Cruces Basin Wetland Action Plan and Wilderness Restoration Road Map

Prepared by Amigos Bravos

in cooperation with the

New Mexico Environment Department

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Front Cover Photo*: Courtesy of Jim O'Donnell, Cruces Basin, 2016.*

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Acronyms

BLM ..... Bureau of Land Management
CWA ..... Clean Water Act
EMNRD ..... Energy, Minerals and Natural Resources Department
FS ..... Forest Service
LLWW ..... Landscape Position, Landform, Water Flow Path, Water Body Type
MRA ..... A Minimum Requirements Analysis
MRAF ..... The Minimum Requirements Analysis Framework
NMED ..... New Mexico Environment Department
NMERT ..... New Mexico Environmental Review Tool
NMRAM ..... NM Rapid Assessment Method
NMRipMap ..... New Mexico Riparian Habitat Map
NWI ..... National Wetlands Inventory
ONRW ..... Outstanding National Resources Waters
PBR ..... Process-Based Restoration
RCOA ..... Riparian Conservation Opportunity Area
SWQB ..... Surface Water Quality Bureau
TMDL ..... Total Maximum Daily Load
USFS ..... U.S. Forest Service
USGS ..... United States Geological Service
WQCC ..... Water Quality Control Commission

Summary of Findings and Plan of Action

The Cruces Basin Wetland Action Plan recommends nine priority restoration projects in the Cruces Basin Wilderness Area. Arresting head cuts and slowing gully formation is the primary restoration need to preserve wetland acreage. The headwater reaches of all the streams in the Cruces Basin Wilderness provide opportunities to preserve wetland acreage by stopping numerous head cuts that are under three feet deep. The map below (also Figure 20) displays the priority reaches in red. Wetland Assessment data can be visualized in an ArcGIS Story Map, which is available here: https://storymaps.arcgis.com/stories/78c812f374134d08b172b1013941529f. The full wetland assessment report including detailed descriptions of the assessed reaches is available in Appendix C. The tools recommended to accomplish this work are: beaver dam analog (BDA) and Assisted Log Structure (ALS) complexes with high structure density, Log Flow Splitters, Worm Ditches, Log Step Falls, Zuni Bowls, One-Rock Dams (ORD), Rock Rundowns, and/or Log Mattresses (LM). Types of materials needed will be Logs, branches, rocks, gravel, and sod harvested on-site. The estimated cost for all nine priority projects is $555,150.000.

Introduction

The Cruces Basin Wilderness consists of 18,876 acres at elevations of approximately 8,500-10,700 feet in the Carson National Forest in Northern New Mexico (Figure 1). It is the smallest wilderness area in the Carson National Forest, and is located northwest of Tres Piedras, New

Mexico, in the southern San Juan Mountains just south of the Colorado Border. According to the 2022 Land Management Plan, Carson National Forest Plan Revision, the Cruces Basin Wilderness is the least visited wilderness in the Carson National Forest, and is also the most difficult to access because it is along 15 miles of dirt road that receives little maintenance. Unlike the Carson National Forest's other wilderness areas, the Cruces Basin Wilderness is situated around a single watershed rather than a mountain range or region containing multiple watersheds, and has no designated trails (US Forest Service, 2022).

