



Southwest Rivers Business Plan

National Fish and Wildlife Foundation

October 2018 (Updated 2023) – October 2028

Purpose of a Business Plan

The purpose of a NFWF business plan is to provide a concise multi-year blueprint of the strategies and resources required to achieve the desired conservation outcomes by the end of the plan. This plan incorporates the views of federal, state, academic, and organizational experts consulted during its development and is intended to complement existing efforts in the larger conservation community.

NFWF implements these strategies to generate a measurable conservation impact in a landscape, and NFWF uses progress towards species goals as a measure that healthy, functioning habitat has been restored and that threats can be managed. Although the landscape-scale conservation need is typically greater than the investment from a single business plan, NFWF monitors species response to interventions within the business plan's focal areas to demonstrate that the conservation strategies *can* move the needle on its goals, thus building the case for larger investments in the strategies.

Acknowledgements

NFWF gratefully acknowledges the time and content expertise provided by individuals and organizations who contributed to NFWF's thinking on this business plan, although the plan does not necessarily represent each of their specific views. In particular, thanks go to:

Jennifer Bachus, Bureau of Reclamation (USBR); Megan Bean, Texas Parks & Wildlife Department (TPWD); Timothy Birdsong, TPWD; Nick Forman, NMDGF; Whitney Gann, TPWD; Gary Garrett, University of Texas at Austin; T. Luke George, Bird Conservancy of the Rockies (BCR); Shawn Gray, TPWD; Louis Harveson, Borderlands Research Institute (BRI); Joanna Hatt, NMDGF; Mike Janis, TPWD; Stewart Liley, NMDGF; Ivana Mali, Eastern New Mexico University; Russell Martin, TPWD; Ross Melinchuk, TPWD; Toner Mitchell, Trout Unlimited; Arvind Panjabi, BCR; Kirk Patten, NMDGF; Leland Pierce, NMDGF; Amy Roberson, Rio Grande Joint Venture; Alexa Sandoval, NMDGF; Michael Sloane, NMDGF; Scott Somershoe, U.S. Fish & Wildlife Service (USFWS); Nicole Tatman, NMDGF; Anthony Opatz, NMDGF; Mieke Titulaer, BRI; Justin French, BRI; Daniel Trujillo, NMDGF; Sharon Wirth, USBR; Vance Wolf, USFWS; Daniel Boyes, Rio Grande Headwaters Restoration Project (RGHRP); Connor Born, RGHRP; William Macfarland, Utah State University.

About NFWF

Chartered by Congress in 1984, the National Fish and Wildlife Foundation (NFWF) protects and restores the nation's fish, wildlife, plants and habitats. Working with federal, corporate, foundation and individual partners, NFWF has funded more than 6,000 organizations and generated a total conservation impact of \$7.4 billion. Learn more at www.nfwf.org.

Cover photo credits: *The Rio Grande River near south Belen, NM* (Quantina Martine, National Audubon Society); *Sprague's pipit* (Glenn Bartley, National Audubon Society); and *Rio Grande cutthroat trout* (Kevin Terry, Trout Unlimited).

Conservation Need

In the southwestern United States, iconic desert rivers begin their journey on high mountain peaks and wind their way through a stark and arid landscape. These rivers are the lifeblood of the region, providing critical resources for local communities and wildlife.

Streams and their associated riparian habitats in the desert southwest have a disproportionate impact on wildlife, with 70 percent of threatened and endangered vertebrate species dependent upon riparian zones for at least a part of their life cycle (Johnson 1989). These river corridors are crucial for biodiversity, as wildlife and aquatic species in the desert southwest are uniquely adapted to this harsh but beautiful landscape, and many are endemic to the region. A number of native species are now found only in small portions of their historic ranges.

Species such as Rio Grande silvery minnow, southwestern willow flycatcher, and most recently Texas hornshell, have been listed as federally endangered species, while others are state-listed as endangered, like Pecos pupfish. The life cycles of these native species are intimately tied to the flood-dominated hydrology characteristics of rivers in the desert southwest, which have been altered by human development, particularly dam building (Dearen 2016). Rivers that once spread wide across floodplains during flood events, supporting dynamic side channels and shallow rearing habitat for fish and nourishing native riparian vegetation, are now limited by dam releases and water diversions, and have become narrow channels disconnected from their historic floodplain.

Upstream, the headwaters of many of the southwest's desert rivers occur in high elevation environments, where conifer forests surround cold-water streams fed by snowmelt. Headwaters streams that used to support broad wetlands have incised and become intermittent as beaver were removed from the landscape and the water table has dropped. The headwaters regions of desert rivers contribute significantly to the landscape's biodiversity, including a variety of native trout species. As temperatures increase across the region and more precipitation occurs as rain rather than snow, these headwaters species are at greater risk.

The rivers of the desert southwest are intertwined with the working human landscapes that have grown up around them. Ranching and farming, energy development and mining all play major economic roles in the region and utilize large areas of land and much of the available water in these systems. As development increases, the demands on these watersheds also increase, altering habitats and resources for wildlife.

This Business Plan is focused on three focal areas that together support the health of southwestern ecosystems: 1) the Trans-Pecos, 2) the Rio Grande Basin, and 3) the Colorado River Basin, including the headwater streams of the Lower Basin as well as the Escalante and San Juan River watersheds (Figure 1).

Trans-Pecos

The Pecos River winds more than 900 miles from its headwaters in the ponderosa pine forests of northern New Mexico through the Chihuahuan Desert grasslands of southeastern New Mexico and West Texas, meeting the Rio Grande on the Mexican border. Historic agricultural use and grazing practices have increased sediment transport into river channels, reducing water quality and paving the way for

woody brush encroachment and grassland habitat loss (Dearen 2016). In its lower elevations, the Pecos River travels through the Permian Basin, one of the worlds' largest production areas for oil and natural gas. Although fossil fuel extraction began in the Permian Basin in the 1920s, it is expected to comprise a major component of U.S. oil and gas production for the next 20 to 30 years due to recent technological advances. As the extent and intensity of the energy sector increases in the region, so do the potential impacts to fish and wildlife.

Riparian Habitat

The Pecos River and its tributaries support one of the most biodiverse semiarid ecosystems in the world, playing host to fish and other aquatic species found nowhere else in the world such as the Pecos pupfish and Pecos gambusia.

In New Mexico and across the border in Texas, there are several mainstem impoundments which serve to provide both irrigation and flood control, but which have altered the natural hydrologic flow regime. The river and some of its major tributaries also support significant agricultural irrigation demands that stress water resources on the river. In many areas, the riparian habitat and the stream or tributary itself are just a few feet across, and even the main river channel can run dry. There are also significant impairments from invasive species such as tamarisk that threaten conservation outcomes if not addressed (Gregory *et al.* 2013).

Grassland Habitat

Just as the floodplain has been altered by human activity, so have the formerly vast Chihuahuan grasslands once found throughout the Pecos watershed. Migratory grassland birds like the chestnut-collared longspur fly up to 1,500 miles from their summer range on the Northern Great Plains to restricted wintering grounds in the southwestern U.S. and northern Mexico, while the iconic pronghorn are year-round residents (Commission for Environmental Cooperation 2013 and Ellison *et al.* 2017). These native grasslands have dwindled to just a fraction of their former extent and productivity. This puts pressure not only on the wildlife that inhabit these areas, but also on working ranches that need high-quality forage for livestock production. During a pronounced drought in 2012, the Trans-Pecos pronghorn population decreased to less than 2,700 individuals, an 80-year low (Gann *et al.* 2017).

