2.7, p. 15: Presumably no vegetation would grow on the soil cement areas. If true, this should be made explicit.

Response: Vegetation would not grow on or within the soil-cement slope after construction. See revised text in Section 2.2.4.

33) 2.2.9, p. 17, Conservation measure 2: Consider rerouting major construction traffic that would travel close to occupied flycatcher nests where this is practical. In some areas alternate access routes are available.

Response: This conservation measure has been reworded and clarified.

34) 2.2.9, p. 17, Conservation measure 3: Please clarify what is meant by flycatchers being present. Does this mean just a sighting of a bird or does it mean nesting activity as on page 77? (also on page 76)

Response: This has been reworded and clarified to indicate that it means any bird present, migrant or territorial.

35) 2.2.9, p. 17, Conservation measure 5: Change “the watercourse” to “any watercourse”; otherwise, specify the Rio Grande if that is the only intended watercourse.

Response: Corrected as suggested.

36) 3.3.2, p. 28: State why flooding of Tiffany Basin is a concern if there are no facilities or farmland within the basin (for example, that water ponded there after a flood would be lost to downstream use).

Response: Section 3.3.2 has been revise accordingly.

37) 4.2.3, p. 56, Flycatcher Breeding Habitat: Provide affiliations for D. Ahlers and M. Sogge.

Response: Corrected as suggested.

38) 4.2.3, p. 63: The lower incidence of cowbird parasitism on flycatcher nests in the Elephant Butte habitat areas may be due to greatly reduced riparian habitat fragmentation in this area due to more favorable conditions for denser and more continuous riparian growth. See Morrison and Hahn (2002). This has implications for the evaluation of both impacts and mitigation.

39) 5.1, p. 71: It would be helpful to include typical cross sections to show the differences between the work upstream and downstream of Highway 380. It would be helpful to include a variety of cross sections of the current spoil levee and the future levee at that location and assess the encroachment.

Response: Typical cross-sections are contained in Appendix A, Sheet C-141.

40) 5.1, p. 71-72: It is not clear how Action 1 and Action 2 are different as described. Both descriptions of the actions primarily address the encroachment of the levee on the floodway. It would make more sense to consolidate encroachment effects under one discussion and construction effects (noise, traffic, temporary disturbance, etc.) under the other.

Response: Chapter 5 has been revised to more clearly describe the effects of different project features and activities.

41) 5.1, P. 73: The NLAA determination needs further rationale. It appears that there are net gains in the floodway area and potential long-term gains in nesting habitat, but some nesting habitat is still lost in the short term. The quality of the habitats lost and gained are not detailed. Generally, if there are losses of habitat occupied by breeding flycatchers, that is an adverse determination; if suitable but unoccupied habitat is lost and is re-created elsewhere that could be not adverse; if there is a drop in groundwater elevation in riparian areas that causes loss in native vegetation (we see this when the river bed elevation drops), this could be adverse if it affects territories. The bigger picture potential effect is the future effect of continuing the river's confinement. The BA acknowledges the negative effects that dams, levees and drains, diversions, and flow regulation have had. This project perpetuates part of those effects.

Response: The discussion of affected vegetation has been clarified in Section 5.1.1.
Regarding the 'future condition: Should the existing spoil bank be breached or damaged, it would be immediately rebuilt on the same alignment. The future condition is the same for the with- and without-Corps-project conditions for discharges less than the breaching/ damaging flow (of approx. 11,800 cfs).The differential effect of the Corps proposed action relates to the confinement of flows greater than 11,800 cfs with the floodway.

42) 5.1, P. 74: ETL 1110-2-571 allows only perennial grasses (paragraphs 4-8), not "grasses and most herbaceous plant species". This implies removal of forbs by means of herbicides, and also negates planting of forbs in the vegetation-free zone.

Response: Section 2.2.6 has been revised accordingly.

43) 5.1, p. 75: Would any of the riparian forest plantings in Tiffany Basin be close enough to water to potentially serve as willow flycatcher habitat? This piece of information is essential to determining whether any of these plantings may qualify as mitigation for project impacts to this species.

Response: The location and type of plantings in Tiffany Basin are discussed in Section 5.1.8. These would consist of upland vegetation and would not likely be utilized by the flycatcher.

44) 5.1, p. 76: Why is the amount of riparian forest to be removed by the project exactly equal to the amount of space that is *suitable* for riparian forest mitigation?

Response: Their numeric similarity was coincidental.

45) 5.1, Action 5, p. 77: Text states that "This offset would replace..." does not explain what the offset it. Presumably this refers to the excavation work on the east bank discussed lower on the page; if so, this work should be referenced here. Also, the reference to water velocities should compare these to the no-action condition. I also note that the habitat removed by the excavation of about 12.4 acres is not described. For minnow, the construction of this excavation is very important for determining potential take of minnow. Needs details.

Response: The text clarifies this discussion in Sections 2.2.2 and 2.2.4, and in Sections 5.1.1 and 5.1.2.

46) 5.1, Rio Grande Silvery Minnow, p. 77: The statement that the west bank for 0.75 mile downstream of the SADD is "generally unsuitable for silvery minnows and other fish species because of very high water velocities in this area" seems to refer to flood flows. This bank currently has riparian forest along its entire length and may provide habitat for this species under low-flow conditions. Habitat conditions here under varying flow conditions and their relationship to the vertical location of proposed channel modifications should be clarified. (also on page 79)

Response: This analysis focuses on in-channel baseflow along vertical bankline. The aquatic habitat where the soil cement wall would be installed has high water velocities as a function of river width, local slope, etc. The high water velocity is why a soil cement wall is appropriate for bank protection, and why this area is unsuitable as minnow habitat.

The comment is correct in stating that as flow increases, there will be increased area of low-velocity habitat in other areas of the channel. There is an area of low velocity habitat across the channel.

47) 5.1, Action 7, p. 79: The discussion of the 1% and 10% floods does not adequately address the effects under the no-action alternative of such a flood (or any flood large enough to cause the spoil bank to fail). In such an event, the river would flood the agricultural lands normally protected by the spoil bank. This would leave large amounts of sediment on these lands, and in the downstream reaches large amounts of water unable to return to the floodway. The flow predictions are confusing – a quick online search reveals that there have been no discharges above 9,500 cfs at San Acacia at least since 1959 (the plot downloaded).

Response: The revised text in Section 5.1.6 discusses these topics.

Regarding flow predictions: The flood discharges and frequencies (Table 3.1) were based on standard Corps methodology, including the annual peak discharge series, and certified hydrology. These are explained in detail in the GRR/SEIS and its appendices.

48) Breaches in the spoil bank and resulting flooding could have a variety of effects, including temporary scouring, down-cutting, and loss of riparian forest near breaks in the spoil bank, stranding of fish in the agricultural area, channel avulsion from the floodway into the agricultural area (at least until corrected by Reclamation), habitat impacts due to prolonged flooding on the BDANWR, or abandonment of some agricultural lands after an extreme flood event due to soil and infrastructure damage. Such effects could have both negative and positive impacts on listed species.

Response: The revised text in Section 5.1.6 discusses these topics.

49) The proposed project would not eliminate the potential for these flooding effects and their potential impacts on listed species. However, it would greatly decrease their probability in any one year and the number of times they occur over the life of the project, relative to the no-action alternative.

Response: This has been acknowledged in Section 4.2.3.

50) Another consideration is the extent to which this change in flood regime could affect river and floodplain morphology and dynamism. While upstream dams and reservoirs reduce flood peaks, keeping more of the remaining flood flows within the remaining floodway and habitat area through levee construction may partially compensate for this condition. The return of somewhat higher flood peaks may result in a more dynamic river channel and floodplain. Losses of riparian vegetation due to floods may increase but this could also mean greater regeneration and development of more of the young age classes of riparian vegetation which can provide nesting habitat for the willow flycatcher.

Response: The revised text in Section 5.1.6 discusses these topics.

51) There is also the question of the long-term sustainability of the current and future project area. Is sediment accumulation in the floodway expected to continue, worsening the problem of the elevation differential between the floodway and the agricultural area and the drain in downstream areas? In the long term this would be expected to make the existing floodplain on the west bank of the river less and less suitable for riparian forest due to the ground surface continuing to elevate in relation to the water table which is controlled by the LFCC. This also might or might not affect the amount of surface flow in the river, depending on whether infiltration would increase or not in response to the water table being deeper.

Responses: The information for this comment has been updated and can be found within Section 3.03.2.

52) The discussion of effects on the silvery minnow should relate the <2 feet/second criterion used in the discussion with known responses of the silvery minnow to water velocities. I am not convinced that the flood flows will occur enough to cause high velocities often enough to even be considered as an effect on silvery minnow. Plus I thought it was stated that there are plenty of low velocity habitats available even at the highest peaks. Similarly, the increase in river stage due to high flow is so infrequent that it probably cannot be considered of any benefit to riparian vegetation.

Response: Concur. High water velocities occur within the normal range of flow at this site. See Section 5.1.2 and 5.1.6.

53) 5.4, p. 85: Discussion of Pecos sunflower should address the potential for this species to be found in the impact area. Given the lowered water table caused by the LFCC this is very unlikely, but this reason should be stated.

<u>Editorial Clarifications and Corrections</u>

General

1) Suggest that the indicative mood (will, etc.) or subjunctive mood (would, etc.) be used consistently throughout the document as appropriate rather than interchangeably.

Response: "Will" has been replaced with "would" throughout the document for consistency.

Specific

1) 1.4, P. 5: Change the name of NEPA to National Environmental *Policy* Act.

Response: Corrected as suggested.

2) 2.1, p. 7, line 36: insert "to" in front of "the Rio Grande".

Response: Corrected as suggested.

3) 2.2.7, p. 15, line 22: Text states "2.5 to 1 foot side slopes". Does this mean 2.5 to 1 side slopes, or side slopes that are 1 to 2.5 feet tall?

Response: 2.5 ft horizontal to 1 ft vertical, corrected in text.

4) 2.2.8, p. 15: Text states "This condition exists from approximately the city of Socorro and increases in the downstream direction...". Insert "downstream" after Socorro. Also, text states "For the 1% chance flood, depth in the floodway floodplain averages approximately 3 feet with some low lying areas reaching depths of up to 10 feet." Please reword to show this is the future condition with the project, not the present condition.

Response: The text in Section 5.1.6 has been revised accordingly.

5) 2.2.9, p. 17, Conservation measure 9: Insert "would" before "include".

Response: Corrected as suggested.

6) 2.2.9, p. 18, Conservation measure 10: Text states "..no leaks or discharges or lubricants, hydraulic fluids, ...". Is this supposed to read "...no leaks or discharges of lubricants..."?

Response: Corrected as suggested.

7) 3.3.2, p. 27: "The existing spoil bank limits meandering to the areas within the spoil banks...". The significant spoil bank is on only on one side of the river so this does not make sense. Suggest rewording to "limits meandering to the area east of the spoil bank". Corrected as suggested.

8) 4.2.3, p. 64: "Levees drains have greatly restricted..." Please clarify text.

Response: Sentence was revised to read: "Spoil banks have restricted the extent of floodplain inundation from discharges up to 7,000 or 10,000 cfs and, along with their attendant riverside drains, have functionally separated the river from most of the historical floodplain."

9) 4.5.2, p. 69: Correct Sporobolus airoide to Sporobolus airoides.

Response: Corrected as suggested.

10) 5.1, P. 74: Change "with the Tiffany Basin" to "within Tiffany Basin".

Response: Corrected as suggested.

11) 5.1, p. 79: Change "29.900 cfs" to "29,900 cfs".

Response: Corrected as suggested.

Reference used in Comments

Morrison and Hahn (2002) Geographic Variation in Cowbird Distribution, Abundance, and Parasitism, IN Effects of Habitat Fragmentation on Birds in Western Landscapes: Contrasts with Paradigms from the Eastern United States, T. Luke George and David S. Dobkin, ed. Studies in Avian Biology No. 25, Cooper Ornithological Society.

PROGRAMMATIC
BIOLOGICAL ASSESSMENT OF
U.S. ARMY CORPS OF ENGINEERS
RIO GRANDE FLOODWAY,
SAN ACACIA TO BOSQUE DEL APACHE UNIT,
SOCORRO COUNTY, NEW MEXICO

November 28, 2011

With clarifying information added on May 4, 2012

Prepared by

U.S. Army Corps of Engineers

Albuquerque District, New Mexico

CONVERSION FACTORS

	From	Multiplier	To
Distance:	inches (in)	25.4	millimeters (mm)
	feet (ft)	0.3048	meters (m)
	miles (mi)	1.6093	kilometers (km)
Area:	acres (ac)	0.0407	hectares (ha)
	square miles (mi^2)	2.590	square kilometers (km^2)
Volume:	cubic yards (CY)	0.7646	cubic meters (m^2)
	acre-feet (ac-ft)	1,233.5	cubic meters (m^2)
	acre-feet (ac-ft)	325,851	gallons (gal)
Discharge:	cubic feet/second (cfs)	0.0283	cubic meters/second (cms)
Mass (weight) :	tons [short]	0.9072	metric tons [long]
Velocity:	feet/second (fps)	0.3048	meters/second (cms)
Salinity:	µSiemens/cm or µmhos/cm	0.32379	parts/million NaCl or mg/liter NaCl
Temperature:	° Fahrenheit (°F)	(°F-32)/1.8	° Celsius (°C)

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1. Introduction

1.1 Scope of the Biological Assessment

The U.S. Army Corps of Engineers (Corps) is submitting this Programmatic Biological Assessment (BA) to the U.S. Fish and Wildlife Service (Service) pursuant to Section 7(a)(2) of the Endangered Species Act (ESA). This BA evaluates the effects of the Corps' Rio Grande Floodway, San Acacia to Bosque del Apache Unit actions on federally listed species and designated critical habitat in the proposed action area within the Middle Rio Grande valley of New Mexico.

Because of the relatively long duration of anticipated construction (approximately 20 years), this consultation is being conducted programmatically. During the construction period, changes in design, construction methods, or the condition of ecological resources could alter the determinations of effects made by the Corps or Service at the present time. Should there be a change in the determination of effects, or in the suitability of stipulations of the Biological Opinion or Incidental Take Statement, the Corps would provide to the Service a supplemental BA tiered to this Programmatic BA. The Corps also will provide annual reports on progress to the Service during the construction period.

When determining the proposed action for this consultation, the Corps carefully considered the water management activities of non-Federal and other Federal entities in the action area. Activities appropriate for inclusion as a proposed action are those that are discretionarily authorized, permitted, funded, or implemented by the Corps. Additionally, activities that are interdependent or interrelated (as defined in 50 CFR §402.02) with our primary actions could be included as a proposed action in this BA. None of the water management activities of other entities met these criteria for inclusion. Therefore, the proposed action in this Section 7 consultation includes construction, operation and maintenance of the Rio Grande Floodway, San Acacia to Bosque del Apache Unit. The proposed action is described in detail in Chapter 2 of this BA.

This BA considers the effects of the Corps' proposed action on Federally listed species and their designated critical habitat occurring from the San Acacia diversion dam (SADD) downstream along the Rio Grande to the area referred to as Tiffany Junction just north of San Marcial, New Mexico. A detailed description of the action area is provided in Section 2.1 of this document. The BA focuses on the endangered Rio Grande silvery minnow (*Hybognathus amarus*) (minnow), the endangered Southwestern Willow Flycatcher (*Empidonax traillii extimus*) (flycatcher), the endangered Interior Least Tern (*Sternula antillarum athalassos*) (tern), the endangered Northern Aplomado Falcon (*Falco femoralis*) (falcon), and the threatened Pecos sunflower (*Helianthus paradoxus*) (sunflower).

The remainder of this chapter summarizes the general location, description of the project authorization, and purpose and need for the action. Chapter 2 includes a detailed description of the proposed action. Chapter 3 describes historic and existing conditions. Chapter 4 contains detailed information regarding the status of listed species. Chapter 5 includes the analysis of proposed action. Table 5.4 summarizes the Corps' determination of effects.

1.2 Study Area Location and Description

The study area comprises a stretch of the Rio Grande extending from the San Acacia diversion dam (SADD), near the historic community of San Acacia, south through the Bosque del Apache National Wildlife Refuge (BDANWR) to the headwaters of the U.S. Bureau of Reclamation's (Reclamation) Elephant Butte Reservoir, south of the former village of San Marcial. The action area is largely contained within Socorro County, New Mexico. The City of Socorro, New Mexico is the largest population center within the county. The study area is shown on Figure 1.1

The Rio Grande stretches approximately 2,000 miles from its headwaters in the San Juan Mountains of southwestern Colorado to its terminus in the Gulf of Mexico near Brownsville, Texas. The Rio Grande is the fifth longest river in North America and the 20th longest in the world. The watershed measures approximately 336,000 square miles ($mi^{2)}$, although only about half of the total area, 176,000 mi^2, contributes to the river's flow. The Rio Grande passes through three states in the United States (Colorado, New Mexico, and Texas) and four in the Republic of Mexico (Chihuahua, Coahuila, Nueva Leon, and Tamaulipas). The Rio Grande, known as the Rio Bravo in Mexico, forms the international boundary between Texas and Mexico. In 1997, the U.S. Environmental Protection Agency designated the Rio Grande as an American Heritage River.

The Albuquerque District maintains jurisdiction over what is known as the Upper Rio Grande Basin, which is defined as that part of the river upstream of Fort Quitman, Texas. Within this reach, the river measures approximately 700 miles in length with a drainage area of approximately 30,000 mi^2. The Continental Divide forms the western boundary of the Upper Rio Grande Basin while the Sangre de Cristo, Sandia, and Manzano Mountains, and a series of north-south mountain ranges form the eastern boundary.

The major Upper Rio Grande tributaries in Colorado and New Mexico are, from north to south, the Conejos River (watershed area: 821 mi^2), Rio Chama (watershed area: 3,150 mi^2), Galisteo Creek (watershed area: 670 mi^2), Jemez River (watershed area: 1,038 mi^2), Rio Puerco (watershed area: 6,057 mi^2), and Rio Salado (watershed area: 1,394 mi^2). The Rio Grande watershed upstream of El Paso, Texas, also contains five closed basins: San Luis in Colorado (watershed area: 2,884 mi^2), the Llano de Albuquerque (watershed area: 147 mi^2), North Plains (watershed area: 1,373 mi^2), San Agustin Plains (watershed area: 1,990 mi^2), and Jornada del Muerto (watershed area: 3,316 mi^2) in New Mexico.

The Middle Rio Grande refers to the portion of the Upper Rio Grande Basin that passes through central New Mexico and is typically defined as extending from Cochiti Dam downstream approximately 160 miles to San Marcial and the head of Elephant Butte Reservoir. The Middle Rio Grande Valley extends across four New Mexican counties (from north to south: Sandoval, Bernalillo, Valencia, and Socorro) and six Pueblos (Cochiti, Santo Domingo, San Felipe, Santa Ana, Sandia, and Isleta). The Pueblos of Jemez, Santa Ana, and Zia are located along the Jemez River, a tributary to the Rio Grande. The cities and towns of Bernalillo, Rio Rancho, Corrales, Albuquerque, Los Lunas, Belen, and Socorro are located within the Middle Rio Grande Valley.

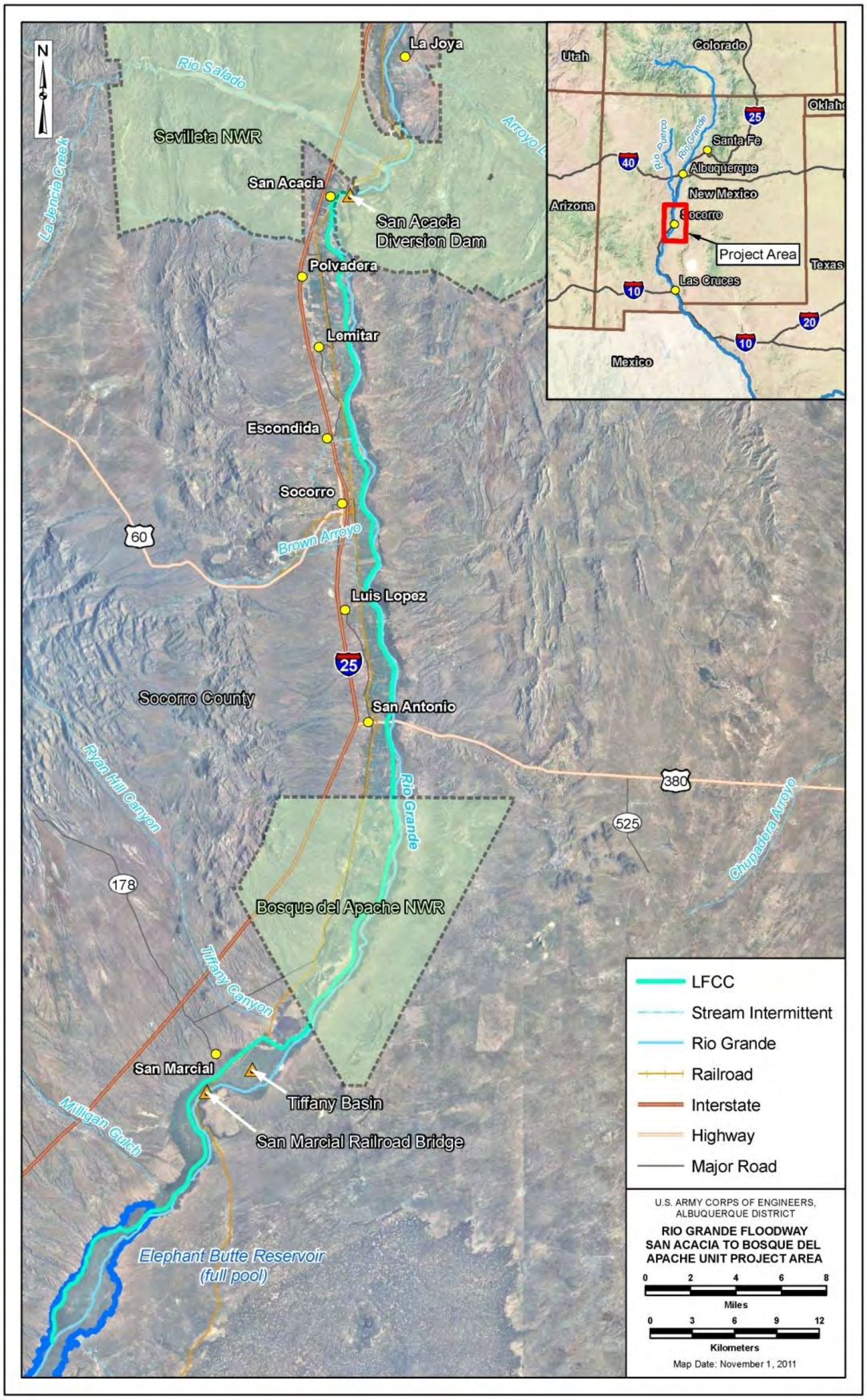

Figure 1.1. Map of study area.

The San Acacia to Bosque del Apache Unit is the southern-most section of the Middle Rio Grande Valley, comprising the 58 miles between the SADD and the northern end of Elephant Butte Reservoir just below the San Marcial Railroad Bridge. The principal city in this reach is Socorro with a 2010 census population of 9,051 (U.S. Census Bureau 2011). In addition, six small agricultural villages occur on the flood plain: Polvadera, Lemitar, Escondida, Luis Lopez, San Antonio, and San Marcial. The western boundary of this section of the river basin is marked by the Magdalena, Chupadera and Lemitar Mountains and the eastern boundary by a series of lower ranges.

In the San Acacia to Bosque del Apache Unit, the principal land and facility managers in the valley include the Middle Rio Grande Conservancy District (MRGCD), Reclamation, and the Service. The New Mexico Office of the State Engineer (NM OSE) and the New Mexico Interstate Stream Commission (NM ISC) administer water rights and address Rio Grande Compact compliance. Elephant Butte Reservoir, immediately downstream of the action area, is the largest reservoir in New Mexico, storing water for irrigation, hydroelectric power, and recreation. Three major Federally owned facilities within the area of consideration are the Service's Bosque del Apache and Sevilleta National Wildlife Refuges, and Reclamation's Low Flow Conveyance Channel (LFCC) (Figure 1.1).

BDANWR encompasses 57,191 acres straddling the Rio Grande within the project area between the towns of San Antonio and San Marcial. The heart of the BDANWR is about 12,900 acres of moist bottomlands--3,800 acres are active flood plain of the Rio Grande and 9,100 acres are areas where water is diverted to create extensive wetlands, farmlands, and riparian forests. The goal of refuge management is to provide habitat and protection for migratory birds and endangered species and provide the public with a high quality wildlife and educational experience (USFWS 2010). BDANWR cooperates with local farmers to grow crops for wintering waterfowl and cranes. Farmers plant alfalfa and corn, harvesting the alfalfa and leaving the corn for wildlife. The refuge staff grows corn, winter wheat, clover, and native plants as additional food.

In addition to farming, natural and created habitats are managed to provide wildlife habitat. Prescribed burning, exotic plant control, moist soil management, and water level manipulation are used to maintain these habitats. Wetlands within created impoundments are managed via irrigation and water level manipulation. Marsh management is rotated so that varied habitats are always available for resident and migratory wildlife. Wildlife foods grown this way include smartweed, millets, chufa, bulrush, and sedges. Irrigation canals ensure critical water flow. Daily monitoring, along with occasional mowing and clearing, keeps them functioning. Controlling the water enables refuge staff to manage the habitat (USFWS 2010).

The LFCC, completed in 1959, is an artificial channel that runs parallel to the Rio Grande between San Acacia, New Mexico, and Elephant Butte Reservoir. Reclamation built the LFCC as part of the 1948 Rio Grande Basin authorization for the purpose of reducing consumption of water, providing more effective sediment transport, and improving valley drainage. Operation and maintenance of the LFCC are continuing Reclamation responsibilities.

The LFCC was constructed by Reclamation to aid the State of New Mexico in the delivery of water obligated to Texas under the Rio Grande Compact (Compact). Prior to LFCC construction, the channel into Elephant Butte Reservoir was obstructed with sediment and vegetation such that surface flows entered the reservoir were reduced, resulting in an estimated water loss of 140,000 acre-feet per year. Historically, the LFCC conveyed up to 2,000 cfs to Elephant Butte Reservoir, saving considerable amounts of water that would otherwise have been lost to evapotranspiration. The LFCC has been credited with assisting New Mexico to significantly decrease its Compact compliance deficit (which was 325,000 acre-ft in 1951). Average annual water salvage ranges from 35,000 to 66,000 acre-feet during full operation.

Elephant Butte Reservoir storage increased in the early to mid-1980s, inundating and burying the last 15 miles of the channel above the reservoir with sediment. As a result, the channel was shortened to 58 miles. Reclamation has proposed moving the LFCC west in the flood plain, away from the floodway, for a distance of approximately 15 miles upstream of the Elephant Butte Reservoir (Reclamation 2000). Since no structures, irrigation infrastructure, or agricultural fields exist here, the LFCC is the only facility subject to damage from flooding in this reach. The uncertainty of the future location of the LFCC prompts the elimination of this reach from the flood risk management considerations at this time. Thus, the reach under current consideration is 43 miles long, extending from the SADD only as far as San Marcial, and not including the segment from San Marcial to Elephant Butte Reservoir.

Difficulties with maintenance in the Elephant Butte Headwaters and endangered species considerations are among the reasons that Reclamation is not currently operating the LFCC as designed. The LFCC currently provides valley drainage benefits, water for pumping to benefit the Rio Grande silvery minnow, and supplemental irrigation water supplies to the BDANWR and irrigators of the Middle Rio Grande Conservancy District. Various rehabilitation or relocation strategies would potentially increase water deliveries to Elephant Butte Reservoir, a primary interest of the Compact states.

1.3 Description of the Authorized Project

The Rio Grande Floodway, San Acacia to Bosque del Apache Unit Project was authorized for construction by the Flood Control Act of 1948 (Public Law 80-858, Section 203), in accordance with the recommendation of the Chief of Engineers, as found in House Document No. 243, 81st Congress, 1st Session, dated 5 April 1948, which reads as follows:

> *The comprehensive plan for the Rio Grande Basin as set forth in the report of the Chief of Engineers, dated April 5, 1948, and in the report of the Bureau of Reclamation, dated November 21, 1947, all in substantial accord with the agreement approved by the Secretary of the Army and the Acting Secretary of the Interior on November 21, 1947, is hereby approved except insofar as the recommendations in those reports are inconsistent with the provisions of this Act and subject to the authorizations and limitations set forth herein.*
>
> *The approval granted above shall be subject to the following conditions and limitations:*
>
> *a) Construction of the spillway gate structure at Chamita Dam shall be deferred so long as New Mexico shall have accrued debits as defined by the Rio Grande Compact and until New Mexico shall consistently accrue credits pursuant to the Rio Grande Compact;*
>
> *b) Chiflo Dam and Reservoir on the Rio Grande shall be excluded from the Middle Rio Grande Project authorized herein without prejudice to subsequent consideration of*

Chiflo Dam and Reservoir by the Congress;

c) *The Bureau of Reclamation, in conjunction with other interested federal agencies, is directed to make studies to determine feasible ways and means of reducing non-beneficial consumption of water by native vegetation in the flood plain of the Rio Grande and its principle tributaries above Caballo Reservoir; and*

d) *At all times when New Mexico shall have accrued debits as defined by the Rio Grande Compact, all reservoirs constructed as a part of the project shall be operated solely for flood control except as otherwise required by the Rio Grande Compact, and at all times all project works shall be operated in conformity with the Rio Grande Compact as it is administered by the Rio Grande Compact Commission.*

The comprehensive plan for development for flood control in the Middle Rio Grande broke the river into separate units, many of which have already been constructed. The proposed action, levee construction in the San Acacia to Bosque del Apache Unit, is one of the last units required for comprehensive flood control in the Middle Rio Grande.

Additional language was provided in WRDA 1992, Section 102 regarding the equitable cost share portioning due to the large amount of Federal properties to be protected by the proposed project:

> *(s) RIO GRANDE FLOODWAY, NEW MEXICO.--Notwithstanding any other provision of law, the project for flood control, Rio Grande Floodway, San Acacia to Bosque del Apache Unit, New Mexico, authorized by section 203 of the Flood Control Act of 1948 (Public Law 80-858) and amended by section 204 of the Flood Control Act of 1950 (Public Law 81-516), is modified to more equitably reflect the non-Federal benefits from the project in relation to the total benefits of the project by reducing the non-Federal contribution for the project by that percentage of benefits which is attributable to the Federal properties; except that, for purposes of this subsection, Federal property benefits may not exceed 50 percent of the total project benefits.*

1.4 Purpose and Need for Action

The study area has a long history of flood damage (Scurlock 1998). Recorded flood history in the study area dates back to the 1920s. Before that time, newspaper accounts identify major floods that occurred in July 1895 and September 1904. Recorded major floods, which would have exceeded the estimated protection afforded by the existing levee in the study area, occurred twice in 1929 (August 12, with Rio Salado flows of 27,400 cfs, and September 23, with Rio Puerco flows of 37,000 cfs); as well as in 1936 (August 4, with Rio Puerco flows of 24,000 cfs); in 1941 (September 23¸with Rio Puerco flows of 18,800 cfs); and in 1965 (July 31, with Rio Salado flows of 36,200 cfs). A recurrence of any of these floods would have devastating effects downstream in the study area. In addition, there have been numerous flood events in recent years, more specifically, 1976, 1979, 1995, and 2005, when the Middle Rio Grande Conservancy District (MRGCD) and Reclamation had to conduct flood fights to prevent levee failure. Without these actions, the existing spoil bank would have failed several times in the past 35 years. It has been estimated that a 1%-chance flood event (colloquially referred to as the 100-year flood) occurring today would result in $241.4 million (2010 price level) in damages in the study area.