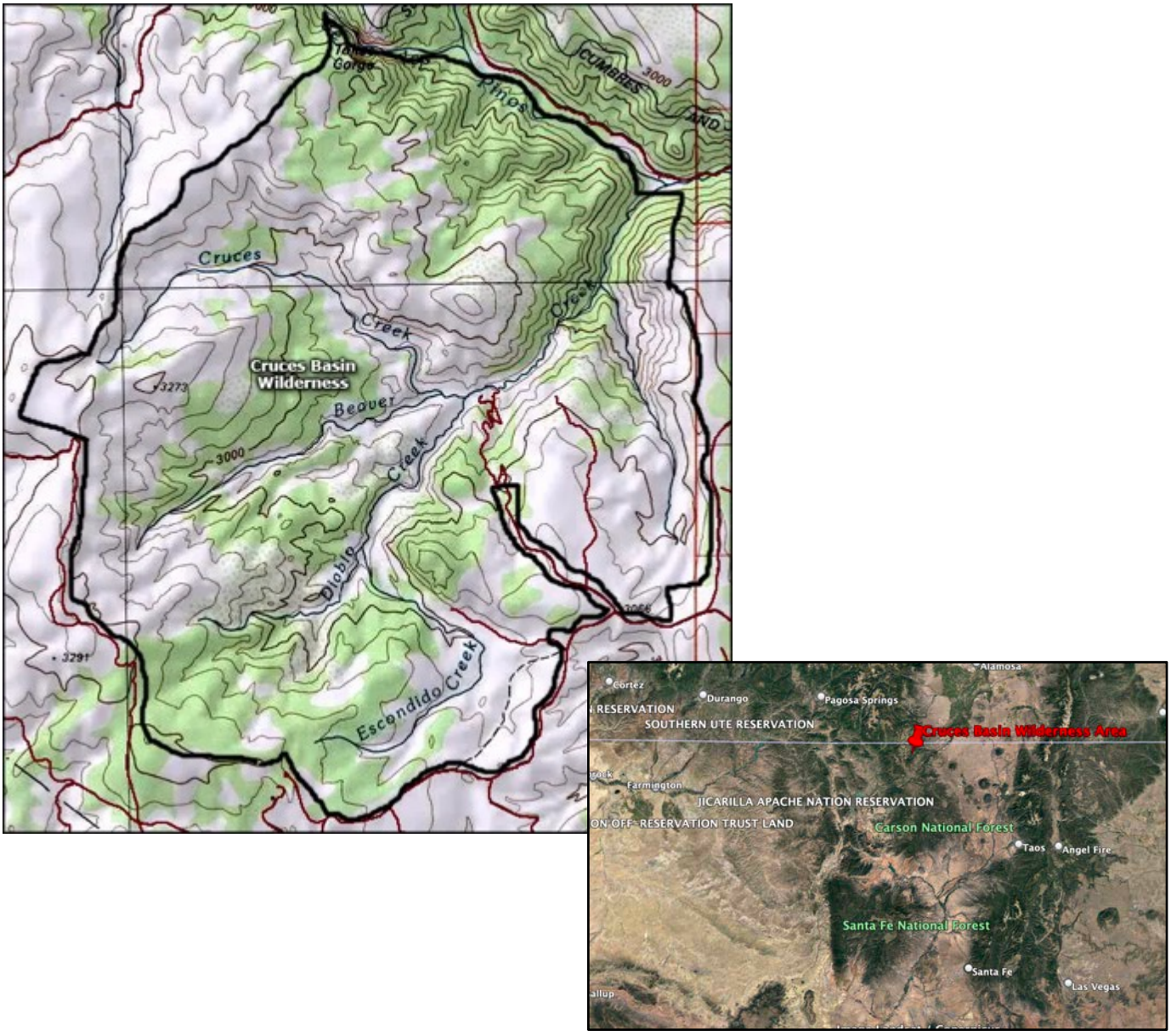


Figure 1: Maps of Cruces Basin Wilderness and it's general location. Source: Google maps for general location, and "The Arm Chair Explorer" for the topographic map.

Water resources in the basin include headwater slope wetlands and riverine wetlands along four creeks: Beaver, Cruces, Diablo, and Escondido. The Cruces Basin Wilderness is a roadless protected area under the federal 1964 Wilderness Act, and all wetlands therein are designated by the State of New Mexico as Outstanding National Resources Waters (ONRW), which provides further protection against development and water quality degradation. However, the area is used for recreation, cattle grazing, and is also subject to browsing by wildlife (elk and deer). According to the US Forest Service's Watershed Condition Framework system, Beaver Creek Watershed is identified as Functioning At Risk, with Aquatic Biota Condition listed as Poor, and Riparian Wetland Condition listed as Fair (United States Department of Agriculture Forest Service, 2011). Beaver Creek is identified as impaired for temperature by the New Mexico Environment Department Surface Water Quality Bureau (New Mexico Environment Department, SWQB, 2024).

The Cruces Basin Wilderness wetlands have been degraded by human-related activities such as logging and livestock grazing. Therefore, they are not functioning at their full capacity for a variety of functions including water storage, water filtration, and soil health among others. This Wetland Action Plan serves as a guide to improve wetland health in the Cruces Basin Wilderness. Chapter 4 also serves as a stand-alone document for other Wilderness Areas to use as a guide for accomplishing wetland restoration in Wilderness Designated Areas.

Chapter 1: Cruces Basin Watershed Summary

1.1 Historical Documentation

1.1.1 Archeological and Land Use History

The San Luis Valley area, bordering the San Juan Mountains and Cruces Basin Wilderness, has a long history with a variety of people utilizing its natural resources. The land was frequented by various nomadic Native American groups, including the Comanche, Apache and Ute tribes. In the mid-16th century, when the first Spanish explorers arrived, they found a land full of wildlife, beautiful wetlands, and water resources which promised agriculture production and successful grazing opportunities (Thomas, 1969; Wroth, 2000; San Antonio and Los Piños Watersheds Wetland Action Plan, 2006).

Creamer and Haas provide evidence for an origin story of the Tewa Puebloan culture that suggests origins at the "Sandy Place Lake" in the vicinity of the Great Sand Dunes National Monument, 90 miles northeast of the Cruces Basin (Creamer and Haas, 1999). Harrington (1916) also indicates that the San Luis Valley is the point of emergence for the Tewa. Geary (1997) mentions a Taos Pueblo origin story, similar to that of the Tewa, that suggests the location of emergence near the summit of Blanca Peak (Martorano et al, 1999).

More specific details of the use of the Cruces Basin Wilderness area specifically by native cultures is unclear, but it was likely used for hunting, and as lookouts by Native cultures. The earliest mention of aboriginal cultures in the San Luis Valley and surrounding mountains was made during expeditions through the San Luis Valley by Don Diego de Vargas in 1694 (Colville 1995), and later by Juan Bautista de Anza in 1779 (Kessler 1994). The expeditions chronicled the presence of Ute, Apache, and Comanche groups in the valley.

Two specific historical notes in close vicinity to the Cruces Basin Wilderness include:

1) Retracement of Anza's campaign against Comanche leader Cuerno Verde in 1779. The Diary of Lieutenant Colonel Juan Bustista de Anza (August 15 to September 10, 1779) places his August 20th, 1779 camp on the Los Piños River (Anza labeled it the Rio Conejos) where 200 Ute warriors joined the campaign (Web De Anza, 2022)

1) The route of the Denver Rio Grande and Western Railroad through the Toltec Gorge on the north boundary adjoining the Cruces Basin Wilderness is highlighted as a scenic railroad travel-way in a 1892 tourist guide (Hooper, S. K., 1982).