Rio Grande Basin

The Rio Grande is one of the iconic rivers of the American Southwest, flowing from high peaks in the Colorado Rockies through a rift valley. Today, the Rio Grande supports agriculture, industry, the cities of Albuquerque and El Paso, and many unique species. In the Middle and Lower Rio Grande Valleys of New Mexico, agricultural communities have relied on the river and its aquifer for irrigation for centuries, but increased demand and more frequent drought have caused stretches of the river to regularly run dry in recent decades. This poses a threat to species such as the silvery minnow, which depends on side channels and overbanking flows during flooding, and southwestern willow flycatchers, which inhabit the cottonwood-willow forest canopy supported by the river and shallow groundwater.

Upstream in the headwaters Rio Grande cutthroat trout require clear, cold water and intact stream corridors to thrive. Efforts to improve and maintain riparian zones in headwater streams can support native aquatic species. This habitat benefits from the dam-building efforts of North American beaver, whose numbers were dramatically reduced due to trapping, but which are now reentering parts of their

former range. Maintaining healthy headwater streams can help store water upstream and provide security for water users, fish, and wildlife downstream.

Colorado River Basin

Headwaters tributaries of the Colorado River Basin face similar challenges to the Rio Grande Headwaters region. Species such as Chiricahua leopard frog require consistent surface water in wet meadows and small streams, many of which have dried up due to the historical removal of beaver and the associated drop in the water table, and remaining headwaters streams have become increasingly intermittent, subject to higher temperatures and prolonged drought, due to climate change. Through past investments in habitat quality and protection from non-native invasion, NFWF and others have succeeded in bringing the iconic Apache trout to the point of proposed delisting; however, these climate change impacts to water availability and thus aquatic habitat pose a growing threat to such native fishes.

Background

The Southwest Rivers Program was formed through partnerships by the National Fish and Wildlife Foundation (NFWF), public agencies, and corporations to develop new strategies and provide additional resources to address the pressing conservation needs of the region.

In the Pecos watershed several energy companies have partnered with NFWF, the U.S. Bureau of Land Management and the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) to form the Pecos Watershed Conservation Initiative which addresses wildlife and habitat conservation issues. In the Rio Grande Basin, NFWF and the Bureau of Reclamation (USBR) are partnering to implement innovative water leasing strategies to support endangered species and historical agricultural uses. Higher in this Basin, State and non-profit partners are collaborating to address water and habitat issues around headwater streams in northern New Mexico and southern Colorado. In the Colorado River Basin, NFWF, the U.S. Forest Service (USFS) and private philanthropy have a growing interest in restoring headwater wetland and stream habitats across the Lower Basin and Four Corners region.

The Southwest Rivers Program was approved by the NFWF Board of Directors in August 2017. An initial slate of grants for the Pecos Watershed Conservation Initiative was made in March 2018 and have proceeded annually. In 2019, the Rio Grande Headwaters RFP debuted and later transformed into the Southwest Rivers Headwaters Fund in 2022, with a total of four grant slates to date. The Middle Rio Grande Native Water Leasing Pilot Program has offered funding rounds as needed and has achieved four years of voluntary water leasing to benefit Rio Grande silvery minnow. This updated Business Plan will guide future investments to achieve targeted conservation goals.

Current Conservation Context

A number of viable public and non-profit conservation entities are committed to working in this landscape. In many cases, significant planning has occurred, and local entities are seeking funds to implement their vision. For example, conservation priority documents have been produced for Chihuahuan Desert fishes (Desert Fish Habitat Partnership Workgroup 2015), pronghorn in Texas (Gray 2017), Texas hornshell in New Mexico (Carman 2007), silvery minnow (USFWS 2016), southwestern willow flycatcher (USFWS 2002), and Rio Grande cutthroat trout (Rio Grande Cutthroat Trout

Conservation Team 2017). Conservation priority documents for still more focal species are in development (e.g., migratory grassland birds).

Trans-Pecos

State wildlife agencies in New Mexico and Texas are interested in pursuing conservation efforts in the Pecos watershed but have had limited resources to implement conservation measures there. The region has been sparsely studied and, outside of a few species, much is yet to be learned about the region's fish and wildlife.

The U.S. Fish and Wildlife Service (USFWS) is active in the region, but like the state agencies, have not spent as much time and resources relative to other parts of New Mexico and Texas. Farm Bill programs administered through NRCS have supported extensive collaborations with private landowners, but do not always have a wildlife focus. These conservation programs, such as the Environmental Quality Incentives Program (EQIP), have been used to protect perennial grass cover and incentivize better management. NRCS programs have also addressed water efficiency on agricultural lands. The Bureau of Land Management (BLM) has a significant presence in New Mexico, but less so in Texas, where there is relatively more private land. Since 2005, BLM has partnered with NRCS, conservation districts, local land managers, non-profits and the State of New Mexico to restore grasslands in southeast New Mexico.

Several non-profit conservation organizations are also engaged in the region, including Rio Grande Joint Venture, Borderlands Research Institute at Sul Ross State University, Bird Conservancy of the Rockies, and The Nature Conservancy.

Rio Grande Basin

Substantial conservation investments, along with species research, have been made in the Rio Grande Basin in Colorado and New Mexico, where outdoor recreation, hunting and angling contribute significantly to local economies. Species like the Rio Grande cutthroat trout are a centerpiece of the region's fly-fishing industry, while the riparian bosque in the Middle Rio Grande Valley is a highlight of local recreation.

In the Middle Rio Grande Valley, species impacts due to water management actions are governed by the 2016 Biological Opinion on the silvery minnow, southwestern willow flycatcher and yellow-billed cuckoo (USFWS 2016). The need for adequate spawning habitat for silvery minnow, and to keep critical reaches of the Rio Grande wetted through the Valley, have led to extensive collaboration between the Middle Rio Grande Conservancy District (MRGCD) and federal, state, municipal, and non-profit partners, both in managing water resources and in planning for conservation measures. In a proactive attempt to understand how Middle Rio Grande flows are impacted by the Upper Rio Grande Basin, USBR, MRGCD, and U.S. Geological Survey are also partnering to produce the Upper Rio Grande Basin Study.

In the Lower Rio Grande Valley in New Mexico, southwestern willow flycatcher conservation activities relating to water management actions are guided in upstream reaches by USBR's flycatcher management plan for the Rio Grande Project (USBR 2012) and in downstream reaches by the *Final Biological Opinion for U.S. International Boundary and Water Commission Long-Term River Management of the Rio Grande Canalization Project, NM* (USFWS 2017). In recent decades, non-profit partners including National Audubon Society and World Wildlife Fund have executed projects to benefit flycatcher habitat in this part of the basin through habitat creation and water leasing, however both of those programs have sunsetted. NFWF previously partnered with the U.S. International Boundary and

Water Commission (USIBWC) on an environmental water transactions program from 2012-2015 in partnership with Audubon and the Elephant Butte Irrigation District (EBID), which manages irrigation from Elephant Butte Dam to the Texas state line. EBID and the State of New Mexico's Interstate Stream Commission will be key local and state partners in any future flycatcher habitat and water conservation activities.