Start of damages is estimated to be between the 20%- and 14%-chance flood events. Thus, the study area would suffer large economic losses during a flood, beginning with a small flood event.

As a result, the Corps has received numerous requests from Federal and State agencies, local municipalities and agencies, and individuals to address the flood problems of the Middle Rio Grande Basin. These requests resulted in the U.S. Congress directing the Corps to define the problems of the basin, formulate and evaluate various solutions to these problems, evaluate their applicability under existing Federal programs, and recommend a corrective course of action. The discharge for the 10%-chance exceedance flow is 15,400 cfs at the SADD, which exceeds the minimum discharge of 800 cfs required for study under Corps authorities. Thus, several analyses have been conducted with the objective of addressing the water resource problems of the watershed.

The Flood Control Act of 1948 concluded that the flood problems of the Rio Grande Basin were severe and could be addressed under the Corps' flood risk management program. Due to changes within the basin over the years, including budgetary requirements, real estate constraints, flood risk management features implemented in the upper watershed, and environmental concerns, the features of the project have changed several times. Preparation of updated environmental compliance documents became necessary due to these changes and specifically those that have occurred since 1993, when the San Acacia to Bosque del Apache Unit Project was last reaffirmed to be implementable, as previously approved, in a Limited Reevaluation and Supplemental EIS (U.S. Army Corps of Engineers [Corps] 1992). Currently, a draft General Re-evaluation Report/Supplemental Environmental Impact Statement (GRR/SEIS; Corps 2012) is available for public review and comment. The GRR/SEIS is the final response to the project authority with respect to the San Acacia to Bosque Del Apache unit.

The major purposes for the flood control phase of the comprehensive plan described in the 1948 authorization, House Document 243, Appendix E, Project Planning are:

a. Provide protection against inundation by flash floods
b. Provide a stable channel having a lower river bed so that controlled releases of 5,000 cfs could be efficiently carried
c. Provide a lower river bed so that the channel effectively drains the river valley lands and results in a lower water table

Items b and c were intended to be performed by the Bureau of Reclamation through channel rectification and dredging. Flood control, now referred to as flood risk management, was to be performed by the Corps of Engineers through construction of dams and levees. Alternative methods for accomplishing flood risk management in the study area have been evaluated for compliance with Corps planning policy as well as the National Environmental Policy Act (NEPA), both of which were established after 1948.

2. Description of Proposed Action

2.1 Action Area

The action area comprises a the reach of the Rio Grande extending from the San Acacia Diversion Dam (SADD), near the historic community of San Acacia, south through the Bosque del Apache National Wildlife Refuge (BDANWR) to the Burlington Northern Santa Fe railroad near Tiffany Junction (where the railroad crosses the Low Flow Conveyance Channel (LFCC).

2.2 Description of the Proposed Action

Eleven total alternatives as well as the no-action alternative were considered and are presented in detail in the GRR/SEIS (Corps 2012). That document provides details as to the plan formulation process, the entire array of alternatives considered, alternatives not considered, and why the proposed plan was chosen. The following sections provide a description of the proposed plan and its various features (generally, from the north to south).

2.2.1 General Description

The proposed action consists of replacing approximately 43 miles of non-engineered spoil banks with engineered levees along the west bank of the Rio Grande from the SADD to Tiffany Junction. The spoil banks were constructed in the late 1960s by Reclamation using the spoil excavated from the adjacent LFCC and generally cannot withstand erosive flows. The spoil bank is estimated to fail at flows in the range of 11,800 to 13,240 cfs at San Acacia. The proposed engineered levees would be designed such that they would convey the 1%-chance event with a 98.9% level of confidence of not failing. The proposed levee would reduce potential flood-damage to inhabitants of the western flood plain, the LFCC, and numerous railroad, irrigation, drainage, transportation, and agricultural improvements within the length of the project area.

The levee alignment would follow that of the existing spoil bank between the LFCC and the Rio Grande. The levee design height is equivalent to the water surface elevation corresponding to the 1% chance flood, plus an additional 4 vertical feet. The discharge for the 1% chance flow is 29,900 cfs at the upstream end, attenuating to 15,000 cfs at the downstream end of the project.

The Corps regularly considers 50 years as the functional life of flood control structures. Non-Federal operations and maintenance requirements extend to perpetuity.

Appendix A to this BA contains plates showing the preliminary layout for the proposed action and will be referenced in the following sections. Appendix B depicts the with- and without-project floodplains of the 1%-chance flood event.

2.2.2 East Side Excavation

The floodway of the Rio Grande is constricted between higher ground on either side of the river at the San Acacia Diversion Dam. Special design features are required in this area to provide bank protection and to decrease the velocity and erosive potential of the design flood. To provide a wider corridor for flood flows, excavation of approximately 9.3 acres of the east bank would create a terrace at the 10%-chance exceedance water surface elevation along approximately 300 yards (Appendix A, Sheet C-111). At the base of the proposed terrace, an additional 3.1 acres of the existing bank would be excavated to the approximate 50%- exceedance water surface, sloping downward to the existing channel. Overall, the excavation and widening would increase the cross-sectional flow area and proportionally decrease the velocity. In addition, overbank lowering would allow river flows into higher-roughness areas, causing an overall reduction in velocity. Excavation would be scheduled for four months during fall and winter when river flow is relatively low and reliably stable.

During construction, a temporary river crossing would be required to access the east bank from the LFCC service road on the west bank of the Rio Grande. The temporary crossing would consist of an earthen ramp approximately 300 feet long, with a 15 foot top width and 2.5 horizontal to 1 vertical side slopes. Six 60-inch corrugated metal pipes would allow low flows through the crossing to maintain a wet river channel during construction. Conservation Measures would be used to minimize impacts to water quality for this feature and include the use of rubber cofferdams and silt curtains for the reduction of turbidity, ease of construction, provide a barrier between construction activities and river waters (and fish), slope protection for the culverts, and specialized grading to prevent runoff or sediment from entering the river at the location of the ramps. Rubber coffer dams also would be employed along the east bank to minimize contact between construction activities and the river waters.

Cofferdams and silt curtains would be deployed to minimize disturbance to fish in the immediate area. These barriers would be deployed by Corps biologists from the shoreline into the current to exclude fish from the area where the temporary ramp is constructed. These barriers also would be deployed to exclude fish from the construction activities when the ramp is removed.

2.2.3 Floodwall

In the vicinity of the Sana Acacia Diversion Dam, the corridor between the western bank of the river and the railroad track is too narrow to accommodate an earthen levee. Therefore, a cement floodwall would be constructed on top of the bank beginning at a point about 400 feet upstream of the diversion dam and extending 650 feet downstream (Appendix A, Sheet C-111). The floodwall would be approximately 4 feet high and would be flanked by a roller-compacted concrete apron along the downstream portion. Nearly the entire area encompassing the floodwall and apron is currently disturbed and devoid of vegetation. Approximately 0.25 acres of honey mesquite and fourwing saltbush would be removed to accommodate the floodwall at its upstream terminus.

2.2.4 Soil Cement Embankment

Although the East Side Excavation decreases the velocity of the design flood, there still would be a high potential for bank erosion along the eastern bank, especially in the large bend downstream from the SADD. Therefore, a soil-cement embankment would be constructed along 5,700 feet of the west bank immediately downstream from the SADD (Appendix A, Sheet C-112 – C-112). Soil cement would be placed in a series of horizontal lifts resulting in a stepped wall with an overall slope of 1:1 (Appendix A, Sheet C-142). The river bank is sufficiently high within this reach that a floodwall or levee would not be required to contain flood flows; however, the soil-cement embankment would be required to prevent erosion and undermining of the railroad track.

Vegetation would not grow on or within the soil-cement slope after construction.

Vertically, the soil-cement embankment begins at the base of railroad embankment and would be buried approximately 12 feet below the existing base of the riverbank slope[1]. The base of the soil-cement wall would fill approximately 0.56 acres of the present river channel. During excavation and placement of the soil-cement embankment, construction precautions similar to those described above for the temporary channel crossing would be employed to minimize the potential for water quality degradation or entrapment of fish.

2.2.5 Earthen Levee Construction

The new earthen levee would follow the alignment of the existing spoil bank throughout the reach. The earthen levee would begin where the soil-cement embankment ends (at 1.2 river-miles downstream from SADD). The proposed levee would terminate at the railroad embankment near Tiffany Junction, approximately 43.6 river-miles from the SADD.

The construction of the proposed levee would entail removing the existing spoil bank with heavy machinery, processing the material removed to obtain suitable fill material for new construction. All sorting and material mixing would occur within the footprint of the existing spoil bank during construction. Selected materials required for construction (*i.e.*, riprap and bentonite) would be acquired from commercial sources or borrowed at approved sites.

The landward toe of the proposed levee would be separated from LFCC maintenance road by an 18-foot-wide drainage ditch. Generally, the base of the proposed levee would be narrower than that of the existing spoil bank north of U.S. Highway 380, and would be equal to or greater than the base width of the spoil bank south of Highway 380. Positioning the landward toe as close as practicable to the maintenance road in order to minimize floodway encroachment by the structure was one of the design objectives for the new levee.

The proposed levee would remain trapezoidal in cross-section with a 15-foot-wide crest (Appendix A, Sheet C-141). Side slopes would vary between 1 vertical to 2.5 horizontal and 1 vertical to 3 horizontal, depending on the height of the levee. Levee height would range from 4 to 14 feet. Perforated pipe toe drains, discharge pipes into the LFCC, and risers would be required for levee heights greater than 5 feet. An 8-foot-wide by 4-foot-high inspection trench, with 1V:1H side slopes, would also be required for levee heights greater than 5 feet. In addition, a 2-foot-wide bentonite slurry trench extending downward from the design water surface elevation to the bottom of the inspection trench would be required for levee heights greater than 5 feet. The slurry trench would extend from 2 feet below the levee embankment crest to 5 feet into the foundation material. The slurry trench and toe drain system decrease the likelihood of the levee becoming saturated during long-duration floods.

Turnarounds would be located on the levee or existing disturbed locations used for spoil bank and LFCC maintenance. Specific locations would be determined after further coordination with all parties using the levee.

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[1] In the 30 November 2011 version of this BA, this feature was described as a combination of soil cement and riprap. Rather, the entire embankment would consist of soil cement.

The contractor would not be allowed to construct any new haul roads for the construction of this project. The existing haul road adjacent to and between the existing spoil bank and the LFCC would be used for the construction of the levee. A relatively small amount of surplus material would be stockpiled during construction of a given levee segment. Short-term stockpiles would be located within the disturbed footprint during construction of a given segment. Long-term stockpiles will only be located at staging areas or previously disturbed sites outside of the floodway.

2.2.6 Vegetation-free Zone

The Corps' Engineer Technical Letter 1110-2-571 (10 April 2009) provides guidelines to assure that landscape planting and vegetation management provide aesthetic and environmental benefits without compromising the reliability of levees. The vegetation-free zone requires that no vegetation, other than approved grass species be allowed to grow on the levee or within 15 feet of the riverward or landside toes of the levee. During construction, existing vegetation would be removed adjacent to the riverward and landside toes by clearing and grubbing, and root-plowing where salt cedar occurs. Since the landward side of the levee is currently maintained as an access road very little vegetation exists. Following construction, disturbed soils including the levee side slopes would be seeded with native grass species to prevent wind and water erosion. A 15-foot-wide vegetation-free zone would be permanently maintained to be devoid of any vegetation other than grasses. Vegetation-free zones would be mowed, when dry, at any time the grass reaches a height of 12 inches. Mowing would be triggered by grass heights of less than 12 inches if important to the health maintenance of the particular grass species.

2.2.7 Structures to Accommodate Tributary Flow

Three tributary arroyos in the project area empty into the Rio Grande from the west, crossing the LFCC and existing spoil bank: 1) San Lorenzo Arroyo enters the Rio Grande approximately 2.9 river-miles downstream of the SADD; 2) the Socorro Diversion Channel captures flows from the Socorro Canyon Arroyo, Nogal Canyon Arroyo, and several smaller arroyos, and empties into the Rio Grande just upstream of the city of Socorro, at 13.7 river-miles downstream from SADD; and 3) Brown Arroyo enters the Rio Grande approximately 22.2 river-miles downstream from SADD. Each of these tributaries was evaluated in order to determine if closure structures were needed to prevent flood flows on the Rio Grande from escaping the floodway.

Closure structures were determined not to be needed at San Lorenzo Arroyo and the Socorro Diversion Channel. Instead, levee tie-backs were designed to prevent overtopping of the interior drainage facilities at these places. It was determined that a closure structure was needed at Brown Arroyo (Appendix A, Sheets C-138 – C-139) to prevent the 1%-chance flood event from backing into Brown Arroyo for a distance of approximately 7,500 feet and a depth of up to 9 feet. Brown Arroyo is confined by non-engineered spoil banks that have a high risk of failure at high flood stages. This gated closure structure would be designed to pass Brown Arroyo flood flows while preventing longer-duration Rio Grande flood flows from potentially breaching the existing interior drainage facilities and is described below. The gated floodwall structure would be located where the new levee intersects the outfall channel of Brown Arroyo. The gate structure would consist of 10 sluice gates. Brown Arroyo inlet is skewed to the Rio Grande Floodway, so the gates are aligned in a zigzag configuration which would allow for flows from Brown Arroyo to enter directly into the gates.

Approximately 11.7 river-miles downstream from SADD, the "Nine-mile Outfall" consists of three large conduits that direct flow from the LFCC to the river when the canal is operated. The Corps would replace these with conduits equipped with flap gates to prevent flood flow from entering the LFCC.

There currently are three locations along the proposed levee alignment where Reclamation pumps water from the LFCC through the levee to the river when required to benefit endangered species. Currently, pumps are located approximately 3 miles north of Highway 380, and at both the north and south boundaries of BDANWR. The pumps provide flexibility for future water operations and adaptive management tools. The Corps would install permanent conduits through the proposed levee to accommodate these pumps at their current locations (or at alternate locations agreed to by Reclamation and the Service). Appropriate measures to ensure levee performance would be incorporated to the conduit design, including concrete encasement, appropriate filter materials, and slope protection.

2.2.8 Placement of Riprap along the Toe of the Levee

Ten portions of the new levee would require toe protection based on hydraulic analysis of scour velocities and proximity of the river channel to the proposed levee. The proposed locations of riprap protection are noted on the plans and profile plates in Appendix A (Sheets C-112 – C128). The protected portions range from 500 to 4,850 feet long, and the total length of erosion protection is approximately 31,700 linear feet (6.0 miles). Riprap protection would blanket the riverward slope of the levee from crest to toe, and would be buried to a depth of 6.5 to 12 feet beneath the levee toe (Appendix A, Sheet C-142). Self-launching riprap would be buried below the ground surface at the toe of the levee for potential scour depths greater than 12 feet but not exceeding 17 feet. Rock sizes used for riprap would vary from 0.75 to 3.5 feet in diameter depending of the velocities at potential scour locations. Coloration for rock used for riprap would vary; however, suitable material in the local area consists of dark colored basalt or grey metamorphic rock. Jetty jacks are currently located in and around the proposed project area and would continue to provide erosion protection to the proposed project.

2.2.9 Material Quantities and Waste Spoil

The existing spoil bank was built from material excavated for the LFCC rather than being designed relative to a specific flood discharge. The height of the proposed levee was initially designed to accommodate the mean water surface elevation of the 1%-chance flood event. After construction of the new levee, a large amount of excavated spoil material would remain unused. Hauling the waste spoil to a disposal location can be more expensive than incorporating that material into a larger levee structure. As required for all Corps-built flood risk management projects, the proposed levee was designed to maximize National Economic Development (NED) benefits. The cost of increasing the levee’s height in one-foot increments was evaluated relative to the increment benefit of reduced flood damages afforded by the taller levee. NED benefits were maximized by a levee structure 4 feet taller than the 1%-chance event structure. Still, a significant amount of spoil material requiring disposal results from the proposed levee’s design.

Table 2.1 summarizes the amount of excavation, usable soil material, and disposal requirements of the proposed action. The proposed levee would use approximately 44% of the excavated material, resulting in approximately 3 million cubic yards (1,881 acre-feet) of spoil material requiring disposal.

Three potential alternatives for the disposal of spoil waste would be employed in the proposed action. A number of existing borrow areas occur near the project area and could be used as disposal locations for the spoil waste generated during levee construction. The Corps would evaluate the cost effectiveness of utilizing these disturbed areas as disposal locations. Only locations that are devoid of significant ecological or cultural resources would be utilized.

Secondly, where the proposed levee would be narrower than the existing spoil bank, there may be opportunities to slightly shift the base of the new levee riverward while remaining within the disturbed footprint of the spoil bank. In these instances, some waste spoil (up to 656,000 cubic yards) could be deposited on the landward slope of the new levee structure.

The default location for the disposal of spoil waste evaluated in this BA is within the undeveloped Tiffany Basin at the south end of the project area. Although the ground surface in the basin is lower than the current riverbed, the basin would only be inundated due to failure of the spoil bank along its eastern edge. A spoil deposition area of up to 300 acres would accommodate the waste material from the proposed levee (3 million cubic yards, or 1,881 ac-ft). The area considered for spoil deposition is currently vegetated by salt cedar.

Table 2.1. Excavation and disposal quantities for the proposed action.

Item	**Volume (bank cubic yards)**
Excavated from spoil bank	5,233,730
Excavated from East Side Excavation	152,650
Excavation subtotal	*5,386,380*
Used as random fill in new levee	2,176,901
Used in rip rap toe protection (screened oversized waste)	174,152
Used subtotal	*2,351,053 (43.7% of excavated)*
Disposal total	3,035,327 (1,881 ac-ft)

2.2.10 Project Schedule

Based on anticipated Federal funding, the total construction period for the project entails 20 years. The current levee plan has been divided into 6 segments to provide manageable pieces of the project to construct in phases (Table 2.2). The first segment anticipated to be constructed is at

Socorro, extending from the Socorro Diversion Channel downstream to Brown Arroyo. The two segments north of Socorro would be next in order. Thereafter, phasing of the levee construction would occur from north to south beginning at Brown Arroyo. The Plans and Specifications for segment 1 of the levee plan would be initiated upon the completion and approval of the GRR/SEIS, expected in 2012. Construction for this segment is anticipated to begin in October 2012. Subsequent segments would be constructed annually as funding is received. Depending on the timing and seasonality of construction or presence of species of concern, construction of levee portions within a given segment may not be contiguous. Construction of concrete structures may occur prior to or after earthwork has been completed in a particular levee segment.

Table 2.2. Construction Schedule for the proposed action.

Segment	Location	Levee length (mi)	Number of annual contracts	Fiscal Years
1	Socorro North. Channel to Brown Arroyo	7.3	3	FY13 – 15
2	San Lorenzo Arroyo to Socorro North Channel	9.4	4	FY16 – 19
3	San Acacia Diversion Dam to San Lorenzo Arroyo	2.6	1	FY20
4	Brown Arroyo to US Hwy 380	4.7	2	FY21 – 22
5	US Hwy 380 to LFCC-weir at BDANWR	11.9	5	FY23 – 27
6	LFCC-weir at BDANWR to end	6.8	4	FY28 – 31
Total		42.7	19	

2.2.11 Conservation Measures

The following is a list of conservation measures and stipulations that would be complied with during construction of the proposed action to protect water resources and endangered species habitat from degradation:

1. Beginning with the breeding season prior to the initiation of each phase of construction, the Corps would perform or fund annual Southwestern Willow Flycatcher protocol surveys (5 visits per site per season) along the western bank of the floodway, eventually extending from San Acacia to San Marcial. Annual surveys would continue until the completion of construction and would continue for five years following the phased construction of each levee segment.
2. Levee and floodwall construction may occur throughout the calendar year; however, no construction would be performed within 0.25 mile of occupied flycatcher breeding territories (generally, late May through August 15). Traffic associated with construction

activities may continue along the construction alignment adjacent to occupied flycatcher breeding territories. All construction equipment and large trucks would be restricted to the maintenance roads adjacent to the LFCC. The levee and/or spoil bank would serve as a buffer between this traffic and flycatchers within the floodway. Small vehicles (*e.g.*, pickup trucks and SUVs) would occasionally travel along the top of the spoil bank / levee, as they do currently.

3. Vegetation removal and clearing-and-grubbing activities would be performed between August 15 and April 15. If needed, vegetation removal between April 15 and August 15 would only be performed if inspection by a qualified biologist determines that flycatchers (including both migrant and territorial birds) are not present within 500 feet of the vegetation patch to be removed.
4. If stream flow exists, it would be maintained during construction and the streambed contoured so that fish can migrate through the project area during and after construction.
5. Silt curtains, cofferdams, dikes, straw bales and other suitable erosion control measures would be employed to prevent sediment-laden runoff or contaminants from entering any watercourse.
6. Work would be performed below the elevation of the ordinary high water mark only during low-flow periods. This includes placement of the lower portions of the soil-cement wall, riprap blankets, and excavation along the east bank downstream from the SADD. No erodible fill materials would be placed below the elevation of the ordinary high water mark.
7. Qualified fisheries biologists would evaluate measures to exclude fish from in-channel construction areas. Cofferdams and silt curtains would be deployed by Corps biologists from the shoreline into the channel to exclude fish from construction areas where possible. If appropriate, biologists would coordinate with Service personnel to seine areas prior to placement of barriers in the construction area.
8. Concrete would be poured in forms and would be contained to prevent discharge into the river. Wastewater from concrete batching, vehicle washdown, and aggregate processing would be contained, and treated or removed for off-site disposal.
9. Fuels, lubricants, hydraulic fluids and other petrochemicals would be stored outside the 1%-chance floodplain, if practical. At the least, staging and fueling areas would be located west of the LFCC and would include spill prevention and containment features.
10. Construction equipment would be inspected daily to ensure that no leaks or discharges of lubricants, hydraulic fluids or fuels occur in the aquatic or riparian ecosystem. Any petroleum or chemical spills would be contained and removed, including any contaminated soil.
11. Only uncontaminated earth or crushed rock for backfills would be used.
12. Water quality would be monitored during construction to ensure compliance with state water quality standards for turbidity, pH, temperature, and dissolved solids.

2.2.12 Operation and Maintenance

Upon completion of each functional segment of the new levee, that portion of the project would be turned over to the local sponsor for operations and maintenance (O&M). The Corps would provide the sponsor with a manual describing the duties necessary for proper O&M of the segment, and the entire project.

In general, O&M would consist of maintaining the vegetation management zone free of woody vegetation larger than 0.5-inch-diameter stems or trunks. The sponsor would be responsible for maintaining levee integrity by repairing runoff erosion, eliminating rodent burrows in the levee, replacing riprap lost in flow events, and inspecting and cleaning seepage infrastructure regularly. The Corps and the sponsor also would perform annual inspections of the levee system.

2.2.13 Monitoring and Reporting

During the relatively long construction period (up to 20 years) for the proposed action, changes in design, construction methods, or the condition of ecological resources could alter the determinations of effects to listed species that are made by the Corps or Service at the present time. Therefore, this Section 7 consultation is being conducted programmatically to adapt proposed activities to changed conditions. The Corps, in conjunction with other concerned agencies, will monitor the condition of listed species, hydrology, and ecological resources in the action area throughout the construction period.

The criteria for reinitiation of formal consultation are contained in 50 CFR §402.16:

> "Reinitiation of formal consultation is required and shall be requested by the Federal agency or by the Service, where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and: (a) If the amount or extent of taking specified in the incidental take statement is exceeded; (b) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (c) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in the biological opinion; or (d) If a new species is listed or critical habitat designated that may be affected by the identified action."

Should any of these conditions arise, the Corps would reinitiate Section 7 consultation by providing the Service with a supplemental BA tiered to this Programmatic BA.

Several of the Conservation Measures in Section 2.2.11 of this BA include construction and monitoring activities that would avoid or minimize the potential for adverse effects to water quality during construction and would serve to avoid or minimize direct effects to the silvery minnow. Qualified fisheries biologists would monitor all construction activities within or adjacent to the Rio Grande channel and its tributaries.

Conservation Measure 1 provides that the Corps would perform or fund annual protocol surveys for the flycatcher in the action area, beginning with the breeding season preceding construction and continuing for five years following the phased construction of each levee segment. Flycatcher surveys for each anticipated segment of construction (see Table 2.2) would be conducted on the west bank of the Rio Grande one breeding season prior to the anticipated construction. Additional survey areas will be added for each segment as overall construction progresses. Information resulting from these surveys would be used to update resource conditions, avoid direct effects from construction activities, and to revise the determination of effects of the proposed project, if needed.

Construction contracts will include warranties or performance standards for the establishment of vegetation. For seeding, the requirements will specify that planted areas will exhibit vigorous growth after a one-year establishment period. Requirements typically will include stem density or percent cover measures which the Contracting Officer Representative will use to verify that the performance standards have been, or have not been, met. Any additional planting activities to meet the performance standard will be performed at the contractor's expense. The stem density or percent cover criteria included in each contract will vary depending on location-specific soil and moisture conditions, as well as the specified seed mix. For woody plantings (trees and shrubs), the performance standard will require at least 85% survival of planted material at the end of the third growing season following planting. If survival is less than this criterion, the contractor will install additional plantings to assure at least 85% living trees or shrubs.

The success of mitigative revegetation measures will be based on the acceptable development of vegetation and its likelihood of continued development into a mature stand. The exact criteria for success will be determined during ongoing ESA consultation with the Service and coordination with the Sevilleta and Bosque del Apache NWRs. Monitoring will be conducted by the Corps once each year during the summer growing season for five years following planting. Monitoring requirements beyond five years (to be determined during ongoing consultation and coordination) would be conducted by the project sponsor.

Avian utilization of revegetated areas will be documented through variable-distance point counts Ralph et al., 1993; Martin et al., 1997; Bibby et al., 2000; Buckland et al., 2001), and vegetation characteristics will be measured using commensurate methods (James and Shugart, 1970; Noon, 1981; Martin et al., 1997). Photographs will be taken at permanently established photo points.

The Corps will provide an annual report on progress to the Service during the construction period of the proposed action. Copies of the report will be furnished to the project sponsors, and pertinent Federal and local resource agencies. Annual reports will include:

- A summary of construction activities performed during the preceding year.
- A description of construction activities anticipated in the upcoming year.
- A description of refinements in design or construction activities, if any.
- A description and evaluation of Conservation Measures employed.
- A summary of the status of listed species, including the results of species-specific surveys.
- A description and evaluation of compliance with Reasonable and Prudent Alternatives in the Programmatic Biological Opinion, and with stipulations in its associated Incidental Take Statement.
- The status and success of mitigative revegetation measures and associated results of monitoring activities.

2.3 Consideration of Related Actions

In addition to activities authorized, funded, or carried out by Federal agencies, Section 7 consultation regulations also require agencies to consult on interrelated and interdependent actions. Interdependent actions are those having no independent utility apart from the proposed action (defined in 50 CFR §402.02). Interrelated actions are those actions that are part of a larger action and depend on the larger [proposed] action for their justification (defined in 50 CFR §402.02).

Both Reclamation and the Corps received the primary Congressional authorization for their actions in the Middle Rio Grande from the Flood Control Acts of 1948 (P.L. 80-858) and 1950 (P.L. 81-516). The responsibilities of each agency were defined in these acts and in a Joint Agreement[2] signed by the Corps, Reclamation, and the Department of Interior in 1947. The Corps is responsible for the construction, operation, and maintenance of:

- Abiquiu Dam and Reservoir
- Cochiti Dam
- Jemez Canyon Reservoir
- Levees for local flood protection.

Reclamation is responsible for:

- El Vado Reservoir
- Channel rectification
- Irrigation and project rehabilitation
- Drainage rehabilitation and extension

The Corps has determined that Reclamation's activities and the operation of Corps dams are not interrelated or interdependent with the proposed action evaluated in this BA. El Vado Reservoir, irrigation, channel rectification, flood-control operation, and drainage actions each have an independent utility separate from levee rehabilitation; and they do not singly or collectively depend on a new engineered levee for their justification or implementation.

The principal non-Federal water-management actions in the Middle Rio Grande are summarized in Section 3.2 of this BA. Additionally, several non-Federal signatories in the Middle Rio Grande Endangered Species Collaborative Program (Collaborative Program) have compiled summaries of their water management and depletion-related activities. The Corps has evaluated these activities and determined that they each have an independent utility separate from the Corps' proposed action; and they do not singly or collectively depend on Corps actions for their justification or implementation.

[2] Joint Agreement Between the Secretary of the Interior and the Secretary of the Army on a Unified Plan for the Control of Floods, Irrigation, and use of Water in the Middle Rio Grande Basin in New Mexico, July 25, 1947.

3. Environmental Baseline

Under Section 7(a)(2) of the ESA, when considering the effects of the action on Federally listed species, agencies are required to take into consideration the environmental baseline. Regulations implementing the ESA (50 CFR 402) define the environmental baseline as the past and present impacts of all Federal, State, Tribal, or private actions and other human activities in the action area; the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early Section 7 consultation; and the impacts of State and private actions that are contemporaneous with the consultation in progress. For each species, the environmental baseline describes its current status and its habitat in the action area as a point of comparison to assess the effects of the action now under consultation.

This chapter outlines the environmental baseline for this Section 7 consultation. The environmental baseline describes a "snapshot in time" that includes the effects of all past and present federal and non-federal human activities. All existing facilities and all previous and current effects of construction and operation of the dams, as well as all ongoing, Federal actions, non-Federal irrigation activities and existing physical features such as diversion dams, storage dams, and flood control dikes are part of the environmental baseline.

3.1 Recent and Contemporary Federal Actions

This list is not intended to be a comprehensive list of all recent and ongoing Federal actions, but rather to be a selection of recent actions located near or within the San Acacia to Bosque del Apache Unit.

3.1.1 U.S. Army Corps of Engineers

Reservoir Operations

The Corps of Engineers is currently preparing a biological assessment (BA) that evaluates the effects of the Corps' continuing, discretionary reservoir operation actions on Federally listed species and designated critical habitat within the middle Rio Grande valley of New Mexico. These activities include discretionary flood control operation of reservoirs, delivery of "carryover" floodwater, San Juan Chama water storage at Abiquiu Reservoir, delivery of Cochiti recreation pool water, maintenance actions at Corps-managed reservoirs, and temporary deviation for spawning and recruitment flows. It is expected that formal consultation would begin sometime during the winter of 2011.

3.1.2 Bureau of Reclamation

River Mile 111 Priority Site Project

In March 2008, Reclamation submitted a BA to the Service evaluating the effects of relocation of the Low Flow Conveyance Channel and the associated levee on the endangered flycatcher and minnow and designated critical habitat. The project would allow the Rio Grande more freedom to move within its historic floodplain. Reclamation determined that the project "may affect, is not likely to adversely affect" the minnow and its designated habitat. The Service concurred with this determination (Consultation #22420-2008-I-0067), provided the following conditions were met: 1) all construction of woody debris piles would occur under dry working conditions or during low flow conditions; 2) recent surveys of the Low-Flow Conveyance Channel (LFCC) downstream of the proposed construction area did not find any minnows; 3) the Lemitar radial gate structure would be closed during the construction operations; 4) cottonwood root wads would be placed on the bank near river mile (RM) 111 and would cascade into the river as it migrates west; and 5) the mitigation plan described in the BA would be fully implemented and the Conservation Measures described in the BA would also be fully implemented by Reclamation.

