

# RECLAMATION

*Managing Water in the West*

## Joint Biological Assessment

**Bureau of Reclamation, Bureau of Indian Affairs, and  
Non-Federal Water Management and Maintenance  
Activities on the Middle Rio Grande, New Mexico**

**Middle Rio Grande Project, New Mexico  
San Juan-Chama Project, New Mexico  
Upper Colorado Region**



## Mission Statements

The U.S. Department of the Interior protects America's natural resources and heritage, honors our cultures and tribal communities, and supplies the energy to power our future.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

The Bureau of Indian Affairs' mission is to enhance the quality of life, to promote economic opportunity, and to carry out the responsibility to protect and improve the trust assets of American Indians, Indian tribes and Alaska Natives.



# **Joint Biological Assessment**

**Bureau of Reclamation, Bureau of Indian Affairs, and Non-Federal Water Management and Maintenance Activities on the Middle Rio Grande, New Mexico**

## **Part IV – Proposed Actions and Effects: Measures to Offset Effects and Provide Conservation Benefits**

**Middle Rio Grande Project, New Mexico  
San Juan-Chama Project, New Mexico  
Upper Colorado Region**

**Submitted to the U.S. Fish and Wildlife Service**

**Rio Grande Silvery Minnow**

**Southwestern Willow Flycatcher**

**Yellow-billed Cuckoo**

**New Mexico Meadow Jumping Mouse**

**Pecos Sunflower**

**Interior Least Tern**





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# **1. Proposed Offsetting and Conservation Measures**

## **1.1 Introduction**

Part IV of the BA presents proposed measures to (1) minimize and avoid existing and anticipated adverse effects to listed species from the Proposed Actions and (2) address current river conditions and improve the status of the listed species and contribute to their recovery.

Offsetting Measures are defined as commitments that Reclamation, BIA, MRGCD, and the State will implement to minimize and/or avoid anticipated adverse effects of the Proposed Actions on the silvery minnow. The Offsetting Measures are described in Chapter 2 of this part; an assessment of their anticipated beneficial effects is presented in Table IV-1. The analysis shows how the Offsetting Measures address the identified effects of the Proposed Actions on the silvery minnow.

Conservation Measures are defined as commitments that address multiple species and river system considerations beyond those needed to minimize or avoid anticipated adverse effects of the Proposed Actions. Conservation Measures are intended to address effects of current river conditions, improve the status of the listed species, advance species conservation, and contribute to recovery. The Conservation Measures proposed by Reclamation, MRGCD, and the State are described in Chapter 3 under four main categories; the anticipated benefits to listed species and their critical habitat are provided in Table IV-2. The Conservation Measures that are submitted by the State are not separable from implementation of the RIP.

The Service has identified four focus areas to improve the status of the silvery minnow: (1) a draft Hydrologic Objective (HO), (2) habitat restoration, (3) river reconnectedness, and (4) conservation storage. The Offsetting and Conservation Measures, including the new approach River Integrated Operations using Adaptive Management (RIO), are intended to take into account those focus areas.

Neither the Offsetting Measures nor the additional Conservation Measures were taken into consideration in the effects determination stated in Part V, and they do not alter those determinations.

## **1.2 River Integrated Operations using Adaptive Management**

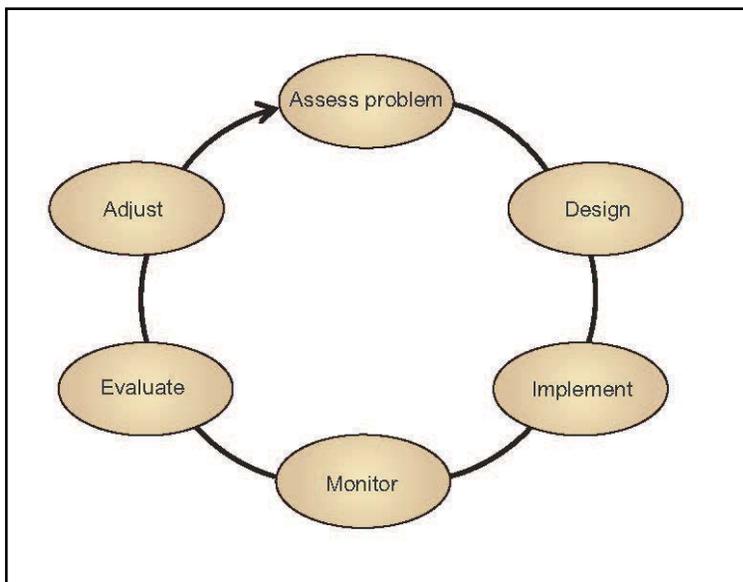
The use of a defined Adaptive Management (AM) process is supported by AM policy within the Department of the Interior. Development of a defined AM process for the MRG, integrated with

ongoing AM efforts in the basin, will help to reduce uncertainties over time and improve our collective understanding of how to achieve sustainable management of the MRG.

The Department of the Interior policy on AM implementation for resource management (522 DM 1) describes AM as follows:

“Adaptive Management is a decision process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a ‘trial and error’ process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits.”

The Department of the Interior’s 2009 Technical Guide on Adaptive Management provides guidance on the operational components of AM and also emphasizes that AM “gives special emphasis to uncertainty about management impacts, iterative learning to reduce uncertainty, and improved management as a result of learning.” The steps to the AM process, as provided in the DOI Technical Guide, include the following: Assess, Design, Implement, Monitor, Evaluate, and Adjust (Figure IV-1).



**Figure IV-1. Adaptive Management process (from Williams et al. 2009)**

A recent draft assessment by the Missouri River Recovery Program examined 9 different AM programs throughout the United States and identified key lessons learned through those programs (Burns et al. 2015). One of the lessons learned was that most restoration or recovery programs use a passive AM approach (where monitoring is used to learn from implemented actions), while only some use active AM (where focused hypothesis-testing experiments are

conducted on key uncertainties). The active AM approach using hypothesis-testing allows programs to “learn, fill data gaps, and address critical uncertainties,” whereas the “more traditional passive AM techniques . . . assess performance associated with implemented management actions.” This two-tiered approach to an AM program can help balance resource use by focusing the more rigorous hypothesis-testing on priority areas (i.e., the critical uncertainties) and using overall monitoring for the wider range of management actions to evaluate and adjust accordingly.

### **1.2.1 Adaptive Management and Science through the Recovery Implementation Program**

The MRG basin has a history of pursuing and supporting the need for AM, in particular through the Collaborative Program. The need for AM was referenced in the 2003 BO, and the Collaborative Program developed an initial Version 1 Adaptive Management Plan through the Corps’ contract with ESSA Technologies Ltd. (Vancouver, BC) and Headwaters Corporation (Kearney, NE) in 2011 (Murray et al. 2011). This Version 1 plan identified the need for additional work that would generate sufficient information to develop Version 2 and identify the specific hypotheses to be carried through the AM process. Version 2 of the AM plan would focus on a defined AM approach that can be incorporated into the RIP’s overarching AM program.

### **1.2.2 The RIO – River Integrated Operations**

Because of the complexity of the MRG system hydrology, geomorphology, and tributary inputs and the variability of silvery minnow demographics, as well as other background trends, uncertainties exist related to the relationships between MRG hydrology and the silvery minnow. Given these uncertainties, the use of AM is particularly appropriate within the context of species-hydrology relationships that inform water operations and management.

Reclamation and the BA Partners propose to develop and implement an AM approach specific to those species-hydrology relationships, termed the RIO (River Integrated Operations). The RIO would use hypothesis testing to improve our understanding of how MRG hydrology can meet the needs of the silvery minnow and other ESA-listed species in the MRG in a sustainable manner over time. The intent of the RIO approach is to guide the continual refinement of hydrologic management for listed species and their habitat in the MRG through the steps of the AM cycle in the context of the RIP. The RIO would become part of the RIP’s AM plan once that plan is developed in the future.

Some preliminary hypotheses for the RIO AM process are provided by the draft HO developed by the Service. To support the ongoing ESA consultation process for a new BO, the Service developed a draft HO on May 2, 2013, with amended versions on June 6 and June 27, 2013, and

presented it to Reclamation and the Collaborative Program’s Executive Committee. The draft HO provides the Service’s draft recommendations for water needed to support the recovery of the silvery minnow between Cochiti Dam and San Marcial under current river channel and floodway conditions.

Reclamation and the BA Partners have provided various recommendations for refining the draft HO and proposed implementing a defined Adaptive Management process to specifically test and modify the draft HO over time so that it can more consistently meet the needs of the silvery minnow. More information on those specific refinements can be found in Reclamation’s September 29, 2014 letter to the Service (Reclamation 2014b). Specifically, the RIO process would include the following steps of the AM cycle:

- Steps 1 and 2 (Assess Problem, Design Component Hypotheses) would incorporate the Service’s draft HO into the AM cycle as the overarching hypotheses to be tested; experiments would be scientifically designed in coordination with Reclamation, the BA Partners, and ultimately the RIP.
- Step 3 (Implement) would be conducted by Reclamation and its BA Partners, with Service input and coordination.
- Steps 4 and 5 (Monitor and Evaluate) would be a combined effort to monitor and evaluate the outcome of ongoing tests and experiments by Reclamation, its BA Partners, the Service, and other RIP entities.
- Step 6 (Adjust) would be a combined effort by Reclamation, its BA Partners, and the Service to determine lessons learned and recommended adjustments to Steps 1 and 2 for the next iteration of the AM cycle.

The RIO is our proposal for integrating the Service’s water management hypotheses (the draft HO) more explicitly into a defined AM framework. It is Reclamation and the BA Partners’ understanding based on the June 27<sup>th</sup> version that the draft HO will be “a starting point for annual decision-making that will be modified through time based on rigorously testing the assumptions through an Adaptive Management process that incorporates targeted research and feedback mechanisms.” As such, the draft HO in concept does not provide flow targets, but consists of initial flow recommendations presented as hypotheses to be tested through AM over time. In the current context of a limited water supply, new and innovative condition-dependent approaches to experimentation will have to be developed that can utilize available water supplies for testing hypotheses. Accordingly, it will be essential to continue to gain a better understanding of the complexities of MRG hydrology, the riverine system, and silvery minnow life history to the extent possible to provide a strong scientifically based framework for decision-making. Testing the hypotheses associated with the draft HO under the RIO will help define and

reduce critical uncertainties related to species and water management, and thereby improve our collective understanding of the MRG.

While the draft HO acknowledges the dynamic hydrologic conditions within the MRG, available flows in the MRG are not sufficient to meet the current draft HO values in many years under existing authorities and river conditions. An integrated, workable river management approach, including water management, habitat restoration, improvements to connectivity, sediment management, and other steps toward active reconfiguration of the MRG system, presently exists and can be expected to improve our ability to provide for species' needs. As floodplain connection is improved, either through passive or active restoration, it is anticipated that spawning success and subsequent recruitment of silvery minnow will be able to be achieved at a broader range of peak runoff values than suggested in the Service's draft HO.