Partnerships like The Nature Conservancy's Rio Grande Water Fund and USFS partnerships with the private sector and non-profits have demonstrated promising new approaches that fund water quantity and quality investments in the headwaters region by proactively managing upland forests for water runoff and fire protection. The Rio Grande Water Fund has focused less on riparian habitat areas, but there are planning processes in place in both northern New Mexico and Colorado's San Luis Valley that prioritize aquatic and riparian conservation needs. Plans have been developed by a suite of partners including federal agencies (USFS, BLM, USFWS, USBR), state agencies (Colorado Parks and Wildlife, New Mexico Department of Game and Fish), and non-profit organizations (Trout Unlimited, The Nature Conservancy) (e.g., Bird *et al.* 2013 and Rio Grande Cutthroat Trout Conservation Team. 2013). The planning efforts of these partners have made the region ripe for investment in conservation projects on-the-ground.

In summary, significant planning on an individual species basis has already taken place in this landscape and many of the strategies for successful conservation activities are well known and tested. However, they generally lack the funding and conservation capacity to be implemented. With strategic funding focused on achieving measurable conservation outcomes, the Southwest Rivers Business Plan will fund conservation projects that reinvigorate degraded habitats and benefit wildlife.

Colorado River Basin

As the source of freshwater for a population of over 40 million people in the southwest, the Colorado River Basin has been the subject of much negotiation over water use and concern over the impacts of climate change and long-term drought to the people, fish, and wildlife of the region. Private funders with a particular interest in the region, such as the Walton Family Foundation, have invested significant resources in developing capacity for improved water management for humans and nature in the region. Many of the large, national non-profit conservation organizations host entire programs devoted to conservation of the Colorado River including American Rivers, National Audubon Society, and The Nature Conservancy. Together with several others, this group of non-profits commissioned the report *Ten Strategies for Climate Resilience in the Colorado River Basin* (Martin & McCoy and Culp & Kelly LLP, 2021). This report identified restoration of natural wetlands and streams in headwater regions, termed "natural distributed storage," as a key strategy for achieving not only water supply resilience in the Colorado River Basin, but also increasing stream and wetland habitat for native species. Critically, this effort includes expanding the population of North American beaver throughout the region, a strategy this Program has already deployed in the Rio Grande headwaters region.

Conservation Outcomes

The overarching vision of the Southwest Rivers Business Plan is to **benefit the focal species and overall ecosystem health of riparian and wetland habitat in the Rio Grande Basin and Colorado River Basin, as well as the riparian habitat of the Pecos watershed and upland Chihuahuan grasslands habitats of the Trans-Pecos region.** The focal species identified in this business plan were chosen in part to represent a number of important habitat types within the landscape (Table 1, Figure 1), including:

- a) headwaters (in the Rio Grande with North American beaver and Rio Grande cutthroat trout);
- b) tributaries, wetlands and associated sinkholes (Pecos watershed with Pecos gambusia, Pecos pupfish, and Texas hornshell);
- c) mainstem river (Rio Grande with silvery minnow and Pecos watershed with Texas hornshell);
- d) riparian vegetation (Rio Grande with southwestern willow flycatcher); and
- e) Chihuahuan grasslands (Trans-Pecos with chestnut-collared longspur, Sprague’s pipit, and pronghorn).

Table 1. Business plan species conservation goals by focal area.

Trans-Pecos	
<i>Pecos gambusia</i>	Secure at least 2 populations of Pecos gambusia.
<i>Pecos pupfish</i>	Establish 2 and secure at least 4 populations of Pecos pupfish.
<i>Texas hornshell</i>	Maintain 1 population and establish a new population to at least 1 site.
<i>Chestnut-collared longspur</i>	Increase the mean bird density of chestnut-collared longspur at NFWF-funded project sites to greater than the baseline of 32.5 birds/km ² .
<i>Sprague’s pipit</i>	Increase the mean bird density of Sprague’s pipit at NFWF-funded project sites to greater than the baseline of 1.0 birds/km ² .
<i>Pronghorn</i>	Support the development of an assessment tool to quantify improvements in pronghorn habitat condition and connectivity in the Trans-Pecos grasslands. Remove or modify 900 miles of fencing.
Rio Grande Basin	
<i>Rio Grande cutthroat trout</i>	Within Rio Grande headwaters, secure 10 populations of RGCT in priority stream reaches and establish 5 populations in secured streams.
<i>North American beaver</i>	Establish beaver occupancy in 30 new stream miles through habitat improvement and translocations.
	Restore stream and riparian habitat at 10 Rio Grande headwaters sites to support natural expansion of beaver populations into at least 2 sites.
<i>Silvery minnow</i>	Avoid population extirpation of Rio Grande silvery minnow in at least 6 outfalls/refugia within the Middle Rio Grande River by maintaining water flow.

<i>Southwestern willow flycatcher</i>	At restored Middle Rio Grande riparian sites, achieve a 3-year moving average nest success rate for southwestern willow flycatcher of 30% or more, and Maintain or increase the number of pairs above the baseline of 75.
Colorado River Basin	
<i>North American beaver</i>	Restore stream and riparian habitat at 5 Colorado River Basin sites to support natural expansion of beaver populations into at least one site.

Focal Areas

These species goals are embedded within three focal areas within the Southwest Rivers Business Plan (Figure 1): the Trans-Pecos region in southeast New Mexico and West Texas, including the Chihuahuan Desert grasslands for terrestrial species and the Pecos watershed for aquatic species; the Rio Grande Watershed, including the watersheds of the upper Rio Grande Basin in southern Colorado and northern New Mexico, and the Middle and Lower Rio Grande Valleys in New Mexico; and the Colorado River Basin, which includes headwaters streams of the Colorado River in the Lower Basin and in the Escalante and San Juan River watersheds. Business plan focal areas can also be found in this [interactive map](#).