Rio Grande Sediment Plug Removal Project at Bosque del Apache National Wildlife Refuge

In August 2008, Reclamation submitted a BA to the Service addressing potential impacts of removal of a sediment plug, which had formed within the Rio Grande at the BDANWR during spring runoff 2008, on the endangered minnow and its designated critical habitat and on the endangered flycatcher. Reclamation's environmental commitments for the Sediment Plug Removal Project include: 1) construction of at least four embayments (each approximately 30 to 50 feet in width and 50 to 70 feet in length) on the west side of the pilot channel to promote channel widening to be completed during Phase I(b); 2) collection of data for four years following excavation of the pilot channel to monitor channel degradation/aggradation and overbanking patterns, including *i.* cross-section data of the river channel from the north boundary of the BDANWR to the San Marcial Railroad Bridge; *ii.* at least two inspections of the river channel by boat when overbanking begins during runoff; and *iii.* at least once during the four years, cross-section data of the river channel and floodplains that extend between endpoints for these rangelines; 3) data collected as above will be analyzed and compared to 2002 and 2005 cross-section data to assess changes to the riverbed thalweg and channel geometry, including width/depth ratio, and data and analysis will be provided to the Service (New Mexico Ecological Service Field Office and the BDANWR); and 4) in-depth analysis of alternatives to pilot channel construction within the aforementioned reach of river to be initiated within six months of completion of Phase I(b) of the project. This included: at least three strategies to address sediment transport through the reach; maintenance of connected unvegetated river bars; opportunities for river realignment following sand plug formation; river connectivity during low flows; river/floodplain surface connectivity; surface water supplies to adjacent wetlands; and effects on threatened, endangered, or candidate species. This analysis must be conducted in coordination with the Service, and the final report must be completed within three years and will be used in all future sediment plug removal or maintenance activities within the BDANWR.

Drain Unit 7 Extension River Maintenance Priority Site Project

On June 13, 2008, Reclamation submitted a BA, along with a letter formally requesting consultation reinitiation, to the Service for the proposed Drain Unit 7 (DU7) Extension River Maintenance Priority Site Project. The project will reinforce the bankline and protect the adjacent access road and drain by placing riprap along the bank within the active river channel. Reclamation determined that this action may affect, and is likely to adversely affect, the endangered minnow during construction; and may affect, and is not likely to adversely affect, designated minnow critical habitat. The Service concluded that the proposed action is not likely to jeopardize the continued existence of the minnow and that there is likely to be short-term adverse effects on a very small portion of designated critical habitat at the construction site.

Environmental commitments associated with the proposed DU7 Project include: implementing construction Best Management Practices (BMPs) and dust abatement during construction; re-vegetating the site; and performing construction outside minnow spawning periods (construction exclusion period of April 15 through July 1).

3.2 Recent and Contemporary Non-Federal Actions

The past and present impacts of non-Federal actions which are contemporaneous with the consultation in process are included in the environmental baseline. Future impacts of these same non-Federal actions will be considered as cumulative effects in the analysis of effects discussion in Chapter 5 of this BA. The following is considered a non-exhaustive list of non-Federal actions.

3.2.1 Rio Grande Compact

Water uses on the Middle Rio Grande must be conducted in conformance with the Compact administered by the Rio Grande Compact Commission. The four-member Commission is composed of Commissioners from Colorado, New Mexico, and Texas, as well as a Federal representative who chairs Commission meetings. Colorado is prohibited from accruing a debit, or under-delivery to the downstream States, of more than 100,000 ac-ft, while New Mexico's accrued debit to Texas is limited to 200,000 ac-ft. These limits may be exceeded if caused by holdover storage in certain reservoirs, but water must be retained in the reservoirs to the extent of the accrued debit. Any deviation from the terms of the Compact requires unanimous approval from the three state Commissioners.

In order to meet delivery obligations under the Compact, depletions within New Mexico are carefully controlled. Allowable depletions above Otowi gage (located outside of Santa Fe, near the Pueblo of San Ildefonso) are confined to levels defined in the Compact. Allowable depletions below Otowi gage and above the headwaters of Elephant Butte Reservoir are calculated based on the flows passing through Otowi gage. The maximum allowable depletions below Otowi gage are limited to 405,000 ac-ft in addition to tributary inflows. In an average year, when 1,100,000 ac-ft of water passes the gage, approximately 393,000 ac-ft of water is allowed to be depleted below Otowi gage, in addition to tributary inflows. Depletion volumes are lower in dry years. For instance, in 1977, allowable depletions were 264,600 ac-ft in addition to tributary inflows. No Indian water rights may be impaired by the State's Compact management activities.

3.2.2 State of New Mexico

The State of New Mexico has a wide range of agencies that actively represent different aspects of the State's interest in water management:

New Mexico Office of the State Engineer

The New Mexico State Engineer has general supervision of the waters of the State and of the measurement, appropriation, and distribution thereof (N.M. Stat. Ann. 72-2-1 Repl. Pamp. 1994). The Office of the State Engineer (OSE) grants state water rights permits, ensures that applicants meet state permit requirements, and enforces the water laws of the State. The OSE is responsible for administering water rights, including changing points of diversion and places or purposes of use. The OSE uses the "Middle Rio Grande Administrative Area Guidelines for Review of Water Right Applications" to assess the validity and transfer of pre-1907 water rights.

New Mexico Interstate Stream Commission

The New Mexico Interstate Stream Commission (NMISC) is authorized to develop, conserve, protect and to do any and all things necessary to protect, conserve, and develop the waters and stream systems of the State. It is responsible for representing New Mexico's interests in making interstate stream deliveries, as well as for investigating, planning, and developing the State's water supplies. The State cooperates with Reclamation to perform annual construction and maintenance work under the State of New Mexico Cooperative Program. In the past, this work has included some river maintenance on the Rio Chama, maintenance of Drain Unit 7, drain and canal maintenance within the BDANWR, similar work at the state refuges, and temporary pilot channels into Elephant Butte Reservoir.

New Mexico Department of Game and Fish

The New Mexico Department of Game and Fish (NMDGF) administers programs concerned with conservation of endangered species and of game and fish resources. It also manages the La Joya Wildlife Management Area and Bernardo Wildlife Area.

New Mexico Environment Department

The New Mexico Environment Department (NMED) administers the State's water quality program including compliance with various sections of the Clean Water Act. Section 303 of the Clean Water Act allows NMED to establish water quality standards for water bodies and total maximum daily loads for each pollutant. Section 402 of the Clean Water Act includes the National Pollutant Discharge Elimination System Storm Water Permit Program.

3.2.3 Counties

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

3.2.4 Villages, Towns, and Cities

Citizens in a multitude of villages, towns, and cities are served with municipal and industrial water systems. While most use groundwater exclusively, Santa Fe also uses surface water supplies, and both the cities of Albuquerque and Santa Fe use San Juan-Chama surface water in addition to groundwater. To the extent that future groundwater pumping or use of surface water depletes the river, the New Mexico State Engineer requires that these depletions be offset, either by acquiring other water rights or with San Juan-Chama Project water. Many of these contractors have voluntarily entered into annual lease programs with Reclamation to enhance Middle Rio

Grande valley water management. Municipalities also manage wastewater treatment systems that are point source discharges into the Rio Grande. Municipalities also release storm water discharge into the Rio Grande.

3.2.5 Irrigation Interests

Irrigation interests include a variety of the acequias, pueblos, individual irrigators, and ditch associations, as well as the MRGCD, which have water rights to divert the natural flow of the Rio Grande for beneficial use and then return unused water to the Rio Grande. Many of these irrigation interests have existed for hundreds of years. The MRGCD was established under state law in 1928, to address issues such as valley drainage and flooding, and currently operates the diversion dams of the Middle Rio Grande Project to deliver irrigation water to lands in the middle valley, including areas on six pueblos.

3.3 General Environmental Setting

The proposed project is located in the Middle Rio Grande, a 219-mile-long reach of the river in New Mexico extending from Velarde to Elephant Butte Reservoir. In this reach, the floodplain is entrenched in an alluvium-filled rift valley that ranges from less than 1 mile to about 12 miles wide. Principal tributaries to the Rio Grande below Cochiti Dam are Galisteo Creek, Rio Jemez, Rio Puerco, and Rio Salado. The latter two tributaries are located approximately 10 and 2 miles upstream of the project area, respectively.

The project area extends from the SADD, located 12 miles north of the City of Socorro, New Mexico, downstream to the railroad bridge over the LFCC at the northern end of Tiffany Junction. Several of the alternatives considered extended south to include the railroad crossing at San Marcial. This area includes the southern-most section of the Middle Rio Grande. River channel, off-channel wetlands, riparian woodlands, floodplain farmland, river terraces and piedmont (bajada) surfaces covered in grasses and shrubs, basalt-capped mesas, and nearby mountains characterize a cross-section of the rift from the river to the adjoining uplands. The floodplain and bordering terraces are mostly rural and used for irrigated farmland, livestock grazing, and wildlife conservation. The City of Socorro is the only urban center in the region. Smaller communities are scattered throughout the project area. Elephant Butte Reservoir, downstream of the project area, is the largest reservoir in New Mexico; it stores water for irrigation and recreation. The project area runs through BDANWR, which provides habitat for wintering waterfowl, cranes, other wading birds, endangered species, and a rich diversity of resident and migrant wildlife (Corps 1992).

Historically, the segment of the Rio Grande in the proposed project area was a large, braided, and meandering river system with a diversity of channels, oxbows, and marshes, influenced by cycles of frequent floods and periodic channel desiccation. Conversion of riparian areas to farmland and diversion of water for irrigation began as early as AD 1350, and peaked about 1880, when an estimated 125,000 acres in the Middle Rio Grande Valley were in cultivation (Scurlock 1998). Tree harvest for fuelwood and building materials, first by the Pueblo people and later by early European settlers, further depleted the larger woody riparian vegetation. The introduction of exotic (non-native) trees and shrubs, including Russian olive, saltcedar, and Siberian elm, which started during the late nineteenth century, created habitat competition for the native species. Large-scale grazing has been important in the valley since the 18th Century. Collectively, these activities narrowed the bosque, reduced and altered the species composition of its woodlands, and increased the sediment yield from the watershed (Crawford *et al*. 1993). There is evidence that drier climatic conditions also affected the watershed's sediment yield by reducing vegetation ground cover (Lagasse 1980), a phenomena that may increase with climate change.

The ecology of the valley is conditioned by the Great Basin Grassland, Semidesert Grassland, and Chihuahuan Desert Scrub biotic communities through which the river flows (Crawford et al. 1993). The major plant communities in the active floodplain of the Middle Rio Grande Valley include woodlands, shrublands, grasslands, and emergent wetlands (Tetra Tech 2004). Vegetation mapping produced by Parametrix (2008) has been used to quantitatively characterize the vegetation composition and is the most complete digitized coverage available to date.

The proposed action area has an arid to semi-arid continental climate characterized by light precipitation, abundant sunshine, low relative humidity, and wide diurnal and annual range of temperature (Crawford et al. 1993). Summer daytime temperatures can exceed 100 degrees Fahrenheit (°F). Average maximum temperatures in January range from the upper 30°F range to the upper 40°F range. Temperatures below freezing are common during the winter. Relative humidity is usually low, mitigating considerably the effects of the temperature extremes in both winter and summer. Humidity during the warmer months is below 20% much of the time. Wind speeds are usually moderate; however, relatively strong winds often accompany frontal activity in late winter and spring, and may exceed 30 miles per hour for several hours. Sources of these moisture-laden air masses are the Pacific Ocean and the Gulf of Mexico. Average annual precipitation is less than 10 inches throughout the proposed action area. Approximately 50% of the annual precipitation occurs during the three-month period of July through October, usually as brief, intense thunderstorms. Winter precipitation, most of which comes from the Pacific Ocean, falls primarily in connection with frontal activity associated with the general movement of storms from west to east. In winter and spring, moisture transported from the Pacific by westerly winds can be amplified by the El Niño/La Niña phenomenon, which ties regional precipitation to global climate (Crawford et al. 1993).

3.3.1 Geology and Soils

The project area lies within the San Marcial structural basin in central New Mexico, which extends from San Acacia to the upper end of Elephant Butte Reservoir. This basin is bounded to the west by the Socorro, Magdalena, and San Mateo mountains. The eastern boundary of the San Marcial basin is the San Pasqual Platform, which is a north-south trending block of Mesozoic sedimentary rocks overlain by Santa Fe Formation alluvium.

Rifting (extension and uplifting) began in the region approximately 36 million years ago resulting in a central valley surrounded on both sides by faulted, upthrown mountain ranges. The rift valley itself is segmented by faults, with different structural basins (half grabens) tilted strongly to the east or west depending on the location of the master structural faults (Keller and Cather 1994). The Tertiary Datil Volcanic Field borders the project area to the west. Silic and andesitic volcanic rocks of the Datil field overlie older Mississippian, Pennsylvanian, and Permian sedimentary rocks (Keller and Cather 1994). The Socorro, Magdalena, and San Mateo mountains that bound the western part of the study area are composed of uplifted, faulted blocks of Datil volcanic and older sedimentary rocks (Keller and Cather 1994).

As uplift and volcanism occurred, sediment eroded from the highlands was washed into the basin producing a complex sequence of gravel, sand, silt, clay, and volcanic deposits known as the Santa Fe Formation. Much of the Santa Fe Formation is overlain by unconsolidated Quaternary alluvium and locally thick piedmont detritus. The thickness of the deposits in the deeper parts of the basin is estimated at 15,000 feet. Soils within the proposed action area are generally silty sands and sandy clays.

A subsurface investigation was conducted within the proposed project area at the LFCC and Rio Grande for the Rio Grande Floodway: Feature Design Memorandum. San Acacia to Bosque del Apache Unit, NM, which was published in 1991 by the Corps (Corps 1991). The borings for the Feature Design Memorandum were drilled to a maximum depth of 25 feet and indicate that the foundation soils in these areas are composed of alluvium consisting of predominantly fine silty sand and sand with traces of silt, clay, and gravel. The soils are typically very loose to medium dense with corrected blow counts ranging from a low of 6 to a high of 22.

In 2006, 2008, and 2010, additional subsurface investigations were conducted along the proposed levee alignment in accordance with ETL 1110-2-563 *Engineering and Design: Design Guidance for Levee Underseepage*. Drill log data indicates the foundation materials were predominantly poorly sorted sand and silty sand. Relative densities, determined from correlation to Standard Penetration Tests, varied from soft/loose at shallower depths with generally increasing relative density to hard/very dense to 50 feet. Drill log data indicates the existing spoil bank was constructed of sands, silty sands, and clayey sands, with random layers of clay. Drill log data indicates the majority of the materials are very loose to loose. Materials in the existing spoil bank are layered, potentially indicating that construction was phased. No identifiable zoning or seepage control measures were noted.

Typical alluvial deposits and soils are quite variable and discontinuous. Foundation materials along the proposed levee alignment are generally sands, silty sands, and sandy clays. These foundation soils are generally considered suitable provided adequate preparation is provided at locations of identified low-density material. Weak clay layers composed of high-plasticity clay are also present in the foundation. Exploration indicates that the layers are generally randomly located, are relatively thin, and have sand layers above and below that allow dissipation of excess pore pressures upon construction of new levee, leading to consolidation and increased strength. During construction of the new levee, soft clay layers near the foundation surface can be over-excavated and removed. Lower layers of existing spoil bank foundations have been previously consolidated by the upper layers placed on the existing spoil bank; therefore, only the weight of fill required to increase the height of the existing spoil bank would contribute to additional consolidation and settlement of the foundation. Since in most cases the new levee would be smaller than the existing spoil bank, consolidation and settlement of the foundation is considered to be minimal for the project. Areas where the new levee height is greater than the spoil bank would be evaluated for potential consolidation or settlement issues by analysis of the boring logs at those locations. The levee section would be overbuilt at locations where consolidation or settlement is deemed an issue by further analysis.

3.3.2 Hydrology and Hydraulics

There are more than 8,500 square miles (mi^2) of contributing, uncontrolled drainage upstream of the project area. The two largest ephemeral tributaries are the Rio Puerco (7,350 mi^2) and Rio Salado (1,395 mi^2). These tributaries meet the Rio Grande approximately 10 miles and 2 miles upstream of the project area, respectively. In combination, these two tributaries can produce flows far greater than the protection provided by the existing spoil banks. Flows from these two tributaries, coinciding with high flows on the mainstem of the Rio Grande, would create the most severe flooding condition possible through the proposed action reach. Other contributing tributary drainages east of the river provide small flood potentials in comparison to the Rio Puerco and Rio Salado.

River Geomorphology and Sedimentation

Present water management in the Middle Rio Grande valley implemented as a result of the 1948 authorization for the Rio Grande Floodway includes flood risk and sediment management dams and reservoirs, irrigation storage reservoirs, levees, channel maintenance, irrigation diversions, drainage systems, and runoff conveyance systems. In addition, the river has been laterally stabilized in the floodplain by the installation of jetty jacks in the 1950s and 1960s (Crawford *et al.* 1993). River sediment loads and debris settled in the jacks, creating stable banks and a riparian zone of cottonwood, Russian olive, willow, and saltcedar (Crawford *et al.* 1993). All these activities affect channel morphology through alterations in discharge and sediment load. The river discharge influences the size of the channel, whereas the type of material transported influences the character of the channel. The existing spoil bank limits meandering to the area east of the spoil bank and controls the degradation/aggradation process. The increased vegetation hastens aggradation in the overbanks through increased roughness and lowered velocities and energy. The current status of the channel morphology is a result of these earlier and ongoing activities and water management.

In the San Acacia to Bosque del Apache Unit, stream channel incision has been pronounced from immediately upstream of the San Acacia diversion dam extending downstream of the SADD to approximately 4 miles above a point on the river parallel to the intersection between US 60 and Interstate 25. Localized geologic uplift is a major contributor to stream channel incision in this reach. Below this point, for a distance of less than 10 miles, the river is neither incising nor aggrading, and below this, the river channel is in a long-term aggradation pattern (Massong *et al.* 2006). Aggradation is occurring within the floodway, raising it as much as 10 to 12 feet above the adjacent, sediment-starved historical floodplain (Figure 3.1).

With individual years' average sediment concentrations as high as about 200,000 mg/L the Middle Rio Grande is one of the more heavily sediment-laden streams on earth (Baird 1999). The combination of high sediment loading coupled with confinement of the floodway by spoil banks has resulted in a perched channel, whereby the active channel and adjacent overbanks are elevated above the historic floodplain lying outside the leveed floodway. The elevation differences on either side of the spoil bank are becoming worrisome, with disparities on the order of 10 to 15 feet in downstream reaches.

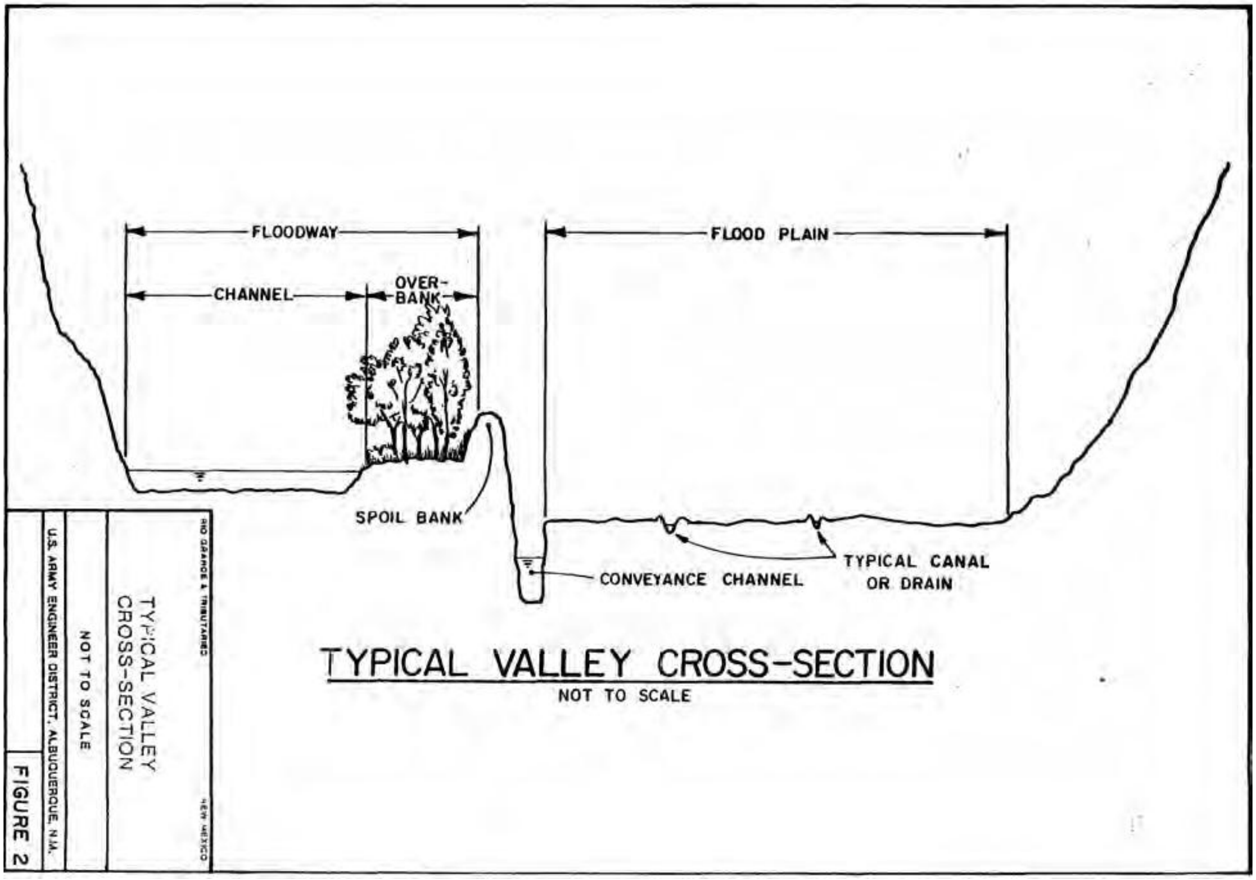

Figure 3.1. Typical cross-section of perched channel where the river channel is significantly higher than the floodplain landward of the spoil bank.

One area of particular concern is Tiffany Basin, located on the west side of the river channel, near the Tiffany Junction railroad siding, immediately upstream of the San Marcial Railroad Bridge. Tiffany Basin has an areal extent of roughly 2,053 acres, is bounded on all sides by either spoil banks or railroad embankment, and is normally isolated from sediment-laden river flows. The absence of frequent deposition has left this basin at a significantly lower elevation than the adjacent river floodway. Separated from spring runoff and flashy peaks by the non-engineered spoil bank, the probability for flooding of this area is greater than its historical frequency would suggest because this flood frequency has been reduced due to flood-fighting efforts by Reclamation. During floods larger than the 20%-chance event (11,800 cfs), the spoil bank would likely fail and could induce a significant headcut in the Rio Grande channel and threatening portions of the spoil bank upstream from the breach. Additionally, this closed basin would capture approximately 10,000 to 15,000 acre-feet of water and, after flood flows recede, all fish that have entered.

Sediment is primarily provided by uncontrolled, ephemeral tributary flows from the Rio Puerco and Rio Salado, which contribute large volumes of sediment due to their large drainage areas, arid climate, and sparse vegetation cover throughout most of their drainages. These high sediment loads have contributed to the high aggradation rate in the San Marcial Reach, which historically has been greater than in any other reach in the Middle Rio Grande. For example, from approximately 1880 to 1924, the riverbed aggraded 9 feet at the San Marcial Railroad Bridge. These high sediment loads also contributed to a history of sediment plug formation in the reach often forming approximately 1.5 miles upstream of the San Marcial Railroad Bridge, near RM 70. Four plugs have formed in this area in the last 18 years in 1991, 1995, 2005, and 2008.

There are indications of plugs forming in years prior to 1991, but they were apparently removed as part of Reclamation's routine river dredging program of that era. The 1991 plug caused a breach of the spoil bank on the west side of the river. The 1995 plug grew to a length of approximately 5 miles and the 2005 plug to 3 miles. Both of these plugs caused a significant rise in the water surface against the spoil bank and prompted emergency levee work during periods of high runoff.

During the 2008 spring runoff, a fourth sediment plug formed in the main channel of the river within BDANWR, immediately downstream of RM 81. The main channel was completely plugged with sediment for a length of 0.5 miles and partially plugged upstream of that for a distance of over a mile. After the spring runoff, a pilot channel, approximately 25 feet in width, was excavated through the plug and excavated spoil material was placed on the west side of the channel to form a spoil bank. The length of the pilot channel was 1.4 miles. The river widened the excavated pilot channel quickly. Within three months, most of the pilot channel returned to the pre-plug width, with only two short sections of spoil banks remaining, totaling 600 linear feet.

Sediment plug formation is a symptom of the larger problem of aggradation due to channel confinement due to constructed spoil banks, jetty jacks, channel rectification, and other factors. When the channel and floodplain inside the spoil banks aggrade, the river channel becomes "perched" above the former floodplain. This perched channel condition exacerbates the consequences from flooding since water entering the former floodplain has no way to drain back into the river. Flood water remains on the floodplain until it infiltrates or evaporates.

In addition to being affected by the high sediment loads, the geomorphology of the San Marcial reach and the lower part of the proposed action area also have been affected by the pool level in Elephant Butte Reservoir since its construction in 1916. During wet periods with a full reservoir, slower flows in the river reach immediately upstream of the reservoir leads to high rates of sedimentation and channel aggradation. During dry periods and recession of the reservoir, base level fall leads to channel incision and degradation.

During high reservoir stages, a delta typically forms where the river enters Elephant Butte Reservoir, and sometimes a temporary channel must be cut into this delta to facilitate stream flow. Following the drought-induced drawdown of Elephant Butte Reservoir that began in 2003, a headcut developed near RM 58 within the upper reach of the temporary channel that had been cut through the reservoir delta that had formed during preceding wet years. By September 2009 this headcut had migrated north into BDANWR. As this reach has historically been rapidly aggrading, this incision is presumed to be temporary (Massong *et al.* 2008). The aggraded overbanks, which occupy a large proportion of the floodway capacity, are largely unaffected by this localized and transient headcut. From a design perspective, any capacity added through this headcut is ephemeral and could not be relied upon to add meaningful longer-term flood protection within the reach.

Hydrology and Flooding

Surface flows of the Middle Rio Grande are of two general types: snowmelt runoff and stormwater runoff. Snowmelt runoff generally occurs from April through June as a result of snowmelt, which may be augmented by general precipitation (Corps *et al.* 2007). Spring flows are characterized by gradual rises to moderate discharge rates, large runoff volumes, and approximately two-month-long flow durations, with shorter duration peak flows included. Since it was completed in 1975, flow regulation upstream at Cochiti Dam substantially limits potential for spring flooding through the proposed action area. Stormwater runoff is typified by summer monsoonal flash flows that may occur from May through October. Summer monsoon flows are characterized by sharp, high peak flows that recede quickly and generally contain smaller runoff volumes (Corps *et al.* 2007). However, most of the floods producing the greatest damage within the proposed action area have been flows from summer storms entering the Rio Grande through tributary inflows from the Rio Puerco and Rio Salado. The potential for significant floods within the proposed action area originating through either of these tributary watersheds remains largely unaltered from historical flood potentials. Currently, flows above 7,000 cubic feet per second (cfs) through the Middle Rio Grande valley are considered flood flows. During years of low snowmelt runoff and precipitation, surface flows in the main channel of the river can be eliminated for extended periods because of irrigation or water delivery diversions. The river channel below San Acacia can be dry for several months due to upstream diversions during the irrigation season (Corps *et al.* 2007).

There are two different methods commonly used for referring to the likelihood or frequency of a flood event of a specific magnitude. In the past, the Corps has used periods of time (*e.g.*, the 100 year-event) to describe a flooding event that is expected to happen on the order of once every 100 years. However, this convention is somewhat misleading because a 100-year-event can happen multiple times within a single century. For that reason, the Corps has started describing these flooding events by the percent chance that these events have of being equaled or exceeded in any given year. For example, the 100-year-event has a 1% chance of occurring or being exceeded any given year. The Corps used hydrologic routing models to predict flood routing and magnitudes at various cross-sections in the action area without construction of the proposed levee. A discussion on how these discharges are derived is presented in Appendixes F2-F4 (Hydrology, Hydraulics, and Sedimentation) of the GRR/SEIS (Corps 2012) and events referred to in this BA are presented in Table 3.1.

Table 3.1. Discharge frequency, return interval, and projected peak flow at San Acacia Diversion Dam.

Percent chance event (%)	Return period flood event (year event)	Projected peak flow at San Acacia diversion dam without proposed action (cfs)
0.2	500	43,500
1	100	29,900
2	50	25,000
10	10	15,400
14	7.1	13,240
20	5	11,800
50	2	7 ,380
80	1.25	4,770
99	1.01	2,420

The existing west bank spoil levee in the project area provides the current level of flood risk management and corresponding degree of active channel restriction. Analysis performed by the Corps (see Corps 2012 for a complete list of references) indicates that with maintenance such as described in the previous subsection, the existing spoil bank would potentially fail at a flood magnitude equal to the 20%- to 14%-chance event or at flows between 11,800 and 13,240 cfs.

The area subject to major flood damage from inundation, scour, and sediment deposition by the Rio Grande, prior to placement of the existing spoil bank, was the floodplain on the west side of the river from San Acacia to the upstream end of the Elephant Butte Reservoir pool. The east side of the river is largely undeveloped, with few improvements susceptible to flood damage from the Rio Grande, although there are a couple of rural communities across the river from Socorro (Corps *et al.* 2007).

3.3.3 San Marcial Railroad Bridge

The existing San Marcial Railroad Bridge, originally constructed in 1929, is a significant restriction that limits the capacity of the channel to pass unregulated flood flows originating downstream from Cochiti Dam. This, in turn, enhances the deposition of sediment and aggradation of the river channel and floodplain. The bridge alignment is skewed with an angle of approximately 30 degrees with respect to the river channel. The existing bridge crossing consists of five modified Warren through trusses, each spanning nearly 150 feet. The reinforced concrete bridge piers with timber crib wall abutments supporting these spans are wide, flat-nosed, and inefficient at passing flows. The lower chord of the bridge has been as little as 5 feet above the river bottom in the recent past. The combination of poor bridge alignment and inefficient pier design causes the flow of Rio Grande to slow drastically through the area, dropping much of its sediment load, which backs-up upstream of the bridge.

Sedimentation in the immediate vicinity of the existing San Marcial Railroad Bridge have been significant, and increasing as time goes on, in terms of reductions in conveyance capacity and increases in maintenance effort. The Corps examined the sedimentation impacts and determined that the sediment would continue to deposit and that the floodway would continue to aggrade at historic rates. For conditions 50 years into the future, the Corps assumed that the BNSF will replace the bridge at some point during the intervening years.

In May 1996, the Corps initiated formal consultation (Consultation #2-22-95-F-180) on the *Rio Grande Floodway, San Acacia to Bosque del Apache* project, which entailed the replacement of 42 miles of existing spoil bank with a superior and competent engineered levee. The Service issued a draft Biological Opinion BO (USFWS 1996) in November 1996 that determined the proposed project would likely jeopardize the continued existence of both the Southwestern Willow Flycatcher and the Rio Grande silvery minnow, and would likely result in destruction and adverse modification of proposed critical habitat for the minnow. The attendant Reasonable and Prudent Alternative (RPA) included, in part, the "management of the Middle Rio Grande to mimic timing of the historic hydrograph with sufficient flows to provide adequate overbank flooding to meet flycatcher needs."

During continuing plan formulation for the *San Acacia to Bosque del Apache* project, hydraulic analyses indicated that the proposed levee would sufficiently increase water surface elevations in the Rio Grande to result in an increased probability and frequency of damage to the railroad bridge, and that the railroad bridge would sustain damages that it normally would not sustain under existing (pre-construction) conditions. The Corps does not have the authority to routinely improve or replace private property that can potentially be physically or economically damaged by regulated flood flows. However, the increased probability and frequency in damage to the San Marcial Railroad Bridge as a result of proposed levee construction was determined to represent a compensable taking under the Fifth Amendment of the Constitution. In such cases, the Federal Government has the responsibility and is authorized to provide compensation for actions which negatively affect private property rights. In this case, it was determined that the least expensive compensation alternative was to replace the bridge in-kind, at a height and location where it would no longer be subject to damage. The replacement and relocation of the railroad bridge was incorporated as a justified feature of the Corps reevaluation study for the *San Acacia to Bosque del Apache* flood protection project.

