

Long-Range Plan

San Juan River Basin Recovery Implementation Program



The logo for the San Juan River Basin Recovery Implementation Program is circular. It features a central illustration of a fish, likely a trout, swimming in a river. The fish is colored in shades of green and yellow. The text "San Juan River Basin" is written in a curved path above the fish, and "Recovery Implementation Program" is written in a curved path below it. The background of the logo consists of concentric rings of color: blue, green, yellow, and red. To the right of the logo is a rectangular inset photograph showing a wide river flowing through a valley with rolling hills in the background under a clear sky.

May 2022

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INTRODUCTION

Background

The San Juan River Basin Recovery Implementation Program (Program) was initiated in October 1992 to protect and recover populations of two federally-listed endangered fish species in the San Juan River Basin (Basin) while water development proceeds in compliance with all applicable federal, state, and tribal laws. The two listed fish species are the Colorado Pikeminnow (*Ptychocheilus lucius*; formerly known as Colorado Squawfish) and Razorback Sucker (*Xyrauchen texanus*). Activities and actions within the Program serve as the "reasonable and prudent alternative" for projects in the Basin and help to ensure that those projects will not jeopardize the continued existence of the endangered species. It is anticipated that actions taken under the Program will benefit other native fishes in the Basin and prevent them from becoming endangered.

The goals of the Program are:

1. To conserve populations of Colorado Pikeminnow and Razorback Sucker in the Basin consistent with the recovery goals established under the Endangered Species Act of 1973, as amended, 16 U.S.C. §§ 1531 *et seq.* (ESA).
2. To proceed with water development in the Basin in compliance with federal and state laws, interstate compacts, U.S. Supreme Court decisions, and federal trust responsibilities to the Southern Ute Tribe, Ute Mountain Ute Tribe, Jicarilla Apache Nation, and Navajo Nation.

The Program was initiated with the signing of a Cooperative Agreement in 1992 after the rediscovery and documentation of successful spawning by Colorado Pikeminnow and the continued presence of Razorback Sucker in the San Juan River. Adult and young-of-year (YOY) Colorado Pikeminnow and adult Razorback Sucker were collected during 1987-1989 by biologists gathering detailed fish community data for use in potential Razorback Sucker reintroduction efforts (Platania et al. 1991). This discovery resulted in the reinitiation of Section 7 consultation through the Bureau of Reclamation (Reclamation) for the Animas-La Plata (ALP) Project; and subsequently, the Navajo Indian Irrigation Project (NIIP) underwent Section 7 consultation through the Bureau of Indian Affairs (BIA).

A 7-year research program, conducted during 1991-1997, provided a baseline of information that identified and characterized factors limiting the two endangered species. The research program was incorporated into the Recovery Program when it was formed in 1992. Culmination of the research program in 1997 marked the end of the research phase and the beginning of the implementation and management phase for the Program. In 1991, a Program Document (Document) was developed to provide the framework for Program implementation. The original Document was adopted in 1992 by the Cooperative Agreement signatories. The Document was modified by the Coordination Committee in 2006, 2010, and 2012 (Program 2012a). The Document outlines the Program's purposes, authorities, structure, and operating procedures including funding and budgeting. The Document details the purposes of the Program's committees and defines their composition, authorities, and duties. The Document also includes a description of the process for conducting Section 7 consultations and for reviewing sufficient progress. The Section 7 procedures specifically reference implementation of a long-range plan as the principal means for determination of ESA compliance for water projects in the Basin. The Program operates through committee processes that identify the actions needed to attain the Program goals. The committees include representatives of the signatories to the Cooperative Agreement (extended in 2006 to September 30, 2023), including state and federal agencies and Native American Tribes. Water development and conservation interests are also participants of the Program.

Purpose

The purpose of this Long-Range Plan (LRP) is to identify specific actions to be implemented in the Basin that will contribute to recovery of the Colorado Pikeminnow and Razorback Sucker in accordance with species recovery goals (U.S. Fish and Wildlife Service [Service] 2002a, 2002b). Recovery of both protected species will be accomplished within the context of conservation and management of the entire native fish assemblage and in a manner that does not compromise, impair, or diminish persistence of unprotected native fishes. The updated LRP is based on research information from past studies in the Basin and other regions and Program evaluation reports to identify multi-year research, monitoring, and recovery actions necessary to achieve the Program goals.

The first LRP was developed in 1995 by the Biology Committee and was intended primarily to guide the Program through the completion of a 7-year research program to identify and characterize factors limiting the two endangered species. The research phase of the Program was completed in 1997 and the LRP was updated and revised to provide guidance on the implementation and management phase of the Program. This LRP is a culmination of drafts and reports that updated the 1995 plan (Holden 2000; Miller 2006; Service 2010, 2012). New recovery actions identified are based on evaluation and review of the Program's progress, and recovery goals. The LRP is reviewed and updated annually. The relationship of the LRP to the various Program components is shown in Figure 1.

This LRP identifies actions and tasks to be accomplished, provides estimated period for carrying out these tasks and activities consistent with species recovery and appropriate for evaluating Program progress. This LRP identifies and describes the progression and priority of implementing identified recovery actions that are expected to result in recovery and delisting of the Colorado Pikeminnow and Razorback Sucker. Because actions identified in this LRP are linked to recovery goals and plans adopted by the Service (Service 2002a, 2002b), accomplishing the actions and tasks described in this LRP constitutes the milestones toward achieving recovery of the endangered fish species. As long as these actions and tasks are satisfactorily met and demonstrably, contribute toward recovery of the listed fishes, it is the mutual expectation of the participants that the Program serves as the foundation for a reasonable and prudent alternative for Section 7 consultations, but does not preclude the development of reasonable and prudent alternatives independent of the Program.

In order to define and describe specific program activities and projects for upcoming years, the Program develops an Annual Work Plan (AWP). The AWP identifies and describes activities to be conducted by the Program in a given year for conservation of the endangered species. The LRP guides the Program in the development of the AWP and helps link Program activities for continuity and consistency. Approval of the AWP and budgets by the Coordination Committee is based, in part, on consistency and compliance with the LRP and available funds.

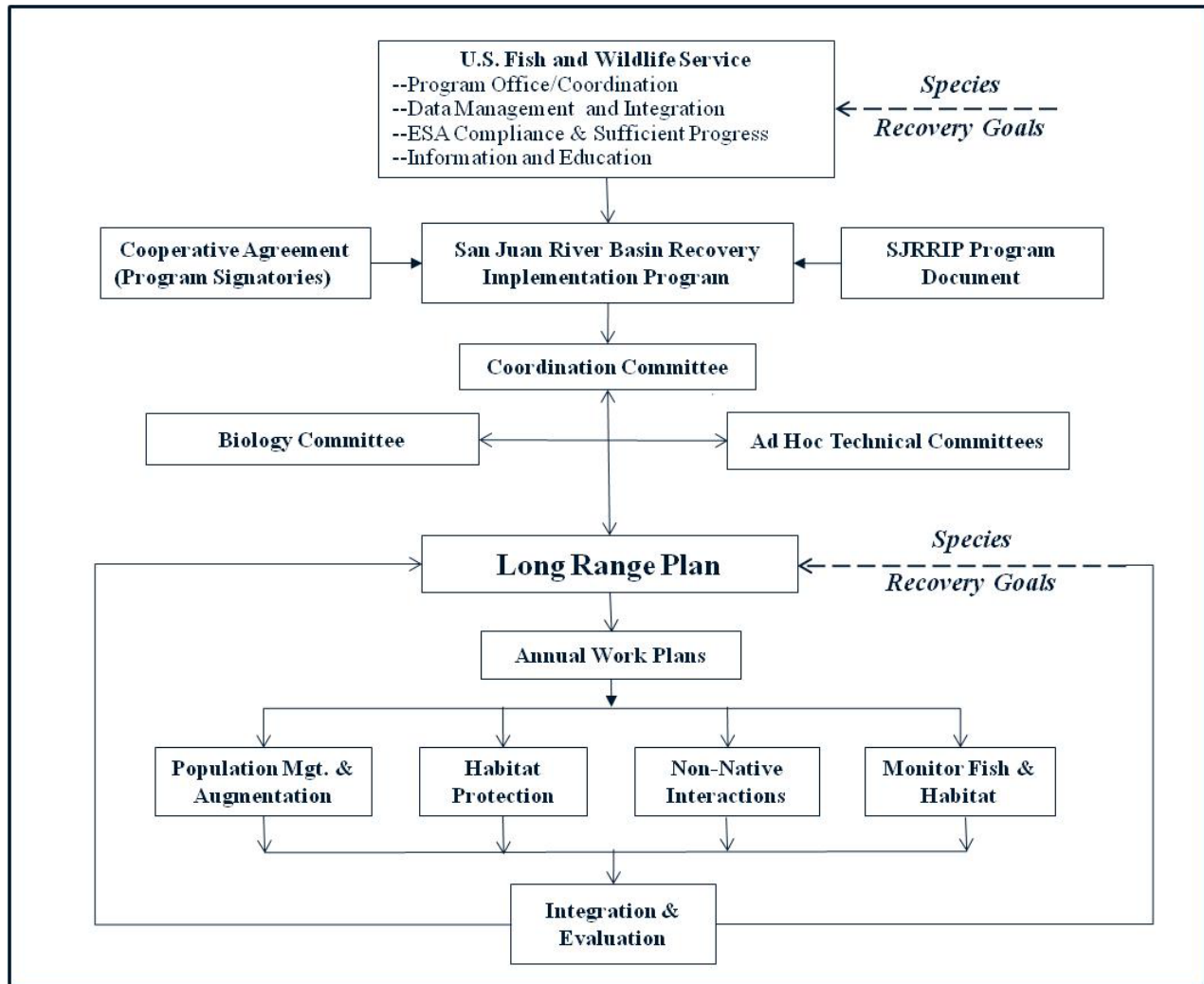


Figure 1. Components and relationships of the San Juan River Basin Recovery Implementation Program including the Long-Range Plan.

Authority

The Program became operational in October 1992 upon execution of a Cooperative Agreement signed by representatives of the Department of the Interior; the States of Colorado and New Mexico, and the Ute Mountain Ute and Southern Ute tribes; and the Jicarilla Apache Nation. The Bureau of Land Management became a participant in the Program in October 1993 as a condition of a Biological Opinion regarding oil and gas development in the Basin, and the Navajo Nation joined the Program in November 1996. In 2006, the 1992 Cooperative Agreement was extended through 2023.

Funding reliability is critical to the success of the Program to ensure that the Program is conducted on a continuous basis and that high priority recovery elements are funded every year. Prior to 2001, funding of the Program was provided by Reclamation, the BIA, and the Service. On January 24, 2000, Congress enacted Public Law 106-392 that authorized and directed Reclamation to fund this Program and the Upper Colorado River Endangered Fish Recovery Program. Public Law 106-392 authorized the Secretary of the Interior to use Colorado River Storage Project (CRSP) power revenues to fund annual base costs of both programs and to

provide a cost-share, to be matched by state cost-shares, towards the costs of implementing capital recovery projects under both recovery programs. The legislation also authorized federal appropriations to be made to contribute a federal cost-share towards implementation of the capital recovery projects. Public Law 112-270, signed into law on January 14, 2013, extended the authorization to expend CRSP power revenues for base (non-capital) funding for the two programs through 2019. If the availability of power revenues proves insufficient to meet the annual base funding, the Western Area Power Administration and Reclamation will request federal appropriations to meet these needs. In 2016, partners from both programs initiated efforts to extend the authorization to 2023.

DEMOGRAPHIC AND RECOVERY FACTOR CRITERIA

Recovery goals for Colorado Pikeminnow and Razorback Sucker identify demographic and recovery factor criteria needed to achieve recovery of the species in the Colorado River System (Service 2002a, 2002b). The recovery goals provide site-specific management actions; objective, measurable criteria; and estimates of time and costs as guidance for each of the recovery programs. The Upper Colorado River Endangered Fish Recovery Program implements and coordinates these management actions in the Upper Colorado River Basin in Colorado, Utah, and Wyoming, exclusive of the San Juan River Basin. This Program implements and coordinates these management actions in the San Juan River and its tributaries in Colorado, New Mexico, and Utah. The Service is currently in the process of updating the recovery plan for the Colorado Pikeminnow and will revise the recovery goals, as necessary, through that process and incorporate them into the new plan for the species. A draft recovery plan was sent to the Upper Colorado and San Juan Programs for a stakeholder review on December 5, 2014. The Service hosted two half-day webinars for the Recovery Programs in April and May of 2015, to discuss the draft plan and the comments received to date. Program participants were asked to submit written comments after the webinars by June 5, 2015. Based on comments received, the Service agreed to defer completion of an updated recovery plan until a population viability assessment (PVA) for the species was conducted. The PVA is scheduled to be completed by the spring of 2016.

In 2015, the Service implemented a methodology to conduct a species status assessment (SSA) framework to support many regulatory documents including species recovery planning. An SSA is intended to be a science document assessing species viability and does not determine policy or legal recommendations. The SSA methodology and framework will be used to summarize the status of Razorback Sucker, which will determine if a change in the status of the species is warranted by the Service. Completion of the SSA for the Razorback Sucker is expected to be completed end of the calendar year of 2016.

Demographic criteria and recovery factor criteria for the San Juan River Basin identified in the current recovery goals are summarized below. The demographic criteria identify the number of populations, numbers of individuals in each population, and the recruitment rates necessary for downlisting and delisting each species. The recovery factor criteria identify actions that should be taken to minimize or remove threats to each of the endangered fish species as identified for each of the five listing factors in Section 4(a)(1) of the ESA. As described in the species recovery goals, implementation of actions and achievement of criteria for downlisting and delisting of the Colorado Pikeminnow and Razorback Sucker are the responsibility of each of the conservation programs in charge of management of these species for their region of the Colorado River System. Hence, achievement of demographic and listing factor criteria in the San Juan River Basin is the responsibility of this Program. The demographic criteria and recovery factor criteria for each of the two endangered fish species are provided in this LRP to help identify specific actions and tasks that are considered necessary for downlisting and delisting these species.