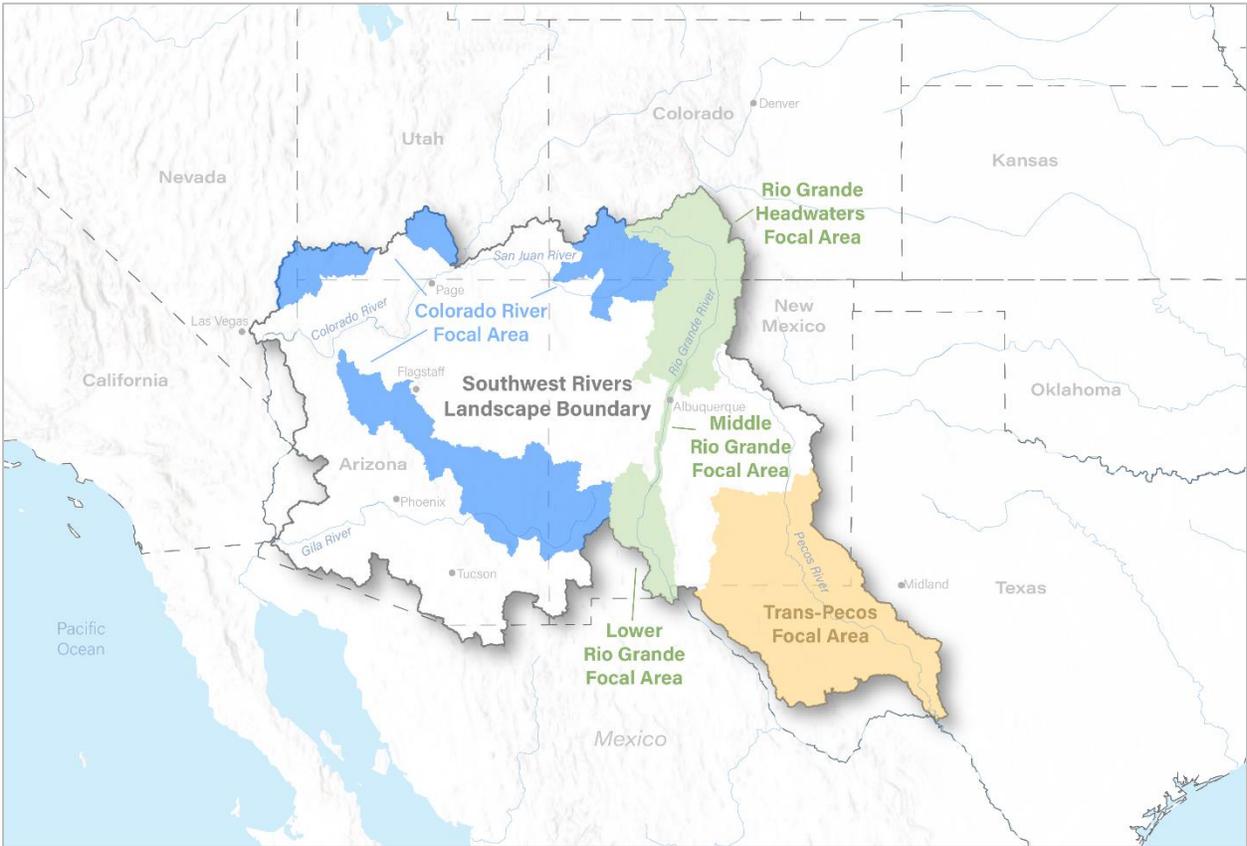


Figure 1. Southwest Rivers Business Plan focal areas.

Prospective Species

The following prospective focal species requires additional information and/or investment before NFWF can include it as a species with measurable conservation goals in a future Southwest Rivers business plan (Table 2).

Table 2. Planned Actions for Prospective Species

Prospective Species	Planned Actions
Rio Grande cooter	In order to prioritize conservation efforts, surveys to determine the distribution of Rio Grande cooter within the Pecos watershed are needed. Understanding the current population status is also warranted, including any habitat improvement needs, as well as the establishment of a monitoring program to assess population health over time.

In 2018 NFWF considered desert massasauga as a business plan species, but one whose taxonomic validity first needed to be confirmed before goals could be set for it. To answer the taxonomic question, NFWF funded research on the snake’s genomic and morphological characteristics in relation to prairie massasauga. This research confirmed that the two purported species are in fact the same (Bylsma *et al.* 2022) — thus lowering the conservation need of the now wide-ranging species, which is collectively referred to as western massasauga. As a result, NFWF has chosen to prioritize other species for funding, and so has removed desert massasauga as a species for investment within this business plan.

Implementation Plan

NFWF will fund the following implementation strategies to support the southwest's terrestrial and freshwater species described in this business plan. The results chain in Figure 2 provides a model for how the collective strategies are anticipated to contribute to the identified conservation outcomes.

Strategy 1. Pecos Watershed Riparian and Trans-Pecos Grasslands Restoration and Enhancement

1.1 Riparian habitat restoration and enhancement – Restoring stream banks to increase floodplain connectivity and recruitment of native riparian vegetation.

Floodplain reconnection – Remove or improve infrastructure at road crossings, culverts and check dams that act as barriers to the movement of aquatic species to ensure habitat connectivity.

Instream restoration – Improve instream habitat and channel structure to benefit target aquatic species throughout their life cycle.

Support engineering design and analysis for riparian restoration projects – Make possible the necessary planning to implement riparian habitat restoration and enhancement projects.

1.2 Improve infrastructure – Road crossings, culverts and dams are often problematic for aquatic species. They can block organism passage, radically alter the hydrology and habitat, and be sources of unwanted siltation and contaminants.

Increase habitat connectivity – Removal or improvement to infrastructure at road crossings, culverts and dams that act as barriers to the movement of aquatic species.

Secure infrastructure to reduce unwanted inputs – Secure road crossings through sensitive aquatic habitat to prevent unwanted contaminant spills. Rework culverts and other road crossings when they cause undue siltation. Address persistent point source contaminant inputs from infrastructure.

Support engineering design and analysis for infrastructure improvement projects – Make possible the necessary engineering design and analysis to implement infrastructure improvement projects.

1.3 Increase water quantity and quality for species and their habitats – Make available more water for environmental flows that are necessary to sustain species and their habitats and improve the quality of that water where it will benefit focal species.

Implement infrastructure projects and improve management practices to limit salinity – Strategies may be employed that reduce salinity in the Pecos watershed to benefit Texas hornshell and other aquatic species.

Support the voluntary leasing or acquisition of water rights – Fund the leasing or acquisition of water rights to increase water availability to riparian species and habitat.

Adopt water efficiency techniques and BMPs on agricultural lands – Support the voluntary shifting of agricultural practices and/or adoption of techniques to reduce water demand in agriculture, making more water available for riparian species and habitat.

Support source switch water use, whereby alternative sources of water supply are identified to avoid acute surface water reductions in areas with focal species – Fund strategies to shift the location of water withdrawals and/or increase local water availability to focal species habitats.

1.4 Species-specific restoration and management – Restore and manage focal species whose range and population have declined.

Translocation of Pecos pupfish and Pecos gambusia – Translocate Pecos pupfish and Pecos gambusia to appropriate stream reaches with improved habitat or isolated aquatic environments to increase the redundancy of the populations overall (thus safeguarding the future of the species).

Construct barriers to secure existing populations of Pecos pupfish and Pecos gambusia – Invest in barriers or other strategies to protect existing native fish populations from invasive species to stabilize current populations and prevent further decline.

Establish or translocate Texas hornshell – Translocate and create the necessary habitat conditions to establish a Texas hornshell population.

Support capacity development for implementing species-specific management – Support capacity needed to develop and implement species-specific management projects.

1.5 Improve upland and riparian land management practices – Prevent channel erosion, siltation, and entrenchment by promoting stream-friendly agricultural land management on adjacent lands. This is essential for the health of the Pecos watershed and for Texas hornshell.

Support implementation of landowner outreach programs – Fund landowner outreach programs to encourage participation in the Pecos watershed conservation strategies described in this plan.

Outreach to increase capacity for landowners to participate in best management practices – Provide resources for willing landowners to adopt best management practices to reduce impacts to focal species and their habitat from upland agricultural and ranching activities.