### **1.2.3 Inclusion of 5-Year Adaptive Management Review**

Reclamation and the BA Partners propose to implement a defined Adaptive Management process during the duration of the BA/BO to allow for evaluation and adjustment of Offsetting and Conservation Measures at 5-year intervals. This AM review process will allow for lessons learned through Adaptive Management to be applied in the prioritization of Offsetting and Conservation Measures and resources benefiting listed species and critical habitat.

Reclamation and the BA Partners propose that at 5-year intervals, the lessons learned through AM would be reviewed and incorporated into milestones related to performance elements for the upcoming 5-year timeframe. This process would be implemented through the 15-year duration of the BO. Adjustments to Offsetting and Conservation Measures could also occur within the 5-year intervals, as appropriate.

## **2. Offsetting Measures**

### **2.1 Reclamation’s Offsetting Measures**

Offsetting Measures are proposed by Reclamation for its proposed actions in Part II and Part III of this BA. Offsetting Measures for Reclamation’s river and infrastructure maintenance and restoration actions also include BMPs that are detailed in Part III of this BA; therefore, the BMPs are only briefly repeated here in Part IV. The effectiveness of Offsetting Measures is summarized in Table IV-1.

Reclamation proposes to utilize several tools, within current authorities, to meet RIO needs and goals. Reclamation will continue leasing water, as part of its Supplemental Water Program, and utilize SJC Project waivers of mandatory release dates from Heron Reservoir to maximize the use of such tools for the RIO. In addition, Reclamation proposes to coordinate with the BA Partners to work within existing authorizations to establish a conservation pool. Finally, Reclamation proposes to work with the BA Partners to modify operations and adjust timing of storage at El Vado Reservoir, within current authorizations, for RIO needs. These tools are described and their effectiveness discussed in Table IV-1.

### **2.2 BIA’s Offsetting Measures**

The BIA offers several measures to offset their proposed actions described in Part II of this BA. BIA proposes to work with the Pueblos in developing species habitat, facilitate exchange actions for management of prior and paramount stored water, and assess conditions of irrigation facilities on Pueblo lands to identify ways to increase efficiency of the irrigation infrastructure.

### **2.3 MRGCD’s Offsetting Measures**

In addition to participation in RIO using AM, as described in Chapter 1, MRGCD’s Offsetting Measures described in Table IV-1 are proposed to offset anticipated adverse effects of its proposed actions described in Parts II and III of this BA. MRGCD Offsetting Measures intended to offset effects from river and infrastructure maintenance actions (i.e., BMPs) are detailed in Part III of this BA. MRGCD Offsetting Measures are summarized for their effectiveness in Table IV-1.

### **2.4 State’s Offsetting Measures**

In addition to participation in RIO using AM, as described in Chapter 1, the State’s Offsetting Measures described in Table IV-1 are proposed to offset anticipated adverse effects of its proposed actions described in Parts II and III of this BA. The State’s Offsetting Measures intended to offset effects from river and infrastructure maintenance and restoration actions

(i.e., BMPs) are detailed in Part III of this BA. The State’s Offsetting Measures are summarized for their effectiveness in Table IV-1. Proposed State Offsetting Measures as approved by the NMISC on June 9, 2015 are provided in Appendix F.

## **2.5 Effectiveness of Offsetting Measures**

These Offsetting Measures are listed in Table IV-1, which (1) summarizes the adverse and beneficial effects of the Proposed Actions as described earlier in Parts II and III, (2) describes the commitments to associated Offsetting Measures by Reclamation, BIA, MRGCD, and the State, and (3) describes the effectiveness of each Offsetting Measure with respect to the silvery minnow and/or its critical habitat.

ESA coverage is requested for any adverse effects associated with implementation of these measures. The Offsetting Measures are listed in order from upstream to downstream in the MRG system, along with the associated agency(ies) responsible for implementation. Table IV-1 only includes those commitments needed to minimize or avoid anticipated adverse effects of the Proposed Actions.

**Table IV-1. Effects of proposed actions and Offsetting Measures on the Rio Grande silvery minnow**  
(Responsible entities are listed in **bold**. Full analysis for Summary of Effects column is provided in Parts II and III of this BA.)

| Action Category  | Summary of Effects   | Offsetting Measure(s)  | Beneficial Effects for Silvery Minnow of Proposed Actions and/or Offsetting Measures  |
|--|--|--|---|
| <i>Heron Releases</i> – Release of non-native San Juan-Chama (SJC) Project water from Heron Reservoir ( <b>Reclamation</b> )   | <p><b>May affect, but not likely to adversely affect:</b></p> <ul style="list-style-type: none"> <li>Beneficial effects to silvery minnow and critical habitat PCEs due to release of SJC Project water that would otherwise not be in the Rio Grande system to meet MRG water demands.</li> </ul>   | <ul style="list-style-type: none"> <li>No Offsetting Measure is warranted.</li> </ul>  | <ul style="list-style-type: none"> <li>The release of SJC Project water provides water that would otherwise not be in the Rio Grande system to meet MRG water demands.</li> <li>Increases annual average discharge of the MRG about 15% from below Heron Reservoir to Elephant Butte, with variable amounts consumptively used in route. Effects on natural hydrograph are beneficial by increasing rates of flow and thus available habitat, and by partially offsetting consumptive use of water by New Mexico water rights holders between Heron and Elephant Butte Reservoirs.</li> <li>Releases in the winter for contractors may provide higher flows for silvery minnow adults and juveniles through the MRG.</li> <li>Benefits various PCEs of critical habitat (summer, fall, winter).</li> </ul>  |
| <i>El Vado Reservoir Operations</i> – Manage (store, release, administer) non-native SJC Project water, including MRGCD SJC storage and release in Abiquiu ( <b>Reclamation, MRGCD</b> )   | <p><b>May affect, but not likely to adversely affect:</b></p> <ul style="list-style-type: none"> <li>Beneficial effects to silvery minnow and critical habitat PCEs due to release of SJC Project water that would otherwise not be in the Rio Grande system to meet MRG water demands.</li> <li>Insignificant effect on eggs and larvae within the minnow’s occupied range during spring runoff because there is no reduction to native flow (both El Vado and Abiquiu).</li> </ul>   | <ul style="list-style-type: none"> <li>No Offsetting Measure is warranted.</li> </ul>  | <ul style="list-style-type: none"> <li>The release of SJC Project water provides water that would otherwise not be in the Rio Grande system to meet MRG water demands.</li> <li>The release of SJC Project water benefits various PCEs of critical habitat in the summer and fall.</li> </ul>   |
| <i>Relinquishment</i> – Allocation of relinquishment credit for storage and release of relinquished water for existing uses ( <b>State</b> )<br>[Note: see below in “El Vado Reservoir Operations” for additional actions associated with relinquished water.] | <p><b>May affect, but not likely to adversely affect:</b></p> <ul style="list-style-type: none"> <li>Action is beneficial for silvery minnow and critical habitat PCEs</li> </ul>  | <ul style="list-style-type: none"> <li>No Offsetting Measure is warranted.</li> </ul>  | <ul style="list-style-type: none"> <li>Allocation of New Mexico relinquished credit for irrigation, M&amp;I and environmental uses is beneficial to the ecosystem because it provides more water to the system during low flow periods. It is included as a Conservation Measure that supports the BO and MRG RIP.</li> <li>Release and use of this water helps to maintain flows and habitat for larvae, juveniles, and adults.</li> </ul>   |
| <i>El Vado Reservoir Operations</i> – Store native water at the request of MRGCD or reserve P&P water at request of BIA; store allocated relinquished water ( <b>Reclamation, BIA, MRGCD</b> )   | <p><b>May affect, and likely to adversely affect:</b></p> <ul style="list-style-type: none"> <li>Due to existing channel restraints and the flood control operations authorized by law at El Vado, Abiquiu, and Cochiti reservoirs, storage of RG water can have a maximum effect on flow through the MRG critical habitat area of less than 1800 cfs. Because of tributary inflows at points below reservoirs, the maximum effect is often lessened during the spring runoff peak. During most years, there is limited effect on the hydrograph magnitude, timing, and duration within occupied habitat during spring runoff, in part, due to the proportionally low volumes on the Rio Chama as compared to the mainstem Rio Grande, as described in Part II. Storage at El Vado is likely to adversely affect silvery minnow eggs and larvae, but with a minor impact on spawning and recruitment as described in Part II.</li> <li>When the Army Corps of Engineers is in flood control operations at Abiquiu, there is no effect of storage at El Vado.</li> <li>In most years, storage at El Vado has no effect or minor effects on PCEs of critical habitat in the spring.</li> </ul> | <p>River Integrated Operations (RIO) includes Offsetting Measures, within current authorities, described in Sections 1.1 and 1.2 and in this table and Conservation Measures in Table IV-2. Offsetting Measures are as follow:</p> <ul style="list-style-type: none"> <li>Supplemental SJC water will be used for the highest need, such as spring peak flows or summer water, as guided through Adaptive Management and RIO (<b>Reclamation</b>).</li> <li>Coordinate to develop conservation pools in upstream reservoirs (<b>Reclamation, MRGCD, State</b>).</li> <li>Modify reservoir operations within current authorizations including those at Heron and El Vado, to attempt to better meet the needs of the species, e.g., 2015 Rio Grande Compact Commission Resolution regarding the temporary modification of operations at El Vado Reservoir. (<b>Reclamation, State, MRGCD</b>).</li> <li>Adjust timing of storage during spring peak within current authorizations. For example, storing early to minimize the impact on peak spring flows (<b>MRGCD and Reclamation</b>).</li> <li>Pursue exchanges of SJC water from downstream to upstream to aid in addressing impacts during spawning period (<b>MRGCD and Reclamation</b>).</li> <li>Utilize diversion structures to aid in providing spawning conditions (<b>MRGCD</b>).</li> </ul> | <ul style="list-style-type: none"> <li>RIO is an Adaptive Management process that incorporates scientific learning to inform decision-making and improves interagency coordination leading to efficient water management that is more supportive of species needs.</li> <li>Supplemental SJC water supplies, estimated between 8,000 and 12,000 AFY, are adequate in combination with the other measures to support species needs. This could result in a tradeoff between spring peak flows for spawning and an equivalent reduction in water for direct flows later in summer.</li> <li>Conservation pool is expected to be used for low runoff and drought conditions.</li> <li>Modified operations are expected to provide flexibility to benefit the silvery minnow through changes in timing of releases.</li> <li>Adjusting timing of storage would minimize impact on spring peak flows.</li> <li>Exchanges of SJC water would help support spring peak flows and offset the minor impacts from storage.</li> <li>Using diversion structures could aid in stimulating spawning by adding to or generating localized spikes in spring flows, particularly at lower runoff levels. This helps offset minor impacts of El Vado storage.</li> </ul> |