Razorback Sucker

Demographic Criteria

Objective, measurable criteria for recovery of Razorback Sucker in the Colorado River Basin were developed for each of two recovery units, the Upper Basin and the Lower Basin¹ (Service 2002b). Recovery of the species is considered necessary in both the upper and lower basins. In order for the species to be considered for downlisting, each population must consist of fish that are recruiting into the adult population in the wild. When recruitment in the wild occurs, hatchery fish can be included in recovery demographic criteria and count towards recovery. Without viable wild populations, self-sustaining populations need to be established through augmentation with hatchery-produced fish. Once each self-sustaining population is established, the downlist monitoring period is five years and the delist period is an additional three years.

Downlisting

Downlisting can occur if, over a five-year period:

1. genetically and demographically viable, self-sustaining populations are maintained in the Green River subbasin and EITHER in the Upper Colorado River subbasin or the San Juan River subbasin such that: (a) the trend in adult (age 4+; >400 millimeter (mm) Total Length (TL)) point estimates for each of the two populations does not decline significantly; (b) the mean estimated recruitment of age-3 (300-399 mm TL) naturally produced fish equals or exceeds mean annual adult mortality for each of the two populations; and (c) each point estimate for each of the two populations exceeds 5,800 adults (5,800 is the estimated minimum viable population [MVP] needed to ensure long-term genetic and demographic viability);
2. a genetic refuge is maintained in Lake Mojave in the lower basin recovery unit;
3. two genetically and demographically viable, self-sustaining populations are maintained in the lower basin recovery unit (e.g., Colorado River mainstream and/or tributaries) such that: (a) the trend in adult point estimates for each population does not decline significantly; (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each population; and (c) each point estimate for each population exceeds 5,800 adults; and,
4. certain site-specific management tasks to minimize or remove threats have been identified, developed and implemented.

Delisting

Delisting can occur if, over a three-year period beyond downlisting:

1. genetically and demographically viable, self-sustaining populations are maintained in the Green River subbasin and EITHER in the Upper Colorado River subbasin or the San Juan River subbasin such that: (a) the trend in adult point estimates for each of the two populations does not decline significantly; (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean

¹ The Upper Basin includes the Green River, Upper Colorado River, and San Juan River subbasins, and the Lower Basin includes the Colorado River mainstem and its tributaries from Glen Canyon Dam downstream to the southerly International Boundary with Mexico.

- annual adult mortality for each of the two populations; and (c) each point estimate for each of the two populations exceeds 5,800 adults;
2. a genetic refuge is maintained in Lake Mojave;
 3. two genetically and demographically viable, self-sustaining populations are maintained in the lower basin recovery unit such that: (a) the trend in adult point estimates for each population does not decline significantly; (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each population; and (c) each point estimate for each population exceeds 5,800 adults; and,
 4. certain site-specific management tasks to minimize or remove threats have been finalized and implemented, and necessary levels of protection are attained.

Recovery Factor Criteria

Recovery factor criteria in the recovery goals describe site-specific management actions necessary to minimize or remove threats to the species and support wild self-sustaining populations. This LRP incorporates these actions to ensure that this Program is carrying out activities consistent with species recovery. Actions 2 and 5 do not apply to the San Juan River, but are included to show the full scale of actions necessary to address threats to the Razorback Sucker. The following actions are quoted from the Razorback Sucker recovery goals (Service 2002b):

1. Reestablish populations with hatchery-produced fish.
2. Identify and maintain genetic variability of Razorback Sucker in Lake Mohave.
3. Provide and legally protect habitat (including flow regimes necessary to restore and maintain required environmental conditions) necessary to provide adequate habitat and sufficient range for all life stages to support recovered populations.
4. Provide passage over barriers within occupied habitat to allow unimpeded movement and, potentially, range expansion.
5. Investigate options for providing appropriate water temperatures in the Gunnison River.
6. Minimize entrainment of subadults and adults at diversion/out-take structures.
7. Ensure adequate protection from overutilization.
8. Ensure adequate protection from diseases and parasites.
9. Regulate nonnative fish releases and escapement into the main river, floodplain, and tributaries.
10. Control problematic nonnative fishes as needed.
11. Minimize the risk of hazardous-materials spills in critical habitat.
12. Remediate water-quality problems.
13. Minimize the threat of hybridization with White Sucker.
14. Provide for the long-term management and protection of populations and their habitats beyond delisting (i.e., conservation plans).

Colorado Pikeminnow

Demographic Criteria

Objective, measurable criteria for recovery of Colorado Pikeminnow in the Colorado River Basin were developed for the Upper Colorado River Basin (Service 2002a). Recovery of the species is considered

necessary only in the Upper Basin because of the status of the populations and because information on Colorado Pikeminnow biology support application of the metapopulation concept to extant populations. The need for self-sustaining populations in the Lower Basin and associated site-specific management actions and tasks necessary to minimize or remove threats will be reevaluated during the recovery plan update and status reviews of the species.

Downlisting

Downlisting can occur if, over a five-year period, the Upper Basin metapopulation is maintained such that:

1. a genetically and demographically viable, self-sustaining population is maintained in the Green River subbasin such that: (a) the trends in separate adult (age 7+; >450 mm TL) point estimates for the middle Green River and the lower Green River do not decline significantly; (b) the mean estimated recruitment of age-6 (400-449 mm TL) naturally produced fish equals or exceeds mean annual adult mortality for the Green River subbasin; and (c) each population point estimate for the Green River subbasin exceeds 2,600 adults (2,600 is the estimated MVP needed to ensure long-term genetic and demographic viability);
2. a self-sustaining population of at least 700 adults (number based on inferences about carrying capacity) is maintained in the Upper Colorado River subbasin such that: (a) the trend in adult point estimates does not decline significantly; and (b) the mean estimated recruitment of age-6 naturally produced fish equals or exceeds mean annual adult mortality;
3. a target number of 1,000 age-5+ fish (>300 mm TL; number based on estimated survival of stocked fish and inferences about carrying capacity) is established through augmentation and/or natural reproduction in the San Juan River subbasin; and,
4. certain site-specific management tasks to minimize or remove threats have been identified, developed and implemented.

Delisting

Delisting can occur if, over a seven-year period beyond downlisting, the upper basin metapopulation is maintained such that:

1. a genetically and demographically viable, self-sustaining population is maintained in the Green River subbasin such that: (a) the trends in separate adult point estimates for the middle Green River and the lower Green River do not decline significantly; (b) the mean estimated recruitment of age-6 naturally produced fish equals or exceeds mean annual adult mortality for the Green River subbasin; and (c) each population point estimate for the Green River subbasin exceeds 2,600 adults;
2. either the Upper Colorado River subbasin self-sustaining population exceeds 1,000 adults **OR** the Upper Colorado River subbasin self-sustaining population exceeds 700 adults and San Juan River subbasin population is self-sustaining and exceeds 800 adults (numbers based on inferences about carrying capacity) such that for each population: (a) the trend in adult point estimates does not decline significantly; and (b) the mean estimated recruitment of age-6 naturally produced fish equals or exceeds mean annual adult mortality; and,

3. certain site-specific management tasks to minimize or remove threats have been finalized and implemented, and necessary levels of protection are attained.

Recovery Factor Criteria

Recovery factor criteria in the recovery goals describe site-specific management actions necessary to minimize or remove threats to the species and support wild self-sustaining populations. This LRP incorporates these actions to ensure that the Program is carrying out activities consistent with species recovery. Action 3 does not apply to the San Juan River subbasin, but is included to show the full scale of actions necessary to address threats to the Colorado Pikeminnow. The following actions are quoted from the recovery goals for the Colorado Pikeminnow (Service 2002a):

1. Provide and legally protect habitat (including flow regimes necessary to restore and maintain required environmental conditions) necessary to provide adequate habitat and sufficient range for all life stages to support recovered populations.
2. Provide passage over barriers within occupied habitat to allow adequate movement and, potentially, range expansion.
3. Investigate options for providing appropriate water temperatures in the Gunnison River.
4. Minimize entrainment of subadults and adults in diversion canals.
5. Ensure adequate protection from overutilization.
6. Ensure adequate protection from diseases and parasites.
7. Regulate nonnative fish releases and escapement into the main river, floodplain, and tributaries.
8. Control problematic nonnative fishes as needed.
9. Minimize the risk of hazardous-materials spills in critical habitat.
10. Remediate water-quality problems.
11. Provide for the long-term management and protection of populations and their habitats beyond delisting (i.e., conservation plans).

RECOVERY ELEMENTS AND ACTIONS

This LRP consists of the following six Program elements:

1. Management and Augmentation of Populations of Colorado Pikeminnow and Razorback Sucker.
2. Protection, Management, and Augmentation of Habitat.
3. Management of Nonnative Aquatic Species.
4. Monitoring and Evaluation of Fish and Habitat in Support of Recovery Actions.
5. Program Coordination and Assessment of Progress toward Recovery.
6. Information and Education

This LRP identifies activities believed necessary to recover the Colorado Pikeminnow and Razorback Sucker in the San Juan River Basin. The LRP describes what actions will be implemented, who will implement them, when they will be implemented, and why. Details of how actions and tasks will be carried out are left to supporting documents and plans, such as genetics management plans, augmentation plans, monitoring plans, and AWP. This LRP functions under the principles of adaptive management where annual updates and periodic revisions are necessary to ensure use of the best available scientific information in modifying or eliminating existing activities and formulating future Program activities.

The LRP is intended to facilitate evaluation of the Program's progress toward species recovery and development of sufficient progress reports for ESA Section 7 compliance. Furthermore, this LRP is designed to facilitate tracking of projects and associated budgets to assist the Program Coordinator and Reclamation's budget office. Goals, actions, and tasks are identified that began in 1992, at the initiation of the Recovery Program. Numerous tasks have been completed and that information used to develop strategies for management actions, monitoring, and research. Including past Program activities in the LRP provides documentation and accounting of activities, time schedules, and successes and failures of each. This institutional knowledge of the Program will enable interested parties to review overall Program progress over time. Current goals, actions, and tasks are described in the narrative sections for each Recovery Element. Appendix A is used to track tasks and includes priorities, start and end times, primary responsibilities, and status. Priorities assigned to tasks reflect necessary actions identified in recovery goals.

Recovery Elements 1, 2, and 3 include management actions to recover the two endangered fish, whereas Recovery Elements 4 and 5 include activities to monitor, evaluate, and assess if the management actions are achieving the intended purposes. Although the primary goal of this Program is to conserve populations of Colorado Pikeminnow and Razorback Sucker in the Basin consistent with species recovery goals, it is also important to ensure protection, restoration, and maintenance of the components of the physical and aquatic habitats that supports them. Environmental conditions that support the endangered species also provide suitable conditions for the native fish community and vice versa. Native fishes provide an important food source for the predaceous Colorado Pikeminnow, are important in maintaining ecological balance and food web dynamics, and serve as indicator species for a healthy ecosystem. The San Juan River Basin supports seven fish species native to the warm reaches of the drainage, including Roundtail Chub (*Gila robusta*), Colorado Pikeminnow, Speckled Dace (*Rhinichthys osculus*), Bluehead Sucker (*Catostomus discobolus*), Flannelmouth Sucker (*Catostomus latipinnis*), Razorback Sucker, and Mottled Sculpin (*Cottus bairdi*) (Holden 1999).

Description of Program Elements

The elements and associated tasks are designed to guide the Program through 2023 with annual updates as new information is obtained. This schedule is consistent with the Recovery Program goals that estimate recovery for the Colorado Pikeminnow and Razorback Sucker by the year 2023.

For each Recovery Element, a general explanation of the recovery activities and background are provided in the following narrative sections. Specific goals, actions, and tasks deemed necessary to achieve each element are identified in Appendix A tables. The goals under each element identify major targets that need to be achieved in order to fulfill the specified element; actions identified under each goal describe the principle actions; and the tasks describe the specific activities or projects. Appendix A tables include the identified tasks and provides a priority, the year(s) in which the activity is planned, the lead Program participant(s), and a status update for each task (updated annually).

Element 1. Management and Augmentation of Populations of Colorado Pikeminnow and Razorback Sucker

This element ensures that the Program's augmentation protocols maintain genetically diverse fish species while producing and rearing Colorado Pikeminnow and Razorback Sucker to stock in the river system. Wild self-sustaining populations of Colorado Pikeminnow and Razorback Sucker have currently not been documented in the San Juan River Basin. Recovery goals for both species identify the need to establish self-sustaining populations through augmentation with hatchery-produced fish. The Program has adopted a genetics management plan (Crist and Ryden 2003) that identifies appropriate genetic lineages for use in hatchery programs and stocking efforts for the San Juan River. Augmentation plans for each of the two

endangered species were originally developed by Ryden (2003a, 2003b) and updated as needed. Production, rearing, and stocking of these fish need to continue to establish wild populations. The numbers and size of fish that need to be produced are identified in the species augmentation plans. Stocking protocols and fate of stocked fish are monitored and evaluated to determine the best strategies for enhancing survival and recruitment. Survival models are used to estimate and adjust stocking goals of augmentation plans and to ensure that sufficient numbers of genetically viable fish are being stocked.

Surveys in the late 1980s reported a few wild Colorado Pikeminnow and Razorback Sucker in the San Juan River (Platania 1990; Platania et al. 1991). Prior to initiation of the Program, the Service proposed stocking Razorback Sucker into the San Juan River in 1986 to restore the species to the river. The effort was not undertaken, but Colorado Pikeminnow and Razorback Sucker persistence in the river was documented. An experimental stocking program for Razorback Sucker began in 1994, under Program auspices, and experimental stocking of Colorado Pikeminnow began in 1996. In the early years of the stocking program, finding consistent sources of the two listed species for stocking, the right facilities, and the best methods were challenging and involved much trial and error. Since its inception, the Program continues to identify and develop strategies for producing and rearing both Colorado Pikeminnow and Razorback Sucker, including hatchery production and grow-out facilities.