1.6 Grassland restoration – Pronghorn require large uninterrupted areas of grassland to thrive and will not use otherwise suitable habitat that is above a certain threshold of woody shrub density. In many areas of the Pecos watershed, woody shrubs, particularly mesquite and creosote, have invaded former grasslands and both pronghorn and migratory grassland birds, such as Sprague’s pipit and chestnut-collared longspur, have stopped using those areas. By focusing on shrub-invaded areas adjacent to existing grasslands occupied by pronghorn, the functional range of the species can be increased by achieving larger grassland patch sizes.

Improve range quality – Restore range quality by addressing woody shrub encroachment. Reclaim areas from woody shrubs through chemical treatments, mechanical treatments or controlled burns at some locations. This restoration should be sustained through sound grazing management following restoration (Strategy 1.8).

Support implementation of landowner outreach programs – Fund landowner outreach programs to encourage participation in the Pecos watershed conservation strategies described in this plan.

1.7 Increase grassland connectivity – Improvements in grassland connectivity allow for the seasonal movements of resident pronghorn within the species’ range that are important for their survival.

Fence modification – Fence modification, removal and measures that allow for increased ability to cross bottlenecks, such as road crossings, are relatively simple solutions that can be instituted at scale. Often the simple removal of woven wire fences or the installation of a smooth bottom wire can allow safe passage for pronghorn (Jones *et al.* 2018). In many cases, the location of bottlenecks or problematic fences is well known and will be addressed. In other areas, the movements of pronghorn are not well understood and some research on pronghorn movement will inform strategic investment of future funding.

Support implementation of landowner outreach programs – Fund landowner outreach programs to encourage participation in the Pecos watershed conservation strategies described in this plan.

1.8 Improve grazing and range management practices – In large grasslands, management alterations and improved pasture infrastructure can yield impressive results on a landscape scale. Studies have shown that once behaviors are changed and positive results achieved, managers are likely to maintain those practices, even after financial incentives are removed (Ramsdell *et al.* 2015). Practices may include the introduction of rotational grazing, changed intensity and duration of grazing, and adoption of technology to deliver water, monitor range health and account for the impact of such changes on livestock production.

Support implementation of landowner outreach programs – Support landowner outreach programs to encourage participation in the Pecos watershed conservation strategies described in this plan.

Outreach to increase capacity for landowners to participate in best management practices – Provide resources for willing landowners to adopt best management practices to reduce impacts to focal species and their habitat in upland grasslands.

1.9 Research data gaps for species and their conservation needs – Research species present in the Pecos watershed about which not enough is known to implement conservation strategies, including abundance and density estimates, demographics and habitat requirements.

Describe the distribution and status of Rio Grande cooter throughout the Pecos watershed – Support research to increase our understanding of Rio Grande cooter’s habitat needs, distribution and threats, particularly in Texas, so that conservation strategies may be identified.

Assess Texas hornshell populations in the Lower Pecos watershed – Support research to increase our understanding of the Texas hornshell’s distribution in lesser-known parts of the Pecos watershed and the feasibility of conservation strategies that may be implemented.

Establish baseline population and demographic values for Sprague’s pipit and chestnut-collared longspur – Fill targeted research gaps on species distribution, abundance and densities, measures of productivity, movements and habitat preferences, including restored lands and where management prescriptions have been introduced.

Assess pronghorn habitat quality and connectivity – Support the development of a pronghorn habitat assessment tool to quantify changes in habitat quality and degree of connectivity between suitable habitat patches within the Trans-Pecos focal area.

Determine the taxonomic validity of desert massasauga.

Strategy 2. Rio Grande Basin Riparian and Wetland Ecosystem Restoration and Enhancement

2.1 Increase water availability for species and their habitats – Make available more water for environmental flows that are necessary to sustain species and their habitats.

Implement a pilot water leasing program in New Mexico’s Middle Rio Grande Valley – In order to recruit and sustain populations of silvery minnow, water for environmental use must be identified and deployed to stretches of the Rio Grande that now frequently run dry.

Implement a water transactions program in New Mexico’s Lower Rio Grande Valley – Facilitate the development of a program that can reduce groundwater pumping to raise the water table to benefit riparian habitat and dedicate surface water flows for environmental purposes.

Support water leasing or acquisition in the headwaters upstream of the Middle and Lower Rio Grande Valleys – Fund voluntary leasing or acquisition of water rights in Rio Grande headwaters and the mainstem upstream of Cochiti Dam to increase water availability to riparian species and habitat.

2.2 Water delivery infrastructure development – To deliver transacted water to riparian restoration sites, it is necessary to design and construct new water delivery infrastructure, or improve existing infrastructure, within the Middle and Lower Rio Grande Valleys in New Mexico.

2.3 Riparian habitat restoration and enhancement – Restore stream banks to increase floodplain connectivity and recruitment of native riparian vegetation.

Floodplain reconnection – Reconnect the floodplain and stream channel to restore and enhance riparian habitat for focal species. Plant native riparian plants where appropriate. Where practicable, implement process-based restoration practices that can attract and sustain immigrating beaver populations.

North American beaver reintroduction – Reintroduce beaver into headwater streams of the Rio Grande in a manner compatible with ongoing agricultural use and irrigation, to benefit both beaver and Rio Grande cutthroat trout populations which depend on the habitat beaver create.

Support engineering design and analysis for riparian restoration projects – Make possible the necessary planning to implement riparian habitat restoration and enhancement projects.

2.4 Stream channel restoration and enhancement – Restore and enhance stream channels that have been channelized, thereby restoring the natural variety of stream substrate and flow patterns that benefit aquatic species’ life cycles. Specific activities may include process-based restoration, stream channel engineering and bank re-shaping.

Instream restoration – Improve instream habitat and channel structure to benefit target aquatic species throughout their life cycle.

Increase habitat connectivity – Remove or improve infrastructure at road crossings, culverts and check dams that act as barriers to the movement of aquatic species to ensure habitat connectivity.

2.5 Species-specific restoration and management – Restore and manage focal species whose range and population have declined.

Translocate Rio Grande cutthroat trout – Translocation of Rio Grande cutthroat trout to stream reaches with improved habitat will increase the number of stream miles in which they are present.

Remove invasive species – Remove invasive fish that compete with and/or threaten to hybridize with Rio Grande cutthroat trout from streams which are or could be occupied by the native species.

Strategy 3. Colorado River Basin Riparian and Wetland Ecosystem Restoration and Enhancement

3.1 Increase water availability for species and their habitats – Make available more water for environmental flows that are necessary to sustain species and their habitats.

Support water leasing or acquisition in Colorado River Basin’s headwater streams – Fund voluntary leasing or acquisition of water rights to increase water availability to riparian species and habitat.

3.2 Riparian habitat restoration and enhancement – Restore stream banks to increase floodplain connectivity and recruitment of native riparian vegetation.

Floodplain reconnection – Reconnect the floodplain and stream channel to restore and enhance riparian habitat for focal species. Plant native riparian plants. Where practicable, implement process-based restoration practices that can attract and sustain immigrating beaver populations.

North American beaver reintroduction – Reintroduce beaver into headwater streams of the Colorado River Basin in a manner compatible with ongoing agricultural use and irrigation, to benefit both beaver and native aquatic species populations which depend on the habitat beaver create.

Support engineering design and analysis for riparian restoration projects – Make possible the necessary planning to implement riparian habitat restoration and enhancement projects.