In 2003, the Corps consulted on the operation of its Middle Rio Grande reservoirs relative to the Endangered Species Act (Consultation # 2-22-03-F-0129). The Biological Opinion (BO) issued in March 2003 (USFWS 2003) found that the proposed action would likely jeopardize the continued existence of the endangered Rio Grande silvery minnow and the endangered Southwestern Willow Flycatcher, and would likely adversely modify designated critical habitat for the silvery minnow. The Corps proposed the replacement of the San Marcial Railroad Bridge as an environmental commitment that would facilitate increased discharges and subsequently benefit the listed species. Element U of the RPA of the 2003 BO therefore states, in part: "Action agencies … shall collaborate on the river realignment and proposed relocation of the San Marcial Railroad Bridge project, which is necessary to increase the safe channel capacity within the Middle Rio Grande." This inclusion in the 2003 BO was, at the time, consistent with the scope of the Corps' legal authority and jurisdiction.

Subsequently, analyses based on updated hydro-meteorological data resulted in a significant (30%) decrease in the magnitude of the 1%-chance flood event; that is, from 43,000 cfs to approximately 30,000 cfs at San Acacia. Based on these new evaluations, construction of an engineered levee along the west bank of the Rio Grande would have minimal effect on the potential for damaging the San Marcial Railroad Bridge. In essence, the probability of damages to the bridge is the same for both the with- and without-levee project condition. Therefore, there are no induced flood damages to the Bridge that can be attributed to construction of the levees, which means there is no compensable taking under the 5th Amendment, and as a result, the Federal Government would bear no responsibility, nor would it be in the Federal interest to relocate the bridge under the auspices of the *San Acacia to Bosque del Apache* project.

The railroad bridge has not functioned to curtail the regulated flood releases (*i.e.*, 7,000 cfs as measured at Albuquerque) from Corps reservoirs since 1997. High storage in Elephant Butte Reservoir—a few miles downstream from the railroad bridge—was a factor in the channel's reduced capacity at the bridge during the mid-1980s to mid-1990s. These years were a period of unprecedented storage in the reservoir. The only previous time such storage was reached was for a brief period following a major flood event in 1941. Storage levels in Elephant Butte Reservoir have been very low for the past few years, and, as a result, channel capacity has increased in the headwaters area. Specifically, the river bed at the San Marcial Railroad Bridge has incised approximately three feet. The railroad bridge has not substantively limited flood-control operations of reservoirs since 1997, including the extended, above-average runoff experienced in 2005.

3.3.4 Water Quality

Section 404 of the Clean Water Act provides for the protection of "waters of the United States" from impacts associated with irresponsible or unregulated discharges of dredged or fill material in aquatic habitats, including wetlands as defined under Section 404(b)(1). For the proposed action three activities relating to proposed work below the ordinary high water mark (OHWM) are: 1) earthen levee construction; 2) placement of riprap along the riverward slope and toe of the levee; and 3) a temporary river crossing (to access the east side of the river to excavate a terrace above the OHWM). Portions of the proposed work below the OHWM would be located on Sevilleta and Bosque del Apache National Wildlife Refuges. The Corps would obtain a Determination of Compatibility from the respective refuge managers for the proposed construction; and would minimize potential impacts to these lands and resources. In 1993, a Record of Decision (ROD) was signed for the 1992 Supplemental EIS (Corps 1992), and the ROD and EIS were submitted to Congress. An appendix in the 1992 SEIS included an evaluation of effects and a Finding of Compliance relative to Section 404(b)(1) of the Clean Water Act; therefore, meeting the requirements for an exemption under §1344(r) of the Act. The current GRR/SEIS updates this evaluation and compliance with §1344(r).

Section 401 of the Clean Water Act requires that a Water Quality Certification Permit be obtained for anticipated discharges associated with construction activities or other disturbance within waterways in the project area. Water quality certification is the responsibility of the New Mexico Environment Department, Surface Water Quality Bureau.

New Mexico's Water Quality Control Commission has designated stream uses and standards in the proposed action area (NMED 2007). Designated uses for the reach from San Marcial at the US Geological Survey (USGS) gage to the Rio Puerco include irrigation, habitat for marginal warm water aquatic life, wildlife habitat, livestock watering, and secondary contact recreation (fishing, boating). Based on a 2007 water quality review by the New Mexico Environmental Department Surface Water Bureau, designated uses for marginal warm water aquatic life and secondary contact recreation were not fully supported. The survey concluded that aluminum and *Escherichia coli* were the probable cause of the impaired uses, with the probable sources of impairments including avian sources (waterfowl and/or other); impervious surface/parking lot runoff; municipal (urbanized high density area); municipal point source discharges; natural sources; on-site treatment systems (septic systems and similar decentralized systems); and wastes from pets.

Although the Rio Grande has a well-defined channel throughout the proposed action area, flows in portions of the area frequently exceed the bank elevation and inundate the overbank area adjacent to the channel. For the purposes of evaluation, the OHWM relative to Section 404 was estimated to be the water surface elevation of the 50%-exceedance discharge based on mean-daily-discharge values at the USGS stream flow gage at San Acacia for the period 1974 through 2002. This discharge was determined to be 5,660 cfs by Parametrix (2008).

The Parametrix (2008) study also used two-dimensional hydraulic modeling to map the extent of these flows throughout the proposed action area. The modeled 5,660-cfs discharge intersects with the existing spoil bank and proposed construction areas in three small areas in the northern portion of the project area. Beginning at approximately 1.5 miles upstream from BDANWR, the modeled flows inundate the riverward toe of the spoil bank (and proposed levee construction zone) for the entire downstream portion of the proposed action area.

No wetlands, as defined in Section 404(b)(1) of the Clean Water Act, have been identified within the affected area for the final array of levee construction alternatives.

4. Species Status and Life History

4.1 Rio Grande Silvery Minnow

4.1.1 Status and Distribution

Until the late 1950s, the silvery minnow was distributed throughout many of the larger order streams of the Rio Grande Basin upstream of Brownsville, Texas , with a range extending to northern New Mexico (about 2000 miles) in water lying primarily below 5500 ft elevation (1676 m). This elevation coincides with the approximate vicinities of Abiquiu on the Chama River, Velarde on the Rio Grande, and Santa Rosa on the Pecos River. Today the silvery minnow is restricted to a variably perennial reach of the Rio Grande in New Mexico, from the vicinity of Bernalillo downstream to the head of Elephant Butte Reservoir, a distance that fluctuates as the size of the pool of water in storage in Elephant Butte Reservoir changes, but that approximates 150 river miles (241 km).

Historically, the silvery minnow was distributed throughout the Rio Grande Basin over a broad range of environmental parameters (including chemical, physical, hydrological, climatic, and biological attributes) that are typical of the arid southwest. Sublette *et al*. (1990) describe the taxonomic characteristics of the silvery minnow and provides an overview account of the life history and species distribution. Bestgen and Propst (1996) provide a detailed morphometric study of the silvery minnow and document the distinctiveness of the species. The silvery minnow is currently listed as endangered on the New Mexico State list of endangered species, having first been listed May 25, 1979 as an endangered endemic population of the Mississippi silvery minnow (*Hybognathus nuchalis*; NMDGF 1988). On July 20, 1994, the Service published a final rule to list the silvery minnow as an endangered species with proposed critical habitat (Federal Register 1994). The Service issued the final rule for silvery minnow critical habitat on February 19, 2003 (Federal Register 2003).

The primary constituent elements (PCE) for silvery minnow critical habitat include: (i) a hydrologic regime capable of forming and maintaining a diversity of aquatic habitats, including backwaters, shallow side channels, pools, eddies, and runs to support all silvery minnow life-history stages; (ii) the presence of eddies created by debris piles, pools, backwaters, or other refuge habitat within reaches of sufficient length to provide a variety of habitats with a wide range of depths and velocities; (iii) substrates of predominantly sand or silt; (iv) water temperatures that vary on a daily, seasonal and annual basis, and that annually range no lower than 1°C and no greater than 30°C; and (v) water with reduced degraded conditions, such as decreased dissolved oxygen and increased pH.

Designated critical habitat for the Middle Rio Grande extends through Sandoval, Bernalillo, Valencia, and Socorro Counties, New Mexico, from Cochiti Lake downstream to the utility line crossing the Rio Grande at the upstream end of the Elephant Butte Reservoir. The designation includes the tributary Jemez River from Jemez Canyon Dam to the upstream boundary of Santa Ana Pueblo, Sandoval County, but excludes the tribal lands of Santo Domingo, Santa Ana, Sandia, and Isleta Pueblos. The Service considered the Lower Rio Grande around Big Bend National Park, and the Pecos River between Ft. Sumner Dam and Brantley Reservoir for critical habitat but elected not to so designate these areas even though they are essential to silvery minnow conservation (*e.g.*, possible re-introduction). For all of these reaches, the lateral extent of critical habitat includes those areas bounded by existing levees. In areas without levees, the lateral extent of critical habitat is defined as 300 feet (91.4 m) of riparian zone adjacent to each side of the river.

Population monitoring for silvery minnows has been conducted at twenty sites between Angostura Diversion Dam and the Elephant Butte Reservoir pool since 1993 (Dudley and Platania 2008). Population monitoring provides information for the October population index (Figure 4.1), and yields trends in recruitment and population centers. The October population index has rebounded starting in 2004 with spring runoff flows greater than 2000 cfs (Dudley and Platania 2007a), indicating the importance of overbanking floods in creating suitable habitat for population recruitment.

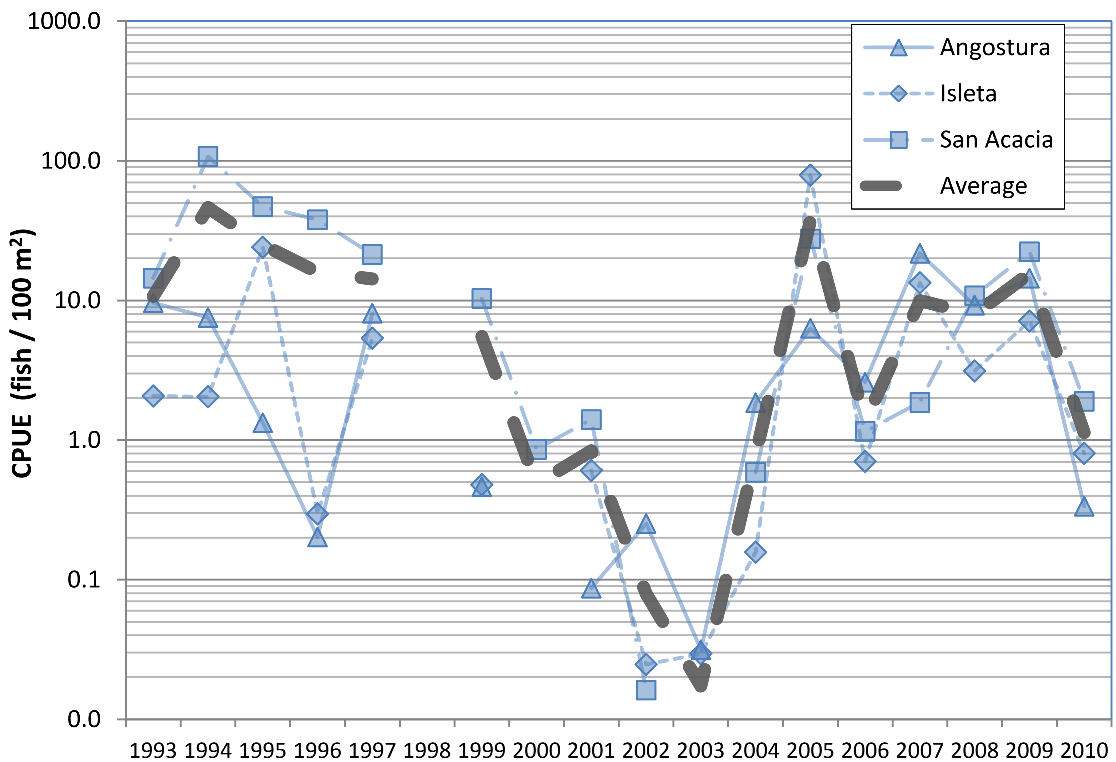

Figure 4.1. Average estimated October density catch per unit effort (CPUE) of Rio Grande silvery minnow by river reaches for the period 1993–2010.

4.1.2 Life History and Ecology

Rio Grande Silvery Minnow Habitat

Floodplain habitat appears important for supporting silvery minnow recruitment (Porter and Massong 2004a, b; Fluder *et al.* 2007; SWCA 2008; Hatch and Gonzales 2008), and habitat fragmentation is likely a major mechanism for extirpation of the silvery minnow from most of its range (Dudley and Platania 2007b). Silvery minnow habitat is typically described as shallow (0.7- 2.6 ft) water bodies with fine grained substrate (silt, sand) and slow water velocities (<1 ft/sec) (USFWS 2010). Silvery minnows are most commonly collected in shallow water (<1.3 ft) with low water velocities (<0.32 ft/sec), primarily over silt and sand substrate (Dudley and Platania 1997). Silvery minnows are capable of moving through narrower incised channels with faster water velocities by remaining in the boundary layer adjacent to the bank to avoid the main current (Porter and Massong 2004b). Surveys in 1977-1978 collected large numbers of silvery minnows in adjacent aquatic habitats connected to the Rio Grande main channel (C. Painter (New Mexico Department of Game and Fish [NMDGF]), unpublished data, 1977-1978), such as the Albuquerque Oxbow, Elephant Butte Marsh (headwaters), the Low Flow Conveyance Channel, and various irrigation drains and canals.

The Rio Grande and Pecos River have been fragmented by dams and reservoirs, resulting in a total of 82 disconnected sub-reaches (Dudley and Platania 2007b). Barriers restricting upstream fish movement between sub-reaches reduce the ability of fish species to re-colonize upstream sub-reaches following downstream movement. While large dams and reservoirs prevent dispersal of fish upstream and downstream, smaller diversion dams may allow limited movement of some fish. The diversion dams on the Middle Rio Grande were designed to pass sediment, allowing passage of fish in both directions during the winter when no irrigation was occurring. Silvery minnow populations (Figure 4.1) also persist in shorter reaches that are unsuitable for other pelagic spawning fishes with semi-buoyant eggs (Dudley and Platania 2007b; Hoagstrom *et al*. 2008). The role of silvery minnow dispersal and habitat connectivity within reaches may benefit from additional research (Rodriguez 2010).

In addition to forming barriers to silvery minnow movement, large reservoirs trap sediment, resulting in channel incision extending downstream from the dam. The extent of downstream incision is a function of scouring flows, time and sediment contribution from downstream tributaries (Massong *et al*. 2006; Schmidt *et al*. 2003). Channel incision increases the depth of turbid water reducing primary productivity within the river (J. Lusk (USFWS) personal communication, 2010). Channel incision also reduces annual connectivity to floodplain and riparian areas for many fish species (Coutant 2004). The loss of inundated riparian habitat for nursery areas limits recruitment by fish species with life histories that are dependent on this habitat. The correlation of October catch rates with spring flow above 2000 cfs ($r^2 = 0.83$-0.91) supports recruitment as a function of inundated habitat for the silvery minnow (Dudley and Platania 2007a). Loss of riparian connectivity within the Rio Grande floodplain has decreased the amount of critical habitat for the silvery minnow.

The USGS modeled silvery minnow habitat availability as a function of instream flow in the lower Isleta Reach between the Rio Puerco confluence and San Acacia diversion dam (Bovee *et al*. 2008). The study focused on hydraulic and structural habitat for juveniles (young-of-year, YOY) and adults at the lower range of flows typical of dry and normal summers in this reach of the river. The maximum area of suitable hydraulic habitat for adults was at flow between 40 to 80 cfs. The area of suitable adult habitat declined rapidly as flow increased above 150 cfs, shifting the preferred shallow, low velocity habitat to the margins of the river.

The MRGCD irrigation system may provide habitat for silvery minnows, particularly as refugia during river drying, with fish returning to the river as flow increases (Cowley *et al*. 2007). Because of this, declines in the occurrence of silvery minnows in the irrigation system since the 1970s (C. Painter (NMDGF), unpublished data, 1977-1978; Lang and Altenbach 1994) indicate the need for more information about how irrigation practices affect minnow survivorship in the ditches. Cowley *et al*. (2007) suggests several concepts for managing the irrigation system to enhance habitat values for native fish species.

Ecologically, the silvery minnow appears to be a physiological generalist with specific habitat requirements for completion of its life cycle to support recruitment, persistence and abundance of the species. Silvery minnow primarily consume diatoms, cyanobacteria, and green algae associated with sand or silt substrates in shallow areas of the river channel (Propst 1999; USFWS 1999; Shirey *et al.* 2007). Dudley and Platania (1997) studied habitat preferences of the silvery minnow in the Middle Rio Grande at Rio Rancho and Socorro. They characterize habitat preference and habitat availability in terms of water depth, water velocity and stream substrate. Both juvenile and adult silvery minnows primarily use mesohabitats with moderate depths (15-40 cm), low water velocities (4-9 cm/sec) and silt/sand substrates. Avoidance of swift water velocities by the silvery minnow is one means of conserving energy, a general life strategy shared by many lotic fish species (Facey and Grossman 1992). Young-of-year (YOY) silvery minnows are generally captured in shallower and lower velocity habitats than adult individuals. Silvery minnows used low velocity habitat with instream debris (cover) more frequently during winter months (Dudley and Platania 1996). At near-freezing water temperatures, silvery minnow become less active and seek habitats with cover such as debris piles and low water velocities.

Rio Grande Silvery Minnow Spawning and Recruitment

Age and body length analyses by Cowley *et al*. (2006) indicate silvery minnows had a maximum longevity of 4-6 years in the late 1800s. Data from minnow rescue in 2006 (USFWS 2007a) indicates five possible classes (Age 0-4) based on standard length size distribution. More recent age-at-length studies using silvery minnow scales and otoliths show four age classes (Age 0-3) (Horwitz *et al.* 2011). The majority of spawning individuals are Age 1 fish (1-year old) with older, larger fish (Age 2+) constituting less than 10% of the spawning population (Platania and Altenbach 1996). Reproductively mature females are typically larger than males. Each female may produce several clutches of eggs during spawning ranging from 2000-3000 (Age 1) to 5000+ eggs (Age 2) per female (Platania and Altenbach 1996). Few adult silvery minnows are captured by late summer, suggesting that spawning adults may either experience high post-spawning mortality or reduced catchability.

Silvery minnows spawn from late April through June and over a relatively narrow range of water temperature 20-25C (Platania and Dudley 1999, 2001). Peak egg production occurs in mid to late-May and generally coincides with high spring discharge produced by snowmelt. Silvery minnows produce numerous semi-buoyant, non-adhesive eggs typical of the genus *Hybognathus*

(Platania and Altenbach 1998). The specific gravity of silvery minnow eggs ranges from 1.012 – 1.00281 as a function of time post-fertilization (Cowley *et al.* 2005). Eggs produced by related species, such as *H. regius* (Raney 1939) and *H. hankinsoni* (Copes 1975), are non-adhesive and considered demersal. More data on the specific gravity of related species of *Hybognathus* may provide useful insights for understanding spawning behavior and site selection among silvery minnow species. Egg hatching time is temperature-dependent, occurring in 24-48 hours at water temperatures of 20-30ºC (Platania 2000). Recently hatched silvery minnow larvae are about 3.7 mm in length. Environmental variables that influence silvery minnow spawning include photoperiod, degree days (average temperature multiplied by the number of days), and water turbidity. Additional research should improve our understanding of environmental factors on the timing and duration of silvery minnow spawning.

The summer catch rates (July catch per unit effort [CPUE]) are correlated with spring flow (mean cfs from April 15th – June 15th: adjusted r^2 = 0.7588-0.7763) and overbank area (inundated acres adjusted r^2 = 0.7594-0.835), supporting recruitment as a function of spring flow (Figure 4.2) and inundated habitat (Figure 4.3) (D. Goodman (University of Montana), personal communication, 2010; Dudley and Platania 2007a). Nursery habitat consists of shallow inundated surfaces with low water velocities where eggs hatch without downstream displacement, and larval fish can readily find food (Pease *et al*. 2006; Porter and Dean 2007). Shallow water areas provide the productive habitats required by larval fishes to successfully complete their early life history (Dudley and Platania 2007a; Turner *et al*. 2010). Creating additional shallow water habitats in the Middle Rio Grande is an objective of temporary deviations of flow from Cochiti and Jemez Canyon Dams (Grand *et al*. 2006; Corps 2009).

Figure 4.2. Relationship of Rio Grande silvery minnow July catch per unit effort (CPUE) as a function of spring runoff from 1993-2010 based on different linear models (r^2 = 0.7588-0.7763).

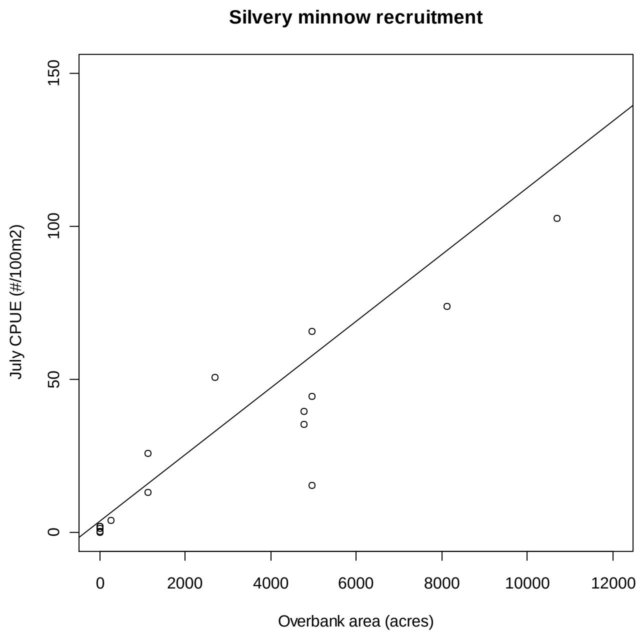

Figure 4.3. Relationship of Rio Grande silvery minnow July catch per unit effort (CPUE) as a function of inundated area during spring runoff from 1993-2010 based on different linear models (r^2 = 0.7594-0.835).

Platania and Altenbach (1998) discussed the difficulty for explaining the persistence of the silvery minnow in the Rio Grande while other minnow species with semi-buoyant eggs were extirpated from the system. Dudley and Platania (2007b) observed that many silvery minnow eggs incubate as they drift downstream through channelized reaches and they suggest that adult silvery minnows migrate upstream to complete their life cycle.

Egg retention from the current into inundated riparian zones favorable for larval fishes provides a mechanism for silvery minnow recruitment in the Middle Rio Grande (Widmer *et al.* 2007, 2010). Egg retention is consistent with the interactions of channel incision and hydrology leading to egg drift, declining recruitment and populations (Porter and Massong 2004b, 2005; Dudley and Platania 2007a, 2007b; Widmer *et al.* 2007, 2010). Larval silvery minnow have been associated with low water velocity habitat including inlets, shelves, and side channels (Pease *et al*. 2006; Turner *et al*. 2010). Higher silvery minnow densities, measured as catch per unit effort (CPUE), appear to be spatially associated with reaches with higher egg retention (Widmer *et al*. 2007).

Rio Grande silvery minnow spawning is closely tied to the annual spring flood. During the ascending limb of the hydrograph, silvery minnows appear to move into flooded riparian areas and backwaters to spawn. Habitat monitoring has documented silvery minnow adults (Hatch and Gonzales 2008; SWCA 2008), and eggs (SWCA 2008) on constructed nursery habitat sites. Similar habitat use by silvery minnows, razorback suckers (*Xyrauchen texanus;* Valdez and Wick 1983; Tyus 1987; Tyus and Karp 1990; Modde et al. 1996; Modde and Irving 1998), and

Colorado pikeminnow (*Ptychcocheilus lucius*, Grand *et al*. 2006) suggests that nursery habitat is important for population management (USFWS 2007b).

There has been annual monitoring of silvery minnow egg drift (Table 4.1) since 2002 (Platania and Dudley 2002, 2003, 2004, 2005, 2008, 2009, 2010, 2011) to evaluate recovery goals. These samples provide information on the magnitude of reproduction carried downstream of nursery habitat in the channelized San Marcial reach (at River Mile (RM) 58.8). The duration of high flows during the April-June spawning season were positively correlated with silvery minnow mean October densities, while extended low-flow periods were negatively correlated with silvery minnow mean October densities (Dudley and Platania 2008). Elevated flows in 7 of the past 10 years (2001-2010) have contributed to silvery minnow recruitment compared with the 2002-2003, 2006 year-classes (Dudley *et al*. 2008; Dudley and Platania 2010).

Table 4.1. Results of monitoring for silvery minnow eggs at irrigation diversion structures and at San Marcial. Values are absolute number of eggs collected.

Date	Albuquerque Main	Peralta Main	Belen Highline	Socorro Main	Totals	San Marcial [d]
2002 [b]	0	729	826	28	1,583	92,000
2003 [a,b]	3	26	48	-	77	13,292
2004 [a,b]	0	3	3	-	6	5
2005 [a,b]	1	1	3	-	4	-
2006 [a,b]	0	1	8	8	17	7,900
2007 [a,b]	0	49	43	2	94	10,995
2008 [a,c]	0	1	0	9	10	155
2009 [a,c]	0	12	3	29	44	645
2010 [a,c]	-	11	1	0	12	364
2011 [a,c]	-	8	4	13	25	96,266

[a] *Diversions managed to minimize entrainment of silvery minnow eggs.*
[b] *Porter and Dean 2007.*
[c] *Data provided to Reclamation by the Service. Monitoring for the Albuquerque Main was discontinued after 2009.*
[d] *Estimated number of eggs collected from Platania and Dudley 2002-2011.*

Reclamation has contracted egg entrainment monitoring from 2002 through 2011 (Table 4.1) as part of RPA elements in the BO (USFWS 2001, 2003b). After 2002, MRGCD has managed diversions to minimize entrainment during peak egg drift. Higher spring flows since 2003 have inundated riparian areas, providing nursery habitat for spawning and rearing. The availability of nursery habitat probably reduces entrainment of silvery minnow eggs into the current, reducing the number of eggs drifting downstream.

Rio Grande Silvery Minnow Population Trends 1994-2010

Long-term monitoring of fish populations is fundamental for evaluating how management affects riverine fish communities and silvery minnow populations. Fish community surveys have been conducted since 1993 (with the exception of 1998) in the Rio Grande of New Mexico between Angostura Diversion Dam (RM 209.7) and Elephant Butte Reservoir (RM 58.8). Survey methodology consists of single-pass seine samples (Dudley *et al*. 2008) with results reported as count data, such as catch per unit effort (CPUE) or catch per area sampled. Although the statistical properties of these indices (*e.g.*, measures of bias, capture or detection probabilities, and variance) are unknown, these surveys document silvery minnow density (fish per 100 m^2) variability over time and space.

The 2001 and 2003 Biological Opinions (USFWS 2001, 2003) included several Reasonable and Prudent Alternative elements for maintaining minimal wetted silvery minnow habitat in the Angostura, Isleta, and San Acacia reaches. It also provided for a one-time increase in flows (spawning spike) between April 15 and June 15 of each year to cue spawning if needed (USFWS 2001, 2003b). This action has been transformed into recruitment flows based on the predictions of nursery habitat and silvery minnow population trends following riparian habitat inundation from 2004-2008 (Corps 2007, 2008a). Though recruitment was highly variable both annually and longitudinally, the 2007 fish community monitoring results show June-July YOY recruitment throughout all three reaches.

Over the period 1993-2010, October counts were conducted in the Angostura, Isleta, and San Acacia reaches (Table 4.1). The data show that the density of silvery minnows was generally lower (CPUE < 35 / 100 m^2) for the October surveys (1993-2010) in the Angostura Reach. The density of silvery minnows (CPUE < 0.1 – 118 / 100 m^2) during October has a broader range in the Isleta Reach. Silvery minnow fall abundance (CPUE < 0.1 – 207 / 100 m^2) has fluctuated the greatest in the San Acacia Reach.

4.1.3 Reasons for Rio Grande Silvery Minnow Decline

Understanding the effects of habitat degradation, connectivity and fragmentation on different fish species' life history patterns provides clues for analyzing future actions (Koster 1955). The range of the Rio Grande silvery minnow has contracted significantly since the 1950s. The Federal Register (Federal Register 1993) proposal to list the silvery minnow as an endangered species discusses many factors that have led to the decline of the species. The silvery minnow has several common factors for extinction prone species including specialized habitat requirements, restricted geographic distribution with limited opportunities for dispersal, and small but demographically-variable populations (Brown and Lomolino 1998).

Habitat Modification

Factors currently affecting silvery minnow habitat include loss of habitat due to: water impoundment; channel drying; channel straightening and other geomorphic channel alterations; and water pollution (Federal Register 1994; Schmidt *et al* 2003; USFWS 2007b). Impoundment of water in the Rio Grande by mainstem dams has affected the flow regime of the river, fragmented habitat, and resulted in geomorphological changes to the channel (Federal Register 1994; USFWS 2007b). Habitat fragmentation and degradation (resulting from dams) may be a factor in the decline of the silvery minnow, including the sequential decline and loss of fish from upstream to downstream (Platania and Altenbach 1998, Porter and Massong 2004a).

The conversion of riverine habitat into reservoirs creates barriers to silvery minnow movement. Silvery minnows are generally obligate riverine species that have not been documented using limnetic habitat. The unsuitability of reservoir habitat creates barriers to silvery minnow dispersal and does not provide refugial habitat for maintaining populations.

Flows in the Middle Rio Grande are extreme and highly erratic, including episodic flooding and, at times, intermittence (Corps 2007, 2009). Reservoir operations may reduce the size of the flood peaks, extend or decrease the duration of the snowmelt runoff (depending on the size of the runoff), and increase the volume of water entering the Middle Rio Grande valley during normal natural low flow periods (USFWS 2007b). Managed flow regimes can alter silvery minnow habitat by reducing the frequency and magnitude of overbank flooding, trapping nutrients, altering sediment transport regimes, prolonging summer base flows, and creating reservoir habitats that favor non-native fish species. The changes in hydrology may reduce silvery minnow food supplies, alter its habitat, prevent dispersal, and provide non-native fish with a competitive advantage.

River engineering projects have variable effects on silvery minnow habitat quality and area depending on how they are implemented. Traditional river engineering activities have confined the Rio Grande to a narrower channel and reduced the connectivity with adjacent riparian habitat. Channels have been straightened and deepened, and aquatic plants and snags have been removed to lessen hydraulic resistance. Sediment retention by upstream reservoirs results in channel incision, reducing surface water inundation. Conventional river engineering projects have reduced the retention time of water and organic matter, surface area and physical complexity of the habitat, and refugial habitats.

Channelization of the Middle Rio Grande has resulted from the placement of Kellner jetty jacks along the river to protect levees by retarding flood flows, trapping sediment, and promoting vegetation (Federal Register 1994; USFWS 2007b). Meanders, oxbows, and other components of silvery minnow habitat have been eliminated in order to pass water as efficiently as possible for agricultural irrigation and downstream deliveries. The loss of low-velocity nursery habitat (inundated riparian vegetation, backwaters, etc.) has likely reduced silvery minnow larval and juvenile recruitment.