Today, brood stocks of Colorado Pikeminnow and Razorback Sucker are held at Southwestern Native Aquatic Resources & Recovery Center (SNARRC) at Dexter, New Mexico where fish are spawned, hatched, and reared. Brood stocks of Colorado Pikeminnow are also held at the Colorado Division of Wildlife J.W. Mumma Native Species Hatchery at Alamosa, Colorado and brood stocks of Razorback Sucker are held at Ouray National Fish Hatchery – Grand Valley Unit (NFH-GVU) at Grand Junction, Colorado. The Program uses grow-out facilities to produce larger Razorback Sucker (>300 mm total length) for stocking to enhance survival. Since 1998, Navajo Agricultural Products Industry (NAPI) Ponds located on the NIIP have been used to grow-out Razorback Sucker from SNARRC for the stocking program. From 2007-2013, Uvalde National Fish Hatchery (Uvalde) in Uvalde, Texas was used to rear and stock 11,400 >300 mm Razorback Suckers to meet stocking goals. Low recaptures rates of Razorback Sucker stocked from Uvalde, prompted the Service and the Program to discontinue using this facility (Durst 2011). Final fish distributions from Uvalde occurred in October of 2013. In 2010, the Coordination Committee approved cost sharing with the Upper Colorado River Endangered Fish Recovery Program to construct, operate, and maintain Horsethief Canyon Native Fish Facility (HCNFF) at Ouray NFH's GVU. This facility became operational in 2012 and includes four 0.25-acre hatchery ponds for use by the Program to grow-out Razorback Sucker for the San Juan River stocking program. In addition to the fish produced by these facilities, excess fish from other facilities that raise Colorado Pikeminnow and Razorback Sucker are occasionally stocked into the San Juan River.

While the overall goals for Element 1, *Management and Augmentation of Populations of Colorado Pikeminnow and Razorback Sucker*, are the same for both the Colorado Pikeminnow and Razorback Sucker, i.e., Establish Genetically and Demographically Viable, Self-Sustaining Colorado Pikeminnow and Razorback Sucker Populations (Goal 1.1) and Identify and Implement Strategies for Improving the Colorado Pikeminnow and Razorback Sucker Augmentation Program and Genetic Integrity (Goal 1.2), some actions and tasks vary by species.

Element 2. Protection, Management, and Augmentation of Habitat

This element identifies actions and tasks that address protection, management, and augmentation of the physical and aquatic habitats needed to support recovery of Colorado Pikeminnow and Razorback Sucker populations including suitable flows, range, the native fish community, and water quality. Following seven years of research on flows and habitat in the San Juan River Basin completed in 1997, the Biology Committee recommended a program of flow releases from Navajo Dam that would mimic the river's natural hydrograph,

thereby improving habitat for native fishes including the Colorado Pikeminnow and Razorback Sucker (Holden 1999). These flow recommendations were based on scientifically-established relationships between flow regime (frequency, timing, magnitude, duration, rate of change, and seasonality of water flow), river geomorphology, and habitat and life history of the two endangered fish species. Reclamation began operating Navajo Dam according to the flow recommendations in 1999 and implemented the flow recommendations using operations decision criteria established in the Final Environmental Impact Statement for operations of the Navajo Dam through 2014 (Reclamation 2006). Releases are made to provide sufficient water at times, in quantities, and for durations necessary to protect the endangered fish and their designated critical habitat while maintaining the other authorized purposes of the Navajo Dam. Biologists have been monitoring the effects of Program's activities, including flow management, for more than twenty years using standardized monitoring protocols established by Propst et al. (2000, 2006) for most of that period.

The authors of the 1999 flow recommendations noted that the flow recommendations were subject to review and revision through an adaptive management process based on monitoring data. Several scientific reports by the Biology Committee and other researchers concluded that prescribed flows from Navajo Dam may not have achieved the expected outcome in terms of channel complexity and fish habitat and maintenance identified in the 1999 flow recommendations (Miller 2006, Bliesner 2010, SWCA Environmental Consultants (SWCA) 2012). Upon reviewing 1999-2003 monitoring results, the Biology Committee determined that although the prescribed flows were successful in some regards, they have been largely unsuccessful in creating and maintaining the secondary channels and backwater habitat critical to reproduction of the endangered fish (Miller 2006). Bliesner (2010) reported that habitat complexity important to all life stages is diminishing. Several committee members also suggested during a 2012 habitat monitoring workshop (SWCA 2012) that encroachment onto the San Juan River floodplain by non-native plants is degrading habitat for endangered fish by "armoring" banks and simplifying the river channel. This bank armoring reduces habitat complexity often associated with higher numbers of Colorado Pikeminnow and Razorback Sucker. The lack of the intended habitat response to the flow recommendations may also be attributed to an apparent change in hydrologic conditions in the 1999 to 2013 period as compared to the longer term period since 1971 (Reclamation 2014). These results suggest that implementation of the initial flow recommendations using the 2006 operations decision criteria may not create and maintain enough habitat to achieve recovery goals for the endangered fish.

Task 2.2.1.2 in this LRP is included to insure the flow recommendations are reviewed and revised based on monitoring data, the new San Juan River Basin hydrologic model, updated climate change projections for stream flow, and expanded scientific knowledge of flow-ecology relationships. To initiate the process, the Program held an environmental flows workshop in February 2015 to review the 1999 flow recommendations, the implementation decision tree, and accumulated fish and habitat monitoring data and results. It was recognized that the basis of the existing flow recommendations (mimicry of the natural hydrograph) was still valid but a new method for implementing them was needed. During the workshop, consensus was reached on utilizing a new interim method for implementing the flow recommendations for 2015, to conduct a comprehensive review of the 1999 flow recommendations, and to continue to further develop the new process for longer term implementation of the flow recommendations (Alliant Environmental 2015). Another environmental flows workshop was held in April 2016 to reach final agreement on implementation of a new decision tree, determine attributes of spring peak releases and base flows, develop a monitoring program to evaluate flow hypotheses, and develop a structure for finalizing the new flow recommendations and operations.

Non-flow alternatives to create and maintain suitable habitats and restore channel complexity that work in conjunction with flows are being investigated including mechanical manipulation and removal of invasive riparian species at selected locations. Non-flow alternatives for creating and maintaining suitable habitat could also help offset possible effects of climate variability and to augment the beneficial effects of flow recommendations. In 2011, the Program partnered with The Nature Conservancy (TNC) on a New Mexico

Environment Department River Ecosystem Restoration Initiative (RERI) project to use mechanical manipulation to restore secondary channels along the San Juan River. Construction on these Phase I sites were completed in November 2011. The Program conducted physical and biological monitoring of the sites to assess functionality, sustainability, fish use, and nonnative vegetation encroachment rate. The information collected was used to determine feasibility, location, and design for additional sites. In 2014, TNC completed Phase II of the channel restoration project using private mitigation funds. This brings the total amount of secondary channels restored to 7.1 miles. Monitoring of larval and small-bodied native fish at the original six RERI sites continued in 2014 and both larval and small-bodied fish were captured in good numbers at the restored sites. To provide additional information on the persistence of aquatic habitats and to measure changes in habitat features, larval fish abundance and small-bodied fish abundance from prior to spring runoff to late fall, more intensive monitoring of the Phase II site and a nearby control site began in 2015.

Review of the current scientific literature and relevant case studies as part of a 2014 evaluation conducted by TNC indicates that both water market transactions and irrigation system improvements that integrate infrastructure modernization with operational changes can successfully reduce agricultural river diversions for the benefit of endangered fish. This study identified multiple opportunities to collaborate with agricultural, municipal, and industrial water users in the San Juan Basin to reduce river diversions through water use efficiency improvements, thereby supporting environmental flows.”

Cold water releases from Navajo Dam were identified as a factor potentially limiting reproduction and upstream distribution of the endangered fishes in the San Juan River (Bliesner and Lamarra 2000). Based on modeling of reservoir and release temperatures (Cutler 2006) and an assessment of longitudinal warming and fish temperature requirements (Lamarra 2007), the Biology Committee determined a temperature control device (TCD) at Navajo Reservoir was not warranted. At that time, impacts to spawning and rearing from cold releases from Navajo Dam into the San Juan River appeared to be minimal and it was thought that spawning was determined more by time-of-year than temperature cues. A TCD may provide seasonal range expansion above critical habitat but it is unknown if range expansion above critical habitat is necessary for recovery. Larval fish surveys conducted on the San Juan River since 1991 indicate that temperature has a greater impact on the spawning period (Brandenburg and Farrington 2009). As a result of the Program’s 2012 Habitat Monitoring Workshop, the Biology Committee determined that the extent of riverine habitat available as well as what is being used by the various life stages of the target species needs to be quantified so that management actions to extend that availability can be evaluated. The committee prioritized expanding habitat monitoring into the Animas River and above the Animas River confluence of the San Juan River focusing on temperature and blockages. Miller and Swaim (2016) documented long-term changes in distribution of temperature from high flows since 1993 and prolonged cold water conditions (temperature depression), however temperature depression did not negatively impact timing, number, and size of larvae.

Range fragmentation in the San Juan River impedes movement of fish and access to spawning areas and feeding grounds. Additional range for Colorado Pikeminnow and Razorback Sucker is being provided through modification of water diversions that allow fish to move upstream and downstream. This LRP identifies actions that provide fish passage at diversions that will enable fish to move freely for over 180 miles from the Lake Powell inflow upstream past the confluence of the Animas River. Some of the fish passage facilities selectively pass fish and help to diminish movement by problematic nonnative fishes to key habitats of native and endangered fishes. Eight major diversion structures on the mainstem San Juan River in New Mexico were identified, ranging from soil and boulder dikes to concrete and metal weirs over which the entire river flows. The most upstream of these structures are dikes and levees at the heads of the Citizens Ditch and the Hammond Canal. They are upstream of the Animas River confluence and outside of designated critical habitat for both species. These cooler reaches of river are not likely to be occupied by Colorado Pikeminnow and Razorback Sucker. Five structures, located downstream of Farmington, were identified by Masslich and Holden (1996) as impediments or partial impediments to fish movement. Fish access was restored at three

sites by removing Cudei Diversion Dam at River Mile (RM) ~142 and constructing a passive fish passages at Hogback Diversion Dam at RM 159 in 2001, and constructing a selective fish passage at Public Service Company of New Mexico (PNM) Weir at RM 166.6 in 2003.

Two other potential impediments for fish passage occur in the mainstem San Juan River, Arizona Public Service Company (APS) Weir at RM 163.3 and Fruitland Diversion Dam at RM 178.5. Stamp et al. (2005) identified the need for fish passage at the APS structure and concluded a fish passage was not needed at Fruitland irrigation diversion structure, at that time, but recommended that it be re-evaluated after maintenance work is performed to confirm that the height or composition of the dam is not altered relative to the conditions documented in the study. These two sites are scheduled for reevaluation and modification in 2017.

A waterfall formed at Piute Farms in the lower San Juan River at the Lake Powell inflow (river mile 1.1) in 2003 when water levels of that reservoir declined below ~3,660 feet. This waterfall is an impediment to upstream movement of native and endangered fishes, but also impedes nonnative fishes from moving upstream from the reservoir. The Biology Committee discussed the need for an artificial barrier at the lower end of the San Juan River to exclude nonnative predators and/or potential competitors from recolonizing the river when water levels in Lake Powell rise and the waterfall is again inundated. Reclamation assessed the risk of this occurring and concluded that there is a 60 to 75% chance that the waterfall will be inundated for a total of 30 months (not necessarily continuously) between 2008 and 2030. The waterfall did become inundated for a short period in 2011 when the lake elevation rose above 3,660 feet between July 31 and August 9. It is unknown how many native and nonnative fishes moved into the river during that time; however, sampling crews have subsequently captured Razorback Suckers in the San Juan River that were captured, tagged, and released in Lake Powell (Durst and Francis 2016). Strategies for providing passage of native and endangered fishes from Lake Powell around the waterfall into the San Juan River have been evaluated (e.g., barriers, passive non-native fish removal, temporary weirs). If a barrier is determined to be necessary, measures for providing selective upstream passage for native species will be developed.

Designated Critical Habitat for the endangered fish in the San Juan River basin extends approximately 35 miles downstream into Lake Powell to Neskahai Canyon. Any Colorado Pikeminnow or Razorback Suckers existing in this portion of Lake Powell are considered to be part of the San Juan River fish assemblage. A two-year fish survey of the San Juan Arm of Lake Powell was initiated by the Program in 2011 to assess the extent of San Juan River fish lost over the waterfall especially as it relates to the Program's augmentation program to recover the listed species. During sampling in 2011 and 2012, 147 Razorback Suckers and 25 Colorado Pikeminnows that were released in the San Juan River were captured in the reservoir (Francis et al. 2015). Considering the limited amount of samples taken during the two years and limited amount of lake area that could be covered, it is assumed there are large numbers of Razorback Suckers present in Lake Powell. Biologists also documented active spawning grounds and Razorback Sucker reproduction and believe recruitment may be occurring. Inter-basin exchange of Razorback Suckers between the San Juan, Colorado, and Green Rivers was also documented. Considering limited slackwater or backwater habitats on the San Juan River, Lake Powell may be essential to recruitment and potential recovery of the species in this river basin (Francis et al. 2015). In 2014, the Upper Colorado Endangered Fish Recovery Program initiated sampling in the Colorado River Arm of Lake Powell and will repeat it in that location again in 2015. Additional sampling in areas of Lake Powell downstream from the San Juan and Colorado river arms of the lake is needed to help determine the extent of Razorback Sucker distribution within the lake. The information gained from all Lake Powell surveys will be used by the Program to determine future Program management actions regarding Lake Powell.

Entrainment of all life stages of native and endangered fishes in diversion structures is another potential impediment to recovery. In 2005, the Program funded the design of fish screens or a deflection weir for the Hogback diversion to reduce entrainment of endangered fishes in the Hogback Canal. A fish deflection

weir was installed at the Hogback Canal in 2013. Principles for minimizing entrainment that are learned from the experimental Hogback Canal design will potentially be used to construct these features on other diversions and canals. An assessment of potential entrainment structures in the San Juan and Animas rivers will be conducted in 2015.