3.3 Stream channel restoration and enhancement – Restore and enhance stream channels that have been channelized, thereby restoring the natural variety of stream substrate and flow patterns that benefit aquatic species’ life cycles. Specific activities may include process-based restoration, stream channel engineering and bank re-shaping.

Instream restoration – Improve instream habitat and channel structure to benefit target aquatic species throughout their life cycle.

Increase habitat connectivity – Remove or improve infrastructure at road crossings, culverts and check dams that act as barriers to the movement of aquatic species to ensure habitat connectivity.

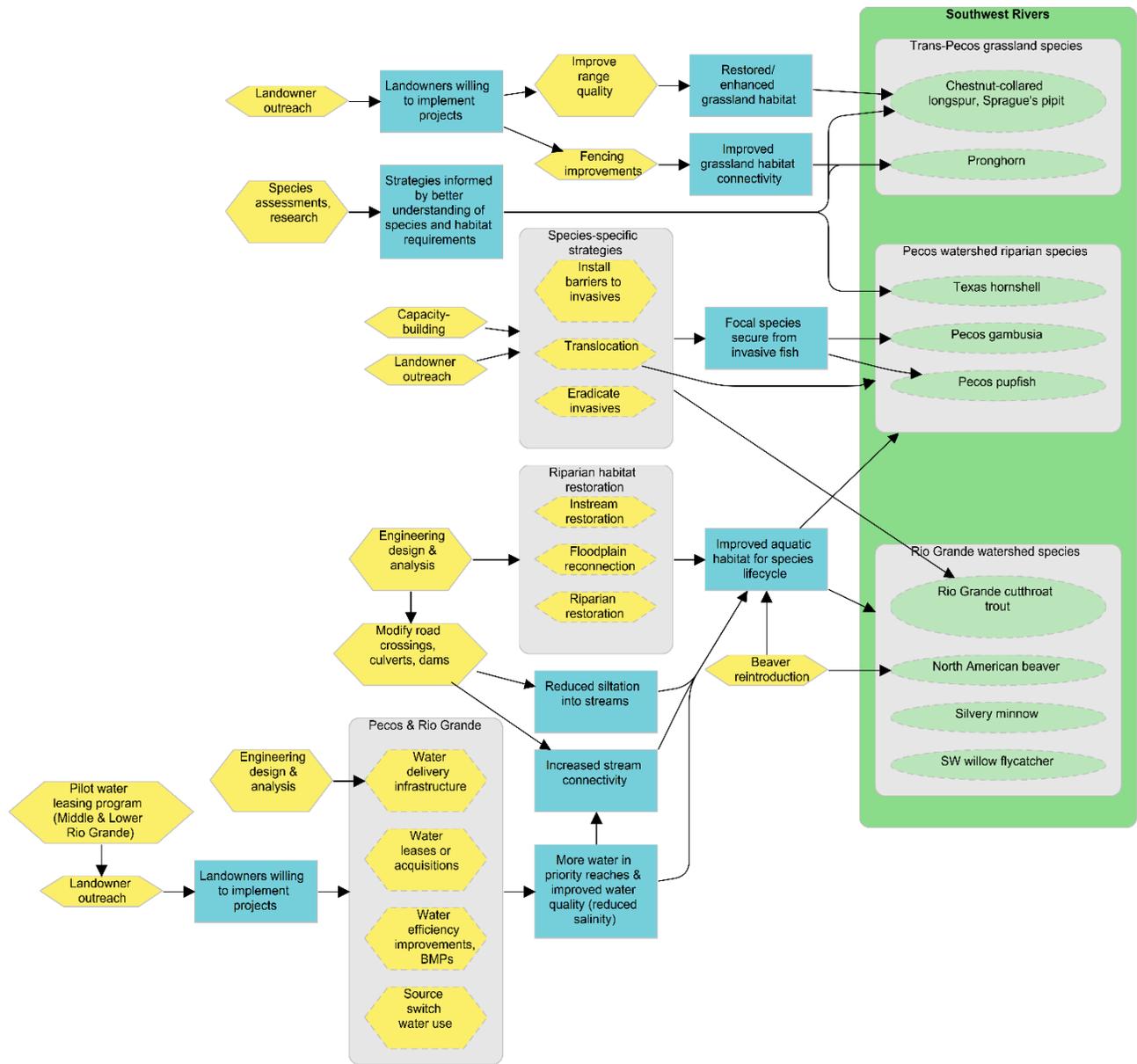


Figure 2. Results chain depicting the relationship of various strategies (yellow hexagons) within the business plan to each other, to the intermediate results (blue boxes) and ultimately to improvements in the target species (green ovals).

Risk Assessment

Risk is an uncertain event or condition which, if it occurs, could negatively affect a plan’s outcomes. NFWF assessed seven risk categories to determine the extent to which they could impede progress towards the business plan strategies and goals during the next 10 years. Table 3 lists the primary risks to success and describes strategies that NFWF will implement to minimize or avoid those risks, where applicable.

Table 3. Business plan risk assessment summary.

CATEGORY	RATING	RISK DESCRIPTION	MITIGATING STRATEGIES
Economic Risks	Low	Energy development remains a part of the landscape and influences the location of conservation efforts. Cost of leased water remains high, which will impact how much water can be leased in the MRG and Pecos.	Business plan investments are directed to areas with less potential for development and where sufficient water is expected to be available for conservation activities.
Environmental Risks	High	Drought, and subsequent water scarcity, has negatively impacted aquatic and grassland systems and is likely to continue to do so in the future. Increasing risk of catastrophic fire, with long-term impacts for riparian habitat.	Restoration projects may improve landscape resilience to drought and fire. Where possible, NFWF will direct projects to locations where surrounding areas are undergoing treatments (e.g., burning) that reduce the risk of fire at the site.
Financial Risks	Moderate	The number of funding partners has increased, but some contributions have decreased. There is some risk around funding long-term maintenance and management of grant projects.	The program includes diverse private and public partners. Some grantees incorporate long-term maintenance and management into their operations, and others are working to identify long-term sources of funds for these activities.
Institutional Risks	Moderate	Institutional support and coordination exist across agencies and NGOs. However, hiring challenges reduce the capacity of these organizations to implement conservation activities, particularly for aquatic efforts and bird monitoring.	The business plan includes investment in organizational capacity, including personnel, and may also consider being more flexible with where funding can be directed to address specific gaps, such as funding for staff housing.
Regulatory Risks	Low	There is no information to suggest that regulatory risks will impact achievement of business plan conservation outcomes.	NFWF will continue to monitor for changes in the regulatory risk environment.
Scientific Risks	Low	Updated goals for focal species already take into consideration available scientific data. However, uncertainty remains regarding potential future climate scenarios.	Business plan strategies take anticipated climate projections into consideration. NFWF will continue to monitor for changes in these projections.
Social Risks	Low	Some risk of insufficient private landowner support for achieving TX hornshell and Pecos gambusia goals. Risks are low for other business plan species for which there has been significant landowner outreach and numerous potential project sites.	NFWF and implementation partners are making a concerted effort to engage landowner-led groups. Partners are considering alternative sites for Pecos gambusia and TX hornshell.

Monitoring & Evaluating Performance

Performance of the Southwest Rivers Business Plan will be assessed at both project and program scales. At the project scale, **individual grants** will be required to track relevant strategy and habitat metrics from Table 4 to demonstrate progress on project activities and to report out on them in their interim and final programmatic reports.