**Table IV-1. Effects of proposed actions and Offsetting Measures on the Rio Grande silvery minnow**  
(Responsible entities are listed in **bold**. Full analysis for Summary of Effects column is provided in Parts II and III of this BA.)

| Action Category   | Summary of Effects   | Offsetting Measure(s)   | Beneficial Effects for Silvery Minnow of Proposed Actions and/or Offsetting Measures   |
|---|--|---|--|
| <p><i>El Vado Reservoir Operations</i> – Release native water from storage for Middle Rio Grande irrigation uses, or at the request of BIA, MRGCD, or the NMISC; release allocated relinquished credit water<br/><b>(Reclamation, BIA, MRGCD)</b></p> | <p><b>May affect, but not likely to adversely affect:</b></p> <ul style="list-style-type: none"> <li>• Beneficial effects to silvery minnow larvae, juveniles, and adults, as well as critical habitat PCEs from release of stored water during times of low flows (primarily in summer) and in the winter as a result of increased flows in the MRG.</li> <li>• There are insignificant effects on water temperature and water chemistry.</li> </ul>  | <ul style="list-style-type: none"> <li>• No Offsetting Measure is warranted.</li> </ul>   | <ul style="list-style-type: none"> <li>• Release of stored water during times of low flows (primarily in summer) is beneficial and results in increased flows for larvae, juveniles, and adults through the Albuquerque Reach.</li> <li>• Releases in the winter for delivery to Elephant Butte are beneficial and may provide higher flows for adults through the MRG.</li> <li>• The release of native water from El Vado increases the rate of flow through MRG critical habitat area, typically through summer and fall low-flow periods. This is beneficial for PCEs of critical habitat in summer, fall, and winter.</li> </ul>  |
| <p><i>Operate Diversions</i> – Divert water, for delivery to and consumption by agricultural users, at Cochiti, Angostura, Isleta, San Acacia dams. See Appendix H for additional detail. <b>(MRGCD)</b></p>  | <p><b>May affect, and likely to adversely affect:</b></p> <ul style="list-style-type: none"> <li>• The MRGCD diverts water at four distinct locations through the MRG critical habitat area. Diversions are typically made between March 1 and Nov 15 each year. During the remaining 3½ months there are no diversions, and therefore no effect. The location of each diversion considerably influences the effect it has. The magnitude of diversions has similarly large influence, and is variable throughout the irrigation season.</li> <li>• During the high-flow period (mid-April – Jun), diversion of water, adjusted for effect of return flow, has the effect of reducing flows at various points through the MRG by 7-33%. Reduced flows may impact spawning and critical habitat. The wetted area affected is different below the four diversion structures as follows: <ul style="list-style-type: none"> <li>– Cochiti, diverting up to 200 cfs, insignificant effect to a reach that is likely to be experiencing natural flows of 1,500–7,000 cfs</li> <li>– Angostura, diverting up to 300 cfs, minor effect to a reach that is likely to be experiencing natural flows of 1,450–6,950 cfs</li> <li>– Isleta, diverting up to 800 cfs, significant effect to a reach that is likely to be experiencing natural flows of 1,300–6800 cfs</li> <li>– San Acacia, diverting up to 265 cfs, minor effect to a reach that is likely to be experiencing natural flows of 300–5,000 cfs</li> </ul> </li> <li>– MRGCD diversions, adjusted for effect of return flow, may have a net depletion on river flows of up to 500–600 cfs. At the lower spring runoff peak discharges, this can represent a reduction in flow of approximately 33%. At the higher end of peak discharges, this represents a reduction in flow of about 7%. Model results show that MRGCD diversions reduce the occurrence of the 2500 cfs threshold by only 6% of the years.</li> </ul> | <p>RIO includes Offsetting Measures, within current authorities, described above in Section 1.2 and in this table. Offsetting Measures are as follow:</p> <ul style="list-style-type: none"> <li>• During high-flow and low-flow periods <ul style="list-style-type: none"> <li>– MRGCD operational management to closely match diversion to actual agricultural demand. Use of a Decision Support System, and irrigation scheduling to manage irrigation diversion rates <b>(MRGCD)</b>.</li> <li>– Use MRGCD diversions and conveyance system to deliver Supplemental Water to specific habitat areas in the river, minimizing naturally occurring losses to supplemental water <b>(MRGCD)</b>.</li> <li>– Exchange supplemental water for RG water, allowing use of supplemental water for environment purposes, while remaining in compliance with the RGC and SJC Project regulations <b>(MRGCD)</b>.</li> <li>– Construction of gauging stations to monitor diversion rates and deliveries to irrigation laterals, and expanded installation and use of automatic controls at MRGCD diversion structures, canals and wasteways <b>(MRGCD)</b>.</li> <li>– Manage MRGCD facilities, e.g., wasteways and outfalls, from which the MRGCD has historically discharged water at a variable rate, to discharge more consistently <b>(MRGCD)</b>.</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• RIO is an Adaptive Management process that incorporates scientific learning to inform decision-making and improves interagency coordination leading to efficient water management that is more supportive of species needs.</li> <li>• River operation coordination will provide maximum efficiency and effectiveness of water movement and use by multiple water users, including supplemental water for listed species, particularly with regards to minimizing inherent conveyance losses to supplemental water.</li> <li>• Additional gaging stations will at times allow for more water flowing downstream of diversion dams and provide an increase in the amount of available habitat for silvery minnow. During high-flow time periods, this results in more water in the river than otherwise would be present.</li> </ul> |

**Table IV-1. Effects of proposed actions and Offsetting Measures on the Rio Grande silvery minnow**  
 (Responsible entities are listed in **bold**. Full analysis for Summary of Effects column is provided in Parts II and III of this BA.)

| Action Category  | Summary of Effects  | Offsetting Measure(s)  | Beneficial Effects for Silvery Minnow of Proposed Actions and/or Offsetting Measures   |
|--|---|--|--|
| <p><i>Operate Diversions</i> – Divert water, for delivery to and consumption by agricultural users, at Cochiti, Angostura, Isleta, San Acacia dams. See Appendix H for additional detail. <b>(MRGCD)</b> (cont.)</p> | <ul style="list-style-type: none"> <li>– During the summer and fall low-flow period, MRGCD diversions, adjusted for effect of return flow, may have a net impact on river flows of up to 500–600 cfs. This analysis excludes water released from storage that would otherwise not be present in the system at this time of year (see beneficial effects of release from storage). Water entering the MRG Valley naturally may be between 150–400 cfs. Naturally occurring depletions (riparian ET and evaporation) can exceed the equivalent of 500 cfs. At the lower end of natural summer fall discharges there can be effects to the Cochiti and Albuquerque reaches by diversion of water, but no effect to Isleta and San Acacia reaches since natural flow is insufficient to wet these areas even when no diversion occurs. At the higher end of natural summer/fall discharges, there is insignificant effect to the Cochiti and Albuquerque reaches, significant effect on the Isleta reach, and variable effect on the San Acacia reach. Under most conditions, the effect is negligible below Cochiti dam, minor below Angostura dam, substantial below Isleta Dam, and there is minor effect below San Acacia Dam as follows. This flow reduction would impact juveniles and adults and critical habitat.</li> <li>– Cochiti, diverting 80–200 cfs, insignificant effect to a reach that is likely to be experiencing natural flows of 150–400 cfs</li> <li>– Angostura, diverting 50-300 cfs, some effect to a reach that is likely to be experiencing natural flows of 0–300 cfs</li> <li>– Isleta, diverting 0–800 cfs, significant effect to a reach that is likely to be experiencing natural flows of between 0–100 cfs</li> <li>– San Acacia, diverting 0–265 cfs, variable effects, ranging from:                             <ul style="list-style-type: none"> <li>◊ no effect to a reach that can be expected to experience no natural flow (46% of modeled years),</li> <li>◊ partial effect to a reach experiencing some natural flow which may be reduced in part by diversion and thus increasing the miles dried (50% of modeled years), or</li> <li>◊ minor effect to a reach that receives enough natural flow to remain flowing with or without diversions and thus no change in miles dried (4% of modeled years).</li> </ul> </li> </ul> <ul style="list-style-type: none"> <li>• MRGCD diversions have the potential to entrain silvery minnow eggs and larvae into diversion structures during the spawning and recruitment period. As with other MRGCD diversion effects, the magnitude is variable with regards to both the rate of MRGCD diversion, and the naturally occurring peak discharge. Small rates of diversion during high peak discharges have a negligible effect on egg entrainment, while high rates of diversion during low peak discharges may have large effects.</li> <li>• At the Isleta diversion structure, when the gates are lifted from the water during the winter months, fish passage is possible. Operation of Isleta dam impedes upstream fish passage of juveniles and adults for 8.5 months, or 71% of each year. The Angostura and San Acacia Diversion Dams are representative of the environmental baseline and, therefore, have no effect on fish passage from their operation.</li> </ul> | <ul style="list-style-type: none"> <li>• Specific to address low-flow periods                             <ul style="list-style-type: none"> <li>– Use MRGCD diversions and conveyance system to manage river recession (“provide a controlled recession”) during low-flow periods; and manage return flows in coordination with Reclamation and the Service to assist with silvery minnow rescue efforts <b>(MRGCD)</b>.</li> <li>– Construction of a surface return flow collection system at MRGCD south boundary to aid in managing river recession and deliver excess flows to the river <b>(MRGCD)</b>.</li> <li>– Maintain selected MRGCD drain and wasteway outfalls to keep sites viable and productive for targeted species, as well as for overall ecosystem health. This will be managed in a manner consistent with the overall purposes of the MRGCD. <b>(MRGCD)</b></li> <li>– <b>Offsetting Measures are intended to cause at least 10 miles of potentially dry silvery minnow habitat to remain wetted.</b></li> <li>– Provide a minimum of \$150,000 in annual ESA and science related funding, a portion of which may support San Acacia reach habitat projects, and may include additional funds for specific habitat projects identified as priorities in the Program <b>(MRGCD)</b> (Also included under Conservation Measures, Table IV-2).</li> </ul> </li> <li>• Specific to address egg entrainment                             <ul style="list-style-type: none"> <li>– During peak egg production times, maintain close coordination with the Service and egg monitoring teams, adjusting diversions to minimize entrainment of eggs. <b>(MRGCD)</b></li> </ul> </li> <li>• Specific to address fish passage                             <ul style="list-style-type: none"> <li>– Implement a program to facilitate fish passage at San Acacia Dam, with assistance from Reclamation and the State, within the first 5 years of the new BO period. An initial pilot study will test small-scale modifications, to determine a feasible approach for a simplified full-scale fish passage. This is expected to require in-channel grade control structures, along with modification of gates and the apron of San Acacia Dam. This simplified approach will entail that San Acacia Dam remain unchecked (gates raised) for much of the year, requiring concurrent construction of a siphon near the Rio Puerco to deliver a portion of east side drain returns to Drain Unit 7 and provide an alternate source of water supply for the Socorro Division. Operation of San Acacia Dam in the checked condition, though necessary under certain conditions, is expected to be infrequent and short duration. The MRGCD will provide the local cost-share necessary to build these projects, with the expectation of federal cost-share also being provided. <b>(MRGCD)</b></li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• At times when natural flow is less than consumptive use in the MRG critical habitat area, the amount of water released from storage will be reduced, enabling that storage to last longer keeping the river wet to Isleta Diversion Dam and increasing available habitat in the Cochiti and Albuquerque reaches, and with a benefit during high flow periods in the spring of having less empty storage to refill, increasing available spawning habitat and triggers for silvery minnow.</li> <li>• Monitoring and management will produce opportunities to maintain specific habitat areas near return flow points that would otherwise experience sporadic flow and be incapable of sustaining aquatic species</li> <li>• Automatic controls on diversion structures allow management of controlled rates of flow, allowing aquatic species to move upstream with receding flow, minimizing stranding and associated mortality.</li> <li>• Consistent discharges assist in maintaining habitat.</li> <li>• Maintenance of drain and wasteway outfalls as viable habitat offsets the effects to habitat during certain low-flow conditions (i.e. at the higher end of natural summer/fall discharges)</li> <li>• Construction and maintenance of habitat projects offsets habitat effects during certain low-flow conditions (i.e. at the higher end of natural summer/fall discharges).</li> <li>• Coordination of return flows helps to conserve supplemental water for use at other times and enhances the effectiveness of salvage efforts.</li> <li>• Use of drain and wasteway flows to control rate of recession minimizes mortality of aquatic species, including silvery minnow, and prolongs the availability of critical habitat PCEs in those areas.</li> <li>• Controlled water supply and return flow collection system for MRGCD Socorro Division will allow for more precise management of water supply in BDA, with benefits to extent of available habitat for silvery minnow.</li> <li>• Allows for brief reduction or suspension of water diversion to minimize egg entrainment.</li> <li>• Facilitating fish passage at San Acacia offsets potential effects on fish passage at Isleta dam.</li> </ul> |