Based on data collection and an evaluation from the 7-year research period by Holden (2000), the Biology Committee concluded that water quality in the San Juan River was not a limiting factor to recovery of the endangered fishes or to restoration and maintenance of the native fish community. In a comprehensive review of water quality and contaminants in the San Juan River, Abell (1994) found a large quantity of information available on water contaminants and pollutants, primarily abiotic data, but very little data linking those contaminants to fish health. Abell found many of the studies could not be compared to each other due to varying methodologies and detection levels. She emphasized the need for agencies responsible for protecting and restoring Colorado Basin fish populations to work together to insure future sampling efforts complement each other to provide as complete a picture as possible of contaminants in the basin. In a synoptic study of contaminants data from the 7-year research period, Simpson and Lusk (1999) concluded that selenium was a contaminant risk for the Razorback Sucker. The Service has serious concerns with current levels of mercury and selenium found in the tissues of Colorado Pikeminnow and Razorback Sucker and in the Upper Colorado River Basin and believes a comprehensive contaminants monitoring and remediation plan is needed to identify sources and magnitude of water quality threats that are adversely affecting the endangered species. This type of effort will require pooling of resources within the Upper Colorado River Basin and the expertise of the Biology Committee, contaminant biologists, fish toxicologists, and management and policy experts.

The Program's goal is to recover both of the endangered fishes within the context of conservation and management of the entire native fish assemblage that supports them. Protection of native aquatic species is critical to the recovery of the Colorado Pikeminnow and Razorback Sucker. Although the Program has not identified any specific recovery actions to actively manage the native fish community, the restoration of backwater habitats and efforts to maintain or increase habitat complexity are active management tools for conserving all native fish species. The Program has been monitoring the native fish community since its inception to assess the status of the native fish community and to determine if specific management actions will be needed in the future to recover the listed species. The Program collaborates with other ongoing programs that are actively managing other native species. For example, three native species, Flannelmouth Sucker, Bluehead Sucker, and Roundtail Chub, have some level of state sensitive species status in each of the states they occur in (Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming). In 2006, a range-wide conservation agreement and strategy was signed by each of the six state agencies as well as federal and tribal agencies with the goal of implementing conservation measures and reducing threats to the species in order to conserve populations and prevent the need for federal listing under the Endangered Species Act. Conservation actions have included three species monitoring, research, propagation and stocking of Roundtail Chub, removal of invasive nonnative species, and habitat conservation and restoration.

To achieve this element, six recovery goals were established to: provide suitable habitat (*Goal 2.1*); provide suitable flows (*Goal 2.2*); provide increased range (*Goal 2.3*); minimize fish entrainment (*Goal 2.4*); provide suitable water quality (*Goal 2.5*), and manage the native fish community (*Goal 2.6*). Providing suitable habitat actions and tasks focus primarily on creating and maintaining habitat complexity to minimize loss and degradation of habitat and managing flows to create and maintain suitable habitat. An action is also included to evaluate and implement habitat restoration strategies to augment the function of flow to create and maintain suitable habitat. The actions and tasks related to providing suitable flows focus on implementing flow regimes beneficial to both listed species and the native fish community, providing flow recommendations and guidance for releases out of Navajo Dam, and maintaining a San Juan River hydrology model to evaluate flow recommendations and basin hydrology over time. Actions and tasks to increase range include construction and maintenance of Program structures at diversions to allow for fish passage in the San Juan

River mainstem and tributaries. An action is also included to evaluate passage of San Juan River fish into Lake Powell in light of the waterfall that has formed and to assess the potential for non-native fish movement into the river if the waterfall becomes inundated. Actions and tasks to minimize fish entrainment identify diversion structures in the San Juan River mainstem and tributaries that need to be assessed and modified, if necessary, to prevent fish mortality. Water quality actions and tasks focus on identifying water quality and contaminant problems that could affect the listed fish and the native fish community, remediating those problems, and minimizing the risk of hazardous materials spills. Actions and tasks to manage the native fish community currently focus on assessing the health of the native fish community as an important component of suitable habitat. Many of the tasks identified in Element 2 will be assessed through tasks under Element 4, *Monitoring and Evaluation of Fish and Habitat in Support of Recovery Actions*.

Element 3. Management of Nonnative Aquatic Species

This element identifies actions to reduce potentially negative interactions between the endangered fish species and problematic nonnative fish species. Over twenty species of nonnative fishes have been documented within the San Juan River Basin. Nonnative fishes can numerically dominate riverine habitats and communities, negatively interacting with native and endangered fish species, and contributing to their decline (Mueller 2005). The 2002 recovery goals for Colorado Pikeminnow and Razorback Sucker (Service 2002a, 2002b) identified predation and competition by nonnative fish species as a primary threat to these endangered species. The recovery goals state that the management of nonnative fishes should be implemented in two steps: (1) develop management programs to identify the levels of management needed to minimize or remove the threat for selected species in selected river reaches (requirement for downlisting), and (2) implement the identified levels of nonnative fish management (requirement for delisting). Nonnative fish management actions conducted by the Program are consistent with these actions.

The suite of nonnative fishes in the San Juan River includes warm-water sport fishes and non-sport fishes (Brandenburg and Gido 1999; Brooks et al. 2000). Rainbow Trout and Brown Trout comprise the tailwater trout fishery below Navajo Dam (Ahlm 1993; Larson and Ahlm 1994) and do not occupy the same river reaches as the endangered fishes, which are found farther downstream in warmer water. The non-sport fish include several species of minnows and suckers with little or no commercial or sport value. No known strategy will eliminate these unwanted species from the Basin and their populations need to be reduced to a level that minimizes or removes the threat of predation and competition to native species. Channel Catfish *Ictalurus punctatus* and Common Carp *Cyprinus carpio* have been identified as a detriment to the recovery of Colorado Pikeminnow and Razorback Sucker (Service 2002a, b) and are the primary focus of the Program's nonnative species removal program.

Mechanical removal of nonnative fishes in the upper and middle sections of the San Juan River began on a limited basis in 1998. Intensive removal efforts began in 2001 with focus on a section of river from PNM Weir to Hogback Diversion (RM 166.6 - 159.0). In addition to this section, intensive nonnative removal from Hogback Diversion to Shiprock Bridge (RM 158.8 – 147.9) has been conducted since 2003. Based on observed increases in Channel Catfish abundance (Ryden 2007, 2008), efforts were expanded in 2008 to include intensive removal from Shiprock Bridge to Mexican Hat, UT (RM 147.9 – 52.9) (Duran 2013). Nonnative removal in the lower San Juan River began in 2001. Since 2003, the focus has been on reducing Channel Catfish and other large-bodied nonnative fishes that occur in the river from Mexican Hat to Clay Hills, UT between river miles (RM 52.8-2.9). Additionally, opportunistic removal of nonnative fishes during research and monitoring activities has augmented this effort. Other removal measures that have been implemented include the operation of the selective fish passage at PNM Weir. Since the facility began operation in 2003, all nonnative fishes that pass through this structure are removed. Nonnative fish stocking and baitfish policies of affected states are evaluated and nonnative fishes are not being stocked in critical habitat of the endangered fishes in the San Juan River. Measurable objectives and quantitative methods for

assessing and maintaining effectiveness of nonnative fish control are developed and implemented through this LRP.

Sport fishes are important to recreational and commercial interests throughout the southwestern United States; however, management of sport fishes sometimes conflicts with conservation of native fish species (Clarkson et al. 2005). The San Juan River does not receive a great deal of fishing pressure other than the blue ribbon trout fishery in the tailwaters of Navajo Dam. Nevertheless, appropriate sport fish management is necessary and important to minimize conflicts and ensure conservation of native and endangered fish species. The States of Utah and New Mexico currently have open bag limits on Channel Catfish and striped bass in the San Juan River. The State of Colorado allows daily bag limits of 10 fish of each species. Although recreational fishing pressure on the San Juan River is limited, maintenance of these regulations will aid the Program in the goal of limiting nonnative fish distribution and abundance. Navajo Nation sport fishing regulations are also included in meeting this goal.

The Biology Committee held a nonnative fish control workshop in 2010 to evaluate and modify the nonnative fish management program. A strong message that came out of the workshop was the importance of prevention in managing nonnative species. Nonnative introductions are not limited to fish as all introduced nonnative aquatic species have the potential to become an invasive species. Overall, introduced or stocked aquatic species undermine and hamper recovery actions. For the San Juan River, a waterfall at Lake Powell currently keeps nonnative fishes from entering the river from that source but other reservoirs in the basin could be sources. Lake Nighthorse, an off-stream reservoir on Basin Creek in the Animas River watershed near Durango, CO, was completed in 2011 as part of the ALP project. Water is pumped uphill from the Animas River and impounded in the reservoir by Ridges Basin Dam. The outlet structure was designed with an energy dissipating sleeve valve inside the discharge pipe to prevent survival and release of fish into the San Juan River Basin (Bark et al. 2013). Fathead Minnow and crayfish (*Orconectes spp.*) were present in Basin Creek before the reservoir filled (White, J., CPW, personal communication 2012). Since the reservoir filled Mottled Sculpin (*Cottus bairdi*), Iowa Darter (*Etheostoma exile*), White, Bluehead, and Flannelmouth Suckers have been documented in the reservoir (Bark et al. 2013). Researchers examined survival of nonnative fish species and embryos, post-larvae and fingerling age classes through the energy dissipating sleeve valve at increments of atmospheric pressure associated various lake elevations as the reservoir filled from 2009-2011. In general, survival of all age classes and species decreased as the reservoir filled and the atmospheric pressure increased but intact eggs could not be destroyed at any of the reservoir. Reclamation is developing a management plan which will include stocking of only trout and salmon species and additional monitoring of releases. The Program needs to be vigilant about preventing introductions of all nonnative species. Nonnative species that are already in the system but not currently a problem need to be tracked because any number of events could potentially trigger a problem.

To achieve this element, two goals have been established to manage nonnative species that could impact the Program's ability to recover the endangered fish species in the San Juan River. These include controlling problematic nonnative fishes (*Goal 3.1*) and preventing the introduction and establishment of other nonnative invasive species (*Goal 3.2*). The actions and tasks under Goal 3.1 focus on full implementation of the nonnative fish control strategy initiated in 2008, evaluation of methods, assessment of effects on the fish community, and development of targets for nonnative fish removal. Goal 3.2 includes actions and tasks that focus on establishing policies and agreements with states and tribes to manage sport fish and bait species in the San Juan River in a manner compatible with endangered fish recovery and to identify potential invasive nonnative species and control their introduction and escapement into the main stem, floodplain, and tributaries. Included are tasks to assess the effects of non-native fish from Lake Powell and from other sources on the fish community in the San Juan River and to track all nonnative species in the basin to the extent possible.

Element 4. Monitoring and Evaluation of Fish and Habitat in Support of Recovery Actions

Monitoring San Juan River native and nonnative fish populations and their habitat is necessary to evaluate management actions and to assess the Program's progress toward achieving recovery of the two endangered fish species. The Biology Committee developed a standardized fish monitoring plan and protocols in 2000 that describes the sampling design and strategies to be used in monitoring Colorado Pikeminnow and Razorback Sucker and their habitat as part of the entire fish community (Propst et al. 2000). The monitoring program also provides a basis of new information to be used to update management and conservation activities as part of the Program's adaptive management process. The monitoring plan and protocols were updated in 2006 (Propst et al. 2006) and through a series of monitoring workshops held by the Biology Committee in 2009, the monitoring plan and protocols were evaluated and updated again in 2012 (Program 2012b). The new fish and habitat monitoring plan includes updated and expanded monitoring protocol sections and a section that addresses annual and long-term data synthesis and integration.

Ongoing monitoring of stocked and wild Colorado Pikeminnow and Razorback Sucker is necessary to evaluate the success of the augmentation strategy and make adjustments, as necessary, to achieve the Program's goal of establishing self-sustaining populations of both species. Bestgen et al. (2009) used methods similar to those he used in the Green and Colorado River subbasins to analyze the survival of stocked Razorback Suckers in the San Juan River using mark-recapture data. He showed season of stocking and size at stocking was related to increased survival. Durst's mark-recapture data analyses resulted in changes to the stocking program regarding hatchery source for Razorback Sucker and age at stocking for Colorado Pikeminnow (Durst 2011, 2013). The results of analyses using mark-recapture data are useful for improving stocking procedures to increase the survival of both species and these analyses are repeated regularly. Continued annual monitoring of the endangered fish populations in the San Juan River is also important for documenting reproduction and recruitment, an indicator of a self-sustaining population. Once populations are established, reliable and precise population estimates will be conducted to determine when the downlist and delist criteria specified in the species recovery goals are being achieved. Because recovery goals require wild populations, criteria are needed to supplement catch rate estimators with mark-recapture population estimates of wild-produced adults and juveniles. The recovery goals for the Colorado Pikeminnow and Razorback Sucker include the Green, Colorado, and San Juan rivers; therefore, this Program and the Upper Colorado River Endangered Fish Recovery Program are closely linked. Population estimate monitoring is currently being done for Colorado Pikeminnow and Humpback Chub in the upper Colorado and Green rivers. Relationships between catch rate estimators and mark-recapture population estimates of fish in the upper basin may be helpful in developing these criteria for the San Juan River. Implementation of mark-recapture estimators will require a comprehensive assessment of logistics, personnel, equipment, and funds.

Other native and nonnative fish populations are being monitored to better understand the status and trends of these species and their inter-relationships with the endangered fish species. To the extent possible, river-wide habitat monitoring is closely coordinated and integrated with fish community monitoring to allow assessment of changing habitat availability and fish use in response to management actions and population recovery. Standardized habitat monitoring for the San Juan River was included in the 2000 monitoring plan and was reviewed and revised for the 2012 version. The plan is designed to monitor and evaluate river-wide habitat changes through time. A focused habitat monitoring workshop was held in January 2012 to evaluate, refine, and improve the river-wide habitat monitoring and mapping work on the San Juan River to insure the Program implements methodologies that are conducive to answering outstanding questions. The Program started conducting physical and biological monitoring at specific sites along the river where secondary channels were restored in 2011 to assess functionality, sustainability, fish use, and nonnative vegetation encroachment rate. The information collected showed both larval and small-bodied native fish in good numbers and was used to determine feasibility, location, and design for additional sites completed in 2014.

Additional intensive monitoring at the restored sites will provide information on the persistence of aquatic habitats and measure changes in habitat features, larval fish abundance and small-bodied fish abundance from prior to spring runoff to late fall for use in restoring more sites in the future.