River Diversions and Dewatering

Dewatering (channel drying) is caused primarily by agricultural water diversion and by climatic drought. For minnows, these actions result in a fragmented range with reduced habitat area and connectivity (Federal Register 1994; USFWS 2007b). The impacts of water diversion may not be severe in years when an average or above average amount of water is available (Federal Register 1994; USFWS 2007b). In years of below-average water availability river channel drying may be extensive from Isleta Diversion Dam downstream to Elephant Butte Reservoir (111 mi).

Dewatering is implicated in many studies of silvery minnow range contraction from its historic extent. For example, Trevino-Robinson (1959) documented the early 1950s "cosmopolitan" occurrence of silvery minnows in the Rio Grande downstream of its confluence with the Pecos

River where, for "the first time in recorded history," a portion of this reach of river went dry in 1953. Although Trevino-Robinson (1959) could not document any "apparent undesirable or severe after effects" from the drought, silvery minnows have not been documented from this lower portion of the Rio Grande since the mid-1950s (in part, USFWS 1999). Edwards and Contreras-Balderas (1991) confirm the absence of the silvery minnow from the Rio Grande below Falcon Dam, which is downstream of the Pecos confluence at Amistad Lake.

Drought leading to channel drying has also been implicated in the extirpation of the silvery minnow from upstream reaches of the Rio Grande. Hubbs *et al*. (1977) documented the "inexplicable" absence of silvery minnow from the Rio Grande in Texas between El Paso and its confluence with the Pecos River where Hubbs (1958) had earlier documented the species to occur. However, Chernoff *et al*. (1982) noted that much of this stretch, particularly the Rio Grande between El Paso and the mouth of the Rio Conchos, is at times dry. Sublette *et al*. (1990) documented the former occurrence of the silvery minnow in the Rio Grande from Caballo Reservoir, NM downstream to El Paso, TX, another stretch that is now often dry and from which the silvery minnow has been extirpated. Thus, between 1950 and 1991, the Rio Grande silvery minnow was extirpated from that portion of its historic range lying downstream of Caballo Reservoir to the Gulf of Mexico.

Observations suggest that during periods of such extreme water scarcity, the silvery minnow seeks out cooler pool habitats associated with overhead cover, irrigation return flow, and shallow groundwater (Federal Register 1994; USFWS 2007b). During periods of no flow, the silvery minnow is thought to have survived in the irrigation ditches and drains, the reaches above the diversions, and in channels maintained by irrigation return flows or leakage from the diversion dams. River drying increases silvery minnow mortality rates due both to decreasing water quality in temporary pools and the eventual disappearance of such pools as water seeps into the substrate.

It has been proposed that the entrainment of silvery minnows (primarily eggs and larvae) in the infrastructure of irrigation systems that derive water directly from the Rio Grande could be a factor contributing to the decline of the species (*e.g.*, USFWS, 1999). Egg entrainment in irrigation canals has been monitored since 2001 (*e.g.*, Reclamation 2003). These studies show that recent management actions have minimized egg entrapment in irrigation infrastructure.

Water Quality for Rio Grande Silvery Minnow Habitat

Water quality in the Middle Rio Grande varies spatially and temporally throughout its course primarily due to inflows of groundwater, as well as surface water discharges and tributary delivery to the river. Factors that are known to cause poor fish habitat include temperature changes, sedimentation, runoff, erosion, organic loading, reduced oxygen content, pesticides, and an array of other toxic and hazardous substances. Both point source pollution (*e.g.*, pollution discharges from a pipe) and non-point source pollution (*i.e.,* diffuse sources) affect Rio Grande water quality.

Changes in water quality from increasing agriculture and urbanization along the Rio Grande during the last century have been suggested as a factor in declining silvery minnow populations (USFWS 1999). A screening level risk assessment based on two Middle Rio Grande datasets suggests that while there may be locally poor water quality, the analysis does not indicate that human activities have adversely impacted silvery minnow populations (Marcus *et al*. 2010). Though there are many natural and anthropogenic factors that affect water quality in the Middle Rio Grande, a 2006-2008 water quality study concluded that water chemistry may be a contributing factor, it is not likely to be the most critical issue affecting the silvery minnow especially compared to a lack/timing of adequate flows to maintain the needed habitat (NMED 2009:). Further downstream the International Boundary and Water Commission (IBWC 2003) and the Texas Natural Resources Conservation Commission (TNRCC 1994) have documented water quality impairment from toxic chemicals at sites along the international border.

The expansion of cities and agriculture along the Middle Rio Grande may have adverse effects on river water quality (Federal Register 1994; USFWS 2007b). During low flow periods, the increased proportion of municipal and agricultural discharge to native flow may allow pollutants to significantly degrade water quality. Agricultural water use appears to reduce nutrient availability in return flows to the river (Van Horn and Dahm 2008). Recent water-quality data have not identified limiting factors for silvery minnows or habitat (NMED 2001, 2009; USFWS 2004; Marcus *et al*. 2005).

Major point sources include wastewater treatment plants and dairy cattle feedlots. The US Environmental Protection Agency (USEPA) conducted endocrine disruption testing of wastewater treatment plant effluents from Rio Rancho, Bernalillo, Albuquerque, Bosque Farms, Los Lunas, Belen, and Socorro in 2007 (NMED 2009). Effluent from Los Lunas and Socorro during the summer (low flow volumes) could make endocrine disruption a seasonal water quality concern for silvery minnow in the Isleta and San Acacia reaches respectively. In 1999, water quality in the Angostura reach (RM 203.3 – 178) was found to not be adversely affecting aquatic life (NMED 2001, 2009). Nitrogen and phosphorous concentrations were less than 2 mg/L, with increasing specific conductance (calcium bicarbonate) in the downstream direction (Langman and Nolan 2005). Diatom species from the late 1800s are indicators of high nutrient loads in the Rio Grande (Shirey *et al*. 2007). Though wastewater treatment plants are a major nutrient source (Van Horn and Dahm 2008), it appears that there is significant removal of nutrients (nitrate and phosphate) from water diverted for irrigation (Peterson *et al*. 2001). These observations are consistent with the low overall gross primary productivity in the Rio Grande (USFWS 2004). There have been no longitudinal studies bracketing wastewater treatment plants to examine the aquatic primary productivity and fish community response to the effluent (*e.g.,* Lewis *et al*. 1981).

Potential major non-point sources include agricultural activities (*e.g.*, fertilizer and pesticide application, livestock grazing), urban stormwater run-off, and mining activities (Ellis *et al*. 1993). Large precipitation events wash sediment and pollutants into the river from surrounding lands through storm drains and intermittent tributaries. Contaminants of concern to the silvery minnow that are frequently found in stormwater include the metals aluminum, cadmium, lead, mercury, and zinc; organics such as petroleum products; the industrial solvents trichloroethene and tetracholoroethene; and the gasoline additive methyl tert-butyl ether (USGS 2001). However, chronic aluminum and *E. coli* are the only water quality impairments in the Middle Rio Grande identified by recent studies (NMED 2009).

Pesticide contamination may originate from agricultural, residential and commercial landscaping activities. Nine pesticides were identified as constituents of concern (Tier II risk) in the Middle

Rio Grande (Marcus *et al*. 2010). The presence of pesticides in surface water depends on the amount applied, timing, location, and method of application. Water quality standards have not been set for many pesticides, and existing standards do not consider cumulative effects of several pesticides in the water at the same time. Pesticide degradation products have been detected in whole body fish collected throughout the Rio Grande (Roy *et al*. 1992).

Semi-volatile organic compounds including polycyclic aromatic hydrocarbons, phenols, and phthalate esters, were analyzed in sediment collected by the USGS (Levings *et al*. 1998). The analysis of the polycyclic aromatic hydrocarbon data by Levings *et al*. (1998) shows that one or more polycyclic aromatic hydrocarbon compounds were detected at 14 sites along the Rio Grande, with the highest concentrations found below Albuquerque and Santa Fe. More recent studies reported the absence of detectable organic chemicals (despite urbanization) in the Middle Rio Grande (NMED 2009). These compounds likely result from past water-quality or stormwater-runoff events, and may pose a greater risk to aquatic life when attached to the sediment on the stream bed or sediment suspended in the water column than as waterborne compounds (Marcus *et al*. 2010).

Sediment-borne contaminants present greater risks to the silvery minnow as they graze on benthic algae in the Middle Rio Grande (Marcus *et al*. 2010). Ong *et al*. (1991) recorded the concentrations of trace elements and organochlorine pesticides in suspended sediment and bed sediment samples collected from the Middle Rio Grande between 1978 and 1988. Available water quality data do not support a conclusion that sediment toxicity has produced population-level impacts to silvery minnows in the Middle Rio Grande (Marcus *et al*. 2010).

Rio Grande Silvery Minnow Population Genetics

While population size (N) is an important variable for endangered species survivorship, the effective population size (N_e) of an endangered species is also crucial because it describes the genetic diversity of the population (Minckley *et al*. 2003). Genetic diversity determines the ability of species to cope with environmental variability (Gilpin and Soulé 1986). The effective size (and therefore genetic diversity) is reduced by genetic drift and inbreeding. Small effective population size can negatively impact long-term survival because reduced genetic variability can translate into a reduced ability to adapt to environmental changes. These values are poorly understood for most species (Minckley *et al.* 2003). The silvery minnow N_e is moderately low based on different estimators (PBS&J 2011).

Due to the increased efforts in captive propagation, recent studies by the Collaborative Program have focused on the genetic composition of the silvery minnow. Several studies since 2003 have demonstrated a decline in overall mitochondrial mtDNA and gene diversity in the silvery minnow (*e.g.*, Osborne *et al*. 2005;Turner *et al*. 2006). The results are consistent with smaller overall population numbers and/or increasing relatedness of the females. In addition, studies need to be conducted on the genetic effects of stocking hatchery fish. Currently, these fish are artificially spawned in groups, where fish are assumed to form pairs. However, competition between males and gametic competition could produce effective numbers far smaller than those that are assumed. The effect of communal spawning on effective number must be assessed so the genetic consequences of stocking hatchery fish can be accurately measured and a true effective population number can be determined.

Finally, the changes in gene frequency caused by fish culture practices must be assessed (Minckley *et al*. 2003). Osborne *et al*. (2006) reported that genetic heterozygosity in captive-reared fish and wild fish were the same, with a loss only in allelic diversity. They also stated that hatchery-reared fish stocked into the wild will cause a lower effective breeding number and could cause a reduction in fitness of the entire population. However, the effects of domestication and inadvertent selection have not been studied in the silvery minnow. Additional problems may occur due to the increased survival in wild genotypes brought into the hatchery that would have died in the wild. These fish survive due to lack of predation and to increased care, and then are stocked back into the river as brooders and are still considered to be "wild fish." This is critical because captive-reared fish could affect the natural population's level of fitness.

Competition, Predation, Disease

Accidental or intentional releases of fishes outside of their native ranges (including bait and aquarium sources) have established numerous exotic fish species in the Rio Grande Basin (Sublette *et al*. 1990), representing potential competitors or predators of the silvery minnow. The silvery minnow evolved sympatrically with about 90 other fish species, including those with similar feeding habitats. Competition among fish species often evokes resource partitioning through selective and interactive segregation.

Predation and competition with other fish species has been cited as a factor possibly contributing to the decline of the species (*e.g.*, USFWS 1999). Predation by piscine and avian predators upon silvery minnows has not been quantified, but probably has a minor role in declining silvery minnow populations (Federal Register 1994; USFWS 2007b). Swimming performance of silvery minnows may provide a reasonable capability for escaping predators (Bestgen *et al.* 2003). Experiments using brassy minnows (*H. hankinsoni*) exhibited a change in habitat use when predators are present (Schlosser 1988). The turbidity of the Rio Grande serves to lessen the impacts of would-be predators on silvery minnows because the effective predatory strike zone is shortened.

Fish confined to pools during periods of low flow may experience outbreaks of *Ichthyophthirius multifilis* (caused by a protozoan and commonly called "ick") or *Lernaea* (a parasitic copepod, Federal Register 1994; USFWS 2007b). Ongoing studies are examining the impact of disease and parasites on silvery minnows (USFWS unpublished data).

4.1.4 U.S. Fish and Wildlife Service Actions to Avoid Jeopardy

Rio Grande Silvery Minnow Population Augmentation

In 2000, the Service identified captive propagation as an appropriate strategy to assist in the recovery of the silvery minnow. Captive propagation is designed to preserve the genetic and ecological distinctiveness of the silvery minnow and minimize risks to existing wild populations. Augmentation of endangered fish species on the lower Colorado River has documented improved survival and recruitment from rearing wild fish larvae in off-channel habitats (Minckley *et al*. 2003; Mueller and Carpenter 2008).

Since 2000, over a million propagated silvery minnows (Table 4.2) have been released into the Angostura Reach (2002-2007) to ensure downstream repopulation (Remshardt 2008).

Augmented fish are marked with a visible fluorescent elastomer tag and released in large numbers at a few locations. Marked fish have been released by the Service since 2002 under a formal augmentation effort funded by the Middle Rio Grande Endangered Species Collaborative Program (Collaborative Program). The percentage of recaptured (marked) silvery minnows (Table 4.2) provides an index of the contribution of augmented fish to the overall population (Annual Recapture) and recruitment (April-May Recapture).

Table 4.2. Summary of augmented (marked), recaptured, and salvaged silvery minnows.

		Annual recapture (USFWS)			April-May recapture (fish community monitoring)			Salvaged silvery minnows	
Year	**Stocked**	**Total captured**	**Marked**	**Percent recaptured**	**Total captured**	**Marked**	**Percent recaptured**	**Total salvaged**	**Ratio (salvaged / stocked)**
2002	43,582	53	7	13.20%	270	0	0.00%	3,662	
2003	83,384	141	32	22.70%	48	14	29.20%	713	0.86%
2004	180,651	450	99	22.00%	566	22	3.90%	12,865	7.12%
2005	255,217	31,457	264	0.84%	280	5	1.80%	207,746	81.40%
2006	418,851	8,375	298	3.60%	2,058	9	0.44%	69,889	16.69%
2007	133,154	10,172	53	0.52%	123	35	28.50%	13,953	10.47%
2008	0	9,666	5	0.05%	455	2	0.44%	N/A	N/A
2009	0		N/A			N/A		18,473	N/A
2010	5,715		N/A			N/A		10,273	189%
Total	1,114,839	50,648	753	1.49%	3,800	87	2.30%	308,828	27.70%

Ongoing research by the Service is designed to document the movement of silvery minnows. Initial studies had crews sample upstream and downstream from the release site in an attempt to capture the marked fish. Preliminary results indicate that the majority of silvery minnows disperse a few miles downstream. Recent studies are using passive injected transponder (PIT) tags implanted in silvery minnows to document individual fish movement (Remshardt 2008; Archdeacon *et al*. 2009).

Rio Grande Silvery Minnow Rescue and Salvage

During river drying periods, the Service's silvery minnow salvage crew capture and relocate silvery minnows upstream to the perennial reaches. Since 2002, over 300,000 silvery minnows (Table 4.2) have been salvaged and relocated to wet reaches. The contribution of salvaged fish to the population is about 28% of the total augmented fish. Silvery minnows were repatriated into the Angostura Reach (2002-2007) of the river near Alameda Bridge. Starting in 2008, silvery minnows were released in flowing water within the reach in which they were captured to minimize handling stress (Remshardt 2008).

4.2 Southwestern Willow Flycatcher

4.2.1 Status and Distribution

The USFWS listed the Southwestern Willow Flycatcher (flycatcher) as endangered in February 1995 (Federal Register 1995). The flycatcher also is classified as endangered (Group I) by the State of New Mexico (NMDGF 1987). The current range of the flycatcher includes Arizona, New Mexico, southern California, extreme western Texas, southwestern Colorado, and southern portions of Nevada and Utah (USFWS 2002). In New Mexico, flycatchers are known to breed along the Rio Grande, and in the Zuni, San Francisco, and Gila River drainages. A recovery plan for the flycatcher has been completed (USFWS 2002).

Critical habitat for the flycatcher was designated in July 1997 (USFWS 1997); however, pursuant to an order from the U.S. District Court of Appeals Tenth Circuit, the USFWS conducted an economic analysis and re-designated critical habitat in October 2005 (Federal Register 2005). Most of the defined critical habitat includes areas outside of the Middle Rio Grande and outside of New Mexico. Critical habitat along the Middle Rio Grande includes, in part, the Rio Grande floodway from the southern boundary of the Pueblo of Isleta downstream to the headwaters of Elephant Butte Lake at RM 62 (approximately 104 river miles), except for lands within Sevilleta and Bosque del Apache NWRs. Within the proposed action area, designated critical habitat for the flycatcher encompasses the entire floodway from the SADD to the headwaters of Elephant Butte Reservoir, except for the portions of the floodway on the two National Wildlife Refuges.

On August 15, 2011, the Service proposed to revise critical habitat for the Southwestern Willow Flycatcher (USFWS 2011). Chapter 5 of this BA also evaluates potential effects of the proposed actions on proposed critical habitat for the flycatcher. The only difference between proposed and designated critical habitat within the action area is the addition of Sevilleta and Bosque del Apache NWRs to the proposed critical habitat.,

The Primary Constituent Elements (PCEs) of both designated and proposed flycatcher critical habitat are similar. The following description is taken from the proposed critical habitat notice (USFWS 2011):

1. Primary Constituent Element 1— Riparian vegetation. Riparian habitat in a dynamic river or lakeside, natural or manmade successional environment (for nesting, foraging, migration, dispersal, and shelter) that is comprised of trees and shrubs (that can include Goodding's willow, coyote willow, boxelder, tamarisk, Russian olive, buttonbush, cottonwood, stinging nettle, alder, velvet ash, poison hemlock, blackberry, seep-willow, oak, rose, false indigo, grape, Virginia creeper, and Siberian elm[3]) and some combination of:

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[3] Only tree and shrub species likely to occur in the action area for this consultation were included in this list.

   a. Dense riparian vegetation with thickets of trees and shrubs that can range in height from about 2 m to 30 m (about 6 to 98 ft). Lower-stature thickets (2 to 4 m [6 to 13 ft] tall) are found at higher elevation riparian forests and tall-stature thickets are found at middle and lower-elevation riparian forests; and/or
   b. Areas of dense riparian foliage at least from the ground level up to approximately 4 m (13 ft) above ground or dense foliage only at the shrub or tree level as a low, dense canopy; and/or
   c. Sites for nesting that contain a dense (about 50 percent to 100 percent) tree or shrub (or both) canopy (the amount of cover provided by tree and shrub branches measured from the ground); and/or
   d. Dense patches of riparian forests that are interspersed with small openings of open water or marsh or areas with shorter and sparser vegetation that creates a variety of habitat that is not uniformly dense. Patch size may be as small as 0.1 ha (0.25 ac) or as large as 70 ha (175 ac); and
2. Primary Constituent Element 2— Insect prey populations. A variety of insect prey populations found within or adjacent to riparian floodplains or moist environments, which can include: flying ants, wasps, and bees (Hymenoptera); dragonflies (Odonata); flies (Diptera); true bugs (Hemiptera); beetles (Coleoptera); butterflies, moths, and caterpillars (Lepidoptera); and spittlebugs (Homoptera).

The flycatcher is an obligate riparian species and nests in thickets associated with rivers, streams and wetlands where dense growth of willow, buttonbush, boxelder, Russian olive, saltcedar, or other plants are present (Finch and Stoleson 2000). Nests are frequently associated with an overstory of scattered cottonwood. Throughout the flycatcher's range, these riparian habitats are now reduced, widely separated, and occur in small and/or linear patches. Flycatchers nest in thickets of trees and shrubs approximately 6 to 23 feet in height or taller, with a densely vegetated understory approximately 12 feet or more in height. Surface water or saturated soil is usually present beneath or adjacent to occupied thickets (Phillips *et al.* 1964; Muiznieks *et al.* 1994). At some nest sites, surface water may be present early in the breeding season with only damp soil present by late June or early July (Muiznieks *et al.* 1994; Sferra *et al.* 1995; Finch and Stoleson 2000). Habitats not selected for nesting include narrow (less than 30 feet wide) riparian strips, small willow patches, and stands with low stem density (USFWS 2002). Suitable habitat adjacent to high gradient streams does not appear to be used for nesting. Areas not utilized for nesting may still be used during migration (Yong and Finch 1997).

Flycatchers begin arriving in New Mexico in early May and spring migration of the Southwestern and more northerly subspecies continues into early June (Yong and Finch 1997). Breeding activity in New Mexico begins immediately and young may fledge as soon as late June. Late nests and re-nesting attempts may not fledge young until late summer (Sogge and Tibbitts 1992; Sogge *et al.*, 1993; Reclamation 2005). Fall migration in New Mexico occurs from early August through mid-September (Yong and Finch 1997).

Six general locations of flycatcher populations have been established throughout the Middle Rio Grande (Figure 4.4). These areas have consistently held several territories; however, the number of territories, pairs, nest attempts, and successful nests has varied through the years.

Formal surveys for breeding flycatchers in the proposed action area were begun by the New Mexico Natural Heritage Program in 1994 (Mehlhop and Tonne 1994) and 1995 (Henry *et al.* 1996) in the San Marcial area, and have been conducted annually by Reclamation throughout the proposed action area.

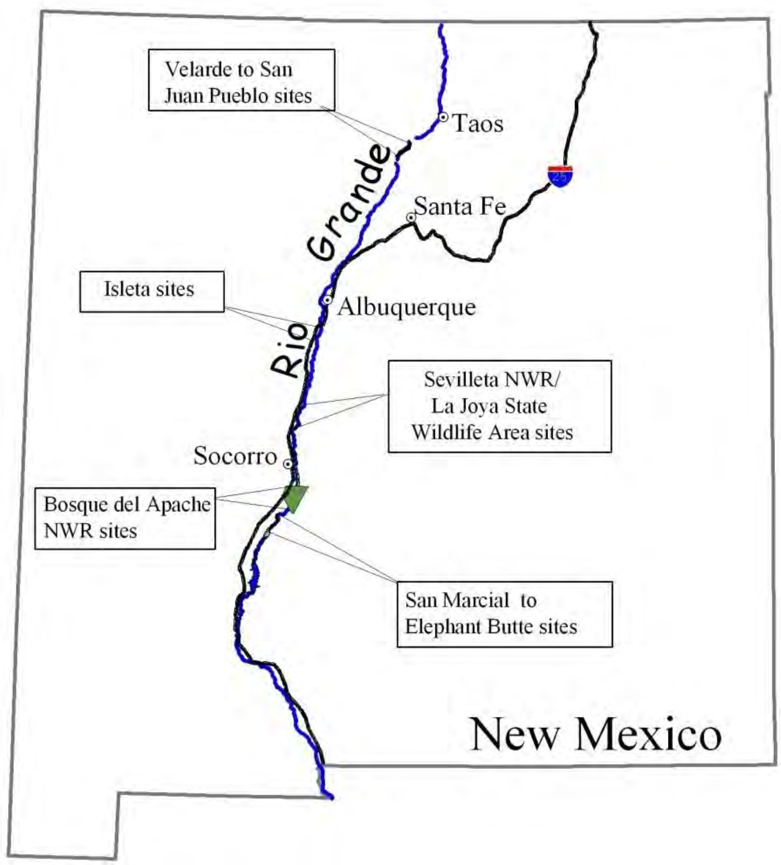

Figure 4.4. Six general locations of flycatcher populations along the Rio Grande of New Mexico.

Table 4.3 summarizes the locations of known territories (that is, occupied by a male or pair of flycatchers) within the floodway of the proposed action area during 2004 through 2011.

Table 4.3. Known Southwestern Willow Flycatcher territories in the action area, 2004-2011.

Reach	**Reach length (river-miles)**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
San Acacia Diversion Dam to US Hwy. 380	29	0	0	1 (0) [2]	0	3 (2)	1 (0)	1 (0)	3 (0)
US Hwy. 380 to south boundary of BDANWR	13	1 (1)	0	4 (2)	7 (5)	5 (2)	20 (11)	37 (27)	54 (40)
South boundary of BDANWR to River Mile 68	6	16 (4)	3 (0)	9 (3)	4 (1)	8 (4)	6 (3)	5 (2)	4 (0)
TOTAL	**48**	**17 (5)**	**3 (0)**	**14 (5)**	**11 (6)**	**16 (8)**	**27 (14)**	**43 (29)**	**61 (40)**

[1] The term "territories" includes pairs or single males detected throughout the breeding season.
[2] Values in parentheses indicate the number of territories on the west bank of the Rio Grande.

Spring migrant flycatchers have been regularly observed in a variety of riparian vegetation types throughout the Rio Grande floodway in the proposed action area. Occupied breeding habitat in the proposed action area is composed of dense riparian shrubs, chiefly Goodding's willow, coyote willow, and saltcedar. At least a partial canopy of Rio Grande cottonwood or Goodding's willow may be present. The majority of flycatcher nests have been found to be situated within 150 feet of the river bank or other water bodies (Reclamation 2005).

Relatively few flycatchers (0 to 3 territories) have nested between the SADD and U.S. Highway 380 near San Antonio since 2004. Also, the locations of territorial birds have changed from year-to-year throughout this 29-mile-long reach.

In the 13 river-mile reach from Highway 380 to the south boundary of BDANWR, flycatcher occupation has increased dramatically from 1 territory in 2004 to 54 in 2011. In 2008, a sediment plug in the Rio Grande channel near the middle of BDANWR caused the majority of the flow to inundate riparian vegetation adjacent to the channel. Flycatchers were attracted to this area, presumably, by the resultant increased willow growth and wetter substrate. In 2010, 27 of the flycatcher territories in this reach were located on the west bank of the river, adjacent to the alignment of the current spoil bank and proposed engineered levee. The number of territorial birds increased to 54 in 201, and their distribution has spread to the north along the banks of the river.

Flycatchers have nested less numerously, but more consistently, in the 6-mile-long reach south of BDANWR to River Mile 68 (Table 4.3). The largest breeding population of flycatchers along the Rio Grande in New Mexico occurs in the upper reaches of Elephant Butte Reservoir, approximately 5 miles downstream from the San Marcial Railroad Bridge. Receding lake levels allowed the establishment of riparian shrub species that were quickly colonized by the flycatcher. The number of territories has grown from 12 in 1999 to 298 in 2010 (Reclamation 2011). This colony could very well serve as a source for birds which nest in the San Marcial and upstream areas.

4.2.2 Reasons for Flycatcher Decline

During the last two centuries, human induced hydrological, geomorphological, and ecological changes have heavily influenced the composition and extent of floodplain riparian vegetation along the Middle Rio Grande (Bullard and Wells 1992; Dick-Peddie 1993). Introduction of exotic species, such as saltcedar, has decreased the availability of dense willow and associated desirable vegetation and habitat important to flycatchers. Fragmentation of forested breeding habitat may also play a role in population reduction of migratory birds (Lynch and Whigham 1984; Wilcove 1988). In addition, the rapid rate of deforestation in tropical areas has been cited as a possible reason for population declines in forest-dwelling migrant land birds (Lovejoy 1983; Robbins *et al*. 1989, Rappole and McDonald 1994).

Brood parasitism by Brown-headed Cowbirds (*Molothrus ater*), has been implicated in the decline of songbirds including those found in the western riparian habitats (Gaines 1974, 1977; Goldwasser *et al*. 1980; Laymon 1987). Brown-headed Cowbirds have increased their range with the clearing of forests and the spread of intensive grazing and agriculture. Flycatchers are particularly susceptible to Brown-headed Cowbird nest parasitism because of the ease of egg laying in the flycatcher's open-cup nest design. Habitat fragmentation and forest openings allow cowbirds easy access to host nests located near these edges. Nest parasitism, combined with declining populations and habitat loss, has placed this species in a precarious situation (Mayfield 1977;Rothstein *et al*. 1980; Brittingham and Temple 1983; Laymon 1987).

4.2.3 Life History and Ecology

Flycatcher Breeding Chronology

The flycatcher is a late spring/summer breeder that builds nests and lays eggs in late May and early June, and fledges young in late June or early July (Sogge *et al*. 1993, Tibbitts *et al*. 1994). If re-nesting or second broods occur, they will fledge into mid-August (USFWS 2002). Based on data from flycatcher survey and nest monitoring along the Middle Rio Grande, particularly in the San Marcial reach, flycatchers have been found in the area as early as May 6; however, actual nest initiation has been documented to occur later in May (Ahlers *et al*. 2002). Flycatchers that re-nest or produce a second brood can remain in the nesting area through the end of August.

Flycatcher breeding chronology in the lower portion of the Middle Rio Grande is presented in Figure 4.5and falls within the generalized breeding chronology of Southwestern Willow Flycatchers (based on Unitt 1987; Brown 1988; Whitfield 1990; Maynard 1995; Sogge 1995; Skaggs 1996; Sferra *et al*. 1997; Sogge *et al*. 1997). Extreme dates for any given stage of the breeding cycle may vary as much as a week from the dates presented. Egg laying begins as early as late May but more often starts in early to mid-June. Chicks can be present in nests from mid-June through early August. Young typically fledge from nests from late June through mid-August but remain in the natal area 14 to 15 days. Adults depart from breeding territories as early as mid-August, but may stay until mid-September in later nesting efforts. Fledglings probably leave the breeding areas a week or two after adults.

Each stage of the breeding cycle represents a greater energy investment in the nesting effort by the flycatcher pair and may influence their fidelity to the nest site or their susceptibility to abandon if the conditions in the selected breeding habitat become adverse.

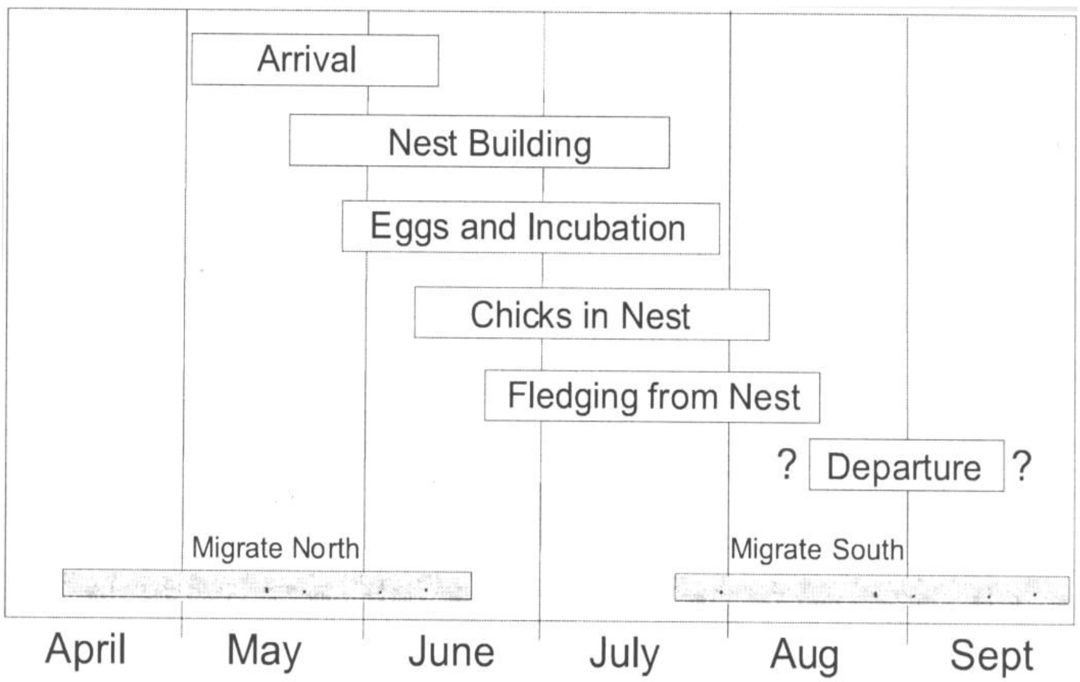

Figure 4.5. Generalized breeding chronology of the Southwestern Willow Flycatcher (from Sogge *et al*. 1997).