The United States Congress added the Cruces Basin Wilderness to the National Wilderness Preservation System on December 19, 1980. What would eventually become Public Law 96-550 was first proposed to the House of Representatives by Manuel Lujan Jr., the representative of New Mexico's 1st Congressional District on October 2, 1980. The new law authorized the establishment of nine new Wilderness Areas and the addition of lands to three existing Wilderness Areas on National Forest land in New Mexico, including the Cruces Basin Wilderness Area (NM Wilderness Act of 1980).

In the early 1900's, exploitation of grazing and agriculture caused extensive landscape scale degradation across habitats. Moreover, uncontrolled logging activities led to the loss of most of the old growth forests in the region. Ponderosa Pine was used heavily in the construction of railroad bridges and other infrastructure, driving an unsustainable level of timber harvest. Open Ponderosa Pine forests with historically low stand densities were replaced by overstocked, predominantly even-aged stands as the fire regime was changed from high frequency to very low frequency due to national policies supporting fire suppression, and extensive grazing, preventing the widespread propagation of surface fires (New Mexico Environment Department Surface Water Quality Bureau Wetlands Program, 2006).

The current communities around the Cruces Basin base their economic activity on grazing, agriculture and recreation. Perennial streams and grasslands around the Cruces Basin have made possible the development of agriculture business through supporting acequia irrigation downstream and productive pasturelands. The community has benefitted from the landscape, but grazing, altered fire regimes, past logging, and climate change are impacting the river environment, wetlands areas and grasslands.

1.1.2 Historical Stream Discharge Data

The USGS Water Data record for the Los Piños Gauge near Ortez, Colorado provides the graph below showing points of peak flows (Figure 2). The following quotes from the USGS notes for this gauge on peak flows just upstream of Cruces Basin Wilderness highlight historic peak flows.

> *"EXTREMES OUTSIDE PERIOD OF RECORD - Flood of Oct. 5, 1911, is the greatest since at least 1854, from information obtained from local residents in 1959. Natural flow of stream affected by diversions for irrigation and return flows from irrigated areas."*

"EXTREMES FOR PERIOD OF RECORD - Maximum discharge, 3,160 ft³/s, May 12, 1941, from rating curve extended above 1,600 ft³/s, gage height, 5.77 ft, site and datum then in use."

Monthly discharge tables dating back to 1915 show that peak flows are in May, and the lowest flows are in January (United States Geographic Survey, 2024).

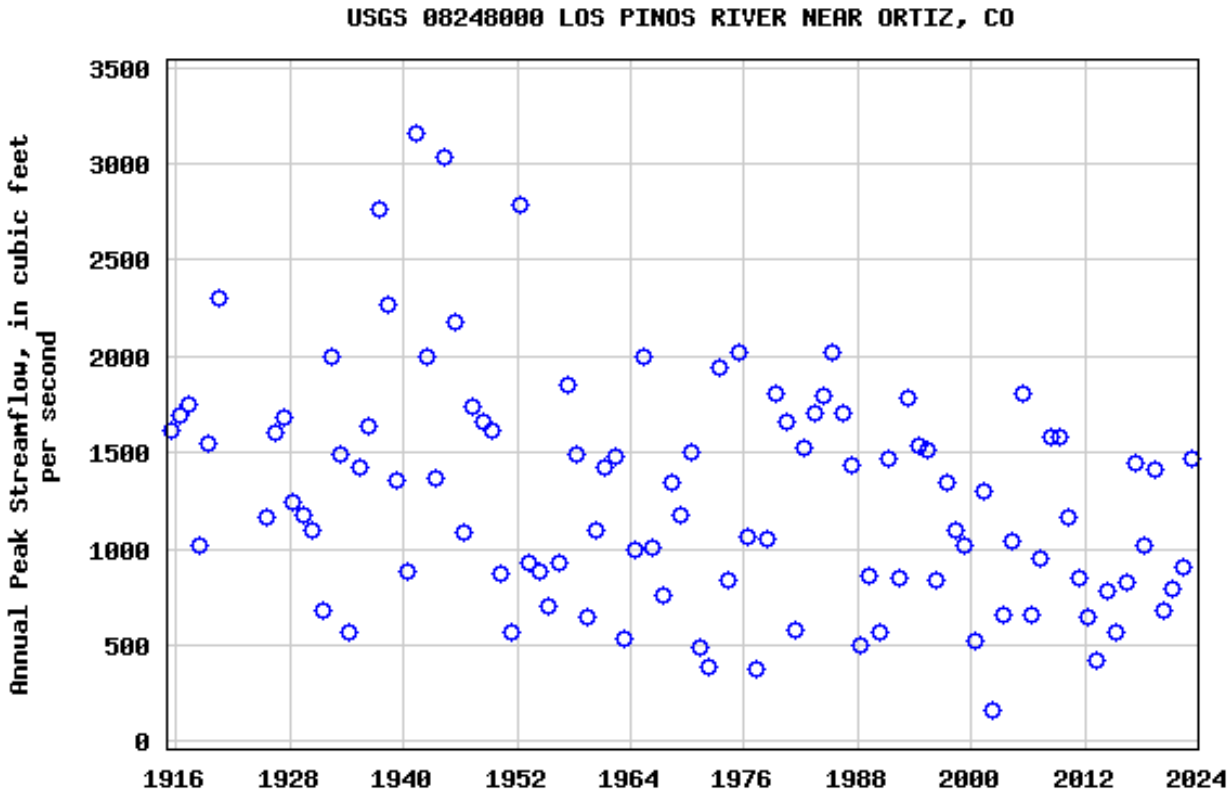


Figure 2: Annual peak stream flow of the Pinos River, just upstream of the Cruces Basin Wilderness Area stream segments.