Annual and long-term data synthesis and integration is a critical component of the Program's fish and habitat monitoring plan. To adequately evaluate the management actions, the data from all monitoring, management, and research activities are collectively synthesized as a comprehensive data set. The monitoring data are analyzed for each individual protocol during annual data analysis by the principal investigator for each protocol. This annual data analysis uses statistics appropriate for each protocol to test relevant hypotheses and examine data temporally and spatially. The integrated data from individual protocols are used to address questions that require data synthesized across protocols. Some synthesis questions can be addressed with the annual monitoring data whereas other questions require datasets over multiple years or specific research efforts. Prioritization of questions relevant to Colorado Pikeminnow and Razorback Sucker recovery in the San Juan River is critical to carrying out annual and long-term data integration exercises.

To achieve this element, five goals have been established to monitor fish populations (*Goal 4.1*), to monitor habitat use and availability (*Goal 4.2*), monitor and evaluate habitat restoration strategies and projects (*Goal 4.3*), to integrate and synthesize monitoring data and other information to evaluate fish community and ecosystem responses to recovery actions (*Goal 4.4*) and to identify and conduct research and monitoring in support of recovery actions (*Goal 4.5*). The focus is on implementation of a long-term, standardized monitoring program that was developed to track the presence, status, and trends of endangered fish populations and the native fish community and to monitor existing and restored habitat. In addition, data from all monitoring, management activities and research are integrated and synthesized annually to assess the status of the fish community, evaluate ecosystem responses to the management actions, and support broader, long-term data and information needs. Actions and tasks are included that use adaptive management concepts to evaluate and assess results and methods to refine current methodologies and develop and implement new monitoring and research strategies. A primary purpose of the actions and tasks under Element 4 is to collect and evaluate data in such a way that the Program's progress toward achieving recovery of Colorado Pikeminnow and Razorback Sucker in the San Juan River can be adequately tracked and assessed.

Element 5. Program Coordination and Assessment of Progress toward Recovery

The U.S. Fish and Wildlife Service is responsible for administering the San Juan River Basin Recovery Implementation Program. To fulfill this responsibility, the Service appoints a Program Coordinator who is responsible for overall Program planning, coordination, and management, information integration and review, and facilitation of contracting funding and management. Reclamation appoints a Funds Manager to maintain and distribute base and capital funds and administer contracts. The Program Coordinator, Program staff, and the Program's technical committees developed this LRP to facilitate achievement of recovery of the endangered fish species of the San Juan River Basin. There are two major components under this element, Program coordination and data integration and evaluation to assess the Program's progress toward achieving recovery.

Program Coordination

The Program Coordinator works with the Program's technical committees to identify and expedite individual projects that are needed to accomplish the LRP tasks for each of the Recovery Elements. The Program Coordinator, together with the Program's technical committees, drafts AWP's consisting of high priority individual projects, and forwards these to the Coordination Committee for review and approval. The Program Coordinator is responsible for maintaining records showing distribution and expenditures of all

annual and capital funds expended under the AWP by each funding source. The Program Coordinator is responsible for ensuring that the Program operates according to the Program Document; including the preparation of this LRP, the AWP, budgets, and annual progress reports. In all these tasks, the Program Coordinator is assisted by the technical committees to ensure that appropriate work products are reviewed by the technical committees and all work products are approved by the Coordination Committee. The Program Coordinator annually compiles Program reports for transmittal to the involved agencies and to the Coordination Committee.

Assessment of Progress toward Recovery

Ongoing development, integration, and evaluation of information are essential for assessing progress toward species recovery as well as for guiding future Program direction. An important first step of the Program was implementation of a research phase to document distribution and abundance of resident fishes, characterize species life histories, and identify limiting factors. A 7-year research program, conducted from 1991 through 1997, provided a baseline of information and identified and characterized factors limiting the Colorado Pikeminnow and Razorback Sucker (Holden 2000). The research program was incorporated into the Recovery Program when it was formed in 1992. An array of potential limiting factors have been investigated, including water quality, spawning habitat, nursery habitat, recruitment, hybridization, truncated range, capture-related stress, nonnative fishes, habitat quantity and diversity, flow regime, food, population size, disease, movement barriers, thermal regime, and entrainment in diversion structures. Although numerous activities have been implemented by the Program to address these factors, much remains to be learned about the life history of the endangered fishes, their relationships with other native and nonnative fishes, their habitat associations, and components of their environment that directly and indirectly influence their welfare.

Many of the actions and tasks identified in the initial 7-year research phase of the Program have been completed and the work has contributed to understanding the San Juan River Basin. However, because contemporary Colorado Pikeminnow and Razorback Sucker populations in the San Juan River were extremely small, there is still the need to identify and characterize limitations to the establishment and maintenance of self-sustaining populations. Once a potential limiting factor is identified and characterized through monitoring and research, efforts are made to implement activities that will eliminate or mitigate its impacts. These activities may not always successfully eliminate threats and mitigation alternatives may be developed.

The knowledge gained from the initial and future research coupled with other Program activities is valuable in evaluating progress toward species recovery and guiding future Program direction through annual revisions of the LRP. Annual data collection and analyses included under Element 4, provide the information base for assessing the Program's progress toward achieving recovery. Long-term, broader-based integration and synthesis of this information is also vital to interpreting results of research and management so that informed decisions can be made on future management actions and strategies. The Program Office will use the information and results obtained under Element 4 to prepare a biennial, written "Sufficient Progress" assessment of the Program's progress towards recovery. This report, as mandated in the Program Document, will assess the Program's ability to provide ESA compliance for water development and management activities and identify any corrective actions needed to ensure future ESA compliance.

To achieve this element, two goals have been established to facilitate Program planning and management (*Goal 5.1*) and facilitate contract and funding management (*Goal 5.2*). Accomplishment of these goals relies heavily on activities included in Element 4 such as establishing and maintaining a comprehensive Program database, annual monitoring data analyses, and synthesizing and evaluating information from all activities and studies.

Element 6. Information and Education

The Upper Colorado River Endangered Fish Recovery Program and the San Juan River Basin Recovery Implementation Program each have a multi-stakeholder structure in which federal and state agencies work with public and private entities to recover endangered fish species in a manner that is consistent with federal, state, and tribal water laws. Although their structure and goals are similar, these recovery programs operate independently, working with their own program partners and governing committees to fulfill requirements detailed in their respective cooperative agreements. Nevertheless, the similarities in these programs provide for effective communication and public outreach under a coordinated effort. The funding for capital construction and ongoing operation and maintenance (O&M) for the Upper Colorado River and San Juan River Basin Recovery Programs is also tied together in Federal legislation (Public Laws 106-392, 107-375, 109-183, 111-11 and 112-270).

Using a shared approach, the two recovery programs coordinate their outreach efforts and work with other organizations throughout the Colorado River Basin to ensure common audiences receive consistent, current, and accurate information about the endangered fishes and efforts to recover them. These audiences include the general public, elected officials, Indian Tribes, landowners, anglers, river rafters and guides, environmental organizations, water and power developers, teachers, students, and Program participants. Although the geographic coverage of these recovery programs differs within the Upper Colorado River Basin, the majority of affected parties are interested in the recovery efforts taking place for both programs.

An annual publication is produced that highlights accomplishments of both programs. The Program Highlights publication serves as a briefing document for the non-Federal partners' annual visit to Washington, D.C., and is used for numerous other purposes throughout the year. In addition to the Program Highlights document, the Swimming Upstream newsletter and freestanding exhibits (in both small and large formats) promote both the Upper Colorado and San Juan programs. Shared outreach efforts help ensure accurate, consistent information about the endangered fish species and recovery programs is disseminated. A shared effort has also proven to be more cost-effective for publication production costs and exhibit fees.

To achieve this element, a goal was established to increase public awareness and support for the endangered fishes and the recovery program (*Goal 6.1*). Actions and tasks focus on providing information about the recovery program to the public and coordinating with the Upper Colorado River Endangered Fish Recovery Program to conduct an effective outreach program.

Tasks That Address Recovery Goals

This LRP addresses the species recovery goals through specific tasks that detail actions necessary to quantify demographic criteria and remove or minimize species threats (Appendix A). For example, the LRP identifies tasks that reestablish endangered populations with hatchery fish in a systematic manner and tasks for monitoring population abundance. Numerous tasks help to provide and legally protect habitat, especially flows, and also provide for fish passage, as well as minimize entrainment. A series of ongoing tasks continue to be evaluated, including protection from overutilization and diseases and parasites, as well as water-quality remediation and minimizing the risk of hazardous materials spills. Control of problematic nonnative fish, regulating their escapement, and minimizing the threat of hybridization for Razorback Sucker are also important activities of this Program and the subject of several tasks.

Ongoing Actions

A series of ongoing reports and other activities are identified in this LRP. The reports are designed to provide cohesive and periodic updates on specific issues and are distinct from project reports that describe the findings of a particular study. These reports are provided to the Coordination Committee, the Program Coordinator, Reclamation, and the technical committees and are listed in Table 1. Also listed in Table 1 are workshops to be held, as necessary, to help coordinate Program activities, evaluate recovery activities, and provide technical assistance to biologists on population estimators and monitoring.

Table 1. Ongoing reports and workshops identified in this Long-Range Plan²

Identified Task	Report or Workshop	Schedule/Interval	Status/Action(s) Required
5.2.1.1	Standardized database; for all stocked and recaptured Colorado Pikeminnow and Razorback Sucker in order to determine the fate of stocked fish.	Annual entry of data with appropriate documentation.	Program Office maintains and annually updates the database; Principal Investigators annually provide data to Program Office by Dec. 31; consolidated data redistributed by Jan. 31.
4.1.1.2	Annual Fish Monitoring Report; to ensure that the best sampling design and strategies are employed.	Annual reports by Biology Committee; compiled by Program Office; posted on Program website	Principal Investigators provide draft reports by March 31 and present results at annual meeting in May. Final reports provided to Program Office by June 30.
5.2.1.2	Data synthesis and integration report; evaluates progress toward minimizing limiting factors, details ongoing Program activities, and assesses current status of native and endangered fish populations.	Annually but may vary in timing due to competing fiscal resources, project scheduling, or significant new information.	Program Office and Principal Investigators conduct focused data integration to address high priority data needs identified by the Biology Committee. Draft reports by March 31 and present results at annual meeting in May. Final reports due by June 30
4.1.1.1	Standardized Fish Monitoring Plan; to assess the presence, status, and trends of Colorado Pikeminnow and Razorback Sucker.	Standing report is revised as necessary by the Program Office and Biology Committee.	Program Office and Biology Committee will continually evaluate the Program's Comprehensive Monitoring Plan and Protocols. The Plan was updated in 2012.
4.2.1.1	Standardized Habitat Monitoring Plan; to assess habitat and flow relationships.	Standing report is part of the Program's Monitoring Plan and Protocols; revised as necessary.	Program Office and Biology Committee updated the Program's Habitat Monitoring Protocols in 2012.
2.2.1.2 2.2.2.1 4.4.4.4	Flow recommendations update report; evaluates and updates flow recommendations and response of native and endangered fishes to flow recommendations.	Environmental Flows Workshop #1 was held in Feb. 2015; Environmental Flows Workshop #2 has not been scheduled yet.	Completion of Reclamation's next generation of the SJRB Hydrology Model is expected in 2015. A technical workshop was held in Feb. 2015 to modify methods for implementing the 1999 flow recommendations. A comprehensive review and revision of the 1999 flow recommendations is expected to begin in 2015.
4.1.1.3	Monitoring Plan Workshop: to coordinate sampling design, data collection, and desired precision and detection levels for detecting responses.	As necessary.	Series of three monitoring workshops were held by the Biology Committee in 2009.
4.2.1.2	Habitat Monitoring and Mapping Workshop; to refine and improve habitat evaluation methods.	As necessary.	Workshop to address this issue was held in January 2012. Program Office and Biology Committee using workshop results to refine current methods and develop new ones.

² Task number are from the 2016 Appendix A. Goals, Actions, and Tasks were revised to reduce redundancy in 2021.

4.1.4.4	Population Estimation Workshop; to evaluate population estimators used in other systems to identify the most reliable and suitable estimator(s) for Colorado Pikeminnow and Razorback Sucker.	As necessary.	A population estimate workshop was held in 2007.
3.1.1.5	Non-native fish control workshop; to evaluate the non-native fish management program.	As necessary.	A non-native fish workshop was held in May 2010. Another workshop will be held in late 2016 or early 2017 to evaluate the revised study design initiated in FY16.