**Table IV-1. Effects of proposed actions and Offsetting Measures on the Rio Grande silvery minnow**  
(Responsible entities are listed in **bold**. Full analysis for Summary of Effects column is provided in Parts II and III of this BA.)

| Action Category  | Summary of Effects  | Offsetting Measure(s)   | Beneficial Effects for Silvery Minnow of Proposed Actions and/or Offsetting Measures   |
|--|---|---|--|
| <p><i>Operate Drains and Wasteways</i> – Collect and return water to river<br/><b>(MRGCD)</b></p>  | <p><b>May affect, not likely to adversely affect:</b><br/>MRGCD drains intercept water seeping naturally from the Rio Grande to low lying lands, and collect subsurface infiltration from precipitation and irrigation water applications, providing a mechanism to control and direct this water for specific purposes, including delivery into the Rio Grande as surface flow, which has beneficial effects to silvery minnow and critical habitat PCEs. Seepage effects are covered under the <i>Drain Maintenance</i> row below.</p>  | <ul style="list-style-type: none"> <li>• Configuration of MRGCD drain outfalls as habitat areas <b>(MRGCD)</b>.</li> <br/> <li>• Use of MRGCD drains and wasteways to manage flows and rates of recession <b>(MRGCD)</b>.</li> <br/> <li>• Use of MRGCD drains and wasteways to convey and deliver supplemental water to Rio Grande for environmental purposes <b>(MRGCD)</b>.</li> </ul> | <ul style="list-style-type: none"> <li>• There are beneficial effects for silvery minnow and critical habitat PCEs from MRGCD wasteways that return water diverted from the Rio Grande at diversion dams, back into the Rio Grande.</li> <li>• There are beneficial effects to silvery minnow and critical habitat PCEs because MRGCD drains generally provide more water to downstream portions of the MRG river system by minimizing evaporative depletions. Minimizing evaporative depletions reduces salt concentration and may have beneficial effects on water chemistry in some reaches.</li> <li>• Use of drain and wasteway flows to control rate of recession increases survival of aquatic species, including silvery minnow larvae, juveniles, and adults, and prolongs the availability of critical habitat PCEs in those areas.</li> <li>• Use of drain and wasteway flows increases habitat available to aquatic species including silvery minnow and increases the presence of critical habitat PCEs, helping to offset effects of water diversion.</li> <li>• Use of drains and wasteways for supplemental water conveyance increases the ability to transport supplemental water to lower reaches, helping to offset effects of water diversion and benefiting silvery minnow.</li> <li>• Use of drain and wasteway flows to deliver supplemental water to critical reaches decreases the response time of managers to changes in river conditions, and increases survival of aquatic species including silvery minnow in those critical reaches.</li> </ul> |
| <p><i>River Maintenance</i> – Up to 8 projects per year (average of 4/yr); includes State cooperative agreement for MRG Project Area<br/><b>(Reclamation, State)</b></p> | <p><b>May affect and likely to adversely affect:</b></p> <ul style="list-style-type: none"> <li>• Adverse effects for all life stages (effects are method dependent) and critical habitat PCEs may occur due to entrainment in constructed features; direct harassment, harm, or mortality from construction activities; and adverse effects to habitat in certain areas (reduced complexity or overbank areas) (Part III). Adverse effects from construction activities have a short duration compared to the long-term beneficial effects of the projects.</li> <li>• Beneficial effects for all life stages (effects are method dependent) and for critical habitat PCEs may include increase in habitat complexity; increase in hydrologic connectivity; increase in low-velocity habitats with potential for nursery habitat and refuge areas during low flows; and increase in sediment mobility. (Part III)</li> </ul> | <ul style="list-style-type: none"> <li>• General BMPs and Category BMPs (Part III)</li> <br/> <li>• Habitat restoration techniques within project footprint, such as bioengineering, revegetation, bank lowering, etc.</li> <br/> <li>• Adaptive Management of project sites (Part III)</li> </ul>  | <ul style="list-style-type: none"> <li>• Long-term beneficial effects to silvery minnow and critical habitat PCEs are expected.</li> <li>• BMPs minimize or avoid short term adverse effects to silvery minnow and critical habitat PCEs from construction activities.</li> <li>• Habitat restoration techniques minimize short-term adverse effects and provide long-term benefits to silvery minnow and critical habitat PCEs.</li> <li>• Adaptive Management provides monitoring of results and subsequent maintenance to ensure beneficial effects for silvery minnow and critical habitat PCEs are realized, as well as to inform design for future projects.</li> <li>• Increased system resiliency will be beneficial, providing the opportunity to pass peak flood flows up to 5,000 cfs.</li> <li>• System disturbances, whether occurring naturally or as a beneficial effect from river maintenance, help to promote greater morphological diversity which supports critical habitat PCEs.</li> <li>• River maintenance projects will be consistent with reach strategies. See Table IV-2 for benefits at a reach scale.</li> </ul>   |

**Table IV-1. Effects of proposed actions and Offsetting Measures on the Rio Grande silvery minnow**  
(Responsible entities are listed in **bold**. Full analysis for Summary of Effects column is provided in Parts II and III of this BA.)