Flycatcher Breeding Habitat

The flycatcher is an obligate riparian species occurring in habitats adjacent to rivers, streams, or other wetlands characterized by dense growths of willows (*Salix* sp.), seep-willow (*Baccharis* sp.), arrowweed (*Pluchea* sp.), saltcedar (*Tamarix* sp.), or other species (Federal Register 1995). Flycatchers may utilize areas without surface water, but if suitable habitat goes without water for several years, substrate plants may die and habitat quality may decline. The presence of surface water may also affect nesting success and food availability.

Nesting habitat for the flycatcher varies greatly by site and includes plant species such as willow, saltcedar, box elder (*Acer negundo*), and Russian olive (*Elaeagnus angustifolia*). Species composition, however, appears less important than plant and twig structure (D. Ahlers, U.S. Bureau of Reclamation, personal communication, 2005), as slender stems and twigs are important for nest attachment. Nest placement is highly variable: nests have been observed at heights ranging from 2 to 33 feet and generally occur adjacent to or over water (M. Sogge, U.S.

Geological Survey, personal communication, 2005). Along the Middle Rio Grande, breeding territories have been found in young and mid-age riparian vegetation dominated by dense growths of willows at least 15 feet high, as well as in mixed native and exotic stands dominated by Russian olive and saltcedar.

A majority of the birds within the Middle Rio Grande have selected habitat patches dominated by native species, usually dense willows, for nesting. Within these willow patches, nests have been found on individual saltcedar plants, especially in older, taller willow patches where an understory of saltcedar provides suitable nesting substrate. It appears that younger trees in the understory having more slender vertical stems and twigs are selected for nest placement. Most recently, nests located at the Sevilleta NWR and La Joya State Wildlife Management Area (WMA) have been established in areas adjacent to the river dominated by saltcedar and Russian olive; however, the overall vegetation type of most of the flycatcher territories established in the Middle Rio Grande is dominated by native species and not saltcedar (Moore and Ahlers 2005, 2008).

A critical component for suitable nesting conditions is the presence of water, usually provided by overbank flooding or some other hydrologic source. Along the Rio Grande, nests have been consistently found within 150 feet of surface water, usually a flowing channel (Moore and Ahlers 2005, 2008). Reclamation has found that 95% of all flycatcher nests in the Reclamation-surveyed areas of the Middle Rio Grande occur within 100 m of surface water, and 91% occur within 50 m (Moore and Ahlers 2008). The presence of surface water at the onset of nest site selection and nest initiation is likely critical, though not absolutely necessary. In rare cases in Arizona, birds have nested over 300 feet from water (Sogge *et al*. 2001). Nesting appears to be initiated only after high flows and groundwater levels have created and maintained at least moist soil conditions underneath the nest tree.

Many flycatcher breeding sites are composed of spatially complex habitat mosaics, often including both exotic and native vegetation. Within a site, flycatchers often use only a part of the patch, with territories frequently clumped or distributed near the patch edge. Therefore, the vegetation composition of individual territories may differ from the overall composition of the patch (Sogge *et al*. 2002).

Generally, four broad categories have been developed to describe species composition at breeding sites and include the following:

- Native: >90% native vegetation
- Mixed: >50% native (50-90% native vegetation)
- Mixed: >50% exotic (50-90% exotic vegetation)
- Exotic: >90% exotic vegetation

Habitat patches comprised of native vegetation account for approximately half (48%) of the known flycatcher territories in the Southwest. As of the 2007 breeding season, range-wide, 19% of breeding territories occurred in patches >50% exotic and 4% in patches >90% exotic (Durst *et al*. 2007). Although only 9% of territories occur at exotic sites, another 39% are located within sites where the habitat includes native and exotic mixtures. In many cases, exotics are contributing significantly to the habitat structure by providing the dense lower-strata vegetation that flycatchers prefer (Sogge *et al*. 2002).

In the Middle Rio Grande, the degree to which flycatchers breed in habitat dominated by a particular tree species was summarized from nest data collected in 1999-2001. Over 76% (n = 119) of territories are found at sites where native species (*Salix* spp.) are the dominant tree species and 12% (n = 19) of the nests are in patches where saltcedar is the most common habitat component.

Data collected and analyzed on nest substrate and surrounding habitat patch communities in the Middle Rio Grande (specifically in the Sevilleta NWR/La Joya State WMA, and San Marcial river reaches) indicate that flycatchers may key in on areas dominated by native vegetation, but often select exotic vegetation, particularly saltcedar, as a nest substrate. Saltcedar may actually be the flycatchers' substrate of choice due to its dense and vertical twig structure. From 1999-2002, approximately 49% of 156 nests located in these river reaches were on exotic plants (Russian olive and saltcedar). In the Middle Rio Grande, between 1999 and 2007, 63 nests (6.3 %) were in saltcedar-dominated territories, 793 (79.5 %) were in *Salix*-dominated territories and 141 (14.1 %) were in mixed-dominance territories (Moore and Ahlers 2008).

Evidence gathered during multi-year studies of color-banded populations shows that, although most male flycatchers return to former breeding areas, They regularly move among sites within and between years (Ellis *et al*. 2008). Between 1996 and 1997, 29% of banded flycatchers in Arizona returned to the breeding site of the previous year, while 11% moved to other breeding areas within the same major drainage (Paxton *et al*. 1997). The remaining 60% of flycatchers were not relocated in 1997 and may have died or moved to undiscovered breeding sites. Distance moved ranged from 66 to 2,950 feet (20 to 900 m). There were also two cases of movement (>1,640 ft [500m]) within a breeding site during the course of a breeding season. The mechanism controlling the decision to return or move, as well as the adaptive value of movement between sites, is unknown.

In two different situations, flycatchers were forced to move because of catastrophic habitat loss by fire. Occupied flycatcher habitat was destroyed because of fire along the San Pedro River in Arizona (Paxton *et al*. 1996) and along the Gunnison River in Colorado (Owen and Sogge 1997). In Arizona, occupied habitat was destroyed as nesting was underway on seven flycatcher territories. All flycatchers abandoned the site and were not seen again in the burned area. Displaced flycatchers had moved to unburned areas within the breeding site or to other breeding areas within 1.2 to 3 miles (1.9 to 4.8 km) of the original site. In Colorado, after a fire destroyed flycatcher habitat, some flycatchers returned to the burned area and attempted to breed even in an area without any live vegetation.

These situations demonstrate that some flycatcher pairs will return to the general breeding area to nest in subsequent years if previously occupied sites become unavailable.

Riparian Habitat Description

Riparian habitat within all the reaches of the Middle Rio Grande where flycatcher population sites occur includes dense stands of willows and other woody riparian plants adjacent to or near the river channel.

Within the San Acacia reach, several major riparian plant communities exist (Table 4.4). Riparian woodlands have a canopy of Rio Grande cottonwood and, less extensively, Goodding's willow (Parametrix 2008). These bosque habitats comprise about 3,885 acres (31%) of the riparian vegetation in the proposed action area. An understory of native shrub species (primarily coyote willow and seep-willow) occurs in only a small percentage of woodland stands. The majority (approximately 3,290 acres) of bosque has an understory dominated by saltcedar and, secondarily, by Russian olive. Riparian shrublands are the most abundant plant community in this reach, occupying over 7,700 acres (61% of all vegetated area). Again, exotic shrub species, primarily saltcedar, dominate this plant community type (Parametrix 2008). The structure of shrub stands can vary widely depending on age and species composition. Young stands or those in relatively dry areas may be short (less than 5 feet in height) and sparsely distributed. The majority of shrub stands in the proposed action area consist of moderately to very dense stands of 5- to 15-foot-tall saltcedar. Native shrub species (coyote willow, seep-willow, and screwbean mesquite) occupy only about 1,600 acres (13% of all vegetated types). Small areas of emergent wetlands are scattered throughout the floodway. These consist of marshes dominated by broad-leaved cattail and hardstem bulrush along the riverbank or in poorly drained depression within the overbank area. Wet meadows consisting primarily of saltgrass also occur. Together, these comprise only 440 acres in the floodway of the proposed action area (3.6% of all vegetation types).

Table 4.4. Vegetation and open water types within the floodway of the proposed action area (Parametrix 2008).

Plant community or open water type	**Acres**	**Percent of vegetated area**
Riparian Woodland:		
Native understory	599	4.7
Mixed understory	1,656	13.1
Exotic understory	1,630	12.9
Woodland Subtotal	*3,885*	*30.7*
Riparian Shrubland:		
Native	1,581	12.5
Mixed native and exotic	236	1.9
Exotic	5,887	46.5
Shrubland Subtotal	*7,704*	*60.8*
Emergent wetland:	459	3.6
Dry grassland and open areas	625	4.9
Subtotal - All Vegetation	*12,672*	*100.0*
Pond and small channel	138	
Rio Grande channel	1,343	
TOTAL	**14,153**	

Modeling Habitat Characteristics

Development of a Geographic Information System (GIS)-based flycatcher habitat suitability model was initiated in 1998 by members of the Middle Rio Grande Endangered Species Collaborative Program (Collaborative Program) for the Middle Rio Grande basin and continues to be refined based on changes in hydrology and updated vegetation maps. The model is currently limited to the Middle Rio Grande from Belen south to Elephant Butte.

Riparian vegetation in the Middle Rio Grande basin between the SADD and Elephant Butte Reservoir had been classified using the Hink and Ohmart (1984) classification system. This system identifies vegetation polygons based on dominant species and structure. Plant community types are classified according to the dominant and/or co-dominant species in the canopy and shrub layers.

During the summer and fall of 2002, as part of the Collaborative Program's efforts, Reclamation personnel updated vegetation maps from Belen to San Marcial using a combination of ground-truthing and aerial photography analysis. In summer of 2004, the conservation pool of Elephant Butte Reservoir was again aerially photographed (true color) and vegetation heights were remotely-sensed using Light Detection and Ranging (LiDAR) methods. The area was ground-truthed during the summer of 2005. In 2008, the conservation pool of Elephant Butte Reservoir was reviewed and habitat mapping was updated based on ground-truthing and aerial photography flow in late summer of 2007. These areas are continually being reviewed as vegetation matures and develops in new areas so that components of the flycatcher habitat suitability model remain current.

In the model, breeding habitat suitability was refined by identifying all areas that are within 328 feet (100 m) of existing watercourses, ponded water, or in the zone of peak inundation. The five categories of flycatcher habitat that lie within 328 feet of water are defined as:

- *Highly Suitable Native Riparian* - Stands dominated by willow and/or cottonwood.
- *Suitable Mixed Native/Non-native Riparian* - Includes stands of natives mixed with non-natives.
- *Marginally Suitable Non-native Riparian* - Stands composed of monotypic saltcedar or stands of saltcedar mixed with Russian olive.
- *Potential with Future Riparian Vegetation Growth and Development* - Includes stands of very young sparse riparian plants on river bars that could develop into stands of adequate structure with growth and/or additional recruitment. This category requires regular monitoring to ascertain which areas contain all the parameters to become flycatcher habitat.
- *Low Suitability* - Includes areas where native and/or non-native vegetation lacks the structure and density to support breeding flycatchers or exceeds the hydrologic parameter of greater than 100 meters from water. The presence of low suitability habitats may be important for migration and dispersal in areas where riparian habitats have been lost (*i.e.,* agricultural and urban areas).

Currently, the Service groups the first three categories listed above as equally suitable habitat for the flycatcher, because a large number of sites are currently occupied in all three categories. Suitable habitats with non-native vegetation are often defined as being less suitable for flycatchers than native habitat when native habitat is available in quantity and in the proper context (*i.e.*, with the proper density and structure and in close proximity to surface water at the onset of territory development and nest initiation). Ultimately, the structure and density of habitat is likely what is most attractive to flycatchers, rather than the plant species composition (Moore and Ahlers 2008, 2009)

Current Availability of Breeding Habitat for Flycatchers within the Proposed Action Area

Breeding habitat in the proposed action area is composed of dense riparian shrubs, chiefly Goodding's willow, coyote willow, and saltcedar. At least a partial canopy of Rio Grande cottonwood or Goodding's willow may be present. The majority of breeding habitat has been found to be situated within 150 feet of the river bank or other water bodies (Reclamation 2005).

Within the proposed action area, designated critical habitat for the flycatcher encompasses the entire floodway from the SADD to the headwaters of Elephant Butte Reservoir, except for the portions of the floodway on the two National Wildlife Refuges. Therefore, suitable breeding habitat exists through the proposed action area. Based on the categories listed above, breeding habitat can be considered either suitable or highly suitable through the project reach.

Flycatcher Habitat Use During Migration

Flycatchers and many other species of Neotropical migrant land birds also use the Rio Grande riparian corridor as stop-over habitat during migration. Studies have shown that during the spring and fall migration, flycatchers are more commonly found in willow habitats than in other riparian vegetation types (Yong and Finch 1997). These birds utilize a variety of vegetation types during migration, many of which are classified as "low suitability" for breeding habitat (Ahlers and White 1997).

The San Acacia reach contains a mosaic of native woody vegetation and dense stands of saltcedar. Flycatchers (and many other species of Neotropical migrant land birds) use the Rio Grande riparian corridor as stop-over habitat during migration. Studies have shown that during the spring and fall migration, flycatchers are more commonly found in willow habitats than in other riparian vegetation types, including the narrow band of coyote willows that line the LFCC (Finch and Yong 1997). Recent presence/absence surveys during May have detected migrating flycatchers throughout the project area in vegetation types that are classified as "low suitability" for breeding habitat (Ahlers and White 1997).

Flycatcher Population Trends 1994-2010

In general, the flycatcher population of the Middle Rio Grande has increased since regular surveys began in 1994. Territories are more abundant in the southern half of the Middle Rio Grande (from the Sevilleta NWR south) than north of this area. Table 4.3 summarizes the locations of known territories (that is, occupied by a male or pair of flycatchers) within the floodway of the proposed action area during 2004 to 2010. The San Marcial reach of the Middle Rio Grande has been surveyed for flycatchers regularly since 1994 (Mehlhop and Tonne 1994; Henry *et al*. 1996; Ahlers and White 1995, 1996, 1997, 1999, 2000; Ahlers *et al*. 2001, 2002; Ahlers and Moore 2003; Moore and Ahlers 2004, 2005, 2006, 2008; Reclamation 2010, 2011). The population in this area has steadily increased and expanded since the initial surveys. In 1994, the only 11 flycatcher territories that were known were located south of the BDANWR (all near the railroad bridge above San Marcial). The population in this river reach remained between 9 and 12 territories through 1999. By 2000, the birds had dispersed and expanded southward following the development of new riparian vegetation in the receding pool of Elephant Butte

Reservoir. This new population has experienced steady growth, with approximately 319 territories were located in the delta area in 2009.

North of the San Marcial reach, portions of the BDANWR have been surveyed for flycatchers annually since 1993. The wetland areas within the inactive floodplain outside of the levees have variably attracted between one and seven territories annually during this period. When the active floodplain channel, or river corridor within the refuge, was surveyed in 2005, no territories were detected. However, in 2009 there were 20 territories detected within this same area.

Development of Suitable Flycatcher Breeding Habitat within the Middle Rio Grande

It is commonly recognized that one of the primary causes for the decline of Neotropical migrants, along with numerous other terrestrial species, is the decrease in the abundance of riparian vegetation over the past hundred years. The reason for this decline in riparian vegetation is due to the removal of the dynamic components of river systems.

The Rio Grande and associated riparian areas have historically been a dynamic system in constant change and, without this change, the plant diversity and productivity has decreased. Sediment deposition, scouring flows, inundation, and irregular flows are natural dynamic processes that occurred frequently enough in concert to shape the characteristics of the Rio Grande channel and floodplain. Through the development of dams, irrigation systems, and controlled flows, the dynamics of the river system have been significantly reduced except at localized areas such as the reservoirs where water storage levels frequently change with releases and inflows.

The interaction of river discharge (timing and magnitude), river channel morphology, and floodplain characteristics are vital components that can favor the establishment of native vegetation and enhance the development of suitable Willow Flycatcher breeding habitat within the Middle Rio Grande. To recreate these dynamic processes in a very static river system, man-made procedures have been developed and implemented including mechanical disturbance, herbicide treatments, prescribed fire, channel realignment, operational flows, avulsions, and river realignment. These man-made processes manipulate the river and floodplain in an attempt to restore the diversity of a healthy river system. It is no coincidence that flycatchers have expanded and dispersed within the delta of the Elephant Butte Reservoir. In the previous several years, this area has had the most dynamic components within the Middle Rio Grande as a result of changing reservoir elevations. Since cottonwoods and willows are aggressive colonizers of disturbed sites (Reichenbacher 1984), the dynamic scouring and deposition process provides the potential for the development of new habitat.

Successful cottonwood and willow recruitment has been shown to coincide with the descending limb of the spring runoff hydrograph. The timing and rate of decline of surface-water inundation, such as that occurring in the headwaters of Elephant Butte Reservoir, have been documented as important factors affecting seedling survival (Sprenger *et al*. 2002).

Several years of prolonged inundation have killed many saltcedar stands within the Elephant Butte Reservoir pool. The receding reservoir pool has exposed new areas for establishment of native vegetation. Newly scoured areas of the river channel or floodplain and areas where sediment has been deposited also provide conditions for regeneration of native species.

In the San Marcial reach, as part of ongoing reviewed and approved projects, Reclamation is conducting non-native vegetation clearing, floodplain expansion, riparian vegetation plantings, channel avulsions, channel widening, and bank destabilization, all of which are man-induced processes to provide the dynamic conditions to enhance the recruitment of cottonwoods and willows, and indirectly increasing the quantity of available flycatcher habitat.

Cowbird Parasitism and Breeding Flycatchers

Brood parasitism by Brown-headed Cowbirds (*Molothrus ater*) may be a contributing factor to the decline of the flycatcher, as well as other Neotropical migrant land birds. Reclamation implemented a cowbird control program from 1996 through 2001 in the San Marcial area. This was an effort to reduce brood parasitism on the endangered Southwestern Willow Flycatcher as mitigation for the presence of cattle within Elephant Butte public lands. From 1997 through 2001, approximately 3,599 cowbirds were captured in the San Acacia reach in the absence of cattle (except trespass cattle). During this time, the number of cowbirds trapped during the summer resident period remained constant, which appeared to indicate that trapping did not reduce the breeding population of cowbirds at Elephant Butte Reservoir over time. However, the number of cowbirds was reduced on a seasonal basis.

Factors influencing cowbird density include host nest availability, habitat quality, presence of livestock, and availability of forage areas such as grain fields (Morrison and Hahn 2002). Cowbird and Neotropical bird observations along the riparian corridor of the Middle Rio Grande were compared between sites with different land-use practices using the point-count methodology. These counts indicate that Sevilleta NWR attracted the highest number of nesting Neotropical bird species likely to provide host nests for cowbirds. This reach is also characterized by the narrowest riparian corridor of the four reaches. Point counts indicate that Sevilleta NWR and BDANWR attracted the highest number of cowbirds. Both of these refugees are not grazed. Increased cowbird numbers may be in response to better habitat or the availability of Neotropical bird host nests.

The effects of cowbird trapping on the success of breeding flycatchers and other Neotropical birds on Elephant Butte public lands was assessed for the period 1999–2001. In the Elephant Butte public lands study area, parasitism was observed in 31% of nests of all Neotropical bird species, but was only 5% in flycatcher nests, according to data sets combining nests monitored from 1999 through 2001 (D. Ahlers, U.S. Bureau of Reclamation, personal communication, 2001). These data indicate that, possibly, factors other than trapping may be responsible for the low incidence of parasitism on the flycatcher nests. Within the reservoir delta, a dramatic increase in the number of breeding flycatchers occurred since 1999. In 2001, nest success for the breeding flycatchers in the delta was 75% in comparison to a 50% nest success of Neotropical birds in the same area. No parasitism had occurred in the flycatcher nests from 1999 through 2001. The increase of breeding pairs and the absence of parasitism in this specific area most likely is a response to high quality habitat. When comparing the Neotropical bird nest data between Elephant Butte public lands with cowbird trapping, and San Acacia and BDANWR reaches where no trapping occurs, there was no statistical difference between nest success observed within the trapped *versus* untrapped areas. These data indicate that trapping cowbirds does not affect Neotropical bird nest success in the Middle Rio Grande, and, therefore, cowbird trapping was stopped.

Addling or removal of Brown-headed Cowbird eggs from parasitized flycatcher nests is a practice that was begun in 2002 and continued through 2005. Of the 79 flycatcher nests parasitized during that period with known outcomes, cowbird eggs were addled or removed from 38 nests, 7 of which successfully fledged flycatcher young (18.4% success). Parasitized nests during 1999 through 2005 in the Middle Rio Grande that were unaltered were as successful. Of 41 parasitized nests monitored, 32 failed, and 9 successfully fledged young (a 22% success rate).

Other Factors Potentially Affecting Flycatchers and Critical Habitat

In the Middle Rio Grande, past and present Federal, State, and private activities that may affect the flycatcher include irrigated agriculture, river maintenance, flood control, dam operation, water diversions, and downstream Rio Grande Compact deliveries. The Rio Grande and associated riparian areas are a dynamic system in constant change. Without this change, the riparian community will decrease in diversity and productivity. Sediment deposition, scouring flows, inundation, base flows, and channel and river realignment are processes that help to maintain and restore the riparian community diversity. Habitat elements for the flycatcher are provided by thickets of riparian shrubs and small trees and adjacent surface water, or areas where such suitable vegetation may become established (Federal Register 2005).

The Rio Grande historically had highly variable annual and seasonal discharge patterns (Platania 1993). Since 1973, flows in the Middle Rio Grande have been determined mainly by regulation of dam facilities and irrigation diversions. The highest flows generally result from snowmelt (April-May), irrigation water releases from the upstream reservoirs, and variable thunderstorms. Lowest flows generally occur from July to October, when most of the available river flow is diverted for irrigation. Summer monsoons can elevate river flows during this time period depending on their frequency and intensity. Water and sediment management have resulted in a large reduction of suitable habitat for the flycatcher, as a result of the reduction of peak flows that helped to create and maintain habitat for this species. Overbank flooding is needed to create shallow, low-velocity backwaters and to maintain and restore native riparian vegetation for flycatcher habitat. Overbank flooding is also currently restricted by the safe channel capacity at the San Marcial Railroad Bridge and for Isleta reach spoil bank levees.

Spoil banks have restricted the extent of floodplain inundation from discharges up to 7,000 or 10,000 cfs and, along with their attendant riverside drains, have functionally separated the river from most of the historical floodplain. A comparison of river habitat changes between 1935 and 1989 shows a 49% reduction of river channel habitat from 22,023 acres (8,916 ha) to 10,736 acres (4,347 ha) (Crawford *et al.* 1993). Between Cochiti Dam and Elephant Butte Reservoir headwaters, there are 235 miles (378 km) of levees including distances on both sides of the river (Federal Register 2005).

The Middle Rio Grande channel width has narrowed over the last century. The trend can be attributed to reduced peak flows, channelization, and reduced sediment supply. Channelization in the 1950s and 1960s is primarily responsible for the elimination of thousands of acres of the shallow, low-velocity habitats required by the flycatcher. Flow regulation below Abiquiu Reservoir and Cochiti Dam has further decreased channel capacity and reduced peak flows. Flood events greater than 10,000 cfs have not occurred since the 1940s. The lack of large peak flows combined with the effects of channelization contributes significantly to channel narrowing and the reduction of overbank flooding. These factors severely limit the development of backwater habitats essential to the survival of the flycatcher (Federal Register 2005).

4.3 Interior Least Tern

4.3.1 Status and Distribution

The Interior Least Tern (*Sternula antillarum athalassos*) was listed as endangered by the Service in 1985 (Federal Register 1985). This subspecies historically bred along the Colorado River (in Texas), Red River, Rio Grande (in Texas), Arkansas River, Missouri River, Ohio River, and Mississippi River systems and has been found on braided rivers of southwestern Kansas, northwestern Oklahoma, and southeastern New Mexico (American Ornithologists' Union 1957). In New Mexico, the Interior Least Tern was first recorded (including nesting) at Bitter Lake National Wildlife Refuge in 1949, and since then, it remained present essentially annually (Marlatt 1984). The species also occurs as an occasional breeder in Eddy County, New Mexico (Doster 2007). The Interior Least Tern is a vagrant elsewhere in New Mexico, including locations such as Española, Sumner Lake, BDANWR, and in wetlands near Glenwood, Las Cruces, and Alamogordo (NMDGF 1988).

4.3.2 Life History and Ecology

Habitat requirements for this species include the presence of bare or nearly bare ground on alluvial islands, shorelines, or sandbars for nesting; the availability of food (primarily small fish); and the existence of favorable water levels during the nesting season so nests remain above water (Ducey 1981). Breeding colonies contain from 5 to 75 nests. Although most nesting occurs along rivers, the tern also nests on barren flats of saline lakes and ponds.

4.3.3 Reasons for Decline

Loss of nesting areas through permanent inundation or destruction by reservoir and channelization projects was identified as the major threat to the species (Federal Register 1985). Alteration of natural river or lake dynamics has caused unfavorable vegetation succession on many remaining islands, curtailing their use as nesting sites by terns. Releases of water from upstream reservoirs and annual spring floods often inundate nests. Recreational use of sandbars may cause destruction of nesting habitat, nests, and eggs by trampling.

4.4 Northern Aplomado Falcon

4.4.1 Status and Distribution

The Northern Aplomado Falcon (*Falco femoralis*) was listed as endangered by the Service in 1986 (Federal Register 1986). The species was historically distributed in the United States across grasslands from southeastern Arizona, southern New Mexico, and western and southern Texas and southward through Mexico to Nicaragua (Macias-Duarte *et al.* 2004). It is a medium-sized falcon, approximately 14-18 inches (35-45 cm) in length. These birds have lead-gray underparts with a dark gray band separating a cinnamon belly from a white upper breast, yellow legs, a banded tail, and a distinct facial stripe.

This species was reported to be fairly common throughout their range but by the early 1900s in New Mexico they were restricted to the southwestern corner of the state (Young and Young

2010). The last documented nest in New Mexico was reported in 1952 and although there have been sporadic sightings, the species was considered extirpated in the state (Meyer and Williams 2005). However, in 2001 and 2002, a nesting pair (presumably from Chihuahua) was confirmed in Luna County (Meyer and Williams 2005). In 2006, an experimental non-essential population was introduced on the privately-owned Armendaris Ranch in Socorro County.

Over the past few years, captive Aplomado Falcons have been released, and have successfully bred, on the Armendaris Ranch, located southeast of San Marcial. During fall and winter, Aplomado Falcons have been occasionally sighted foraging in sparsely vegetated areas of Bosque del Apache NWR.

4.4.2 Life History and Ecology

Northern Aplomado Falcons are associated with grassland habitats with a sparse canopy of woody vegetation. Territories in northern Chihuahua, Mexico, are known to be flat, open grasslands with less than 10% shrub cover consisting of yucca (Yucca spp.), longleaf ephedra (*Ephedra trifurca*), honey mesquite (*Prosopis glandulosa*), creosotebush (*Larrea tridentata*),and tarbush (*Flourensia cernua*) (Meyer and Williams 2005). The diet of this species consists primarily of small birds and insects and less so of small mammals, reptiles, and amphibians (Young and Young 2010).

This species is a secondary nester and relies on stick nests previously constructed by other raptors or ravens (Young and Young 2010). They nest from February to June with an incubation period lasting approximately 31-33 days (Young and Young 2010). In northern Chihuahua, clutch size is approximately 2 to 3 eggs (Macias-Duarte *et al.* 2004). Nestlings fledge four to five weeks after hatching (Young and Young 2010).

4.4.3 Reasons for Decline

The major threats to the species are primarily habitat degradation due to brush encroachment caused by fire suppression and over-grazing (Federal Register 1986), agricultural development of grasslands (Hector 1987; Keddy-Hector 2000) secondarily egg and specimen collecting and continued pesticide application (DDT) within the range.

4.5 Pecos Sunflower

4.5.1 Status and Distribution

Pecos sunflower (*Helianthus paradoxus* Heiser) was listed as a threatened species by the Service on October 20, 1999 (Federal Register 1999). Critical habitat for the species was designated effective May 8, 2008 (Federal Register 2008). The State of New Mexico lists Pecos sunflower as endangered under the regulations of the New Mexico Endangered Plant Species Act (19 NMAC 21.2). This species is also listed as threatened by the State of Texas (31 TAC 2.69(A)).

Pecos sunflower is a wetland plant that was known only from a single population near Fort Stockton, Pecos County, Texas, when it was proposed as a candidate for listing as endangered under the ESA on December 15, 1980 (Federal Register 1980). Subsequent field surveys for this plant found additional populations in New Mexico and Texas. It is presently known to occur in two widely separated locations in the Pecos River valley in eastern New Mexico, two locations on the Rio San Jose, two locations on the Rio Grande in west-central New Mexico, and at two desert springs in west Texas. Little is known about the historic distribution of Pecos sunflower. The plant is associated with spring seeps and wet meadow (cienega) habitats, which are very rare in the dry regions of New Mexico and west Texas. There is evidence these habitats were originally more widespread, but have been historically reduced or eliminated by aquifer depletion, or severely impacted by agricultural activities and encroachment by alien plants (Hendrickson and Minckley 1984; Poole 1992; Sivinski 1996). Existing Pecos sunflower populations occur on a variety of State and Federal lands and several private land holdings, and face a moderate degree of threat. Incompatible land uses, habitat degradation and loss, and groundwater withdrawals are historic and current threats to the survival of Pecos sunflower (Poole 1992; Sivinski 1996; USFWS 2005). In addition, the Southwestern United States is currently experiencing a period of prolonged drought that is exacerbating this habitat degradation. The trend of decreasing habitat availability and suitability justified listing Pecos sunflower as a threatened species. Recovery actions to reverse or stabilize this trend and ensure the long-term sustainability of this species include identifying the ecological parameters of Pecos sunflower habitat, and enlisting the cooperation of the various habitat owners in the long-term conservation of the species (USFWS 2005).

Pecos sunflower is presently known from only seven naturally occurring populations, two in west Texas and five in New Mexico (Figure 4.6), and one reintroduced population in New Mexico. The type locality (the location at which the species was first described) is near Fort Stockton in Pecos County, Texas. Here a large population with several hundred thousand plants currently exists at the Nature Conservancy’s Diamond Y Spring Preserve, with a smaller group of plants downstream at a nearby highway right-of-way. A second Texas population occurs at the Nature Conservancy’s Sandia Spring Preserve in the Balmorhea area of Reeves County, Texas.

In New Mexico, the six Pecos sunflower populations are located in the Roswell/Dexter region, Santa Rosa, two locations in the Rio San Jose valley, and two on the Middle Rio Grande. In the Roswell/Dexter region of the Pecos River valley in Chaves County, Pecos sunflower occurs at 11 spring seeps and cienegas. Three of these wetlands support many thousands of Pecos sunflowers, but the remaining are smaller, isolated occurrences. Springs and cienegas within and near the town of Santa Rosa in Guadalupe County have eight wetlands with Pecos sunflower, one of which consists of several hundred thousand plants in good years. Two widely separated areas of spring seeps and cienegas in the Rio San Jose valley of western New Mexico each support a population of Pecos sunflower. One occurs on the lower Rio San Jose in Valencia County and the other is in Cibola County in the vicinity of Grants. Neither are especially large populations.

Figure 4.6. Distribution of naturally occurring populations of Pecos sunflower (USFWS 2005).