LITERATURE CITED

(Includes literature cited in Appendices)

- Abell, R. 1994. San Juan River Basin water quality and contaminants review. Volumes I and II. Museum of Southwestern Biology, Department of Biology, University of New Mexico.
- Ahlm, L. A., 1993. San Juan River tailwater trout fishery investigations - 1992 Annual Report. New Mexico Department of Game and Fish, Navajo Dam, New Mexico.
- Alliant Environmental. 2015. San Juan River Environmental Flows Workshop 1, Draft Meeting Notes, February 12-13, 2015. Draft submitted to the San Juan River Recovery Implementation Program. U.S. Fish and Wildlife Service, Albuquerque, NM. 32 pp.
- Archer, E., and T. A. Crowl. 2000a. Chapter 2: age-0 native fish year class abundances and size in relation to flow and temperature patterns in the San Juan River 1991-1997. Pages 2-1 to 2-19 in Archer, E., T.A. Crowl, and M. Trammell, editors. Age-0 native species abundances and nursery habitat quality and availability in the San Juan River, New Mexico, Colorado, and Utah. Utah Division of Wildlife Resources, Salt Lake City, Utah.
- Archer, E., and T.A. Crowl. 2000b. Chapter 3: nursery habitat survey of the San Juan River, New Mexico and Utah, 1994-1997. Pages 3-1 to 3-36 in Archer, E., T.A. Crowl, and M. Trammell, editors. Age-0 native species abundances and nursery habitat quality and availability in the San Juan River, New Mexico, Colorado, and Utah. Utah Division of Wildlife Resources, Salt Lake City, Utah.
- Archer, E., T.A. Crowl, and M. Trammell. 2000. Age-0 native species abundances and nursery habitat quality and availability in the San Juan River, New Mexico, Colorado, and Utah. Utah Division of Wildlife Resources, Salt Lake City, Utah.
- Bark, R.C., E.L. Best, K.N. Bloom, and K.W. Frizell. 2013. Ridges Basin Dam sleeve valve passage analysis of nonnative fish and embryos at increasing depths and pressures. Bureau of Reclamation. Technical Memorandum No. 86-68290-12-01. 85 pp.
- Bestgen, K., K. Zelasko, and G. White. 2009. Survival of hatchery-reared Razorback Suckers *Xyrauchen texanus* stocked in the San Juan River Basin, New Mexico, Colorado, and Utah. Final Report submitted to the San Juan River Recovery Implementation Program. Larval Fish Laboratory, Colorado State University. 46 pp.
- Bliesner, R. 2010. San Juan River Basin Recovery Implementation Program Detailed Reach Study 2009 Final Report. Keller-Bliesner Engineering, Logan, Utah.
- Bliesner, R., and V. Lamarra. 2000. Hydrology, geomorphology, and habitat studies. Final Draft Report of Keller-Bliesner Engineering and Ecosystem Research Institute to San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.
- Bliesner, R., and V. Lamarra. 2002. Hydrology, geomorphology, and habitat studies; final report. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

- Bliesner, R., and V. Lamarra. 2007. San Juan River habitat studies; evaluation of constructed experimental backwaters to aid in the retention of stocked Colorado Pikeminnow. Annual Research Report of Keller-Bliesner Engineering and Ecosystems Research Institute to San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.
- Brandenburg, W. H. and K. B. Gido. 1999. Predation by Nonnative Fish on Native Fishes in the San Juan River, New Mexico and Utah. *Southwest Naturalist* 44(3):392-394.
- Brandenburg, W. H. and M. A. Farrington. 2009. San Juan River 2008 Colorado Pikeminnow and Razorback Sucker larval fish surveys. American Southwest Ichthyological Researchers L.L.C., New Mexico, Albuquerque, New Mexico.
- Brooks, J. E., M. J. Buntjer, and J. R. Smith. 2000. Non-native species interactions: management implications to aid in recovery of the Colorado Pikeminnow *Ptychocheilus lucius* and Razorback Sucker *Xyrauchen texanus* in the San Juan River, Colorado, New Mexico, Utah. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Clarkson, R.W., P.C. Marsh, S.E. Stefferud, and J.A. Stefferud. 2005. Conflicts between native fish and nonnative sport fish management in the southwestern United States. *Fisheries* 30(9):20-27.
- Crist, L.W. and D.W. Ryden. 2003. Genetics management plan for the endangered fishes of the San Juan River. Report of Bureau of Reclamation and U.S. Fish and Wildlife Service, San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.
- Cutler, A. 2006. Navajo Reservoir and San Juan River temperature study. Final Report. U.S. Department of the Interior, Bureau of Reclamation, Upper Colorado Regional Office, Salt Lake City, UT.
- Davis, J.E. 2003. Non-native species monitoring and control San Juan River 1999-2001. Final Report. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.
- Duran, B. 2013. Endangered fish monitoring and nonnative species monitoring and control in the upper/middle San Juan River: 2013. Final Report. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM. 33 pp.
- Durst, S. 2011. 2010 Integrated Pit Tag Database Summary of Colorado Pikeminnow and Razorback Sucker In The San Juan River. Final Annual Report. U.S. Fish and Wildlife Service, Albuquerque, NM. 30 pp.
- Durst, S. 2013. 2012 Integrated Pit Tag Database Summary of Colorado Pikeminnow and Razorback Sucker In The San Juan River. Final Annual Report. U.S. Fish and Wildlife Service, Albuquerque, NM. 30 pp.
- Durst, S.L., and T.A. Francis. 2016. Razorback sucker transbasin movement through Lake Powell, Utah. *The Southwestern Naturalist* 61(1):60-63.
- Francis, M.S. 2007. Animas River Fish Passage and Canal Entrainment Evaluation and Recommendations. Bureau of Reclamation, Western Colorado Area Office, Grand Junction and Durango, Colorado. 33 pp.
- Francis, T.A., D. S. Elverud, B.J. Schleicher, D.W. Ryden, and B. Gerig. 2015. San Juan River Arm of Lake Powell Razorback Sucker (*Xyrauchen texanus*) Survey: 2012. Interim Progress Report (Draft Final) to the San Juan River Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM. 70 pp.

- Furr, D.W. 2015. San Juan River razorback sucker *Xyrauchen texanus* and Colorado pikeminnow *Ptychocheilus lucius* population augmentation 2015. New Mexico Fish and Wildlife Conservation Office, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Gido, K. B., and D. L. Propst. 1999. Habitat use and association of native and nonnative fishes in the San Juan River, New Mexico and Utah. *Copeia* 1999(2):321-332.
- Goettlicher, W. P., and M. J. Pucherelli. 1994. Mapping instream habitat on the San Juan River using airborne videography, 1993. For Bureau of Reclamation, Annual Progress Report, Denver, Colorado.
- Holden, P.B. (Ed.) 1999. Flow recommendations for the San Juan River. San Juan River Basin Recovery Implementation Program, Biology Committee. U.S. Fish and Wildlife Service, Albuquerque, NM.
- Holden, P.B. (Ed.) 2000. Program evaluation report for the 7-year research period (1991–1997). San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.
- Lamarra, V. 2004. Statistical analysis of habitat availability and fish abundance in the San Juan River. Ecosystems Research Institute, Logan, Utah.
- Lamarra, V. 2007. San Juan River Fishes Response to Thermal Modification, Utah/New Mexico. A White Paper Investigation. Report prepared for San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Landye, J., B. McCasland, C. Hart, K. Hayden, and J. C. Thoesen. 2000. San Juan River fish health surveys, 1992-1999. U.S. Fish and Wildlife Service, Pinetop Fish Health Center, Pinetop, Arizona.
- Larson, R. D., and L. A. Ahlm. 1994. San Juan River tailwater trout fishery investigations, 1993 Annual Report. New Mexico Department of Game and Fish, Navajo Dam, New Mexico.
- Masslich, W., and P.B. Holden. 1996. Expanding distribution of Colorado squawfish in the San Juan River: a discussion paper. Report of Bio/West, Inc. for the San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.
- Miller, W. J. 2006a. Standardized monitoring program five-year data integration report. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.
- Miller, W. J., and J. Ptacek. 2000. Colorado Pikeminnow habitat use in the San Juan River, New Mexico and Utah. Miller Ecological Consultants, Inc., for San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Miller, W.J., and V.A. Lamarra. 2014. San Juan River population model documentation and report version 2. Draft report of Miller Ecological Consulting Inc. and Ecosystem Research Inc. for San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Miller, W.J., and K.M. Swaim. 2016. Retrospective analysis of water temperature data and larval and young of year fish collections in the San Juan River downstream from Navajo Dam to Lake Powell Utah. Draft report of Miller Ecological Consulting Inc. for San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Mueller, G.A. 2005. Predatory fish removal and native fish recovery in the Colorado River mainstem: what have we learned? *Fisheries* 30(9):10-19.

- Platania, S. P. 1990. Biological summary: San Juan River ichthyofaunal study, New Mexico-Utah, 1987 to 1989. Museum of Southwestern Biology, Department of Biology, University of New Mexico for U.S. Bureau of Reclamation, Salt Lake City, Utah.
- Platania, S.P., K.R. Bestgen, M.A. Moretti, D.L. Propst and J.E. Brooks. 1991. Status of Colorado Squawfish and Razorback Sucker in the San Juan River, Colorado, New Mexico, and Utah. *Southwestern Naturalist* 36 (1):147-150.
- Propst, D. L., A. Hobbes, and K. Lawrence. 1999. Chapter 4: physical and biological response to test flows, red shiner section. Pages 4-1 to 4-88 in P.B. Holden, editor. Flow recommendations for the San Juan River. San Juan River Basin Recovery Implementation Program, USFWS, Albuquerque, New Mexico.
- Propst, D. L., and A. L. Hobbes. 2000. Seasonal abundance, distribution, and population size-structure of fishes in San Juan River secondary channels 1991-1997. Conservation Services Division, New Mexico Department of Game and Fish, Santa Fe, New Mexico.
- Propst, D.L., S. P. Platania, D. W. Ryden, and R. L. Bliesner. 2000. San Juan River monitoring plan and protocols. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Propst, D.L., S. P. Platania, D. W. Ryden, and R. L. Bliesner. 2006. San Juan River monitoring plan and protocols. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Pucherelli, M. J., and R. C. Clark. 1990. San Juan River habitat mapping using remote sensing techniques. U.S. Bureau of Reclamation, AP-90-4-2, Denver, Colorado.
- Pucherelli, M. J., and W. P. Goettlicher. 1992. Mapping instream habitat on the San Juan River using airborne videography. U.S. Bureau of Reclamation Technical Report, R-92-16, Denver, Colorado.
- Renfro, L.E., S.P. Platania, and R.K. Dudley. 2006. An assessment of fish entrainment in the hogback diversion canal, San Juan River, New Mexico, 2004 and 2005. Report prepared for San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Ryden, D. W. 1997. Five-year augmentation plan for Razorback Sucker in the San Juan River. U.S. Fish and Wildlife Service, Grand Junction, CO.
- Ryden, D.W. 2000. Monitoring of experimentally stocked razorback sucker in the San Juan River: March 1994 through October 1997. Final Report, U.S. Fish and Wildlife Service, Grand Junction, CO.
- Ryden, D. W. 2003a. An augmentation plan for Colorado Pikeminnow in the San Juan River. U.S. Fish and Wildlife Service, Grand Junction, CO.
- Ryden, D. W. 2003b. An augmentation plan for Razorback Sucker in the San Juan River; an addendum to the five-year augmentation plan for Razorback Sucker in the San Juan River (Ryden 1997). U.S. Fish and Wildlife Service, Grand Junction, CO.
- Ryden, D.W. 2007. Long term monitoring of sub-adult and adult large-bodied fishes in the San Juan River 2006. U.S. Fish and Wildlife Service, Grand Junction, CO.
- Ryden, D.W. 2008. Long term monitoring of sub-adult and adult large-bodied fishes in the San Juan River 2007. U.S. Fish and Wildlife Service, Grand Junction, CO.

- San Juan River Basin Recovery Implementation Program (Program). 1995. I. Program Document, II. Cooperative Agreement, III. Long-Range Plans, IV. Rip Side By Side Analysis. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, N.M.
- San Juan River Basin Recovery Implementation Program (Program). 2012a. Final Program Document. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, N.M.
- San Juan River Basin Recovery Implementation Program (Program). 2012b. San Juan River Recovery Implementation Program Comprehensive Monitoring Plan. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Simpson, Z. R., and J. D. Lusk. 1999. Environmental contaminants in aquatic plants, invertebrates, and fishes of the San Juan River mainstem, 1990-1996. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Stamp, M., M. Golden, and R.C. Addley. 2005. Evaluation of the Need for Fish Passage at the Arizona Public Service and Fruitland Irrigation Diversion Structures. Report submitted to San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- SWCA Environmental Consultants (SWCA). 2012. Summary Report for the San Juan River Basin Recovery Implementation Program Habitat Monitoring Workshop, January 11–12, 2012. Report submitted to San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 28 pp.
- U.S. Bureau of Reclamation (Reclamation). 2006. Navajo Reservoir operations – Final Environmental Impact Statement. U.S. Department of Interior, Bureau of Reclamation.
- U.S. Bureau of Reclamation (Reclamation). 2014. PowerPoint Presentation on Navajo Navajo Unit Operations & Hydrology Overview. Program Annual Hydrology Meeting. June 23, 2014. Durango, Colorado.
- U.S. Fish and Wildlife Service (Service). 2002a. Colorado Pikeminnow (*Ptychocheilus lucius*) Recovery Goals: amendment and supplement to the Colorado Squawfish Recovery Plan. U.S. Fish and Wildlife Service, Mountain-Prairie Region (6), Denver, Colorado. Available in pdf format at <http://www/r6.fws.gov/crrip/rg.htm>.
- U.S. Fish and Wildlife Service (Service). 2002b. Razorback Sucker (*Xyrauchen texanus*) Recovery Goals: amendment and supplement to the Razorback Sucker Recovery Plan. U.S. Fish and Wildlife Service, Mountain-Prairie Region (6), Denver, Colorado. Available in pdf format at <http://www/r6.fws.gov/crrip/rg.htm>.
- U.S. Fish and Wildlife Service (Service). 2004. Razorback sucker (*Xyrauchen texanus*) genetics management and captive propagation plan. Dexter National Fish Hatchery and Technology Center, U.S. Fish and Wildlife Service, Dexter, New Mexico.
- U.S. Fish and Wildlife Service (Service). 2010. Review and Assessment of the San Juan River Basin Recovery Implementation Program. U.S. Fish and Wildlife Service, Southwest Region (2), Albuquerque, New Mexico.
- U.S. Fish and Wildlife Service (Service). 2012. Review and Assessment of the San Juan River Basin Recovery Implementation Program. U.S. Fish and Wildlife Service, Southwest Region (2), Albuquerque, New Mexico.

APPENDICES

APPENDIX A. Tasks, priorities, responsibilities, dates, and descriptions for elements of the Long-Range Plan

The following Recovery Element Tables 1-6 are included:

1. Management and Augmentation of Populations and Protection of Genetic Integrity
2. Protection, Management, and Augmentation of Habitat
3. Management of Nonnative Species
4. Monitoring and Evaluation of Fish and Habitat in Support of Recovery Actions
5. Program Coordination and Assessment of Progress toward Recovery
6. Information and Education

The following are criteria used as guidance for “Recovery Goals Priority” in the *P* column of the following tables:

Low (<i>L</i>)	The task is not linked to site-specific management actions of recovery goals and is not necessary for species recovery.
Medium (<i>M</i>)	The task is indirectly linked to site-specific management actions and may be supportive of species recovery.
High (<i>H</i>)	The task is linked or related to a site-specific management action cited in recovery goals and may be necessary to achieve species recovery goals.
Critical/Compliance (<i>C</i>)	The task reflects a site-specific management action cited in recovery goals or biological opinions as a compliance measure and is considered necessary to achieve species recovery (formerly Highest).