| Action Category   | Summary of Effects  | Offsetting Measure(s)  | Beneficial Effects for Silvery Minnow of Proposed Actions and/or Offsetting Measures   |
|---|---|--|--|
| <i>River Maintenance – Support activities;</i> includes maintenance of access roads, storage sites, stockpile sites, borrow areas, and quarries. Also covers pumping water for dust abatement and data collection ( <b>Reclamation, State</b> ) | <p><b>May affect and likely to adversely affect:</b></p> <ul style="list-style-type: none"> <li>No effects to silvery minnow or critical habitat PCEs from staging and maintenance of access roads, storage and stockpile sites, borrow areas, and quarries. (Part III)</li> <li>Insignificant effects for silvery minnow or critical habitat PCEs from pumping of water for dust abatement, since the typical range of flow decreases during base flow periods is around 0.1% to 0.2% of the total flow. (Part III)</li> <li>Data collection has some adverse effects to silvery minnow during water and sediment sampling, when sampling in the wet, though impacts would be minimal due to the small area generally affected (less than 1 acre annually). (Part III)</li> <li>No effects to silvery minnow or critical habitat PCEs from rangeline or subsurface monitoring work. (Part III)</li> </ul>  | <ul style="list-style-type: none"> <li>Consideration of species impacts during project design, including BMPs to avoid effects</li> <li>General BMPs</li> <li>BMPs for water pumping. (Part III)</li> <li>Design of data collection minimizes effects to species</li> </ul>  | <ul style="list-style-type: none"> <li>Maintenance support activities are designed to minimize or avoid the potential for harm or harassment of silvery minnow.</li> <li>BMPs minimize or avoid short-term adverse effects to silvery minnow from support activities.</li> <li>Use of BMPs minimize or avoid effects to silvery minnow from pumping</li> <li>Data collection is primarily non-destructive, with little disturbance or intrusion into the natural system, and temporally brief. The area affected is small relative to the size of surrounding habitat, and minimal even when combined on an annual basis.</li> </ul>   |
| <i>River Maintenance – Maintenance of Delta Channel,</i> includes State cooperative agreement for MRG Project Area ( <b>Reclamation, State</b> )  | <p><b>May affect, and likely to adversely affect:</b></p> <ul style="list-style-type: none"> <li>Adverse effects to silvery minnow juveniles and adults may include entrainment in constructed features; direct harassment, harm, or mortality from construction activities; reduction in habitat complexity in certain areas; and decreases in overbank areas in certain locations. (Part III)</li> <li>Beneficial effects for juveniles and adults may include increase in low-velocity habitats with potential for refuge areas for silvery minnow during low flows; allowing natural breaches to remain open during flood stages to provide overbanking flows, increasing return flows from the LFCC to increase base flow conditions, and increase in sediment mobility. (Part III)</li> <li>No effects on silvery minnow from staging and maintenance of access/roads. (Part III)</li> <li>Insignificant effects to silvery minnow from pumping water for dust abatement, since the typical range of flow decreases during base flow periods is around 0.2% to 0.7% of the total flow.(Part III)</li> <li>There is no effect to designated critical habitat because the proposed work does not occur in critical habitat, which is upstream of the Delta Channel. (Delta Channel BA)</li> </ul> | <ul style="list-style-type: none"> <li>General BMPs and specific Delta Channel BMPs (Part III)</li> <li>Maintenance of the Delta Channel to facilitate the development of a natural channel bed allowing greater diversity of hydraulic character (width, depth, and velocity). (Part III)</li> <li>BMPs for water pumping (use of 0.25-inch mesh screen at intake) minimize or avoid adverse impacts, including coordination with the Service for pumping during lower flows to ensure effects are insignificant. (Part III)</li> </ul> | <ul style="list-style-type: none"> <li>BMPs are designed to minimize or avoid contact with any fish and the potential for harm, harassment, or mortality of silvery minnow.</li> <li>Increased system resiliency will be beneficial, providing the opportunity to pass peak flood flows of 5,000 cfs or less</li> <li>Beneficial effects for juveniles and adults may include increase in low-velocity habitats with potential for refuge areas for silvery minnow during low flows, allowing natural breaches to remain open during flood stages to provide overbanking flows, increasing return flows from the LFCC to increase base flow conditions, and increase in sediment mobility.</li> <li>The use of BMPs minimizes or avoids effects of pumping on silvery minnow</li> </ul>  |
| <i>Drain Maintenance – Drain and LFCC maintenance;</i> includes State cooperative agreement for MRG Project Area ( <b>Reclamation, State, MRGCD</b> )   | <p><b>May affect, and likely to adversely affect:</b></p> <ul style="list-style-type: none"> <li>Adverse effects to all life stages of silvery minnow from work in waterways connected to the Rio Grande include direct harassment, harm, or mortality from construction activities; removal of shallow low-velocity areas; and small increases in seepage from the river (areas where drains and LFCC are lower than the Rio Grande) that contributes to drying. (Part III)</li> <li>Beneficial effects to all life stages of silvery minnow from work in waterways connected to the Rio Grande include allowing return flows back to the river.</li> <li>No effects to silvery minnow or critical habitat PCEs from maintenance of access roads or work on spoil levees. (Part III)</li> <li>Small increases in seepage from the river (areas where drains and LFCC are lower than the Rio Grande) that contributes to drying may adversely affect PCEs of critical habitat. LFCC is not critical habitat for silvery minnow. (Part III)</li> <li>Beneficial effects to PCEs of critical habitat through return flows and pumped flows back to the Rio Grande.</li> </ul>   | <ul style="list-style-type: none"> <li>General BMPs</li> <li>Exclusion zones where necessary (seining for silvery minnow and installing temporary migration barriers)</li> <li>Return flows and pumped flows</li> </ul>  | <ul style="list-style-type: none"> <li>BMPs minimize or avoid short-term adverse effects to silvery minnow from construction activities.</li> <li>Exclusion zones help minimize adverse effects to silvery minnow from in channel work</li> <li>Return and pumped flows provide beneficial effects to the Rio Grande, and therefore silvery minnow and critical habitat PCEs, during dry periods that outweigh the short term adverse impacts.</li> <li>Beneficial effects to all life stages of silvery minnow from work in waterways connected to the Rio Grande include allowing return flows back to the river that may provide habitat for silvery minnow during low-flow periods; and facilitating increase of flows in critical reaches through return flows or pumping.</li> <li>Beneficial effects to PCEs of critical habitat from return flows and pumped flows include creation of wetted habitat near drain outfalls and backwaters.</li> </ul> |

**Table IV-1. Effects of proposed actions and Offsetting Measures on the Rio Grande silvery minnow**  
(Responsible entities are listed in **bold**. Full analysis for Summary of Effects column is provided in Parts II and III of this BA.)

| Action Category  | Summary of Effects  | Offsetting Measure(s)  | Beneficial Effects for Silvery Minnow of Proposed Actions and/or Offsetting Measures   |
|--|---|--|--|
| <b>Maintenance of River Facilities – River facilities, dams, and levee maintenance (MRGCD)</b> | <p><b>May affect, not likely to adversely affect:</b></p> <ul style="list-style-type: none"> <li>Maintenance of levees to protect MRG from flood events requires regular periodic activities. Maintenance typically involves earthmoving equipment, excavation, grading, and vegetation control. This work would be conducted in the dry and therefore, there are no effects to silvery minnow or critical habitat PCEs (Part III).</li> <li>Maintenance of diversion structures for proper functioning of the irrigation system has insignificant effects. Maintenance is generally performed on concrete and steel portions of facilities that are not commonly occupied habitats for silvery minnow. Activities such as dredging may be required near these structures, but is limited to the weir pool immediately adjacent, and is thus not likely to significantly affect the silvery minnow or critical habitat PCEs. Physical access to the upstream and downstream faces of these structures is normally confined to existing concrete apron and should have no effect to the silvery minnow or critical habitat PCEs. Most maintenance at diversion structures occurs in the winter months, October–February, when diversions are not occurring.</li> </ul> | <ul style="list-style-type: none"> <li>Implement a BMP program for maintenance of MRGCD structures located between the levees.</li> </ul>  | <ul style="list-style-type: none"> <li>A BMP program would be beneficial to silvery minnow by further reducing any risk of effects to the species and establishing clear communication on best practices.</li> </ul> |
| <b>Administration of Surface water and Groundwater Supplies (State)</b>                        | <p><b>May affect and likely to adversely affect:</b></p> <ul style="list-style-type: none"> <li>Upper Rio Grande (URG): There is no hydrologic effect to the Middle Rio Grande from the Upper Rio Grande because of the NMOSE's continued administration of surface water and groundwater supplies above the Otowi gage to maintain the status quo of the hydrologic system balance (1929 conditions). Therefore, there is no effect to silvery minnow or critical habitat PCEs.</li> <li>Middle Rio Grande: The total hydrologic effect of administering surface water and groundwater supplies is calculated as a reduction of flow in the Albuquerque reach of about 1.5 cfs at the beginning of the consultation increasing to 10 cfs after 10 years.</li> <li>A flow reduction of 1.5 cfs in the MRG is part of the SJC offset program and is small and immeasurable.</li> <li>A flow reduction of up to 7-10 cfs could occur in the Albuquerque Reach during times when MRGCD is not releasing water from storage (about 30% of years for about 2–3 months, Aug-Oct timeframe), resulting in a reduction of wetted habitat for a short time period in some dry years in the Albuquerque Reach only.</li> </ul>  | <p>For the URG, no Offsetting Measures are warranted.<br/>For the MRG:</p> <ul style="list-style-type: none"> <li>The State will provide up to 250 AF per event (not to exceed a total of 4,500 AF in any 15-year period) of Rio Grande Compact relinquishment credit for storage and later release at low flow rates when MRGCD is not otherwise releasing stored water.</li> <li>The State will work with its Program partners to maintain existing overbank habitat constructed by the State since 2006 in the Albuquerque and Isleta reaches for a period of at least 15 years, which will result in habitat availability at a greater range of flows in which spawning, egg incubation, and larval rearing can occur.</li> <li>The State will provide depletion offsets for the USACE MRG Floodway projects in accordance with existing agreements.</li> <li>In addition to the Offsetting Measures listed above, for the two State action categories with “may affect and likely to adversely affect” determinations, the State will provide funding for staffing of operations of the Los Lunas Silvery Minnow Refugium seeking to produce more than 17,000 adult silvery minnow per year of sufficient size for tagging and stocking in the Rio Grande.</li> </ul> | <ul style="list-style-type: none"> <li>Releases during low flows would benefit silvery minnow and their habitat.</li> </ul>  |

**Table IV-1. Effects of proposed actions and Offsetting Measures on the Rio Grande silvery minnow**  
 (Responsible entities are listed in **bold**. Full analysis for Summary of Effects column is provided in Parts II and III of this BA.)

| Action Category   | Summary of Effects  | Offsetting Measure(s)   | Beneficial Effects for Silvery Minnow of Proposed Actions and/or Offsetting Measures   |
|---|---|---|--|
| <p><i>Administration of Domestic, Municipal, Livestock and Temporary Uses (State)</i></p> | <p><b>May affect and likely to adversely affect:</b></p> <ul style="list-style-type: none"> <li>• Upper Rio Grande: There is no hydrologic effect to the middle Rio Grande from the Upper Rio Grande because of the SE's continued administration of surface water and groundwater supplies above the Otowi gage to maintain the status quo of the hydrologic system balance (1929 conditions). Therefore, there is no effect to silvery minnow or critical habitat PCEs.</li> <li>• Middle Rio Grande: The total hydrologic effect is estimated to be zero cfs at the beginning of the consultation period increasing to about 2.25 cfs at the Albuquerque gage and 3.5 cfs at the headwaters of Elephant Butte Reservoir after 10 years. A flow reduction ranging longitudinally from 2.25 cfs at the Albuquerque gage to 3.5 cfs at the headwaters of Elephant Butte Reservoir is small and immeasurable during spring peak flows. During low-flow periods, for the purposes of this evaluation, this is considered as a minor adverse effect on juveniles and adults and critical habitat PCEs although the effect is almost immeasurable.</li> </ul> | <p>For the URG, no Offsetting Measures are warranted.<br/>                     For the MRG:</p> <ul style="list-style-type: none"> <li>• The State will provide up to 150 acre-feet per event (not to exceed a total of 1,500 acre-feet in any fifteen year period) of Rio Grande Compact relinquishment credit for storage and later release at low flow rates when MRGCD is not otherwise releasing stored water.</li> <li>• The State will provide up to 250 acre-feet of senior consumptive use rights from the Strategic Water Reserve (N.M. Stat. § 72-14-3.3) to Reclamation and/or the USACE for offsets of depletions resulting from deviations at USACE reservoirs for the benefit of threatened and endangered species; and</li> <li>• The State will operate and maintain the Atrisco habitat restoration site to function as a holding pond for silvery minnow rescued from the Rio Grande when and if flows in Albuquerque are so low as to warrant doing so. Continued testing and application to FWS for permitting of the site to be used as refugial habitat will occur in 2015-2016.</li> <li>• In addition to the Offsetting Measures listed above, for the two State action categories with “may affect and likely to adversely affect” determinations, the State will provide funding for staffing of operations of the Los Lunas Silvery Minnow Refugium seeking to produce more than 17,000 adult silvery minnow per year of sufficient size for tagging and stocking in the Rio Grande.</li> </ul> | <ul style="list-style-type: none"> <li>• Releases during low flows would benefit silvery minnow and critical habitat PCEs.</li> <li>• Senior consumptive use rights would offset spawning-related depletions resulting from Cochiti Reservoir deviations.</li> <li>• Habitat restoration would help to enhance availability of silvery minnow habitat at a greater range of flows for spawning, egg incubation, and larval rearing.</li> </ul> |

## **3. Conservation Measures**

Conservation Measure categories presented below are not in priority order.