In the Middle Rio Grande, the only known naturally occurring population of Pecos sunflower exists within the La Joya Unit of the Ladd S. Gordon Waterfowl Complex (Figure 4.6).. It represents one of the largest populations of *H. paradoxus* in the range of the species (USFWS 2005), consisting of 100,000 to 1,000,000 plants. This property is owned by the New Mexico State Game Commission. It is managed by the NMDGF for migratory waterfowl habitat, which is compatible with preservation of wetlands for *H. paradoxus*. The site was determined to be essential to the conservation of the species resulting from encroachment of non-native species, degradation of habitat, or a catastrophic event because it is occupied by a very large, stable population, that is sufficiently distant (over 40 mi, 64 km) from other populations to serve as an additional locality that contributes to the conservation of genetic variation (USFWS 2005). As such, it may contain genetic variation not found anywhere else in the range of the species. This naturally occurring population of Pecos sunflower contains all of the Primary Constituent Elements (PCEs) in the appropriate spatial arrangement and quantity, but is threatened by encroachment of non-native vegetation. Because the water source for this population is stable, this population can be expected to persist in very large numbers every year.

With the exception of the La Joya population, most Pecos sunflower habitats are limited to less than five acres (two hectares) of wetland. Some are only a small fraction of a hectare; however, one near Fort Stockton and another near Roswell are more extensive. The number of sunflowers per site varies from less than 100 to several hundred thousand. Because Pecos sunflower is an annual, the number of plants per site can fluctuate greatly from year to year with changes in precipitation and depth to groundwater. Stands of Pecos sunflower can change location within the habitat as well (Sivinski 1992; Bush 2006; Grunstra and Van Auken 2007). This sunflower is completely dependent on water-saturated soil conditions within the soil root zone. If a wetland habitat dries out permanently, even a large population of Pecos sunflower would disappear (USFWS 2005).

In 2008, seeds from the La Joya population were used to establish a reintroduced population on private property approximately 25 miles (40 km) to the south in Socorro County. This reintroduced population was established as a cooperative effort between the landowner, the U.S. Fish and Wildlife Service, and the New Mexico Energy, Minerals and Natural Resources Department, Forestry Division. The State of New Mexico and the Service consider this to be a reintroduction within the historic range of Pecos sunflower. After identifying suitable habitat on the property, biologists planted seeds obtained from the La Joya population in several 1- or 2-m^2 patches. Although a current population estimate is unavailable, some of the original seeded patches have expanded in numbers and area. The population is protected from grazing by an exclosure, and the landowner is conducting habitat management work in cooperation with the Service (R. Sivinski (New Mexico Forestry Division [NMFD]), personal communication, 2010). Due to its recent establishment, the population's long-term viability has not been assessed. This habitat and sunflower population belong to the landowner and neither have ESA protection from the actions of the landowner, unless an action is proposed that would have a Federal nexus (R. Sivinski (NMFD), personal communication, 2010). This population was not considered for critical habitat designation because it became established after the rulemaking process was complete. This reintroduced population must also demonstrate an ability to persist under current land use and environmental conditions.

4.5.2 Life History and Ecology

Pecos sunflower is an annual, herbaceous plant. It grows 3.3 to 10 feet (1 to 3 m) tall and is branched at the top. The leaves are opposite on the lower part of the stem and alternate at the top. Each leaf is lance-shaped with three prominent veins and up to 6.9 inches (17.5 cm) long by 3.3 inches (8.5 cm) wide. The stem and leaf surfaces have a few short, stiff hairs. Flower heads are 2.0 to 2.8 inches (5 to 7 cm) in diameter with bright yellow rays around a dark purplish brown center (the disc flowers). Pecos sunflower looks much like the common sunflower (*Helianthus annuus*) seen along roadsides throughout the West, but differs from common sunflower by having narrower leaves, fewer hairs on the stems and leaves, smaller flower heads, and narrower bracts (phyllaries) around the bases of the heads. The prairie sunflower (*Helianthus petiolaris*) also has narrow leaves and phyllaries, but is distinguished from Pecos sunflower by having white cilia in the dark center of the flower head and a branching pattern from the base of the plant that imparts a bushy appearance. Common sunflower and prairie sunflower usually bloom earlier in the season (May to August depending on location) than Pecos sunflower (September and October) and neither occupies the wet, saline soils that are typical of Pecos sunflower habitats. Pecos sunflower has a highly disjunctive distribution, yet there appears to be very little phenotypic variation between populations.

Pecos sunflower grows in areas with permanently saturated soils in the root zone. These wet soil areas are most commonly associated with desert springs and seeps that form wet meadows called cienegas. Such wetland habitats are rare in the arid southwest region and have decreased historically (Hendrickson and Minckley 1984). This sunflower also can occur around the margins of lakes, impoundments, and creeks. When Pecos sunflowers grow around lakes or ponds, these are usually impoundments or subsidence areas within natural cienega habitats. The soils of these desert wetlands are typically saline or alkaline because the waters are high in dissolved solids, and high rates of evaporation leave deposits of salts, including carbonates, at the soils surface. Soils in these habitats are predominantly silty clays or fine sands with high organic matter content. Studies by Van Auken and Bush (1995) and Van Auken (2001) showed that Pecos sunflowers grow in saline soils, but seeds germinate and establish best when precipitation and high water tables reduce salinity near the soil's surface. Like all sunflowers, this species requires open areas that are not shaded by taller vegetation.

Plants commonly associated with Pecos sunflower include saltgrass (*Distichlis spicata*), alkali sacaton (*Sporobolus airoides*), common reed (*Phragmites australis*), chairmaker's bulrush (*Schoenoplectus americanus*), Baltic rush (*Juncus balticus*), alkali muhly (*Muhlenbergia asperifolia*), southwestern sea lavender (*Limonium limbatum*), clasping yellowtops (*Flaveria chloraefolia*), Wright's marsh thistle (*Cirsium wrightii*), saltcedar (*Tamarix sp*.), and Russian olive (*Elaeagnus angustifolia*) (Poole 1992; Sivinski 1996). All of these species are indicators of wet, saline, or alkaline soils. Pecos sunflowers often occur with saltgrass between the saturated soils occupied by bulrush and the relatively drier soils with alkali sacaton (Van Auken and Bush 1998).

4.5.3 Reasons for Decline

Spring seeps and wet meadow (*cienega*) habitats are rare in the dry regions of New Mexico and Texas. There is evidence these habitats have historically, and are presently, being reduced or eliminated by aquifer depletion, or severely impacted by agricultural activities and encroachment by alien plants (Poole 1992; Sivinski 1996). The Southwestern United States is currently experiencing a period of prolonged drought that is exacerbating this habitat degradation. The trend of decreasing habitat availability and suitability justified listing Pecos sunflower as a threatened species. Recovery actions to reverse or stabilize this trend and ensure the long-term sustainability of this species include identifying the ecological parameters of Pecos sunflower habitat, and enlisting the cooperation of the various habitat owners in the long-term conservation of the species (USFWS 2005).

5. Analysis of Effects of Proposed Action

This chapter provides an analysis of the effects of proposed Corps' actions on listed species and their designated and proposed critical habitat. "Effects of the action" refers to the direct and indirect effects of the proposed action on listed species or critical habitat together with the effects of other activities that are interrelated or interdependent with that action. These effects are considered along with the environmental baseline to determine the overall effects on the species (50 CFR § 402.02). For purposes of this BA, effects on listed species and critical habitat are analyzed individually with respect to the proposed action. The historic and existing conditions discussed previously (*i.e.*, hydrology, geomorphology, aquatic and riparian habitat, and species distribution and abundance) are the basis upon which the proposed action was assessed.

This chapter first addresses the analysis of effects on the Rio Grande silvery minnow (silvery minnow), the Southwestern Willow Flycatcher (flycatcher), and designated and/or proposed critical habitat for each species in Section 5.1. This is followed by three sections addressing effects on the Pecos sunflower, the Interior Least Tern, and the Northern Aplomado Falcon (Sections 5.2 through 5.4, respectively), and a final summary of all effect determinations (Section 5.5).

In Section 5.1, the discretionary activity associated with each component feature of the proposed action is briefly summarized. This brief summary is intended as a reminder to the reader, and does not supplant the formal description of the proposed action in Chapter 2 of this BA.

5.1 Rio Grande Silvery Minnow, Southwestern Willow Flycatcher, and Their Critical Habitats

5.1.1 East Side Excavation

Immediately downstream from the San Acacia Diversion Dam (SADD), approximately 12.4 acres along the east bank of the river would be excavated to provide a wider corridor for flood flows and decrease the velocity and erosive potential of the design flood (Appendix A, Sheet C-111). Excavation would create a level terrace at the 10%-chance exceedance water surface elevation. At the base of the proposed terrace, the existing bank would be excavated to slope downward to the existing channel. Excavation would be scheduled for four months during fall and winter when river flow is relatively low and reliably stable. During excavation of the east bank near the SADD, the existing river bankline would be maintained until all other excavation is completed to minimize sedimentation of the river. Construction would be scheduled during low-flow conditions and no impoundment of water would occur.

Currently, the area to be excavated is not inundated until the discharge measured at the San Acacia gage exceeds 25,000 cfs. Vegetation consists of relict riparian shrubs: 5.0 acres of relatively dense salt cedar, 6.0 acres of short sparse salt cedar, and a narrow band of sparse coyote willow along the bankline. This upland area is not suitable habitat for the flycatcher.

Following excavation, the lowest 3.1 acres would become part of the active Rio Grande channel (that is, would be excavated to an elevation below that of the 50%-chance flow event). A 1.1-acre band of coyote willow and seep-willow would be planted along the new bank-line within this 3.1 acres. The upper 9.3 acres would entail a bench that would be inundated by the 10%-chance flow event (15,400 cfs at the San Acacia gage), and would be revegetated by upland grasses, forbs, and shrubs (*e.g.*, fourwing saltbush).

For the 1%-chance flood event (29,900 cfs) without the proposed project, water velocities along the western bankline immediately downstream from the San Acacia Diversion Dam may reach 17 fps. The East Side Excavation would reduce flood velocities along the west bank to approximately 14 fps. Still, these velocities are considerably higher than quality silvery minnow habitat.

In order to complete the east-side excavation immediately below SADD, a temporary crossing would be constructed to facilitate the movement of equipment. The crossing would be 300 feet long with a top-width of 15 feet. The crossing would entail 1,000 CY of earthen material (from a portion of the excavated spoil bank) and six 60-inch-diameter, 30-feet-long corrugated metal pipes. The majority of these materials would be below the OHWM. The construction and removal of the temporary crossing as well as the east bankline may create a minor and temporary increase in turbidity.

Rio Grande Silvery Minnow

Construction of the temporary crossing would entail moving and placing soil and pipes in the river channel below the Ordinary High Water Mark (OHWM) elevation (5,660 cfs at SADD). Qualified fisheries biologists would be present to seine and remove as many fish from the immediate work area as possible. However, this action may affect and is likely to adversely affect silvery minnows in the immediate vicinity. Because the crossing is only temporary in nature, it would not affect the hydrologic regime (i), instream habitat (ii), fine sediments for substrate (iii), or water temperature (iv). The temporary crossing would temporarily affect local water conditions (v), therefore it may affect but would not adversely modify silvery minnow critical habitat.

Following excavation, an additional 3.1 acres of active river channel would be created, which would be beneficial to the silvery minnow.

Southwestern Willow Flycatcher

The proposed excavation would be conducted during late fall and winter when flycatchers are not present in New Mexico. No migrant or breeding flycatchers have been detected in this reach of the Rio Grande during protocol surveys conducted in 1994 through 2011 (see references in Section 6.1). The excavated area lies entirely within the Sevilleta NWR and is not currently designated critical habitat for the flycatcher; however, the area may be included in currently proposed critical habitat (USFWS 2011). The area to be excavated entails a portion of Reclamation flycatcher site "LF-38," which has been classified as unsuitable flycatcher habitat (Ahlers *et al.* 2010). The proposed East Side Excavation would not affect the Southwestern Willow Flycatcher or adversely modify proposed critical habitat for the flycatcher.

5.1.2 Installation of Floodwall and Soil Cement Embankment

The floodwall and its roller-compacted concrete apron would be installed within a disturbed, upland portion of the terrace west of the Rio Grande. Approximately 0.05 acres of honey mesquite and fourwing saltbush would be removed at the upstream end of the proposed floodwall during construction.

Along 1.1 miles of the western bankline downstream from the SADD, a soil cement embankment would be installed to protect the vertical bankline and railroad. This embankment would replace high velocity habitat along the steep embankment with lower velocity habitat along a terrace-point bar feature. Flow conditions on the south/east bank are likely more conducive for silvery minnow transit. Installation of this feature would fill 0.56 acres of the active channel. Placement of soil cement in this 0.56-acre area would require partial dewatering of the adjacent river channel. Conservation Measures listed in Section 2.2.11—particularly numbers 4 through 8—would minimize the potential for soil erosion, water quality degradation, and entrapment of fish.

Because of the incised condition of the river channel downstream from the SADD, the eastern overbank area is not currently inundated until flows exceed 15,400 cfs. Vegetation largely consists of relatively short and moderately dense salt cedar. Installation of the soil cement embankment would permanently remove 3.5 acres of this vegetation growing on the terrace slope. A 10 to 40-foot-wide band of vegetation closest to the bankline consists of moderately dense salt cedar, coyote willow, and seep-willow, plus several scattered, mature cottonwood trees. Approximately 0.04 acres of this vegetation would be displaced by the soil cement structure.

Vegetation would be temporarily removed from a 20-foot-wide strip bordering the base of the soil cement to accommodate construction access. Vegetation consists of 1.4 acres of salt cedar and 0.4 acres of moderately dense coyote willow and seep-willow. Following construction, this 1.8-acre area would be replanted with coyote willow and seep-willow.

Rio Grande Silvery Minnow

The 1.1 miles of the western bankline downstream from the SADD is generally unsuitable for silvery minnows and other small fish species because of very high water velocities (Figure 5.1, Figure 5.2) in this area. The proposed soil cement embankment to protect the vertical bankline and railroad would result in the loss of 0.56 acres of river channel and critical habitat. The area of silvery minnow critical habitat that would be affected by the placement of soil cement below the 5,660-cfs Ordinary High Water Mark (OHWM) immediately downstream of the SADD would be more than compensated by the channel excavation on the east bank which increases the area below the OHWM by approximately 3.1 acres (Section 5.1.1). The 3.1 acres of created habitat lies immediately across the channel from the 0.56 acres filled by the soil cement embankment (Appendix A, Sheet C-111).

Placement of soil cement for erosion protection on the western bankline below the SADD may affect, and is likely to adversely affect, silvery minnows in the river. Conservation Measures (Section 2.2.11) would be implemented during in-channel construction to minimize adverse effects to the silvery minnow and other fish species. This erosion control embankment may likely adversely modify silvery minnow critical habitat constituent elements ii and iii (instream habitat and fine sediments for substrate). The soil cement would not modify the hydrologic regime (i), water temperature (iv) or water conditions (v).

While the loss of 0.56 acres of aquatic and critical habitat may likely adversely affect the minnow, this effect would be more than offset in the proposed action by the creation of 3.1 acres of channel habitat during east side terrace excavation

Southwestern Willow Flycatcher

The proposed floodwall and soil cement construction would be conducted during late fall and winter when flycatchers are not present in New Mexico. No migrant or breeding Southwestern Willow Flycatchers have been detected in the affected area during protocol surveys conducted in 1994 through 2011 (see references in Section 6.1).

Approximately 0.6 miles of the 1.1-mile-long soil cement embankment lies within the Sevilleta NWR and is not currently designated critical habitat for the flycatcher; however, the area may be included in currently proposed critical habitat (USFWS 2011). Approximately 2.3 acres of the footprint of the proposed soil cement embankment at its downstream end lies within currently designated critical habitat.

The area to be excavated entails a portion of Reclamation flycatcher site "LF-108," the majority of which has been classified as unsuitable flycatcher habitat (Ahlers *et al.* 2010). A 0.3-mile long portion of Reclamation's flycatcher site LF-10 immediately downstream from the SADD was classified as moderately suitable flycatcher habitat (Ahlers *et al*. 2010); however, field inspection by the Corps in 2012 determined that this area is unsuitable nesting habitat for the flycatcher.

To install soil cent, vegetation growing on the 15-foot-tall slope of the terrace embankment would be removed, along with that in a narrow strip at its base. Affected vegetation largely consists of sparse to moderately dense saltcedar that is 15-foot-tall or shorter. As stated, a narrow (10 to 40 feet) band along the riverbank consists of sparse coyote willow and seep-willow, also less than 15 feet tall, mixed with salt cedar. Vegetation throughout the footprint of the soil cement embankment lacks sufficient height and dense branching that characterizes suitable flycatcher nesting habitat.

Therefore, due to its location and the low quality of flycatcher habitat affected, this feature of the proposed action may affect, but would not likely adversely affect the flycatcher, and would not likely adversely modify flycatcher designated critical habitat. (The cumulative effect on riparian vegetation and flycatcher PCEs is discussed in Section 5.1.3.)

5.1.3 Earthen Levee Construction

<u>Vegetation removed due to levee footprint</u>

The basal extent of the proposed levee was superimposed on geo-referenced aerial photography from 2010 and on riparian vegetation coverage mapped in 2007 (Parametrix, 2008). This was used to estimate potential changes to the riparian vegetation bordering the riverward toe of the levee.

From the north end of the proposed levee downstream to the northern boundary of BDANWR, the footprint of the new levee structure would fit entirely within that of the existing spoil bank (once it is removed). No riparian vegetation would be removed to accommodate the earthen structure.

Through BDANWR, the proposed levee would extend beyond the riverward toe of the existing spoil bank, and 8.7 acres riparian vegetation within the floodway would be permanently removed. Of these 8.7 acres, 8.6 acres are dominated by salt cedar. Along the levee alignment on the north end of Tiffany Basin, less than one acre of vegetation would be similarly affected, all of which is sparsely vegetated or occupied by relatively short salt cedar.

Vegetation removal and clearing-and-grubbing activities for all proposed construction would only occur between August 15 and April 15 to avoid disturbance of nesting migratory birds. If needed, vegetation removal outside of that period would only be performed after a survey by a biologist confirms that disturbance to nesting migratory bird species would be avoided.

Vegetation altered to accommodate the Vegetation-free Zone

The Corps Engineer Technical Letter 1110-2-571 (10 April 2009) requires that no vegetation other than grasses be allowed to grow on the levee or within 15 feet of either toe of the levee. This prevents root penetration into the levee that can compromise its structural integrity and allows for unobstructed visual inspections on a periodic basis Vegetation removal in preparation of construction would include the removal of above-ground stems, root crowns, and roots greater than 0.5-inch in diameter. Removal methods may include clearing and grubbing, scraping, or root-plowing and raking. Following construction, a 15-foot-wide zone along the riverward toe of the levee would be permanently maintained to be devoid of all vegetation except grass.

During construction, existing vegetation would be removed adjacent to the riverward toe of the proposed levee to create the Vegetation-free Zone. This would only be necessary where the new levee toe is within 15 feet westward of the existing spoil bank toe, or where the new levee footprint extends riverward (eastward) of the existing toe. No vegetation removal would be required where the basal width of the new levee is sufficiently narrower than that of the existing spoil bank.

For the proposed action a total of 27.5 acres of existing riparian vegetation would be removed to establish the Vegetation-free Zone. The majority of that affected acreage (21.6) would occur within the BDANWR where the proposed levee is wider than the existing spoil bank. Most (72%) of the riparian vegetation to be removed is dominated by salt cedar; 10% is principally native woody species, about 14% is a mixture of native and non-native species, and about 4% is open or grassy. Along the 1.3-mile portion of the levee at the downstream end, about 2 acres of sparse saltcedar would be removed within the Tiffany basin.

Summary of affected vegetation

Table 5.1 summarizes the area of extent and type of vegetation affected by the proposed earthen levee, soil cement embankment and floodwall, as well as the vegetation types that would be converted to grassland within the Vegetation-free Zone. (This table does not include non-riparian vegetation affected by the East Bank Excavation and spoil deposition area which are discussed in Sections 5.1.1 and 5.1.8, respectively.)

Table 5.1. Vegetation affected by the proposed project, and area revegetated (acres).

	Affected areas			Revegetated areas		
Habitat type	Vegetation altered in Vegetation-free Zone	Vegetation removed for footprint of levee, soil cement & floodwall	Total	Area exposed after spoilbank removal (exclusive of Veg.-free Zone)	Other revegetated locations	Total
Riparian vegetation:						
Native-dominated shrub/tree	2.8	0.9	3.7	7.7	8.7	16.4
Mixed native/exotic shrub/tree	3.7	0.0	3.7	0.0	0.0	0.0
Exotic-dominated shrub	19.8	12.1	31.9	0.0	0.0	0.0
Herbaceous	1.3	0.0	1.3	27.8	75.9	103.7
Subtotal	27.6	13.0	40.6	35.5	84.6	120.1
Upland vegetation:						
Native-dominated shrub/tree	0.0	0.2	0.2	0.0	0.0	0.0
Mixed native/exotic shrub/tree	0.0	0.0	0.0	0.0	0.0	0.0
Exotic-dominated shrub	0.9	15.2	16.0	0.0	0.0	0.0
Herbaceous	1.1	1.0	2.1	0.1	1.9	2.0
Subtotal	1.9	16.4	18.3	0.1	1.9	2.0
Total	29.5	29.4	58.9	35.6	86.5	122.1

Mitigative Vegetation Establishment

All areas disturbed by construction activities would be revegetated following construction. These areas include staging and access areas, levees side-slopes, the Vegetation-free Zone, and additional locations within the floodway. Table 5.1 summarizes the extent and type of proposed vegetation plantings.

A total of 77.9 aces would be planted and maintained as grassland within the riverside corridor of the Vegetation-free Zone. Approximately 29.5 acres of existing vegetation (Table 5.1) would be converted to grassland to accommodate this. The remainder of the Vegetation-free Zone would entail grass plantings in areas exposed after removal of the spoil bank.

Following construction, the Corp's operation and maintenance manual would require the local sponsor to maintain the Vegetation-free Zone (the levee itself and the 15-foot-wide strip adjacent to each toe) to preclude the establishment of all vegetation except grass. The Vegetation-free Zone would be periodically mowed, when dry. If required, spot-application of approved herbicides would be used to prevent colonization by invasive weed species.

As discussed in Section 5.1.7below, removal of the spoil bank would increase the floodway area by approximately 75.0 aces. Of that area, approximately 35.5 acres would not be devoted to the Vegetation-free Zone adjacent to the riverward levee toe. Based on current vegetation types and the potential inundation frequency, approximately 7.7 acres the Corps of this area would be suitable for planting with native riparian shrub species (coyote willow, seep-willow, New Mexico olive). The remaining drier, or higher sites (27.8 acres) would be revegetated with native grass and forb species.

In addition to the woody plantings mentioned above, the Corps would establish 8.7 acres of native shrubs and trees (up to 30% tree canopy cover) on or in close proximity to BDANWR. The Corps is currently coordinating with the BDANWR staff on the location and composition of revegetated areas. The Corps would receive guidance from the BDANWR as to where the establishment of native riparian habit would be most practicable on lands managed by BDANWR.

Rio Grande Silvery Minnow

The areas affected by the levee footprint and establishment of the Vegetation-free Zone are within the Rio Grande floodway but are not regularly inundated by river flows. All vegetation removal activities would occur on dry ground and therefore these activities may affect but are not likely to adversely affect silvery minnow. Establishment of the Vegetation-free Zone would preclude the establishment of any native woody riparian vegetation, but would not preclude inundation during periods of higher flows. Silvery minnows can still use these areas for refugial habitat and foraging. Therefore, the proposed action may affect but is not likely to adversely modify any of the critical habitat PCEs elements hydrologic regime (i), instream habitat (ii) and fine sediments for substrate (iii), water temperature (iv), or water conditions (v).

Southwestern Willow Flycatcher

As described in Section 4.2.1, Relatively few flycatchers (0 to 3 territories) have nested between the SADD and U.S. Highway 380 near San Antonio since 1994 (Table 4.3and references in Section 6.1). The location of these isolated, territorial birds has changed from year-to-year throughout this 29-mile-long reach. From Highway 380 downstream to the San Marcial railroad bridge, territorial flycatchers have been present consistently and more numerously (up 54 in 2001).

While all woody riparian habitat is generally valuable to the flycatcher, not all tree and shrub stands posses the pertinent characteristics (*e.g.*, stature, density, cover) identified as primary constituent elements (PCEs) of critical habitat (Federal Register 2005, USFWS 2011). Considering these PCEs, along with the known distribution of breeding flycatchers in 2006 through 2009, Reclamation has determined the flycatcher habitat suitability of all riparian vegetation in the action area (Ahlers *et al.* 2010). The “Suitable” and “Moderately suitable” classifications included vegetation types that included all or most of the PCEs for flycatcher habitat. Other categories also mapped included “Unsuitable” habitat and “Non-habitat” (the latter including upland, grassland, and Unvegetated areas).

From the detailed maps produced by Ahlers *et al*. (2010), the Corps determined the flycatcher habitat suitability of all vegetation affected by the proposed action.[4] Approximately 86% of the vegetation altered or removed by the proposed action entails habitat types unsuitable for breeding flycatchers (Table 5.2). Throughout the action area, approximately 8.4 acres of Suitable or Moderately Suitable flycatcher habitat would be altered or removed. The proposed action includes 16.4 acres of dense riparian shrub plantings which, along with natural germination, would develop into, at least, Moderately Suitable flycatcher habitat.

Table 5.2. Flycatcher habitat suitability (Ahlers *et al.* 2010) of affected vegetation.

	Vegetation altered in Vegetation-free Zone			Vegetation removed for footprint of levee, soil cement & floodwall		
Reach	Suitable	Moderately suitable	Unsuitable or Non-habitat	Suitable	Moderately suitable	Unsuitable or Non-habitat
SADD to Brown Arroyo	0	0	1.2	0	0	20.7
Brown Arroyo to Hwy. 380	0	0.9	2.3	0	0	0
Highway 380 to BDANWR	0	0.6	0.6	0	0	0
BDANWR	0	2.4	19.2	0	2.7	6.0
BDANWR to Tiffany Basin	1.8	0	0.5	0	0	0
Total	1.8	3.9	23.8	0	2.7	26.7

All riparian habitat affected by the proposed action occurs in a narrow strip immediately adjacent to the riverward toe of the existing spoil bank. Geo-referenced locations of flycatchers associated with surveys conducted by Reclamation (see references in Section 6.1) indicate that breeding birds have a propensity to establish territories along or near the bank of the active channel, ranging from 50 to 1,300 feet of the spoil bank alignment. Territorial flycatchers are rarely observed immediately adjacent to the existing spoil bank (Gina DelloRusso, Biologist, BDANWR, March 2012).

Given these considerations, and the incorporation of Conservation Measures (see Section 2.2.11), earthen levee construction may affect, but would not likely adversely affect the flycatcher, and would not likely adversely modify designated or proposed critical habitat for the species.

[4] The precise location and community-structure type of all vegetation affected by the proposed action is detailed in a spreadsheet provided to the Service with this BA.

5.1.4 Ephemeral Channels Adjacent to the Spoil Bank

An ephemeral channel runs along the existing spoil bank from Highway 380 through BDANWR. As is often the case throughout the middle Rio Grande valley, the overbank area tends to slope from the riverbank downwards toward the spoil bank toe. When inundated, flow becomes concentrated along the spoil bank, and, over time, has formed a small channel paralleling the toe. During proposed levee construction, the Corps would fill such depressions within 15-feet of the riverward toe, grade the surface to that of the adjacent overbank, and re-vegetate it with grass species in order to minimize the potential for erosion of the levee toe. During detailed design for specific levee segments, the drainage patterns adjacent to the levee would be evaluated by a Corps biologist, and measures would be include in the design to avoid the creation of depressions that could trap silvery minnows. Such measures may include local contouring, or the creation of small channels to direct receding overbanking flows back to the Rio Grande channel.

Rio Grande Silvery Minnow and Southwestern Willow Flycatcher

Filling the ephemeral channels to the same level with contiguous floodplain would not result in loss of terrestrial or aquatic habitat area for either flycatchers or silvery minnows. A floodplain that generally slopes to the river will continue to function as floodplain habitat for both flycatchers and silvery minnows. Replacing the ephemeral channels with floodplain may affect, but is not likely to adversely affect the minnow or flycatcher, and would not adversely modify critical habitat PCEs for either flycatchers or silvery minnows.

5.1.5 Placement of Riprap Along the Levee

Riprap would be used for erosion protection along a total of 31,700 linear feet (approx. 6.0 miles) of the riverward slope and toe of the proposed levee. Riprap would be installed in the areas most susceptible to scour during large flood events and would be buried at depths of between 6.5 and 12 feet. This riprap would be placed during levee construction activities when the area is dry. Should any portions of the riprap fail in the future, the Corps' operation and maintenance manual would require the project sponsor to repair these areas.

Rio Grande Silvery Minnow

Although minnow critical habitat extends up to the levee (including riprap) during higher flows, water velocities during such flows are above suitable values for the minnow. Therefore, levee erosion-control features may affect but are not likely to adversely affect any constituent elements of silvery minnow critical habitat as the placement of riprap is entirely within the overbank terrace.

Riprap may partially reduce water velocities at the normal range of flows, but would create turbulence which is unsuitable for silvery minnows and velocities are likely to remain above the threshold for silvery minnow use. The current design for riprap would not create quantifiable backwater habitat. Riprap along the bankline toe may provide a solid substrate supporting attached algae, but would otherwise provide little usable habitat.

Riprap would be buried at the levee toe to a depth of 1 to 12 feet. Buried riprap may be inundated at higher flows, but would not contribute to, or adversely affect, aquatic habitat. Buried riprap may be partially exposed by erosion in the future. Changes in aquatic habitat quality caused by exposing riprap at the levee toe would be offset by corresponding geomorphic processes forming point bars on the opposite bank. The buried riprap at most sites would not affect the hydrologic regime (i), instream habitat (ii), fine sediments for substrate (iii), water temperature (iv), or water conditions (v). Therefore riprap may affect, but is not likely to adversely modify critical habitat. Placement of riprap would have no effect of the silvery minnow.

Southwestern Willow Flycatcher

Riprap would be placed during earthen levee construction activities. As a result of this erosion control feature, an additional 5.4 acres of vegetation would converted to grassland to accommodate the widened Vegetation-free Zone along the riverward toe of the levee. This effect is evaluated in Section 5.1.3 along with vegetation effects resulting from earthen levee construction.

5.1.6 Altered Floodplain Inundation

The existing spoil bank has been estimated to fail at discharges in the range of the 20%- to 14%-chance event (11,800 to 13,240 cfs, respectively) at the San Acacia gage. Currently, spoil bank failure would periodically result in inundation throughout the floodplain west of the LFCC. Breached or damaged spoil banks would be quickly repaired or rebuilt along the existing alignment. Flow conditions within the floodway up to the breaching or failure discharge would be the same with or without the proposed action. The principal effect of the proposed action is that higher discharges that would be contained within the floodway. The following discussion focuses on those differential effects. The differential extents of inundation are first described, then changes in water depth and velocity are discussed specific to the minnow and flycatcher.

<u>1%-Chance-Event Floodplain</u>

The existing spoil bank has been estimated to fail at discharges in the range of the 20%- to 14%-chance event (11,800 to 13,240 cfs, respectively) at San Acacia. Currently, spoil bank failure would result in inundation both within the current floodway and throughout the floodplain west of the LFCC. Breached or damaged spoil bank would be quickly repaired or rebuilt along the existing alignment.

Without the proposed project, damages to ecological resources from the 1%-chance flood event (29,900 cfs at San Acacia) are expected to occur both within the current floodway and throughout the floodplain west of the spoil bank. The estimated inundated area of the 1%-chance flood totals approximately 38,800 acres (see Table 5.3). Affected plant communities in the floodplain west of the spoil bank include: rural and suburban yards; agricultural fields and edges; upland Chihuahuan desertscrub; and wetland and riparian communities managed at Bosque del Apache NWR. These plant communities may be subjected to substrate scouring or extensive sediment deposition. Additional stress may result from extended inundation, depending on the tolerance of plant species within each community.