1.1.3 Historical Water Quality Data

The USGS collected temperature data from February 1978 to December 15th 1986 from the Los Piños Gauge upstream from the Cruces Basin Wilderness streams, and did not find any water quality standard exceedances (USGS National Water Information System, 2024).

The NMED has assessed Beaver Creek (Rio de los Piños to Headwaters, Assessment Unit ID: NM-2120.A_904) in the Cruces Basin Wilderness in 2020 and found it to be category 5/5A, meaning that it is: *"Impaired for one or more designated or existing uses and a Total Maximum Daily Load (TMDL) is underway or scheduled. AUs are listed in this category if the AU is impaired for one or more designated uses by a pollutant. Where more than one pollutant is associated with the impairment of a single AU, the AU remains in IR Category 5A until TMDLs for all pollutants have been completed and approved by USEPA."*

The NMED found Beaver Creek to be supporting all assessed parameters except for temperature for the high-quality cold water designated use. The Rio de los Piños in New Mexico was also assessed in 2020 and was found to not be supporting the high-quality cold water designated use for total recoverable aluminum and temperature. A TMDL was created for this reach for Temperature in 2004 indicating the impairment has been persistent for at least 20 years (New Mexico Environment Department, SWQB, 2024).

Beaver Creek was sampled by the NMED during the 2016-2018 Upper Rio Grande survey and first listed on the 2020-2022 List of Impaired Waters for temperature. However, assessment units in the Conejos HUC (13010005) were inadvertently left off the 2022 Upper Rio Grande TMDL scoping list. The NMED plans to update the 2022 URG TMDL and may add Beaver Creek at that time.

1.2 Geology and Soils

1.2.1 Soils

For the full soil survey report produced using the United States Department of Agriculture Natural Resources Conservation Service Web Soil Program 2024, please see Appendix A. There are 29 unique soil types in the project area (Figure 3). The three most prevalent are:

1) Owlcreek –Presa families complex, dry, 15-40% slope (15.4% of the project area).

2) Owlcreek Family loam, dry, 0-15% slope (12.4% of the project area),

3) Nimerick Family loam, 0-40% slope (10.3% of the project area).

Owlcreek soil series are characterized by very deep, well drained soils formed in slope alluvium and colluvium. They are derived from andesite, rhyolite, breccia, or tuff. These soils are on mountain slopes and ridges (Web Soil Survey, 1999, Febraury). The Presa family series consists of deep, well drained soils that formed in material weathered from sandstone and shale. Presa soils are on steep slopes of mountains and canyons (University of California, Davis, 2022). Nimerick Family loams are moderately deep, well drained moderately permeable soils that formed in mixed material from basalt, limestone and sandstone. These soils are on high plateaus and flat mountain tops (Web Soil Survey, 2008, January).

Wetland specific soil types include: Cumulic Cryaquolls, Frequently Fooded; Typic Cryaquolls, Occas Ponding; and Dula, Frequently Flooded. Further details about these specific soils can be found on pages 20, 22, and 51 of Appendix A. Details on all 29 soil types can also be found on pages 15- 68 of the soil report (Appendix A).

Custom Soil Resource Report
Soil Map (Cruces Basin Wilderness Soil Map 1)