### **3.1 River Integrated Operations (RIO) Using Adaptive Management**

In addition to participation in RIO using AM described in Reclamation’s Offsetting Measures and the tools described therein, Reclamation, MRGCD, and the State propose pursuing several tools, currently outside of existing authorizations, to meet RIO needs and goals as described in Section 1.1.1. These tools will likely require the BA Partners seeking additional legislation to establish a conservation pool at upstream reservoirs and to modify operations and adjust timing of storage at upstream reservoirs for RIO needs. These tools and benefit to the species are described on Table IV-2.

### **3.2 River Connectivity**

Reclamation, MRGCD, and the State propose working on several Conservation Measures intended to improve river connectivity at diversion dams. A pilot project and eventual increased river connectivity at San Acacia Diversion Dam would be the highest-priority effort. The BA Partners would also pursue connectivity at Isleta and Angostura Diversions. These efforts and benefits to the species are described on Table IV-2.

### **3.3 Habitat Improvements**

Reclamation, BIA, MRGCD, and the State propose several Conservation Measures intended to improve and create habitat for the needs of the listed species. These efforts and benefits to the species are described on Table IV-2, and listed in priority order by reach.

### **3.4 Recovery Implementation Program Establishment**

Reclamation and the BA Partners propose to establish a Recovery Implementation Program (RIP), including working on several Conservation Measures to transition the Collaborative Program into a RIP. These include revising and signing the RIP documents within 1 year of receiving a BO and continued funding for population monitoring and augmentation efforts as informed by Adaptive Management. These efforts and benefits to the species are described in Table IV-2. See Part V for procedural information on the role of the RIP.

### **3.5 Summary of Conservation Measure Significance**

Table IV-2 categorizes the Conservation Measures in addressing RIO using AM (including conservation storage and the draft HO), river connectivity, habitat improvements, and RIP establishment. The Conservation Measures are limited to those activities to be undertaken by the BA Partners (Reclamation, MRGCD, and the State/ISC) and, with specific exceptions (e.g., Reclamation's river maintenance actions), will be included in a RIP AM plan and implementation schedule.

Reclamation's proposed Conservation Measures represent commitments as part of the MRG Program, including commitments through the RIP. The BA Partners' proposed Conservation Measures demonstrate immediate conservation benefits provided through the RIP under the BO resulting from this consultation, and provide assurance that the BA Partners will develop institutional and operational resources within the initial years of the BO to promote conservation and recovery of the species in concert with other RIP management actions.

Proposed State commitments as approved by the NMISC on June 9, 2015 are provided in Appendix F. Proposed MRGCD commitments as approved by the MRGCD Board July 24, 2012 and on July 13, 2015 are provided in Appendix G.

**Table IV-2. Benefits of proposed Conservation Measures to listed species and critical habitat**

(Responsible entities are listed in **bold**; asterisked State Conservation Measures require NMISC approval [see Appendix F, Element 3].)

| Conservation Measure  | Description of Conservation Measure  | Benefit to Listed Species and Critical Habitat   |
|---|--|--|
| <b><i>River Integrated Operations (RIO) Using Adaptive Management</i></b> |  |  |
| Adaptive Management for River Operations                                  | <ul style="list-style-type: none"> <li>The RIO as described in Section 1.1 will be used to evaluate and determine the best use of available water annually as well as long term potential solutions. The RIO will replace the prescribed flow targets by testing the Service's HO water management hypotheses within an Adaptive Management framework with more strategic use of river operations that is expected to improve species status and which will be scientifically investigated. Conservation Measures in both Tables 1 and 2 that have a river operations component will be integrated into the RIO to the extent possible. (<b>Reclamation, MRGCD, and State</b>)</li> <li>The RIO will also be used to determine the best methodologies for quantification of available habitat over a range of river conditions.</li> </ul> | <ul style="list-style-type: none"> <li>A structured Adaptive Management process for the MRG, termed the RIO, will take into account species needs and, eventually through the RIP, sufficient progress metrics linked to population dynamics. Modeling and on-the-ground evaluations will be performed to assess the benefit to the silvery minnow and other listed species of proposed water management and river operations actions. Testing of how flow magnitude, timing, and duration improves habitat and species life history will be part of the RIO, as it integrates with the RIP.</li> </ul>  |
| Allocation of existing relinquishment credits                             | <ul style="list-style-type: none"> <li>The State will provide over 100,000 AF of previously allocated New Mexico's Rio Grande Compact Relinquishment Credit for use over the next several years when the Rio Grande Compact Article VII storage restrictions are in effect to meet both MRGCD irrigation demand and biological opinion needs. (<b>State</b>)</li> </ul>  | <ul style="list-style-type: none"> <li>Relinquished credit will be used to prolong the irrigation season and provide flows for the listed species, which supports wetted habitat in the Albuquerque and sections of the Isleta and San Acacia Reaches, provides additional Supplemental Water supplies for maintaining flows and producing spawning flows, and initiates a shared conservation storage pool and provides flows that can be used for Compact compliance and ESA needs. Relinquished credit water is used all are used primarily for minnow habitat but also may support habitat for flycatcher, cuckoo, and jumping mouse.</li> </ul> |
| Maximize Compact Credit Status  | <ul style="list-style-type: none"> <li>MRGCD will cooperate with appropriate entities to maximize New Mexico credit status under the RGC, and increase the opportunities for future credit relinquishment to benefit both ESA needs and MRGCD water supply (<b>MRGCD</b>).</li> </ul>  |  |
| Maintenance of the Delta Channel  | <ul style="list-style-type: none"> <li>The State will continue maintenance of the Delta Channel at up to \$1 million per year primarily as a means of aiding in Compact compliance but also, potentially, to accrue additional Compact Credit Water that could be relinquished and provide future relinquishment credit allocations. (<b>State</b>)</li> </ul>   | <ul style="list-style-type: none"> <li>Future relinquishment credit allocations would help to augment flows and benefit the silvery minnow and its critical habitat.</li> </ul>  |
| Efficiency Improvements   | <ul style="list-style-type: none"> <li>MRGCD will provide a minimum of \$500,000 annually toward improving existing water delivery systems to increase flexibility in water operations, for managing during drought and to improve efficiencies for the dual purposes of better service to water users while incrementally reducing diversions, particularly during spring spawn and recruitment events and to reduce the impact of water withdrawal and effects on species habitat (river drying). These funds will be leveraged with federal and state water conservation and infrastructure programs to accelerate system-wide improvements. (<b>MRGCD</b>)</li> </ul>  | <ul style="list-style-type: none"> <li>Increased flexibility in water operations will improve efficiencies for the dual purposes of better service to water users while incrementally reducing diversions, particularly during spring spawn and recruitment events and to reduce the impact of water withdrawal and effects on species habitat (river drying).</li> </ul>  |

**Table IV-2. Benefits of proposed Conservation Measures to listed species and critical habitat**

(Responsible entities are listed in **bold**; asterisked State Conservation Measures require NMISC approval [see Appendix F, Element 3].)

| Conservation Measure                  | Description of Conservation Measure   | Benefit to Listed Species and Critical Habitat  |
|---------------------------------------|---|---|
| Water Conservation Storage and Timing | <ul style="list-style-type: none"> <li>• Pursue modified reservoir operations including those at Heron, El Vado, Abiquiu and Cochiti operations <i>beyond current authorizations</i> (<b>Reclamation, ISC, and MRGCD</b>).</li> <li>• Coordinate to develop conservation pools in upstream reservoirs <i>beyond existing authorities</i> (<b>Reclamation, MRGCD, State</b>) Water sources and storage for the pool may include:                         <ul style="list-style-type: none"> <li>– Pursue storage agreement or permit in Abiquiu. (<b>Reclamation and ISC</b>)</li> <li>– MRGCD will expand its opportunity for storage to manage through drought by completion of agreements with ABCWUA to store up to 50,000 AF of water at Abiquiu Reservoir. (<b>MRGCD</b>)</li> <li>– Excess leased Supplemental SJC water or exchanged water. (<b>Reclamation</b>)</li> <li>– Purchase/leased pre1907 water rights. (<b>Reclamation and MRGCD</b>)</li> <li>– Work with the BA Partners and the Rio Grande Compact Commission to assess the steps needed for future Corps deviations from normal operations at its Flood Control Reservoirs to improve flow management for silvery minnow spawning and make necessary requests. (<b>State</b>)</li> <li>– Utilize MRGCD’s extensive lobbying capacities and political capital to encourage the development of federal legislation that reauthorizes Cochiti Dam and Reservoir as a dual-purpose facility for both flood control and for up to 60,000 AF of conservation storage. The MRGCD will work closely with the federal and state agencies as well as the MRG Pueblos to coordinate this effort during the 2–4 years this may take to get the legislation passed. (<b>MRGCD</b>)</li> <li>– Seek opportunities to conduct modified operations at other reservoirs and/or SJC exchanges that may benefit the species. (<b>State</b>)</li> </ul> </li> <li>• Pursue adjusted timing of storage <i>beyond current authorizations</i>. (<b>Reclamation, State, and MRGCD</b>)</li> </ul> | <ul style="list-style-type: none"> <li>• The listed species will benefit particularly during summer and fall periods from releases of Conservation storage. Because of the importance of spring flows for spawning and overbank habitat for nursery habitat and optimum flycatcher nesting habitat, Conservation storage may also provide a benefit in the spring and early summer should conditions allow. The benefits for cuckoo are expected to be similar and this conservation storage may also benefit the jumping mouse if managed for that purpose.</li> <li>• The development of conservation storage is probably a long term process due to the need to reauthorize some reservoirs and develop operating agreements. Funding will be required to purchase and/or lease water from willing sellers/leasers to fill a conservation pool.</li> </ul> |

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(Responsible entities are listed in **bold**; asterisked State Conservation Measures require NMISC approval [see Appendix F, Element 3].)