Table 5.3. With and without-project flood plain inundation (acres).

Alternative	**10%-chance-event floodplain (15,400 cfs)**	**1%-chance-event floodplain (29,900 cfs)**
Future condition, Without project	36,200	38,800
Proposed action	18,300	20,200

Although periodic floodplain inundation outside of the existing floodway has the potential for providing allocthonous material to the Rio Grande, historic and existing land uses west of the spoil bank alignment also present potential threats to water quality. Following a spoil bank breach, floodwaters would likely be of low quality and could result in the introduction of potential contaminants (sewage, petroleum products) to the river, and, therefore, may not be considered beneficial to aquatic habitat and organisms.

With the proposed action, all flow for the 1%-chance event would be contained within the current floodway, and is estimated to inundate approximately 20,200 acres. Flooding, and potential ecological damages, would be eliminated from approximately 18,600 acres of the floodplain west of the spoil bank alignment.

Within the floodway, however, potentially adverse impacts to riparian and aquatic communities would still occur following levee construction. Currently, the 1%-chance flood event has the potential to scour the substrate and remove, or otherwise damage, vegetation within the Rio Grande floodway. This process is inherent in sand-bed river systems of the Southwestern U.S., and one to which riparian plant species are adapted. After construction of Alternatives A or A+4ft in the study area, the water surface of the 1%-chance event would increase in the Rio Grande floodway by approximately 2.5 feet near Escondida to nearly 5 feet near Tiffany Junction. Water depths would decrease downstream from there, largely due to transit storage afforded by the 2,000-acre Tiffany Basin and areas of Elephant Butte Reservoir outside of the active floodway.

Because of the rarity of the 1%-chance event, quantitative data on ecological impacts are not available for the Southwestern United States. Potential impacts likely include the physical destruction of vegetation from high flow velocities, soil erosion, and/or sediment deposition; the temporary displacement of non-aquatic animals; and the death (primarily through drowning) of animals that cannot escape floodwaters. Qualitatively, we believe that ecological effects within the floodway following construction of any of the levee alternatives would be as extensive and similar to the without-project condition. Although inundation, scouring and sediment accretion are natural processes of sand-bed rivers such as the Rio Grande, the recovery of plant and animal communities following the 1%-chance flood would be slow.

<u>10%-Chance-Event Floodplain</u>

Currently, the more probable 10%-chance flood event (approximately 15,400 cfs at San Acacia) also is expected to result in spoil bank failure and extensive inundation—about 36,200 acres—of the valley (Table 5.3). Because spring runoff floods would be regulated by upstream reservoirs, this event would most likely result from rainstorm activity, and, therefore, would be of short duration. Therefore, resultant ecological damage from scouring, deposition, and inundation would be significantly less than for the 1%-chance event.

After construction of a new levee, the 10%-chance event would be contained to about 18,300 acres of the floodway. The with- *versus* without-project differential in depths and velocities of the 10%-chance events are nominal; therefore, the extent of adverse effects would be similarly small. The magnitude of the event is within the range of unregulated snowmelt and thunderstorm flows recorded in the Middle Rio Grande over the past 100 years, and is well within the flow regime to which native riparian species (cottonwood, willow) have adapted.

Rio Grande Silvery Minnow

Because the Rio Grande channel throughout much of the study area has aggraded to elevations of up to 15 feet above the historical floodplain outside of the existing spoil bank, any breach of the spoil bank during flood flows, under future without-project conditions, would discharge silvery minnows and other fish onto the floodplain. Most of these fish would likely be stranded, and eventually die on the floodplain outside the levees.

Rio Grande silvery minnow are small fish that cannot swim against high velocities for extended periods. Post-construction water depths and velocities determined by Corps hydraulic modeling were reviewed to evaluate potential effects on silvery minnow. Average with-project water depth in the overbank area would increase by 2.5 to 5 feet for the 1%-chance flood, and 1 to 2 feet for the 10%-chance flow. For both events, extensive shallow (2 feet or less) areas would still occur within the floodway. Likewise, with-project velocities (Figure 5.1, Figure 5.2, and Figure 5.3 indicate that relatively slow-flowing (<2 ft/sec) areas are extensive enough to provide refugia for the silvery minnow during the 1%-chance flood, as well for more frequent discharge events. The proposed construction would reduce the risk of silvery minnow stranding outside of the floodway due to a spoil bank breach. Therefore, sufficient slackwater areas would remain after levee replacement to avoid flushing silvery minnow from the San Acacia reach. Therefore, the proposed action may affect but is not likely to adversely affect silvery minnow. It would not affect the hydrologic regime (i), instream habitat (ii), fine sediments for substrate (iii), water temperature (iv) or water conditions (v). Therefore the proposed action may affect but is not likely to adversely modify designated critical habitat.

Southwestern Willow Flycatcher

With-project water depths within the proposed action area were reviewed to evaluate potential effects to the flycatcher from changes in hydrologic characteristics. After construction of a new levee in the proposed action area, the water surface of the 1%-chance event was similar to the without-project conditions within most of the proposed action area. The largest increase in depth occurs within the BDANWR. Under with-project conditions, the water depth of the 1%-chance event averaged approximately 6-7 feet and reached as high as 8 feet. Under without-project conditions, the water depth of the 1%-chance event averaged approximately 5 feet, but reached 7-8 feet near the outer edge of the floodway. The with-*versus* without-project differential in depths and velocities of the 10%-chance events are nominal; therefore, the extent of adverse effects would be similarly small. The magnitude of this event is within the range of unregulated snowmelt and thunderstorm flows recorded in the Middle Rio Grande over the past 100 years, and is well within the flow regime to which native riparian species (cottonwood, willow) have adapted. Retaining flood flows within the floodway would be expected to increase scouring and sediment accretion. These dynamic processes have the potential to increase the loss of older riparian habitat patches while supporting the regeneration of new riparian habitat patches. The net result would be a continually changing mosaic of suitable riparian habitat for the flycatcher.

At BDANWR, where the biggest difference in water depth for the 1%-chance event occurs between the with- and without project conditions, flycatchers are regularly nesting in the riparian zone and the number of territories has significantly increased within the last several years. In the 1%-chance event, within the BDANWR, adult and flighted young flycatchers would be capable of avoiding drowning; however, eggs and nestlings would be susceptible to drowning due to rising floodwaters. The probability of inundation is dependent on the height of the nest above the substrate. At Elephant Butte Reservoir during 2004 through 2008, the average flycatcher nest height in stands with a dry substrate was 10.7 ft (3.27 m; n = 31), but was lower, 8.2 feet (2.49 m; n = 52), at nest sites with saturated substrate (Ahlers and Moore 2009). Generally, flycatcher nest height appears to be lower in stands with dense vegetation closer to the ground (Ahlers and Moore 2009; Paxton *et al.* 2007). In a review of recent literature, the minimum flycatcher nest height that was reported was 4.6 ft (1.40 m) at Roosevelt Lake in Arizona (Graber *et al.* 2007). Assuming that future flycatcher nests within the project area are a minimum of 4 feet above the ground surface, the probability of inundating eggs or nestlings is only somewhat likely in a 1%-chance event for both with- and without-project conditions. The average maximum water depths for with- and without project conditions for a 1%-chance event is approximately 3 to 5 feet throughout most of the project area. The only reach within the project area where the change in depth would most likely inundate eggs or nestlings is within BDANWR. However, even without-project conditions for a 1%-chance event would have similar results. Therefore, the changes due to altered floodplain inundation may affect, but not likely to adversely affect the flycatcher and may affect, but not likely to adversely modify flycatcher designated or proposed critical habitat.

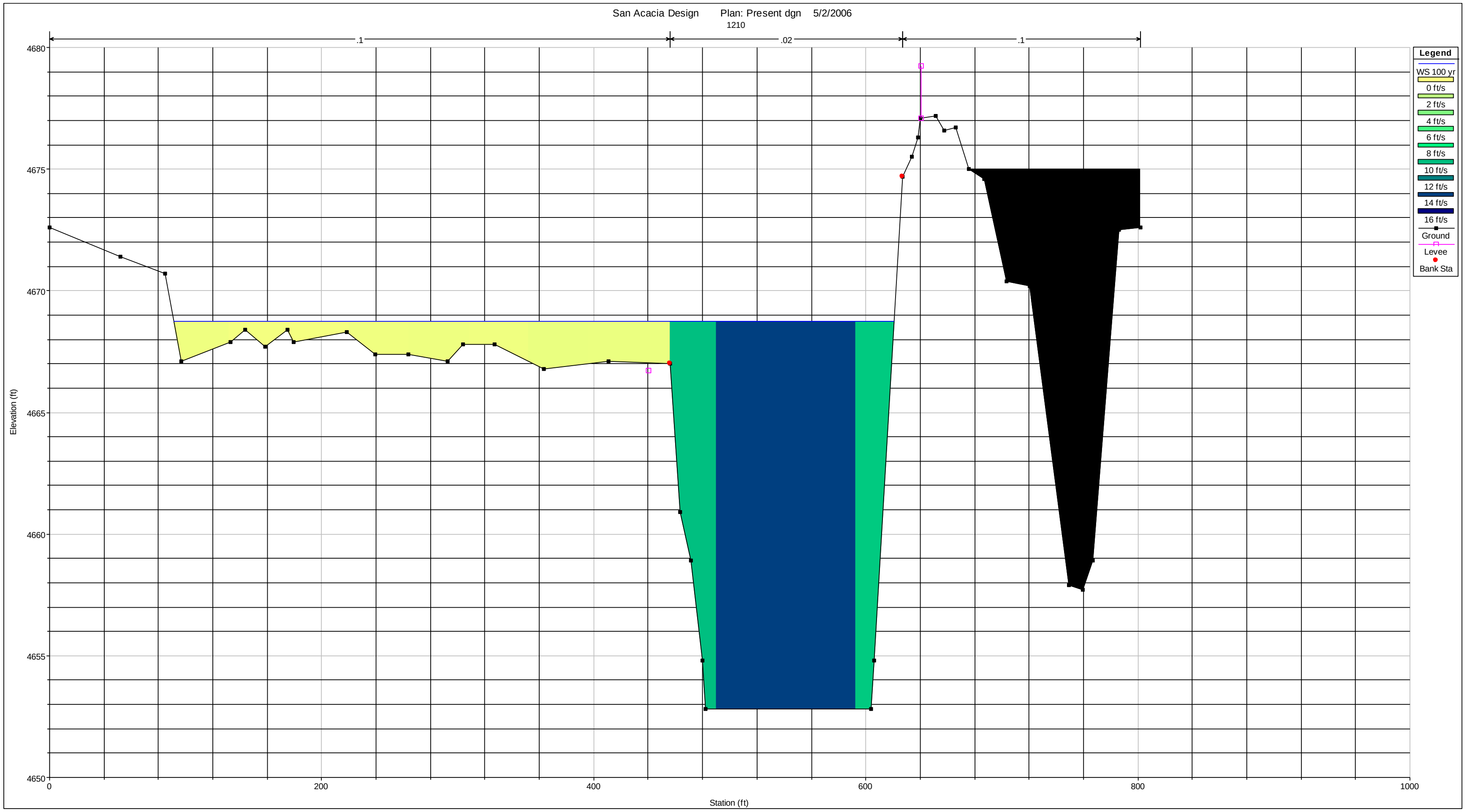

Figure 5.1. RAS cross-section immediately downstream of San Acacia diversion dam without proposed action.

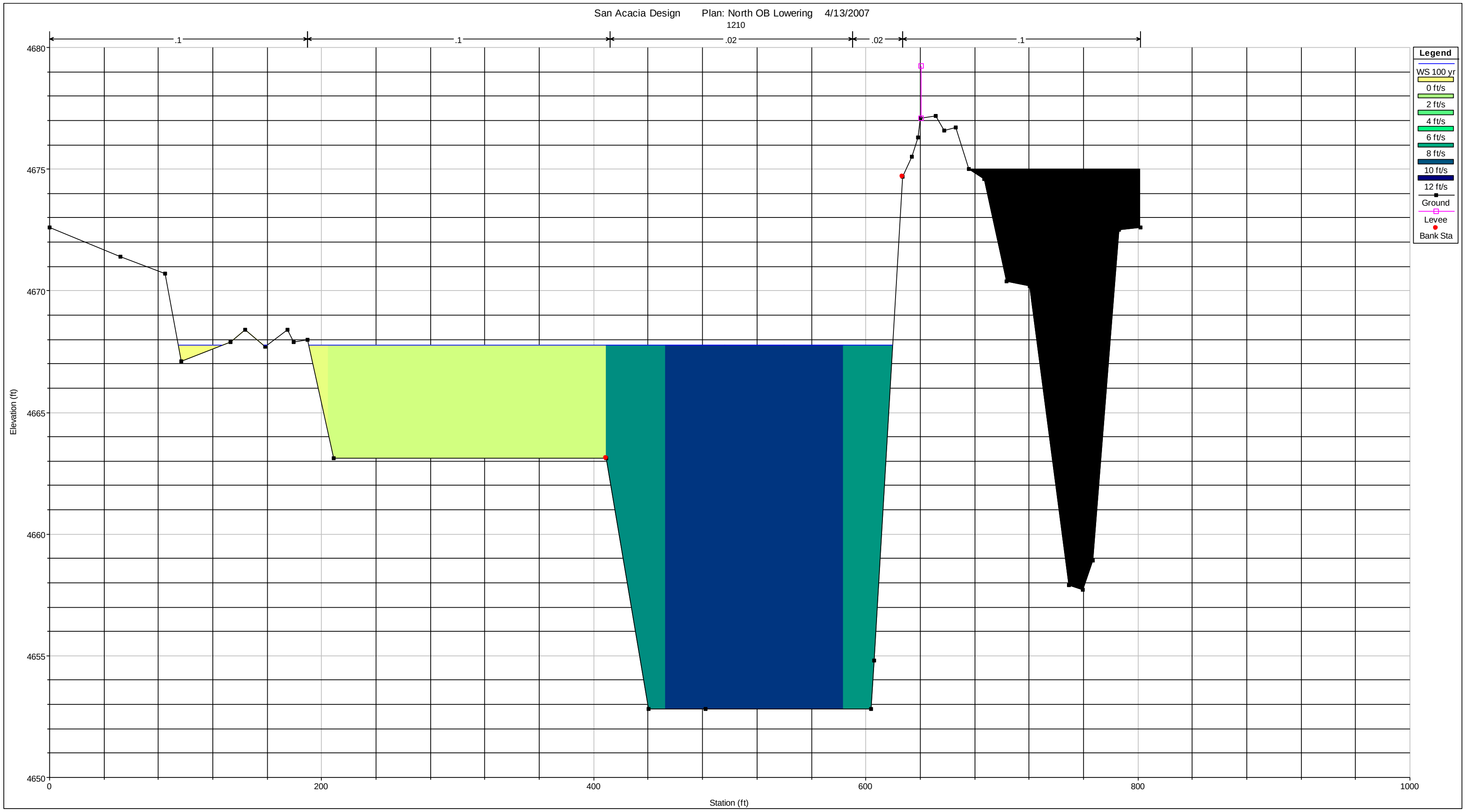

Figure 5.2. RAS cross-section immediately downstream of San Acacia diversion dam with proposed action.

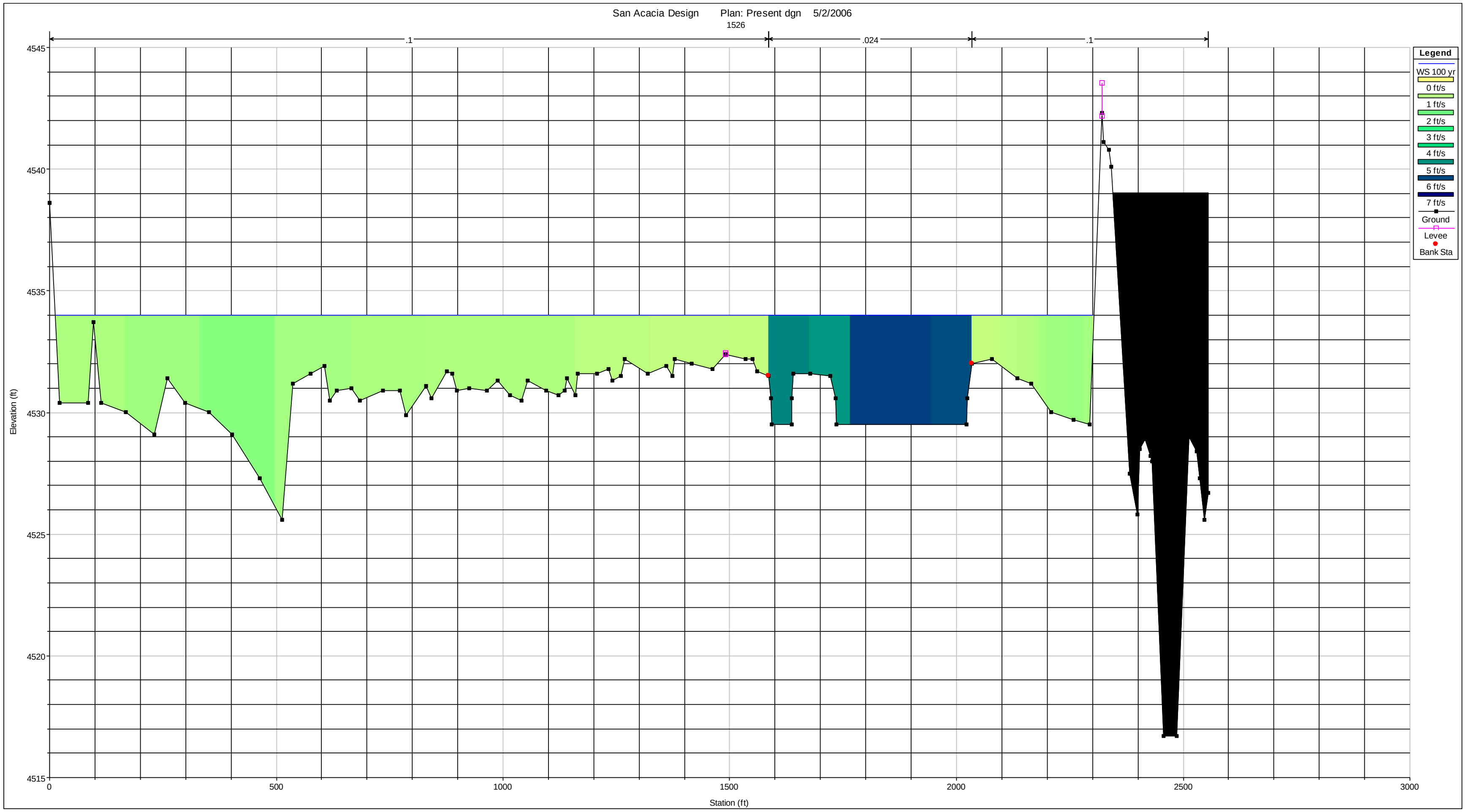

Figure 5.3. RAS cross-section at Bureau of Reclamation aggradation/degradation line 1526 with proposed action.

5.1.7 Change in Floodway Area Due to Physical Footprint of Levee

The basal extent of the proposed levee and associated features was superimposed on geo-referenced aerial photography from 2010. The location of the riverward toe of the proposed levee relative to the current riverward toe of the spoil bank was estimated throughout the reach. Similarly, the location of the riverward extent of the soil-cement embankment was estimated relative to the current bankline. The differential extent of the proposed levee was calculated and formed the basis for the evaluation of potential changes to the floodway area.

From the northern end of the action area to the Highway 380 bridge at San Antonio (approx. 24.9 miles), the landward toe of the proposed levee was aligned on the landward toe of the existing spoil bank. This landward toe is frequently 10 to 20 feet east (riverward) of the maintenance road between the levee and the Low Flow Conveyance Channel. South of Highway 380, the base width of the proposed frequently levee equals or exceeds the existing spoil bank width. Therefore, to minimize encroachment of the levee footprint upon the riparian zone south of Highway 380, the landward toe of the proposed levee was shifted landward to abut the eastern edge of the maintenance road.

From the northern end of the proposed earthen levee to BDANWR, the base width of the proposed levee is equal to or less than that of the existing spoil bank (by an average difference of about 25 ft; range 0-80 ft). Therefore, following construction, upstream from BDANWR, the area of the floodway would increase by approximately 82.3 acres due to the smaller footprint of the proposed levee (Table 5.4).

Through BDANWR, the footprint of the proposed levee would encroach on an additional 8.7 acres of the current floodway. Due to variation in the alignment of the existing spoil bank, the proposed levee would occasionally fall landward of the existing riverward toe, resulting in a minor gain of about 0.6 acres. Therefore, throughout BDANWR, the proposed levee would result in a net loss of 8.1 acres of the floodway.

Within the 1.5-mile reach immediately downstream from BDANWR, the riverward toe of the proposed levee would remain to the west (landward) of the existing spoil bank toe. This would result in a small gain of about 0.8 acres to the floodway area.

Table 5.4 summarizes the expected changes to the existing floodway and floodplain areas. Throughout the entire length of the proposed levee, the net change in area as a result of levee construction would be a gain of approximately 83.1 acres. Considering this net gain in active floodway area, and the distance that the levee alignment is set back from the channel, construction of the levee along the proposed alignment would have no direct effect on aquatic habitat within the proposed action area.

Table 5.4. Net change in floodway and 10%-chance floodplain area due to construction of new levee.

Reach	Reach length (mi.)	Net change in area (acres)	Type
Start (40+00) to BDANWR	28.3	+82.3	Floodway
BDANWR	11.3	-8.1	Floodway
BDANWR to 2133+00	1.5	+0.8	Floodway
Net change in floodway	*41.1*	*+75.0*	
East Side Excavation (bench)	--	+9.3	10%-chance
Sta. 2133+00 to RR track	1.1	-1.2	floodplain
Total (net)	42.2	+83.1	

Rio Grande Silvery Minnow

When inundated, these areas of additional floodway would provide additional foraging, spawning, and nursery habitat for the silvery minnow, and improve critical habitat constituent elements (instream habitat, substrate). Hydraulic modeling indicates that even during the 1%-chance flow (29,900 cfs) there will be refugial areas in the floodway providing lower velocity habitat for silvery minnows. The proposed action may affect but is not likely to adversely affect the Rio Grande silvery minnow. The proposed action would not affect the hydrologic regime (i), instream habitat (ii), fine sediments for substrate (iii), water temperature (iv) or water conditions (v). Therefore the change to the floodway footprint may affect but is not likely to adversely modify critical habitat for the silvery minnow.

Southwestern Willow Flycatcher

Throughout the entire length of the proposed levee, the net change to floodway area as a result of levee construction would be a gain of approximately 75.0 acres. Of these 75.0 acres, approximately 38.2 acres would be planted with grasses as part of the Vegetation-free Zone, and 35.5 acres would be suitable for planting, or otherwise establishing, herbaceous and woody riparian vegetation. The area suitable for woody planting would occur between the upstream end of the levee alignment and BDANWR. The only loss in floodway would occur at BDANWR, where the footprint of the proposed levee would encroach on 8.7 acres of the current floodway. (Vegetation effects within the floodway from the levee footprint are discussed and analyzed in Section 5.1.3). Considering the net gain in active floodway area (in which about half would be areas suitable for establishing native riparian habitat), and the distance that the levee alignment is set back from the channel, construction of the levee along the proposed alignment may affect, but would not likely adversely affect the flycatcher and may affect, but would not likely adversely modify flycatcher designated critical habitat.

5.1.8 Waste Spoil Disposal

Excess soil material from the excavated spoil bank would be deposited within a 300-acre area located at Tiffany Basin (Table 5.4). The area is currently vegetated with salt cedar of varying density, and is not inundated by flows smaller than the 10%-chance event. Spoil will be deposited up to 6.5 feet deep throughout this area, rendering it suitable for upland, rather than riparian, vegetation. The fill material would be revegetated to minimize erosion, to decrease the potential for colonization by invasive weeds, and to replace shrubby wildlife habitat. Following fill deposition, the disturbed area would be seeded with a mixture of grass, herbaceous and shrub species (e.g., four-winged saltbush, with winterfat and Woods' rose).

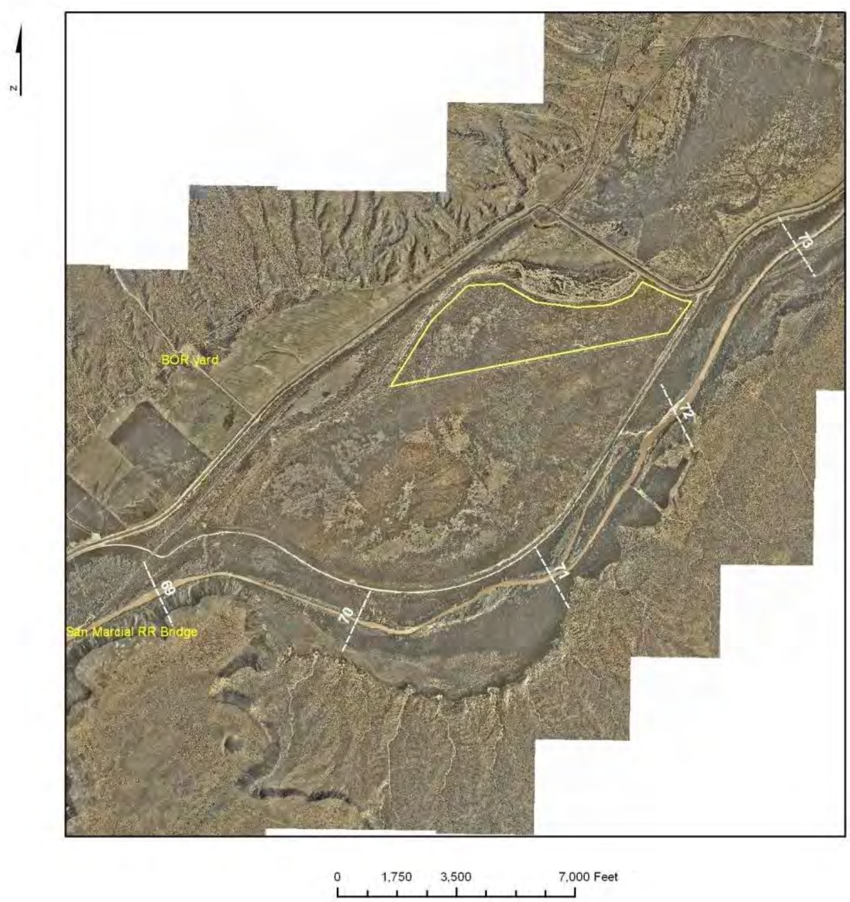

Figure 5.4. Waste disposal location in Tiffany Basin.

Rio Grande Silvery Minnow

The deposition of spoil material in the Tiffany Basin would not affect the silvery minnow or its designated critical habitat.

Southwestern Willow Flycatcher

Willow flycatchers have not been detected within the Tiffany Basin during annual protocol surveys conducted from 1994 through 2011 (see references in Section 6.1). Flycatchers have regularly established breeding territories in the riparian vegetation bordering the Rio Grande channel east of the Tiffany Basin. The basin lies within the 10%-chance floodplain behind a continuation of the spoil bank, and soil conditions are relatively dry in comparison with the riparian zone adjacent to the river channel. Except for a small portion near its western edge, the basin includes designated and proposed critical habitat for the flycatcher. However, all vegetation within the basin has been classified as Unsuitable habitat for the flycatcher (Ahlers *et al.* 2010), lacking the PCEs that constitute high quality habitat. The deposition of spoil material in the Tiffany Basin would not affect the flycatcher and would not adversely modify its designated and proposed critical habitat.

5.2 Interior Least Tern

The Interior Least Tern is a vagrant in the proposed action area, occasionally present along the Rio Grande in central and southern New Mexico. Its principal foraging and resting areas would be along the river channel, or, perhaps, at managed areas of BDANWR.

The majority of the construction activities associated with the proposed action and the various alternatives would be limited to the current spoil bank alignment. Should a tern occur within the project area, the alignment is sufficiently far from the river channel that active construction and related traffic would not interfere with the bird's foraging or resting activities. Construction along the immediate bank of the channel would only occur in the northernmost mile of the alignment, and would take place during the winter, low-flow period, when terns are not present in New Mexico.

Given the relatively rare occurrence of terns in the proposed action area, and the low disturbance factor of the potential construction activities, the implementation of the proposed action is not likely to affect the Interior Least Tern.

5.3 Northern Aplomado Falcon

Northern Aplomado Falcons are known to nest on the Armendaris Ranch, which is adjacent to the proposed action area. However, Northern Aplomado Falcons inhabit desert grasslands and are infrequent visitors to riparian areas. Given the relatively rare occurrence of falcons in the action area, the low disturbance factor of the potential construction activities, the implementation of the proposed action is not likely to affect the Northern Aplomado Falcon.

5.4 Pecos Sunflower

The privately-owned land where the artificially seeded stand of Pecos sunflower occurs is located on the east side of the Rio Grande; that is, on the opposite side of the river from all proposed or alternative levee construction activities. The stand is located near the eastern extent of the 1%-chance floodplain and would not be subject to measurably difference inundation during inundation by the rare and larger flood discharges. The proposed action would not affect the Pecos sunflower.

5.5 Summary of Effects, and Endangered Species Act Consultation

The following, and Table 5.5, summarizes the findings in the sections above and the Corps' determination of effects for the proposed action:

- May affect, and likely to adversely affect, the Rio Grande silvery minnow
- May modify, and likely to adversely modify, designated critical habitat for the Rio Grande silvery minnow
- May affect, but not likely to adversely affect, the Southwestern Willow Flycatcher
- May modify, but not likely to adversely modify, designated and proposed critical habitat for the Southwestern Willow Flycatcher
- Would not affect the Interior Least Tern, Northern Aplomado Falcon, and Pecos sunflower.

Table 5.5. **Summary of analysis of effects of the proposed action.**

Feature or effect of the proposed action	Rio Grande silvery minnow		Southwestern Willow Flycatcher		Interior Least Tern	Northern Aplomado Falcon	Pecos sunflower
	Species	Critical habitat	Species	Critical habitat			
East Side Excavation	May affect, likely adversely	May modify, not likely adversely	No effect	May modify, not likely adversely	No effect	No effect	No effect
Floodwall	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Soil Cement Embankment	May affect, likely adversely	May modify, likely adversely	May affect, not likely adversely	May modify, not likely adversely	No effect	No effect	No effect
Earthen Levee Construction	May affect, not likely adversely	May modify, not likely adversely	May affect, not likely adversely	May modify, not likely adversely	No effect	No effect	No effect
Ephemeral Channels Adjacent to the Spoil Bank	May affect, not likely adversely	May modify, not likely adversely	May affect, not likely adversely	May modify, not likely adversely	No effect	No effect	No effect
Placement of Riprap Along the Levee	May affect, not likely adversely	May modify, not likely adversely	(see Earthen Levee Constr.)	(see Earthen Levee Constr.)	No effect	No effect	No effect
Altered Floodplain Inundation	May affect, not likely adversely	May modify, not likely adversely	May affect, not likely adversely	May modify, not likely adversely	No effect	No effect	No effect
Change in Floodway Area Due to Physical Footprint of Levee	May affect, not likely adversely	May modify, not likely adversely	May affect, not likely adversely	May modify, not likely adversely	No effect	No effect	No effect
Waste Spoil Disposal	No effect	No effect	No effect	May modify, not likely adversely	No effect	No effect	No effect
Overall	**May affect, likely adversely**	**May modify, likely adversely**	**May affect, not likely adversely**	**May modify, not likely adversely**	**No effect**	**No effect**	**No effect**

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