Table 4. Business plan metrics from individual grants.

Strategy	Outcome	Metrics	Baseline (2018)	Goal (2028)
1. Pecos Watershed Riparian and Trans-Pecos Grasslands Restoration and Enhancement				
1.1 Riparian habitat restoration and enhancement	Reconnect floodplain and reestablish native riparian vegetation	# of riparian acres restored	0	50
	Improve instream habitat and channel structure	# instream miles restored	0	50
1.2 Improve infrastructure	Increase habitat connectivity	# of stream miles opened	0	2
		# barriers rectified	0	2
1.3 Increase water quantity and quality	Water acquisitions or leases	Acre feet of water leased	0	15,000
1.4 Species-specific restoration & management	Secure native fish from invasives	# barriers created to prevent passage of non-native species	0	4
	Translocate focal fish species	# translocations	0	2
1.5 Improve upland and riparian management practices	Expand implementation of BMPs upstream	# acres with BMPs for nutrient or sediment reduction	0	1,000
	Communicate water leasing opportunities	# individuals reached by outreach	0	50
	Engage volunteers in riparian restoration	# volunteers participating in projects	0	130
1.6 Grassland restoration	Treat brush encroachment	Acres restored	0	330,000
	Improve grassland management	Acres under improved management (BMPs)	0	250,000
1.7 Increase grassland connectivity	Fence barrier removal or modification for pronghorn	Miles of fence removed or improved	0	800
1.8 Improve grazing and range management practices	Engage with landowners on best management practices	# individuals reached by outreach, training, or technical assistance activities	0	300
	Engage volunteers in grassland restoration	# volunteers participating in projects	0	130
1.9 Research species data gaps	Describe the distribution and status of Rio Grande Cooter	# studies completed for Rio Grande cooter	0	4

	Establish baseline population and demographic values for Sprague’s pipit and chestnut-collared longspur	# studies completed for SPPI and CCLO	0	1
	Develop pronghorn habitat assessment tool	# studies completed for pronghorn	0	1
2. Rio Grande Basin Riparian and Wetland Ecosystem Restoration and Enhancement				
2.1 Increase water availability	Water acquisitions or leases	New water transaction programs	0	2
		Acre feet of water leased	0	40,000
	Increase the days of continuous flow in the Isleta and San Acacia reaches	# of days of continuous flow more than preceding 5-year average	0	10
2.2 Water delivery infrastructure development	Water delivery infrastructure construction or modification	# projects executed	0	15
2.3 Riparian habitat restoration and enhancement	Reconnect floodplain and reestablish native riparian vegetation	# riparian acres restored	0	2,000
2.4 Stream channel restoration and enhancement	Improve instream habitat and channel structure	# instream miles restored	0	200
		# of stream miles opened	0	15
	Increase habitat connectivity	# barriers rectified	0	20
2.5 Species-specific restoration & management	Removal of invasives to prevent hybridization/ predation of RGCT	# stream miles with predation reduction goals met	0	50
3. Colorado River Basin Riparian and Wetland Ecosystem Restoration and Enhancement				
3.1 Increase water availability	Water acquisitions or leases	Acre feet of water leased	0	50,000
3.2 Riparian habitat restoration and enhancement	Reconnect floodplain and reestablish native riparian vegetation	# riparian acres restored	0	500
	Support future expansion of beaver	# of projects implementing process-based restoration	0	5
3.3 Stream channel restoration and enhancement	Improve instream habitat and channel structure	# instream miles restored	0	50
		# of stream miles opened	0	10
	Increase habitat connectivity	# barriers rectified	0	5

At the program scale, **species outcomes** from Table 5 will be monitored through targeted grants to key monitoring partners, existing external data sources, and/or aggregated data from grant projects, as appropriate. Priorities for monitoring grants will be included in annual RFPs under this plan. Where possible, monitoring efforts will be coordinated across species.

Table 5. Business plan metrics for species outcomes.

Species	Outcome	Metrics	Baseline (2018)	Goal (2028)
Trans-Pecos				
Pecos Gambusia ¹	Secure populations	# of populations secured	0	2
Pecos Pupfish ¹	Secure populations	# of populations secured	0	2
	Establish populations ²	# of populations established	0	4
Texas Hornshell ¹	Maintain population	# of populations maintained	1	1
	Establish population	# of populations established	0	1
Chestnut-collared Longspur ³	Increase mean bird density	# of individuals/ km ²	32.5/ km ²	> 32.5/ km ²
Sprague’s Pipit	Increase mean bird density	# of individuals/ km ²	1.0 / km ²	> 1.0 / km ²
Rio Grande Basin				
Rio Grande Cutthroat Trout ⁴	Secure populations	# of populations secured	0	10
	Establish populations	# of populations established	0	5
Rio Grande Silvery Minnow	Maintain populations at outfalls	# of sites maintained	0	6
	Establish additional outfalls	# of sites established	0	≥1
North American beaver	New stream miles occupied via beaver translocations	# of stream miles occupied by the species	0	30
	Support natural expansion of beaver	# of projects implementing process-based restoration	0	15
		# sites occupied by species	0	2
Southwestern Willow Flycatcher	Maintain breeding success	3-year moving average nest success rate	Varies b/t 20-45%	30%
	Maintain or increase nesting pairs	# of nesting pairs	75	≥ 75
Colorado River Basin				
North American beaver	Support natural expansion of beaver	# sites occupied by species	0	1

¹ For Pecos gambusia, Pecos pupfish, and TX hornshell, a baseline survey of conservation needs at each site will be conducted where access is permitted. Sites will be “secured” by reducing the threat of the site drying up, and by either reducing the risk and/or impact of invasive fish. Other site-specific threats will be addressed on a case-by-case basis. The goals for these two fish species were informed using a 3-R approach.

² “Establish” is defined as reintroducing or translocating individuals to restored and secured stream reaches.

³ Chestnut-collared longspur and Sprague’s pipit baseline estimates are from grassland surveys during the non-breeding season in 2022 and 2023.

⁴ For Rio Grande cutthroat trout, “securing” a population is defined as including assessing and restoring habitat, managing, or eliminating invasive species and monitoring population viability.

Budget

The following budget shows the estimated costs to implement the business plan activities (Table 6). NFWF will have to raise funds to meet these costs; therefore, this budget reflects NFWF’s anticipated engagement over the business plan period of performance and is *not* an annual or even cumulative commitment by NFWF to invest. This budget assumes that current activities funded by others will, at a minimum, continue.

Table 6. Budget for the Southwest Rivers Business Plan.