| Conservation Measure   | Description of Conservation Measure   | Benefit to Listed Species and Critical Habitat   |
|--|---|--|
| Flexibility in managed recession                             | To the extent permitted by the Rio Grande Compact, a controlled rate of recession may be produced by the Corps reducing releases from Cochiti reservoir in a series of small steps. The MRGCD will establish a policy whereby during times of floodwater storage and managed recession for silvery minnow, MRGCD available natural flow will be determined by the theoretical release from Cochiti reservoir in the absence of any such managed recession. <b>(MRGCD)</b> | <ul style="list-style-type: none"> <li>• Will minimize impacts of MRGCD diversions on managed recession.</li> </ul>  |
| Native Water Acquisition Program                             | Continue pursuit of a Native Water Acquisition Pilot Program, which might include Strategic Water Reserve and/or Water Banking components, with the goal of determining potential benefits for species conservation <b>(Reclamation, State*, and MRGCD)</b> .   | <ul style="list-style-type: none"> <li>• This allows for improved understanding of opportunities and benefits from native water leasing.</li> </ul>          |
| LFCC Pumping and Evaluation                                  | The benefits of pumping from the LFCC to the river are unclear and the pumping costs continue to rise (over \$1,800,000 a year). Due to these factors pumping will continue while an evaluation of the program occurs to determine the most effective future. <b>(Reclamation)</b>  | <ul style="list-style-type: none"> <li>• Will inform Adaptive Management and allow for more effective resource use to meet species needs.</li> </ul>         |
| Enhanced Measurement and Data                                | Expansion, refinement, operation and maintenance of measurement stations, telemetry equipment, computer processing, and data exchange networks to collect and distribute information on MRGCD water operations. <b>(MRGCD)</b>  | <ul style="list-style-type: none"> <li>• Will inform Adaptive Management and allow for more effective resource use to meet species needs.</li> </ul>         |
| Reduction in Angostura diversions during shortage operations | During MRGCD shortage/conservation operations and when the ABCWUA has agreed to suspend diversions of native Rio Grande water, MRGCD will, if deemed necessary, reduce diversions at Angostura Diversion Dam to the minimum practical rate of flow required to meet irrigation demand within the Albuquerque division (as occurred during the fall of 2011). <b>(MRGCD)</b>   | <ul style="list-style-type: none"> <li>• This will enhance flows in the Albuquerque Reach during low-flow periods.</li> </ul>                                |
| Supplemental Water coverage                                  | Under certain conditions, when Reclamation has begun releasing Supplemental Water but that water has not yet reached its intended destination, MRGCD will assist Reclamation to achieve intended rates of flow below the Diversion Dams. <b>(MRGCD)</b>   | <ul style="list-style-type: none"> <li>• This will assist with achieving intended rates of flow below the Diversion Dams during low-flow periods.</li> </ul> |
| Operating Plan   | The MRGCD will develop annually an Operating Plan that will coordinate the delivery of irrigation water with assistance in providing spawning, recruitment and survival habitat needs as determined by using the best available scientific information. <b>(MRGCD)</b>  | <ul style="list-style-type: none"> <li>• Will inform Adaptive Management and allow for more effective resource use to meet species needs.</li> </ul>         |

**Table IV-2. Benefits of proposed Conservation Measures to listed species and critical habitat**

(Responsible entities are listed in **bold**; asterisked State Conservation Measures require NMISC approval [see Appendix F, Element 3].)

| Conservation Measure   | Description of Conservation Measure   | Benefit to Listed Species and Critical Habitat   |
|--|---|--|
| Increase safe channel capacity in the Middle Valley  | The State will work with the Corps and Reclamation to identify projects, in addition to the San Acacia Levee and the Socorro Levee Project, that when constructed will allow the Corps to increase its safe channel capacity releases from Cochiti and Jemez Canyon Reservoirs so that higher snowmelt runoff flows can safely be passed through the middle valley. That, in turn, will provide for additional overbanking habitat. <b>(State*)</b>   | <ul style="list-style-type: none"> <li>• Ability to pass higher snowmelt runoff will increase channel diversity and benefit the silvery minnow and its critical habitat.</li> </ul>  |
| <b>River Connectivity</b>  |   |  |
| <ul style="list-style-type: none"> <li>• Pilot Project(s) to Assess River Connectivity at Diversion Structures: San Acacia Diversion Dam (SADD)</li> <li>• Re-Connectivity for Other Diversions: Isleta Diversion Dam and Angostura Diversion Dam</li> </ul> | <ul style="list-style-type: none"> <li>• SADD Pilot Project concepts to be prepared and tested at the SADD. Plan and construct a pilot project(s) with possible multiple passage configurations (e.g., GRFs) to test effectiveness in 2015-2018. Conduct approved fish movement studies. <b>(MRGCD, State, and Reclamation)</b></li> <li>• The State will provide up to \$25,000 of technical assistance to MRGCD per year for 3 years to design and prepare fish passage concepts at the SADD, set-up alternative designs, and test them through Service approved fish movement studies. <b>(State)</b></li> <li>• The State will discuss assistance to the MRGCD for construction of the pilot project. <b>(State*)</b></li> <li>• Following the SADD pilot studies, Isleta and Angostura connectivity will be pursued if considered feasible and advisable <b>(MRGCD, Reclamation, BIA)</b>. Implement new standing operating procedures for Isleta Diversion Dam resulting in improved sediment transport and fish passage opportunities. <b>(Reclamation, MRGCD)</b> The State may assist the MRGCD in planning, designing, testing, and constructing projects designed to better provide fish passage at these structures. <b>(State*)</b></li> </ul> | <ul style="list-style-type: none"> <li>• These river connectivity Conservation Measures address the silvery minnow only. This action may improve critical habitat by allowing the fish to move from one area of critical habitat to another in and between the San Acacia, Isleta, and Albuquerque Reaches.</li> <li>• The pilot project(s) will test the feasibility of fish passage from relatively minor changes to the river channel, structures, and operations.</li> <li>• If successful, fish will be able to move from one reach to another within the natural channel (instead of using an off channel structure).</li> <li>• Fish will most likely move upstream during low flows. During river recession of the San Acacia reach, fish are likely to move away from drying to the San Acacia Diversion Dam.</li> <li>• Genetic exchange should be enhanced with better river connection. Small exchanges of fish can result in sufficient genetic diversity.</li> </ul> |

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| Conservation Measure              | Description of Conservation Measure   | Benefit to Listed Species and Critical Habitat   |
|-----------------------------------|---|--|
| <b>Habitat Improvements</b>       |   |  |
| San Acacia Reach<br>(Priority #1) | <ul style="list-style-type: none"> <li>• <u>Lower Reach planning efforts</u> will include multiple planned river maintenance and ESA projects that will be coordinated under the Lower Reach Planning Effort to provide a cohesive approach for this critical and complex reach of the Action Area. Efforts will include agency and public interactions to establish strategies to engage private landowners. <b>(Reclamation, State*, with MRGCD)</b></li> <li>• Provide a minimum of \$150,000 in annual ESA and science related funding, a portion of which may support San Acacia reach habitat projects, and may include additional funds for specific habitat projects identified as priorities in the Program. <b>(MRGCD)</b></li> <li>• <u>BDA River Realignment Project</u> will be completed with construction estimated to commence by 2018, at which time the ISC may be requested to provide funding or other support. Stakeholders will be engaged in planning process. <b>(Reclamation with MRGCD, and State*)</b></li> <li>• <u>Fort Craig to RM 60 Restoration</u> includes improving the LFCC for water delivery and construction at the RM 60 site of a structure to allow return flows to the Rio Grande and also provide the ability to control flows into wetlands and critical habitat. <b>(Reclamation, State*)</b></li> <li>• <u>Fund/Construct Lower Reach Habitat Restoration</u> at approximately \$1 to 5 million/year as part of River Maintenance and Restoration. <b>(Reclamation)</b></li> </ul> | <ul style="list-style-type: none"> <li>• These Conservation Measures address the silvery minnow, flycatcher, cuckoo, and, as noted, the jumping mouse.               <ul style="list-style-type: none"> <li>– For the silvery minnow and its critical habitat: The Conservation Measures described for constructing new and improved habitats within the San Acacia reach will provide more sustainable wetted habitats, deeper areas of inundation and longer time periods when habitats are inundated for egg retention and larvae rearing.</li> <li>– Flycatcher and cuckoo and their habitat: Channel and floodplain habitat improvements are expected to provide additional native vegetation (removal of tamarisk and other nonnatives) for fly-through, nesting, and rearing habitats. Although not currently needed, additional territories outside the Elephant Butte Reservoir delta will assure long-term sustainability of nesting success for the flycatcher and cuckoo.</li> <li>– Habitat enhancement of sites such as the Rhodes property will provide Pecos sunflower habitat and possibly jumping mouse habitat in addition to provided habitat for the flycatcher, the cuckoo, and seasonally, the silvery minnow.</li> </ul> </li> </ul> |

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| Conservation Measure                   | Description of Conservation Measure  | Benefit to Listed Species and Critical Habitat   |
|--|--|--|
| San Acacia Reach (Priority #1) (cont.) | <ul style="list-style-type: none"> <li>• <u>Overbank habitat improvements between San Acacia Diversion Dam and RM 100</u> will begin in 2015-2016. The State will provide up to \$500,000 to plan and construct approximately 100 acres of backwater and ephemeral channels to be lowered to provide inundation at lower spring runoff flows (1,500 cfs). (<b>State with Reclamation, MRGCD</b>)</li> <li>• <u>Riverine Refugia</u>. The MRGCD will cooperate and assist with the creation and enhancement of specific habitat areas near MRGCD outfalls to provide a series of refuge areas where silvery minnow populations may be maintained during normal periods of low and intermittent flow in the MRG. (<b>MRGCD</b>)</li> <li>• <u>Maintenance and Adaptive Management of Projects</u> will be conducted primarily through the River Maintenance and Restoration program but will also seek to engage other federal, state, and local entities (e.g., BLM, BDA, MRGCD, private). (<b>Reclamation</b>)</li> </ul>  | <ul style="list-style-type: none"> <li>• This habitat enhancement will create and maintain refugial habitat areas during periods of low and intermittent flows. Maintaining areas of wetted habitat and increasing the length and quality of the wetted habitat will provide the minnow with higher probability of survival.</li> </ul>  |
| Isleta Reach (Priority #2)             | <ul style="list-style-type: none"> <li>• MRGCD will provide a minimum of \$150,000 in annual ESA and science related funding, a portion of which may support Isleta reach habitat projects, and may include additional funds for specific habitat projects identified as priorities in the Program. (<b>MRGCD</b>)</li> <li>• <u>Sevilleta National Wildlife Refuge flycatcher and minnow habitat improvements</u> being planned and implemented by a consortium of agencies including the BA partners and the Service's Sevilleta Refuge staff. Up to 80 acres of new habitat is planned for 2015-2017. (<b>State, Reclamation, and MRGCD</b>)</li> <li>• <u>Construction and monitoring of Isleta habitat restoration using Adaptive Management</u> includes maintenance and monitoring of new habitat restoration and existing habitat restoration near Los Lunas and Belen through assessment and modification of natural and manmade levees on bank attached bars that restrict spring runoff flows and cause large scale entrapment for minnows. (<b>Reclamation, State*, and MRGCD</b>)</li> <li>• <u>Floodplain Management Plan</u> for MRGCD Lands will address lands controlled by the MRGCD using previous investigations and planning tools to identify areas that need fire management and wildlife improvements. (<b>MRGCD</b>)</li> </ul> | <ul style="list-style-type: none"> <li>• The river near the Sevilleta is a perennial section of the Rio Grande due to the return flows from the Lower San Juan drain and other geomorphic factors. This section of the river is not highly developed and the presence of the La Jolla and Sevilleta wildlife refuges allow for protection and maintenance of habitat improvements.</li> <li>• Additional spawning and rearing habitats that are constructed in this section are expected to provide long-term benefits for the silvery minnow.</li> <li>• In concert with the additional flycatcher habitat improvements on the Sevilleta and preservation of cottonwood canopies by the refuges, additional improvements at the refuges will create new habitat for flycatcher and cuckoo. These improvements include the removal of large monotypic tamarisk, planting of Goodding's and coyote willows, and the lowering and sculpting of overbank habitats.</li> </ul> |