Status Categories: Ongoing, Annually, Pending, To Be Determined (TBD), As Needed, As Requested, On Hold, Completed

The following are abbreviations used in the following Tables:

ASIR	American Southwest Ichthyological Researchers
BC	Biology Committee
BIA	Bureau of Indian Affairs
BHS	Bluehead Sucker
BOR	Bureau of Reclamation
CC	Coordination Committee
CPM	Colorado Pikeminnow
ERI	Ecosystems Research Incorporated
FMS	Flannelmouth Sucker
FWS	U.S. Fish and Wildlife Service
GJFWCO	Grand Junction Fish and Wildlife Conservation Office
HCNFF	Horsethief Canyon Native Fish Facility
MEC	Miller Ecological Consultants
NFWF	National Fish and Wildlife Foundation
NMDGF	New Mexico Game and Fish Department
NMFWCO	New Mexico Conservation Fish and Wildlife Office

NMISC	New Mexico Interstate Stream Commission
NN	Navajo Nation
NNDFW	Navajo Nation Department of Fish and Wildlife
ONFH-GVU	Ouray National Fish Hatchery – Grand Valley Unit
PO	Program Office
P.I.	Principal Investigators
RBS	Razorback Sucker
RERI	New Mexico River Ecosystem Restoration Initiative
Program	San Juan River Basin Recovery Implementation Program
SOW	Scopes of Work
SNARRC	Southwestern Native Aquatic Resources & Recovery Center
TNC	The Nature Conservancy
UDWR	Utah Division of Wildlife Resources
UNFH	Uvalde National Fish Hatchery
USGS	United State Geological Survey

Table A1. Element 1 — Management and Augmentation of Populations of Colorado Pikeminnow (CPM) and Razorback Sucker (RBS).

Priority (P) is listed as low (L), medium (M), as high (H), and critical/compliance (C).

<i>P</i>	Tasks	Start Date	End Date	Who	Status	Status of Activity (focus on previous year – i.e., 2020)
Goal 1.1 — Establish Genetically and Demographically Viable, Self-Sustaining CPM and RBS Populations.						
Action 1.1.1 Develop plans for rearing and stocking CPM and RBS.						
<i>H</i>	Task 1.1.1.1 Review and update augmentation plan including stocking goals for CPM and RBS.	2010	2035	FWS, BC, PO, NMFWCO	Ongoing	The RBS augmentation plan was reviewed and updated in 2020 and alternative strategies for stocking CPM developed and reviewed
Action 1.1.2 Support facilities to produce, rear, and stock sufficient numbers of CPM and RBS to meet stocking goals of augmentation plan.						
<i>C</i>	Task 1.1.2.1 Per augmentation plans, annually stock CPM and RBS and opportunistically stock any excess fish.	2010	2035	NMFWCO, SNARRC, BC, PO, NN, GJFWCO, ONFH-GVU	Annually	In 2020, a total of 2,621 age-1 and 259,754 age-0 CPM were stocked and 12,221 RBS.
Goal 1.2 — Identify and Implement Strategies for Improving the CPM and RBS Augmentation Program and Genetic Integrity.						
Action 1.2.1 Implement methods to evaluate status and success of stocked CPM and RBS.						
<i>H</i>	Task 1.2.1.1 Maintain a standardized database for all stocked and captured CPM and RBS	2009	2035	PO	Annually	In 2020, all passive integrated transponder (PIT) tags that were implanted in stocked and captured fish and those that were recaptured (including detections at PIT antenna) were uploaded to the STReAMs database. Data for all other 2020 captures (non-tagged fish) were sent to the PO and retained in respective databases.
<i>H</i>	Task 1.2.1.2 Identify, describe, and implement strategies for improving survival, retention, and genetic diversity of stocked CPM and RBS, including acclimation prior to stocking, size of fish stocked, time and location of stocking, physiological conditioning, predator avoidance, and brood stock genetic augmentation.	2009	2035	FWS, NMFWCO	As needed	Implementation of a project to assess the effects of source and site stocking on RBS survival was completed in 2020 and demonstrated that fish from Grand Junction survived better than those from NAPI and fish stocked higher in the system did not survive as well. CPM (n=7,314), half which were prey trained and half which were not, were stocked to assess potential for this hatchery enrichment to increase survival. In addition, those CPM (n=7,314) were stocked into McElmo Creek because it has a PIT tag antenna at its confluence with the San Juan River. This allowed assessment of post-stocking retention. The effort resulted in little information potentially because temperature in the creek were extremely low and

						a large flow occurred just after stocking. Analysis was completed by the PO on the effects of flow conditioning RBS prior to stocking (Franssen et al. 2021). The effect was a doubling of RBS survival over the first winter.
Action 1.2.2 Implement a Passive Integrated Transponder (PIT) tag marking program to insure all stocked and/or encountered endangered fish are fitted with PIT tags to track individual CPM and RBS in support of evaluation and assessment activities.						
<i>H</i>	Task 1.2.2.1 Procure adequate numbers of PIT tags for marking endangered fish.	1998	2035	BOR	Annually	BOR procured tags (n=12,000) with a \$40,000 allocation from the program in 2020
<i>H</i>	Task 1.2.2.2 Install and maintain remote PIT tag detectors in the river to passively track fish presence/absence and movement.	2012	2035	BOR	Annually	BOR continued to maintain antennas at the Piute Farms waterfall, PNM, and Hogback in 2020.

Table A2. Element 2 — Protection, Management, and Augmentation of Habitat.

Priority (P) is listed as low (L), medium (M), as high (H), and critical/compliance (C).

<i>P</i>	Tasks	Start Date	End Date	Who	Status	Status of Activity (focus on previous year – i.e., 2020)
Goal 2.1 — Provide Suitable Habitat to Support Recovery of CPM and RBS Populations.						
Action 2.1.1 Implement habitat restoration strategies to augment habitat complexity and the function of river flow to create and maintain suitable habitat.						
<i>H</i>	Task 2.1.1.1 Develop and implement a plan for feasible habitat restoration strategies.	2011	2035	BOR, BC, FWS, NN, PO	As needed	In 2020, the BC finalized the summary from the 2019 Habitat Workshop , which included project rankings. The PO, BOR and NMISC began participation in the San Juan Watershed Plan being developed by the San Juan Watershed Group. That plan is expected to be completed in 2023 or 2024.
Action 2.1.2 Procure products, equipment, and materials in support of Goal 2.1 – 2.6						
<i>H</i>	Task 2.1.1.1 Support operation and maintenance of San Juan River stream gages to monitor flows in the river.	1999	2035	BOR, PO, NMISC	Annually	Funds were expended in 2020 to continue support of USGS stream gages.
Goal 2.2 — Provide Suitable Flows to Support Recovery of CPM and RBS Populations.						
Action 2.2.1 Develop flow regimes to provide adequate flow and function to maintain habitat for CPM and RBS.						
<i>C</i>	Task 2.2.1.1 Implement flow recommendations to provide suitable habitat for endangered and other native fishes.	1999	2035	BOR, FWS, BC	Ongoing	No recommended spring flow metric criteria were realized in 2020. The criteria to achieve 8,000 cfs for 10 days, is now six years overdue.
<i>H</i>	Task 2.2.1.2 Develop and implement a process for evaluating and revising flow recommendations.	2016	2035	BOR, FWS, BC	Ongoing	There is no activity to report on this task from 2020.
Action 2.2.2 Develop and maintain a hydrology model to evaluate flow recommendations in the context of water supply and demand in the Basin.						
<i>C</i>	Task 2.2.2.1 Develop, evaluate, and refine a San Juan Basin hydrology model and provide model analysis for the evaluation of flow recommendations.	1995	2035	BOR, FWS	Ongoing	In 2020, BOR reported on efforts to model the effects of maintenance releases on implementation of the flow recommendations. The modeling indicated maintenance releases would increase the likelihood of meeting flow recommendations. Fiscal year 2020 was also spent developing a modeling framework to assess impacts of climate change on the San Juan River Basin's hydrology.
Action 2.2.3 Coordinate with BOR on Navajo Dam operations.						
<i>C</i>	Task 2.2.3.1 Provide input and recommendations on annual dam operations.	2016	2035	BC, PO	Ongoing	The BC and PO coordinated with BOR on 2020 dam operations. The BC coordinated with BOR on a request from the City of Bloomfield for a release to support outdoor recreation.
Action 2.2.4 Provide and protect flows in the San Juan River consistent with flow recommendations.						
<i>C</i>	Task 2.2.4.1 Develop and implement mechanisms for protecting water required to meet flow recommendations.	1999	2035	BOR	Pending	There is no activity to report on this task from 2020.

M	Task 2.2.4.2 Collaborate with agricultural, municipal, and industrial water users to promote water use efficiency savings and water market transactions that support environmental flows.	2015	2035	FWS, BOR, BC, TNC	Pending	There is no activity to report on this task from 2020.
Goal 2.3 — Provide Increased Range to Support Recovery of CPM and RBS Populations.						
Action 2.3.1 Identify blockages to fish passage at diversion structures in the San Juan River and tributaries to provide and maintain fish passage where needed.						
C	Task 2.3.1.1 Investigate potential barriers in the mainstem San Juan River and provide and maintain fish passage when needed.	2016	2035	BOR, FWS	Ongoing	An assessment of facilitated fish passage at the Piute Farms waterfall and PNM was conducted in 2020 to identify the contribution passed fish made to the overall RBS population and thus, quantify need for fish passage at these locations. A small group of the BC and PO began development of a method to prioritize evaluation needs for fish passage in the mainstem San Juan and its tributaries. BOR completed a draft report and provided it the BC for two design options, each, for fish passage at the Arizona Public Service weir and the Piute Farms waterfall.
H	Task 2.3.1.2 Investigate potential barriers in San Juan River tributaries (Animas Pump Station #2, Farmer’s Ditch Diversion, Ranchman-Terrell’s ditch, etc.) and provide and maintain fish passage when needed.	2007	2035	BOR, FWS, BC	Ongoing	A small group of the BC and PO began development of a method to prioritize evaluation of the need for fish passage in the mainstem San Juan and its tributaries.
Action 2.3.2 Operate and maintain selective fish passages at diversion structures in the San Juan River.						
C	Task 2.3.2.1 Operate and maintain fish passage at the Public Service Company of New Mexico (PNM) Weir while evaluation and remediation of passage issues continue	2003	2035	FWS, NN	Ongoing	The fish passage was run as an open passage during the months of March through May in 2020. During active capture and passage operations (July through October) 282 endangered fishes were passed upstream. This was a reduction in fish passed as the total passed in 2019 was slightly greater than 600.
Goal 2.4 — Minimize fish entrainment at diversion structures in the San Juan Basin.						
Action 2.4.1 Identify diversions that could potentially entrain endangered fish in the San Juan River and tributaries and remediate where necessary.						
C	Task 2.4.1.1 Investigate the need for and construct fish screens or deflection weirs in the mainstem San Juan River, as appropriate.	2016	2035	BOR, BC, PO, FWS	Pending	A small group of the BC and PO began development of a method to prioritize evaluation of the need for fish entrainment reductions in the mainstem San Juan and its tributaries.
H	Task 2.4.1.2 Investigate the need for and construct fish screens or deflection weirs in San Juan River tributaries (Animas Pump Station #2, Farmer’s Ditch Diversions, etc.), as appropriate.	2015	2035	BOR, BC, PO, FWS	Pending	A small group of the BC and PO began development of a method to prioritize evaluation of the need for fish entrainment reductions in the mainstem San Juan and its tributaries.
Action 2.4.2 Operate and maintain fish entrainment prevention structures at diversions in the San Juan River.						
C	Task 2.4.2.1 Operate, maintain, and evaluate a fish deflection weir at the Hogback Diversion.	2013	2035	BOR, BC, PO, FWS, NN	Ongoing	Hogback diversion fish deflection weir was operated in 2020. Coordination with the Navajo Nation, BOR, and the PO occurred to attempt to remediate the interference of the irrigation canals pumps (VFDs) and PIT tag antenna detections.

Goal 2.5 — Provide Suitable Water Quality to Support Recovery of CPM and RBS Populations.						
Action 2.5.1 Describe water quality and identify potential problems to native and endangered fish.						
C	Task 2.5.1.1 Coordinate with other agencies to evaluate water quality in the San Juan River Basin and identify potential effects to endangered and native fishes.	1999	2035	FWS, BOR, BC	Pending	The Navajo Nation EPA began development of a water sampling plan in 2020 for implementation in 2021-2022. Program partners were invited to participate and provide fish tissue/specimens.
C	Task 2.5.1.2 Conduct an evaluation of water quality as potential limiting factors to recovery.	1994	2035	FWS	Pending	In 2020, the PO conducted an experiment with SNARRC through the Four Corners Biological Opinion to assess the effects of temperature on the development rate of larval RBS. This effort will culminate in a journal publication which is expected to be submitted in 2023
Action 2.5.2 Remediate Water Quality Problems.						
C	Task 2.5.2.1 Develop and implement a comprehensive contaminant monitoring plan to identify water quality threats to the endangered species.	2010	2035	FWS	Pending	BOR developed a report on potential thermal control methods (Reclamation Topic Specific Scouting: yet2 Water Temperature Control Devices – summary/pivot report June 18 th , 2020 – no author). This was a general report for BOR facilities but was reviewed and discussed by the BC in consideration of thermal depression caused by Navajo dam releases. These discussions did not result in any recommendations.
C	Task 2.5.2.2 Identify effects of contaminants on recovery of endangered fish.	2010	2035	FWS, BC	Pending	Experimentation on the effect of mercury on CPM reproductive output continued in 2020. Study results expected in 2024.
C	Task 2.5.2.3 Provide assistance in developing recommended water quality criteria for problematic contaminants for state and federal water quality regulatory agency consideration when those agencies adopt enforceable water quality standards.	2010	2035	FWS	Pending	There is no activity to report on this task from 2020.
Action 2.5.3 Minimize the risk of hazardous-materials spills in critical habitat.						
C	Task 2.5.3.1 Identify and remediate potential sources of hazardous materials in areas of designated critical habitat (e.g., petroleum-product pipelines within the 100-year floodplain, riverside retention ponds).	2012	2035	FWS, TNC	Pending	There is no activity to report on this task from 2020.
C	Task 2.5.3.2 Review and recommend modifications to state and federal hazardous-materials spills emergency-response plans to ensure adequate protection for CPM and RBS populations from hazardous-materials spills.	TBD	2035	FWS, PO	Pending	There is no activity to report on this task from 2020.
C	Task 2.5.3.3 Assess the need for and install emergency shut-off valves on problematic petroleum-product pipelines within the 100-year floodplain of critical habitat to minimize the potential of spills.	TBD	2035	FWS, PO	Pending	There is no activity to report on this task from 2020.
C	Task 2.5.3.4 Develop Best Management Practices for heavy equipment use within the 100-year floodplain.	TBD	2035	FWS, PO	Pending	There is no activity to report on this task from 2020.