BUDGET CATEGORY	Years 1-5 (\$)	Years 5-10 (\$)	Total (\$)
Strategy 1. Pecos Watershed Riparian and Trans-Pecos Grasslands Restoration and Enhancement			
1.1 Riparian habitat restoration and enhancement	\$1.25M	\$1.75M	\$3M
1.2 Improve infrastructure	\$750K	\$1M	\$1.75M
1.3 Increase water quality and quantity	\$700K	\$1.25M	\$1.95M
1.4 Species-specific restoration and management	\$600K	\$800K	\$1.4M
1.5 Improve upland and riparian land management	\$500K	\$750K	\$1.25M
1.6 Grassland restoration	\$2.5M	\$3.5M	\$6M
1.7 Increase grassland connectivity	\$600K	\$1.5M	\$2.1M
1.8 Improve grazing and range management	\$1M	\$1.25M	\$2.25M
1.9 Research data gaps	\$1M	\$1M	\$2M
1.10 Monitoring	\$900K	\$1.2M	\$2.1M
Strategy 2. Rio Grande Basin Riparian and Wetland Ecosystem Restoration and Enhancement			
2.1 Increased water availability	\$3.6M	\$9M	\$12.6M
2.2 Water delivery infrastructure development	\$3M	\$8M	\$11M
2.3 Riparian habitat restoration and enhancement	\$2M	\$4.5M	\$6.5M
2.4 Stream channel restoration	\$1.75M	\$4M	\$5.75M
2.5 Species-specific restoration and management	\$500K	\$2M	\$2.5M
2.6 Monitoring	\$250K	\$500K	\$750K
Strategy 3. Colorado River Basin Riparian and Wetland Ecosystem Restoration and Enhancement			
3.1 Increased water availability	--	\$250K	\$250K
3.2 Riparian habitat restoration and enhancement	--	\$4M	\$4M
3.3 Stream channel restoration	--	\$3M	\$3M
3.4 Monitoring	--	\$500K	\$500K
Other			
Communications and community relations	\$100K	\$250K	\$350K
TOTAL BUDGET	\$21M	\$50M	\$71M

Literature Cited

- Bird, B., Budrow, D., Hebert, D., Nguyen, A., and J. Roybal. 2013. *Assessing Beaver Habitat on Federal Lands in New Mexico*. WildEarth Guardians, Santa Fe, NM. 10 pp.
- Bylsma, R., Walkup, D.K., Hibbitts, T.J., Ryberg, W.A., Black, A.N., and J.A. DeWoody. 2022. Population genetic and genomic analyses of Western Massasauga (*Sistrurus tergeminus* ssp.): implications for subspecies delimitation and conservation. *Conservation Genetics* 23:271–283.
- Carman, S.M. 2007. *Texas Hornshell Popenaias popeii Recovery Plan*. New Mexico Department of Game and Fish, Conservation Services Division, Santa Fe, New Mexico. 57 pp.
- Commission for Environmental Cooperation. 2013. *Where Do Grassland Birds Winter? Density, Abundance and Distribution of Wintering Grassland Passerines in the Chihuahuan Desert*. Montreal: Commission for Environmental Cooperation. 30 pp.
- Dearen, P. 2016. *Bitter Waters: the Struggles of the Pecos River*. Norman, OK: University of Oklahoma Press: Norman.
- Desert Fish Habitat Partnership Workgroup. 2015. *Framework for Strategic Conservation of Desert Fishes, 2015*. Desert Fish Habitat Partnership. 42pp. Accessed 9/28/2023 < https://www.fishhabitat.org/files/uploads/DFHP_2015.pdf>.
- Ellison, K., McKinnon, E., Zack, S., Olimb, S., Sparks, R. and E. Strasser. 2017. Migration and winter distribution of the Chestnut-collared Longspur. *Animal Migration* 4:37–50. DOI: 10.1515/ami-2017-0005.
- Gann, W.J., Harveson, L.A., and S.S. Gray. 2017. *Trans-Pecos Pronghorn Restoration and Research Report*. Borderlands Research Institute, Sul Ross State University. 8 pp.
- Gray, S. 2017. Final performance report as required by Federal Aid in Wildlife Restoration Act, Texas, Federal Aid Project No. W-127-R-21/F15AF01146, Big game research and surveys. Project 8: Pronghorn Harvest Recommendations. Texas Parks and Wildlife Department. 35 pp.
- Gregory, L., Hauck, L., Blumenthal, B., Brown, M., and A. Porter. 2013. *Pecos River Watershed Protection Plan Update*. Texas Water Resources Institute TR-447.
- Johnson, A.S. 1989. The thin green line: riparian corridors and endangered species in Arizona and New Mexico. Pages 35–46 in G. Mackintosh (ed). *Preserving Communities and Corridors*. Washington, DC: Defenders of Wildlife.
- Jones, P.F., Jakes, A.F., Eacker, D.R., Seward, B.C., Hebblewhite, M., and B.H. Martin. 2018. Evaluating responses by pronghorn to fence modifications across the Northern Great Plains. *Wildlife Society Bulletin* 42:225–236.

- Martin & McCoy and Culp & Kelly LLP. 2021. *Ten Strategies for Climate Resilience in the Colorado River Basin*. Available at www.tenstrategies.net.
- Ramsdell, P.R., Sorice, M.G., and A. Dwyer. 2015. Using financial incentives to motivate conservation of an at-risk species on private lands. *Environmental Conservation* 43:34–44.
- Rio Grande Cutthroat Trout Conservation Team. 2013. *Rio Grande cutthroat trout* (*Oncorhynchus clarkia virginalis*). *Conservation Strategy*. Colorado Parks and Wildlife, Denver, CO. 60 pp.
- Rio Grande Cutthroat Trout Conservation Team. 2017. *Rio Grande cutthroat trout* (*Oncorhynchus clarkia virginalis*). *Range-wide accomplishments report*. Colorado Parks and Wildlife, Denver, CO. 60 pp.
- USBR (U.S. Bureau of Reclamation). 2012. *Southwestern Willow Flycatcher Management Plan for the Rio Grande Project*. 50pp. Accessed 9/20/2023 <https://downloads.regulations.gov/FWS-R8-ES-2013-0011-1305/attachment_15.pdf>.
- USFWS (U.S. Fish and Wildlife Service). 2002. *Southwestern Willow Flycatcher Recovery Plan*. Albuquerque, New Mexico. i-ix + 210 pp., Appendices A-O.
- USFWS (U.S. Fish and Wildlife Service). 2016. *Final Biological and Conference Opinion for Bureau of Reclamation, Bureau of Indian Affairs, and Non-Federal Water Management and Maintenance Activities on the Middle Rio Grande, New Mexico*. 192 pp. Consultation Number 02ENNM00-2013-F-0033. 12/2/2016.
- USFWS (U.S. Fish and Wildlife Service). 2017. *Final Biological Biological Opinion for U.S> International Bounday and Water Commission Long-Term River Management of the Rio Grande Canalization Project, New Mexico*. 41 pp. Consultation Number 02ENNM00-2017-F-0367. 11/3/2017.

Appendix A. Carbon Co-Benefits

Although NFWF business plans are aimed at achieving habitat and species goals, NFWF is committed to understanding the broader impacts of these investments in conservation. Specifically, NFWF has begun measuring other environmental and social co-benefits from business plan investments, including carbon benefits.

NFWF estimates the activities funded through the life of this business plan will yield a 30-year carbon benefit, either sequestered (i.e., removed from the atmosphere) or through avoided emissions, of between 615,000 to 920,000 metric tons CO₂ equivalent. NFWF produced this estimate using open-source datasets, various scientific reports, and IPCC guidelines. NFWF estimates the carbon benefit not to claim any formal carbon credits, but rather to demonstrate the co-benefits that accrue from our business plan's conservation investments for fish, wildlife, and habitats.