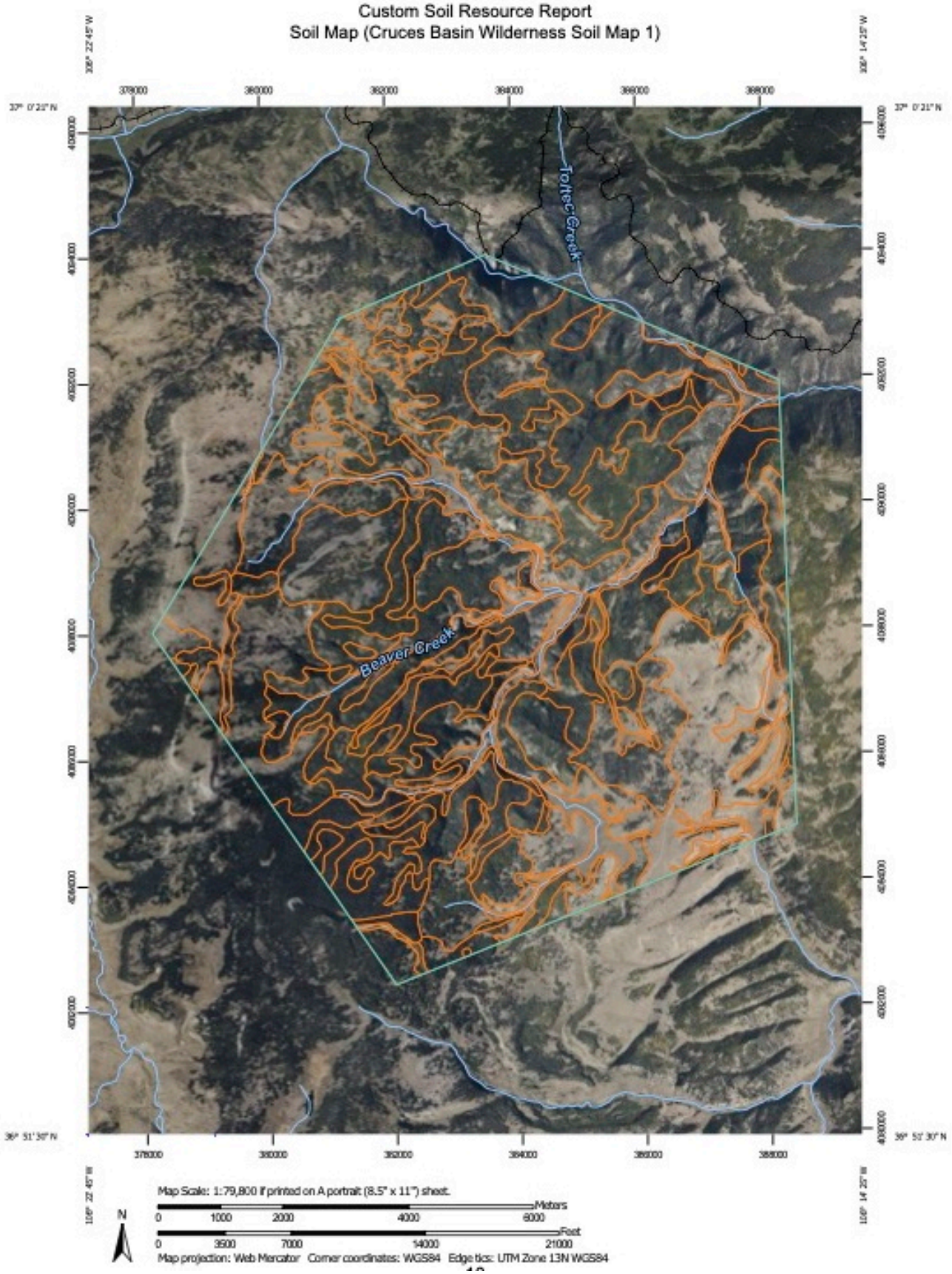
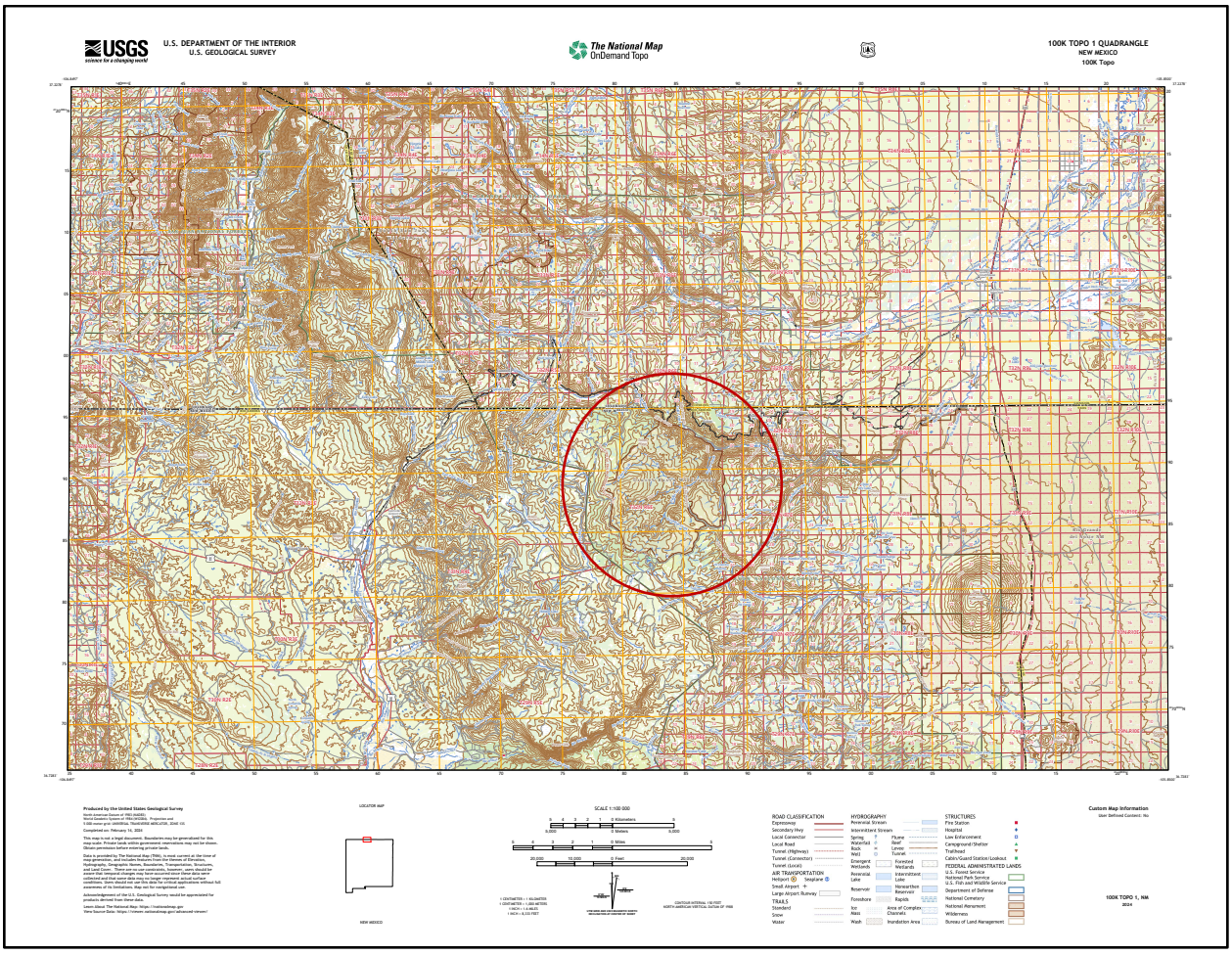