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| Conservation Measure                           | Description of Conservation Measure  | Benefit to Listed Species and Critical Habitat  |
|--|--|---|
| Isleta Reach<br>(Priority #2) (cont.)          | <ul style="list-style-type: none"> <li>• <u>Riverine Refugia</u>: The MRGCD will cooperate and assist with the creation and enhancement of specific habitat areas near MRGCD outfalls to provide a series of refuge areas where silvery minnow populations may be maintained during normal periods of low and intermittent flow in the MRG. <b>(MRGCD)</b></li> </ul>  | <ul style="list-style-type: none"> <li>• Refugial habitats, especially those with a continuous source of fresh water, are critical components for long-term survival of silvery minnow. It is anticipated that river drying will continue to occur during summer and early fall under the time period covered by this BA. Maintenance of numerous and diverse areas of wetted habitat, as well as increases in the length and quality of the wetted habitat will provide the minnow with higher probability of survival. Minnow will have improved survival during ephemeral periods of channel drying if numerous sections of the Isleta Reach contain refugial habitats.</li> </ul> |
| Angostura/Albuquerque Reach<br>(Priority #3)   | <ul style="list-style-type: none"> <li>• <u>Rio Rancho Habitat Restoration Phase II</u> will be constructed using State funding of approximately \$500,000 for habitat restoration in upper portion of the Albuquerque reach by Spring 2017. Bankline lowering and floodplain reconnection is planned. <b>(State)</b></li> <li>• <u>Atrisco Habitat</u> improvements and O&amp;M provide a large and significant backwater and habitat for minnow in the Albuquerque Reach. Continued testing and application to the Service for permitting of the site to be used as habitat will occur in 2015–2016. <b>(State)</b></li> </ul>   | <ul style="list-style-type: none"> <li>• Addressing habitat needs above the South Diversion Channel to the Angostura Diversion Dam provides redistribution of sediment and can address some of the incision concerns in this section of the river. Rio Rancho restoration will be coupled with other existing efforts not described herein to provide minnow and flycatcher habitats.</li> <li>• A large backwater was constructed near the Central Bridge on the west side that has proven to attract minnow during spring runoff. This habitat is being improved to have a fish kettle that will allow for collection of fish after rearing.</li> </ul>                             |
| System-Wide Solutions for Habitat Improvements | <ul style="list-style-type: none"> <li>• <u>Sedimentation Management planning</u> will occur and implementation of BMPs during river maintenance will improve the balance of sediment into the river. <b>(Reclamation)</b></li> <li>• <u>Habitat Monitoring Program</u> established for habitat restoration and improvement of the GIS database to track habitat restoration <b>(Reclamation, State, MRGCD, and others through RIP)</b></li> <li>• <u>Habitat Restoration Planning and Construction</u> – The State will team with MRGCD, Reclamation, the Corps, other Collaborative Program partners, and private landowners to develop proposals for funding from the New Mexico Water Trust Board under the Collaborative Program sector of WTB funding. <b>(State)</b></li> </ul> | <ul style="list-style-type: none"> <li>• The geomorphology of the river system is in disequilibrium or is controlled by physical barriers that reduce the natural evolution of habitats that support the listed species. Active sediment management and an Adaptive Management approach to water operations will be used to assist natural formation and sustainability of habitats for listed species.</li> </ul>  |
| Bernardo Siphon                                | MRGCD will pursue construction of the “Bernardo siphon,” which will create a more reliable water supply at San Acacia Diversion Dam and assist with the management of river connectivity (San Acacia Fish Passage) and downstream refugia. <b>(MRGCD)</b>  | <ul style="list-style-type: none"> <li>• Improve and create habitat</li> </ul>  |

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|--|---|---|
| <b>RIP Establishment</b>                     |   |   |
| Conduct all necessary steps to establish RIP | <ul style="list-style-type: none"> <li>• Reclamation, MRGCD, and the State intend to:                             <ul style="list-style-type: none"> <li>– Establish RIP by signing of RIP Cooperative Agreement within one year of receiving the BO.</li> <li>– Put RIP governance protocols in place:                                     <ul style="list-style-type: none"> <li>◊ Establish initial Executive Committee (EC) for RIP; EC to conduct regular meetings.</li> <li>◊ Hire Executive Director.</li> <li>◊ Hire Science Coordinator.</li> <li>◊ Establish procedures for selection of Independent Science Panel.</li> </ul> </li> </ul> </li> </ul>  | <ul style="list-style-type: none"> <li>• With the RIP, multiple parties can participate in providing conservation activities that contribute to the recovery of the listed species. For example, funding and projects by the Corps, ABCWUA, MRG Pueblos, the Service, and the City of Albuquerque have been proposed for the RIP during planning activities over the past several years.</li> </ul>   |
| Conduct all necessary steps to establish RIP | <ul style="list-style-type: none"> <li>– Put RIP organization structure in place, and commence RIP implementation, within 3 years, which might include:                             <ul style="list-style-type: none"> <li>◊ Form Adaptive Management Committee (and project-specific Implementation Teams, as needed). Commence work of committees.</li> <li>◊ Update Action Plan/Annual Work Plan to include BO requirements, as appropriate, and other commitments by EC signatories.</li> <li>◊ Implement Action Plan elements through Annual Work Plan, as updated.</li> <li>◊ Refine AMP-1 Adaptive Management process; conduct quarterly meetings.</li> <li>◊ Develop consensus on sufficient progress metrics among EC and Service.</li> <li>◊ Prepare RIP Annual Progress Report(s) and related documentation.</li> </ul> </li> </ul>        | <ul style="list-style-type: none"> <li>• A fully established and functioning RIP will among other things, result in integration of activities that benefit the listed species, transparent decision making by the EC, and prioritization of funds and use of available resources for the benefit of the listed species.</li> </ul>  |
| Species and Habitat Monitoring               | <ul style="list-style-type: none"> <li>• Fund portions of hydrology, species and habitat monitoring, in coordination with the RIP. Jumping mouse habitat monitoring will be funded as part of established river maintenance and restoration protocols (described in Part III). Species and habitat monitoring will inform Adaptive Management. (<b>Reclamation, MRGCD, and State</b>)                             <ul style="list-style-type: none"> <li>– State will provide up to \$75,000 for monitoring purposes. (<b>State</b>)</li> </ul> </li> <li>• Revise and refine population monitoring program as determined through a population monitoring workshop and other forums to provide reliable indices to track the status and trend of the population and to inform management decisions. (<b>Reclamation, MRGCD, and State</b>)</li> </ul> | <ul style="list-style-type: none"> <li>• The current program for monitoring silvery minnow provides trends and estimates of abundance of the species. This program is being reviewed during a workshop funded by Reclamation and subsequent efforts will result in a monitoring program that best meets the needs of the RIP. The emphasis by EC members is that species responses to management actions need to be accurately measured.</li> </ul> |

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| Conservation Measure   | Description of Conservation Measure   | Benefit to Listed Species and Critical Habitat   |
|--|---|--|
| Species and Habitat Monitoring (cont.)                         | <ul style="list-style-type: none"> <li>• MRGCD will provide a minimum of \$150,000 in annual ESA and science related funding, a portion of which may support this revision and refinement process. <b>(MRGCD)</b></li> <li>• MRGCD will continue to fund Collaborative Program/RIP PVA and statistical data analysis efforts via research agreement. <b>(MRGCD)</b></li> <li>• MRGCD will provide a minimum of \$150,000 in annual ESA and science related funding that will include support for seeking experts to contribute to the RIP's diverse scientific efforts, including helping to develop and achieve the envisioned Adaptive Management procedures. <b>(MRGCD)</b></li> </ul> | <ul style="list-style-type: none"> <li>• The current program for monitoring silvery minnow provides trends and estimates of abundance of the species. This program is being reviewed during a workshop funded by Reclamation and subsequent efforts will result in a monitoring program that best meets the needs of the RIP. The emphasis by EC members is that species responses to management actions need to be accurately measured.</li> </ul>  |
| Silvery Minnow Propagation for Augmentation and Reintroduction | <ul style="list-style-type: none"> <li>• Fund portion of the propagation and augmentation in coordination with the RIP. <b>(Reclamation, State, MRGCD)</b></li> <li>• <u>Los Lunas Silvery Minnow Refugium will increase production capacity through a \$900,000 capital appropriation over the next four to 5 years, to better support the Service's propagation and augmentation efforts with the goal of producing up to 50,000 adult silvery minnow per year of sufficient size for tagging and stocking in the Rio Grande.</u> <b>(State)</b></li> </ul>   | <ul style="list-style-type: none"> <li>• Captive propagation has been used for over 10 years within the MRG to increase spawning success in the river. In 2014, while almost 100% of silvery minnow collected during monitoring were captive reared adults, the recruitment pulses that occurred in this year resulted in YOY that recruited to October. This information indicates that captive-bred fish may spawn in the wild, and that this is a benefit to silvery minnow recovery; however, additional analysis is needed so that Adaptive Management principles can be applied.</li> <li>• The Propagation facilities also provide opportunity for research and Adaptive Management testing.</li> <li>• The Propagation facilities help preserve the genetic diversity of the silvery minnow and ensure the species will not go extinct.</li> </ul> |
| Minnow Sanctuary   | <ul style="list-style-type: none"> <li>• The State, in coordination with ABCWUA, will provide assistance to the MRGCD to retrofit the Minnow Sanctuary using methods employed successfully at the Atrisco Backwater such that the MRGCD can operate the site by 2020. <b>(State*)</b></li> <li>• MRGCD will assist with operation and maintenance of the Minnow Sanctuary, up to an annual expenditure not to exceed \$50,000, upon completion of system improvements by others and development of a facility operational plan which shall be approved by the Board of Directors. <b>(MRGCD)</b></li> </ul>   | <ul style="list-style-type: none"> <li>• This will benefit the silvery minnow by enhancing survival of eggs and larvae in available flooded habitats in spring.</li> <li>• This also provides habitat for juveniles and adults at high river flows.</li> </ul>   |