Goal 2.6 — Manage the Native Fish Community to Assist in Recovery of the Endangered Species.						
Action 2.6.1. Develop, implement, and evaluate the most effective strategies for maintaining the native fish community upon which the endangered species depend.						
<i>H</i>	Task 2.6.1.1 Conduct annual review of native fish abundance and remediate potential effects on the recovery of the endangered fish.	1999	2035	P.I.'s	Annually	Annual assessment of prey abundance was conducted through small-bodied monitoring in 2020.

Table A3. Element 3 — Management of Nonnative Aquatic Species.

Priority (P) is listed as low (L), medium (M), as high (H), and critical/compliance (C).

<i>P</i>	Tasks	Start Date	End Date	Who	Status	Status of Activity (focus on previous year – i.e., 2020)
Goal 3.1 — Control Problematic Nonnative Fishes.						
Action 3.1.1 Develop, implement, and evaluate the most effective strategies for reducing problematic nonnative fish.						
<i>C</i>	Task 3.1.1.1 Develop and implement a nonnative fish adaptive management plan. Conduct an evaluation and assessment of nonnative fish activities and revise the plan.	2002	2035	NMFWCO , UDWR	Annually	Plans began to develop a nonnative fish management workshop for 2021. Additional analysis of the Channel Catfish diet study was completed and published (Hedden et al. 2020). A second-year effort to increase Channel Catfish removal efficiency (winter removal) was completed in 2020; report due in 2021.
Goal 3.2 — Prevent introduction and establishment of other nonnative invasive species.						
Action 3.2.2 Develop and implement policies and agreements among stakeholders on nonnative game fish management to prevent introduction of invasive species						
<i>C</i>	Task 3.2.2.1 Develop and execute agreements regarding a sport fish stocking policy among the states and tribes.	2009	2035	States, Tribes, PO, BC	Ongoing	The States continued to work with Program participants to finalize the agreement.
Action 3.2.3 Identify potential invasive nonnative species and control their introduction and escapement into the main river, floodplain, and tributaries.						
<i>C</i>	Task 3.2.3.1 Identify locations where escapement of nonnative fish from tributaries and off-channel features are occurring and implement remediation measures as needed.	2009	TBD	PO, BOR, FWS	As needed	There is no activity to report on this task from 2020.
<i>H</i>	Task 3.2.3.2 Coordinate with other programs, agencies, and activities to track occurrences of nonnative species. If a potential invasive species problem is identified, develop and implement preventive actions.	1999	2035	PO, BC, States	Ongoing	There is no activity to report on this task from 2020.

Table A4. Element 4 — Monitoring and Evaluation of Fish and Habitat in Support of Recovery Actions.

Priority (P) is listed as low (L), medium (M), as high (H), and critical/compliance (C).

<i>P</i>	Tasks	Start Date	End Date	Who	Status	Status of Activity (focus on previous year – i.e., 2020)
Goal 4.1 — Monitor Fish Populations of the San Juan River.						
Action 4.1.1 Develop and Implement Standardized Monitoring Plan for fish.						
<i>M</i>	Task 4.1.1.1 Develop, implement, and revise a Standardized Fish Monitoring Plan to assess the presence, status, and trends of CPM, RBS, and the entire fish community.	2000	2035	PO, BC, FWS, NMDGF, UDWR	As needed	There is no activity to report on this task from 2020.
<i>H</i>	Task 4.1.1.2 Conduct larval, juvenile, and adult fish sampling to determine if reproduction is occurring, locate spawning and nursery areas, gauge extent of annual reproduction, and identify distribution of fish.	1998	2035	P.Is	Annually	Reduced monitoring occurred due to the COVID pandemic in 2020 but limited spatial sampling occurred for the larval and juvenile fish communities. Typical Demographic Monitoring effort was shifted to assess density and distribution of young-of-year (age-0) wild-produced RBS.
<i>H</i>	Task 4.1.1.3 Deposit, process, and secure fish specimens, tissues, samples, field notes, and associated data at an organized permanent repository.	1987	2035	P.Is	Annually	All relevant tissues and specimens were deposited and accessioned to the Museum of Southwestern Biology Division of Fishes in 2020.
Action 4.1.2 Obtain demographic parameters to gauge recovery of CPM and RBS.						
<i>H</i>	Task 4.1.2.1 Use mark-recapture population estimators to provide abundance and survival estimates for stocked and wild adults and subadults.	1998	2035	FWS, BC, P.I.s	Ongoing	This effort was postponed due to the COVID pandemic in 2020.
Action 4.1.3 Evaluate the risk of hybridization among sucker species.						
<i>M</i>	Task 4.1.3.1 Quantify the extent of hybridization among native and nonnative suckers and implement necessary actions to minimize hybridization among fishes.	2002	2035	BC, P.Is	Ongoing	Morphologic (field observations) confirmed via genetic analyses revealed hybridization between RBS and Flannelmouth Sucker at the larval and age-0 life stages in 2020.
Action 4.1.4 Monitor health of fish in the San Juan River to ensure adequate protection from diseases and parasites.						
<i>C</i>	Task 4.1.4.1 Evaluate health of fish and identify causes and recommend corrective actions to ensure adequate protection from diseases and parasites.	1998	2035	PO, P.Is	As needed	There is no activity to report on this task from 2020.
Goal 4.2 — Monitor Habitat Availability and Use.						
Action 4.2.1 Develop and Implement standardized monitoring program for habitat.						
<i>M</i>	Task 4.2.1.1 Develop, implement, and revise Standardized Habitat Monitoring Plan.	1999	2035	BC	As needed	There is no activity to report on this task from 2020.

C	Task 4.2.1.2 Monitor water quality, stream flow, habitat, and temperature in the San Juan River.	1999	2035	FWS, BIA, BOR, USGS	Ongoing	An effort to assess the effects of temperature on development and growth rates of larval Razorback Sucker began in 2020; report due in 2021 USGS stream flow and temperature data is available through gage websites.
Action 4.2.2 Identify and refine habitat/fish relationships.						
H	Task 4.2.2.1 Identify and quantify principal river reaches and attributes of habitats important to each life-stage of endangered fish.	2010	2035	FWS, BC	Pending	River-wide habitat mapping was conducted and mesohabitat amounts summarized in 2020. Mapping efforts began in 1993
Goal 4.3 — Monitor and Evaluate Habitat Restoration Strategies and Projects						
Action 4.3.1 Evaluate habitat restoration to augment the function of river flow to create and maintain suitable habitat.						
C	Task 4.3.1.1 Use an evaluation of habitat restoration to determine success of restoration and quantify the need for further restoration efforts.	1999	20203 523	FWS, BC	Ongoing	There is no activity to report on this task from 2020.
Goal 4.4 — Integrate and Synthesize Monitoring Data and Information to Evaluate Fish Community and Ecosystem Responses to Recovery Actions.						
Action 4.4.1 Assess life and natural history parameters of wild CPM and RBS.						
C	Task 4.4.1.1 Identify and alleviate impediments to specific life and natural-history processes necessary for recovery.	1992	2035	FWS, BC	Annually	In 2020, the PO conducted an experiment with SNARRC, funded through the Four Corners Biological Opinion, to assess the effects of temperature on the development rate of larval RBS. This will culminate in a journal article which will likely be submitted in 2023.
Action 4.4.2 Develop fish community and ecosystem response strategies and implement appropriate monitoring and research to evaluate ecosystem response.						
H	Task 4.4.2.1 Develop a centralized database that incorporates all data from standardized monitoring and integrate into the Program database.	2007	2035	PO, BC	Ongoing	All 2020 data for stocked and captured fish with passive integrated transponder tags was sent to the PO and uploaded to the STReaMs database. Data for all other 2020 captures were sent to the PO and retained in their respective databases.
H	Task 4.4.2.2 Use data collected during investigations to characterize dynamics of native fishes and their response to management activities intended to improve the status of listed species.	1992	2035	PO, P.I.s, BC	Ongoing	Agreement was reached in 2020 to change CPM stocking to PIT-tagged age-1 fish from age-0 fish to reduce the likelihood of Channel Catfish consumption, provide for identification of wild produced fish, improve estimates of survival and retention, and provide for assessment of any future hatchery enrichment.
Action 4.4.3 Evaluate and modify recovery activities, as necessary, to ensure progress toward recovery.						
C	Task 4.4.3.1 Implement strategies for improving long-term survival and recruitment of CPM and RBS.	1999	2035	PO, BC	Ongoing	Efforts to identify more efficient methods to trap and transport RBS upstream of the Piute Farms waterfall were investigated in 2020 (of an 800 estimated at the waterfall, 200 were transported upstream) and a scope of work was developed to further optimize trap and transport methodologies.
H	Task 4.4.3.2 Evaluate effects of management actions (e.g., nonnative fish control) on the distribution, abundance, and demographics (e.g., fish size, age, sexual maturity) of the endangered, native, and nonnative fish populations.	2008	2035	FWS, BC	Ongoing	For both species, the effective number of breeders was estimated Nb and compared to census size. This resulted in an estimate of 20.5% (range 3-40) of adult CPM contributing to breeding and 3.8% (range 2.2-7.6) of adult RBS contributing to breeding in 2020.

Goal 4.5 — Identify and Conduct Research and Monitoring in Support of Recovery Actions						
Action 4.5.1 Annually identify potential project/activities/questions/information needs (ongoing list).						
<i>H</i>	Task 4.5.1.1 Annually, following review of the previous year’s findings and data integration, identify and prioritize new projects, activities, questions, and information needs to be addressed in future work plans.	2000	2035	BC, FWS, CC, PO	Ongoing	The BC, PO, and CC developed an annual work plan in 2020 to implement in 2021 based on identified priorities.

Table A5. Element 5 — Program Coordination and Assessment of Progress toward Recovery.

Priority (P) is listed as low (L), medium (M), as high (H), and critical/compliance (C).

<i>P</i>	Tasks	Start Date	End Date	Who	Status	Status of Activity (focus on previous year – i.e., 2020)
Goal 5.1 — Facilitate Program Planning, Management, and Evaluate Progress Towards Recovery.						
Action 5.1.1 Provide Ongoing Program Management.						
<i>H</i>	Task 5.1.1.1 Coordinate and schedule CC, technical, and annual meetings.	1992	2035	PO	As Needed	A total of six BC, three CC, a hydrology, and an annual meeting were held in 2020.
<i>M</i>	Task 5.1.1.2 Maintain a standardized process for peer review by qualified specialists in appropriate technical disciplines for significant Program science projects and reports.	1992	2035	PO, BOR, BC	Annually	The process for peer review continued to be standardized and implemented in 2020.
<i>M</i>	Task 5.1.1.3 Coordinate with Upper Colorado River Endangered Fish Recovery Program and other related programs and promote participation by Program partners.	2019	2035	PO, BOR	Annually	Meetings to develop a post-2023 funding and implementation strategy for both programs occurred throughout 2020.
<i>H</i>	Task 5.1.1.4 Identify prioritized projects to implement recovery and summarize accomplishment/deficiency in completed work.	1995	2035	BC, PO	Annually	The BC, PO, and CC developed an annual work plan in 2020 to implement in 2021 based on identified priorities and a sufficient progress report on the program was completed that identified accomplishments and deficiencies.
<i>M</i>	Task 5.1.1.5 Maintain a Recovery Program website.	1992	2035	PO	Annually	The Program website was updated with meeting summaries, annual reports, and relevant documents in 2020.
Action 5.1.2 Oversee and Conduct Endangered Species Act Compliance.						
<i>H</i>	Task 5.1.2.1 Complete Biological Opinions (BOs) related to water development according to the Program’s Section 7 Principles and ensure BOs are in compliance (take, Reasonable Prudent Measures [RMS], Reasonable Prudent Alternatives [RPA], conservation measures, reinitiation triggers).	1995	2035	PO	Ongoing	No BOs were required in 2020 and four informal consultations were completed for projects related to the two endangered species.
<i>C</i>	Task 5.1.2.2 Conduct a biennial comprehensive review and assessment of Program progress towards recovery (i.e., Sufficient Progress Report).		2035			A sufficient progress analysis and a report was finalized by the USFWS in 2020.
Goal 5.2 — Facilitate Contract and Funding Management.						
Action 5.2.1 Ensure appropriate and legal contract and funding practices.						
<i>C</i>	Task 5.3.1.1 Administer annual base and capital funds in accordance with the annual work plan and provide accounting of annual and capital funds.	1992	2035	BOR, PO	Annually	Annual funds were administered to support efforts to increase trap and transport efficiency at the Piute Farms waterfall, develop designs for fish passage at the waterfall and the Arizona Public Service weir, and for construction of the Phase III habitat project.

Table A6. Element 6 — Information and Education.

Priority (P) is listed as low (L), medium (M), as high (H), and critical/compliance (C).

<i>P</i>	Tasks	Start Date	End Date	Who	Status	Status of Activity (focus on previous year – i.e., 2020)
Goal 6.1 — Increase Public Awareness and Support for the Endangered Fishes and the Recovery Program.						
Action 6.1.1 Provide information to the public on the Recovery Program.						
<i>H</i>	Task 6.1.1.1 Provide information to the public on the Program	1992	2035	PO	Ongoing	Non-federal program partners visited (virtually) with US Congressional representatives to reiterate the importance of the Upper Colorado River Programs and support continued funding.
<i>H</i>	Task 6.1.1.2 Develop Program brochure, exchange information and materials to incorporate into PowerPoint presentations, newsletters, Program highlights, and Program displays.	2012	2035	PO	Annually	A congressional briefing booklet was developed and electronically printed in 2020 that include Program related information. Two San Juan River stories were incorporated into the “swimming upstream” field report in 2020.