Figure 3: Custom soil resource report from the United State Department of Agriculture Natural Resources Conservation Service Web Soil Program (https://websoilsurvey.nrcs.usda.gov/app/). Map is from page 10 of the report, available in Appendix A.

1.2.2 Geology

The USGS Quad Map (Figure 4) shows us the steep slopes present in the Cruces Basin Wilderness and the surrounding geography of the area.



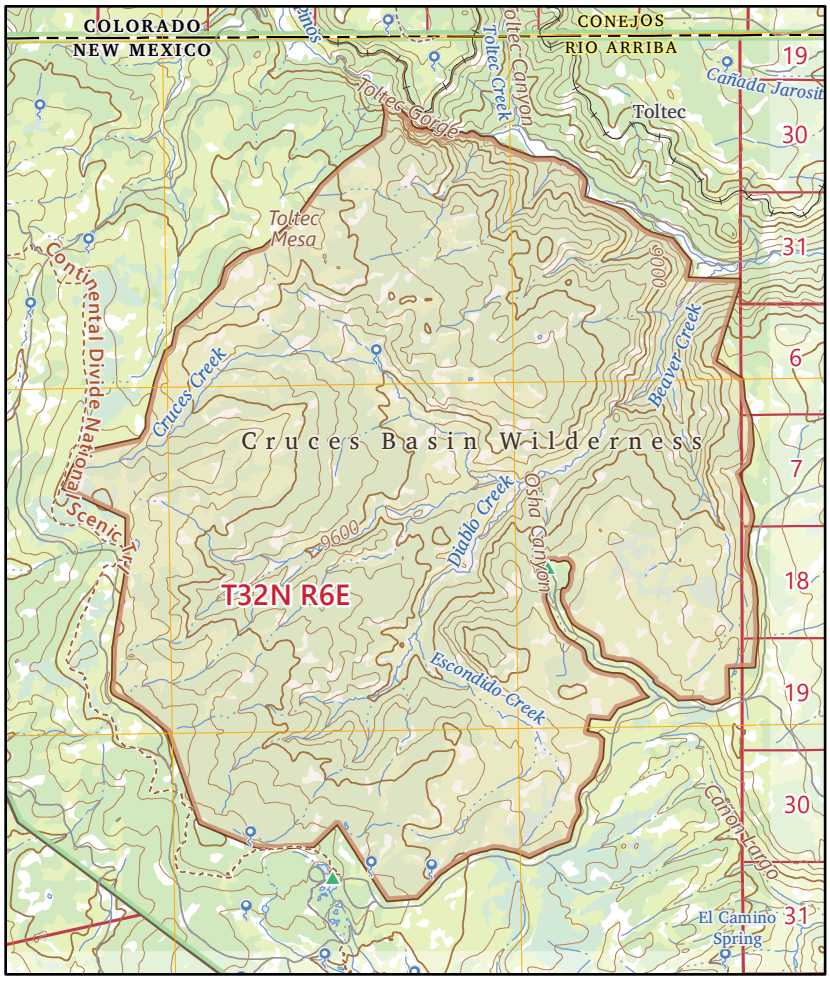


Figure 4. 100K (scale of 1:100,000) Topographical map from the United States Geographic Service. Source: https://topobuilder.nationalmap.gov/. Upper map shows Cruces Basin and surrounding area. Lower map shows zoomed in view of Cruces Basin Wilderness Area.

The principal geology in the Cruces Basin area is Precambrian igneous and metamorphic rocks and Tertiary volcanic related to the Rio Grande Rift tectonic events (NMED, 2004). Figure 5 shows that the Cruces Basin area is dominated by Lower Oligocene and Eocene volcanic rocks around the creeks, and then by Lower Oligocene pyroclastic rocks outside of that. There are also areas of landslide deposits and colluvium (around Cruces Creek), and Miocene and Upper Oligocene as well as lower Proterozoic formations in the area.

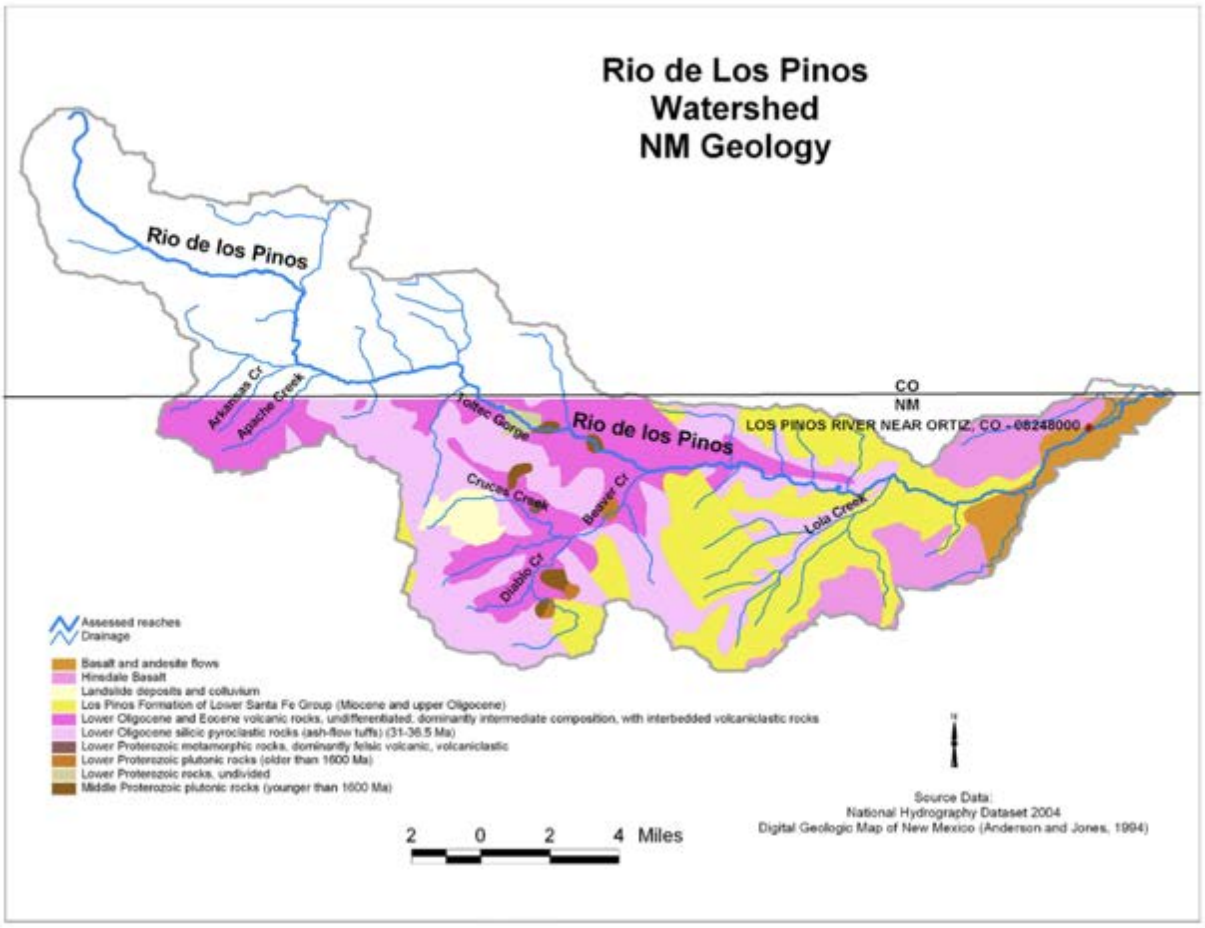


Figure 5: Geologic formations of the Cruces Basin Wilderness and surrounding areas. Source: San Antonio and Los Pinos Wetland Action Plan, NMED 2006.

1.3 Available Plant Inventories

The Cruces Basin overlaps with the highest level (B1-Outstanding) Important Plant Area, designated by the NM Rare Plant Conservancy Strategy (EMNRD 2024). Important Plant Area #9, the San Antonio Mountain Area is listed with a significance of 6.2 and three rare species present. The species in the San Antonio Mountain IPA are:

1. Astragalus ripleyi (FS sensitive, BLM sensitive, NatureServe S3, NM technical council rare list)
2. Lorandersonia microcephala (FS sensitive, NatureServe S2, NM technical council rare list)
3. Salix arizonica (FS sensitive, NatureServe S1, NM technical council rare list)

The plant list in Figure 6 was developed by Rio Grande Return during the Wetland Assessment conducted for this Plan in October 2023. This plant inventory was collected in order to give a general overview of the vegetation communities in Cruces Basin, which consists of spruce-fir

forests and subalpine meadows interspersed with aspen glades. The NM Environmental Review Tool (Appendix B, page 5) reported that Ripley Milkvetch (*Astragalus ripleyi*) is a NM Rare Plant Conservation Strategy Species found in the project area.

Engelman Spruce *(Picea engelmanii)*
Blue Spruce *(Picea pungens)*
Subalpine Fir *(Abies lasiocarpa)*
Limber Pine *(Pinus flexilis)*
Quaking Aspen *(Populus tremuloides)*
Narrowleaf Cottonwood *(Populus angustifolia)*
Willow species *(Salix spp)*
Silverbark Alder *(Alnus incanum)*
Wild Rose *(Rosa sp)*
Shrubby Cinquefoil *(Dasiphora fruticosa)*
Common Juniper *(Juniperus communis)*
Currant *(Ribes sp)*
Timothy grass *(Phleum pratense)*
Poa sp *(Probably Kentucky Blue Grass Poa pratensis)*
Carex spp
Juncus balticus
Other *Juncus* spp
Cattail *(Typha sp)*
Elodea *s*p
Gentian sp *(Gentiania sp)*
Corn Lily *(Veratrum californicum)*
Green Gentian *(Frasera speciosa)*
Wooly Cinquefoil *(Potentilla hippiana)*
Pussytoes *(Antennaria sp*

***Figure* 6:** Plant inventory collected during the Rio Grande Return Wetland Assessment in October 2023. Note, not intended to be a comprehensive species list but rather a general overview of the vegetative community.

The University of New Mexico Natural Heritage New Mexico Riparian Habitat Map (NMRipMap) categorizes the Cruces Basin Wetlands primarily as Montane Marshes and Wet Meadows; Montane Riparian Forest and Woodlands; Montane Dry Meadow and Grassland; and Montane Riparian Shrubland. The map breaks down the area into discrete segments and measures tree, shrub and herbaceous cover and provides a link to more information on each habitat type for each segment. This information can be found in detail here: https://nhnm.unm.edu/riparian/NMRipMap

1.4 Available Information on Threatened and Endangered Species

The Cruses Basin Wilderness area was entered as a project footprint into the New Mexico Environmental Review Tool (NMERT), which auto-generates a project report (Appendix B). The report provides a list of what threatened species that may be present in the Basin, and also provides NMDGF recommendations for mitigating impacts on wildlife during project implementation (Appendix B). Figure 7 displays the Special Status Animal Species Potentially within 1200 Meters of Project Area., which is also available in Appendix B.

Special Status Animal Species Potentially within 1200 Meters of Project Area

Common Name	Scientific Name	USFWS (ESA)	NMDGF (WCA)	NMDGF SGCN/SERI
Western Toad	Anaxyrus boreas	PS	E	SGCN
Boreal Chorus Frog	Pseudacris maculata			SGCN
Northern Leopard Frog	Lithobates pipiens			SGCN
Eared Grebe	Podiceps nigricollis			SGCN
Clark's Grebe	Aechmophorus clarkii			SGCN
American Bittern	Botaurus lentiginosus			SGCN
Peregrine Falcon	Falco peregrinus		T	SGCN
Mountain Plover	Charadrius montanus			SGCN
Flammulated Owl	Otus flammeolus			SGCN
Western Burrowing Owl	Athene cunicularia hypugaea			SGCN
Boreal Owl	Aegolius funereus		T	SGCN
Common Nighthawk	Chordeiles minor			SGCN
Black Swift	Cypseloides niger			SGCN
Lewis's Woodpecker	Melanerpes lewis			SGCN
Williamson's Sapsucker	Sphyrapicus thyroideus			SGCN
Olive-Sided Flycatcher	Contopus cooperi			SGCN
Bank Swallow	Riparia riparia			SGCN
Pinyon Jay	Gymnorhinus cyanocephalus			SGCN
Clark's Nutcracker	Nucifraga columbiana			SGCN
Pygmy Nuthatch	Sitta pygmaea			SGCN
Western Bluebird	Sialia mexicana			SGCN
Mountain Bluebird	Sialia currucoides			SGCN
Loggerhead Shrike	Lanius ludovicianus			SGCN
Gray Vireo	Vireo vicinior		T	SGCN
Virginia's Warbler	Leiothlypis virginiae			SGCN
Grace's Warbler	Setophaga graciae			SGCN
Vesper Sparrow	Pooecetes gramineus			SGCN
Brown-Capped Rosy-Finch	Leucosticte australis			SGCN
Cassin's Finch	Haemorhous cassinii			SGCN
Evening Grosbeak	Coccothraustes vespertinus			SGCN
Rainbow Trout	Oncorhynchus mykiss			SERI
Brown Trout	Salmo trutta			SERI
Brook Trout	Salvelinus fontinalis			SERI
Spotted Bat	Euderma maculatum		T	SGCN
American Pika	Ochotona princeps			SGCN
Gunnison's Prairie Dog	Cynomys gunnisoni			SGCN
Black Bear	Ursus americanus			SERI
Pacific Marten	Martes caurina		T	SGCN

New Mexico Department of Game and Fish
Project ID: NMERT-3081

Special Status Animal Species Potentially within 1200 Meters of Project Area

Common Name	Scientific Name	USFWS (ESA)	NMDGF (WCA)	NMDGF SGCN/SERI
Mountain Lion	Puma concolor			SERI
Elk	Cervus canadensis			SERI
Mule Deer	Odocoileus hemionus			SERI
Pronghorn	Antilocapra americana			SERI

ESA = Endangered Species Act, C = Candidate, LE = Listed Endangered, LT = Listed Threatened, XN = Non-essential Experimental Population, for other ESA codes see this website: https://nhnm.unm.edu/node/1378928; WCA = Wildlife Conservation Act, E = Endangered, T = Threatened; SERI = Species of Economic and Recreational Importance; SGCN = Species of Greatest Conservation Need.

Figure 7: Special Status Animal Species from the New Mexico Department of Game and Fish Project ID: NMERT-3081. Page 4 and 5 of Appendix B. (Note that the Western Toad Status of PS means: Partial Status-Species has status in only a portion of the species' range.)

While not federal or state threatened, beavers are important ecosystem engineers that are present in the project area. Beavers accomplish the work of wetland restoration and creation naturally and for free. Any restoration that can encourage their health and continued occupancy in the area will increase wetland protection and preservation into the future. The eastern part of the project area currently has active beaver populations. Field and geospatial survey results from the Wetland Assessment beaver verifies the presence of beaver in the Cruces Basin (Figure 8). Photos from the Wetland Assessment for this Plan also confirm Beaver presence (Figure 9).

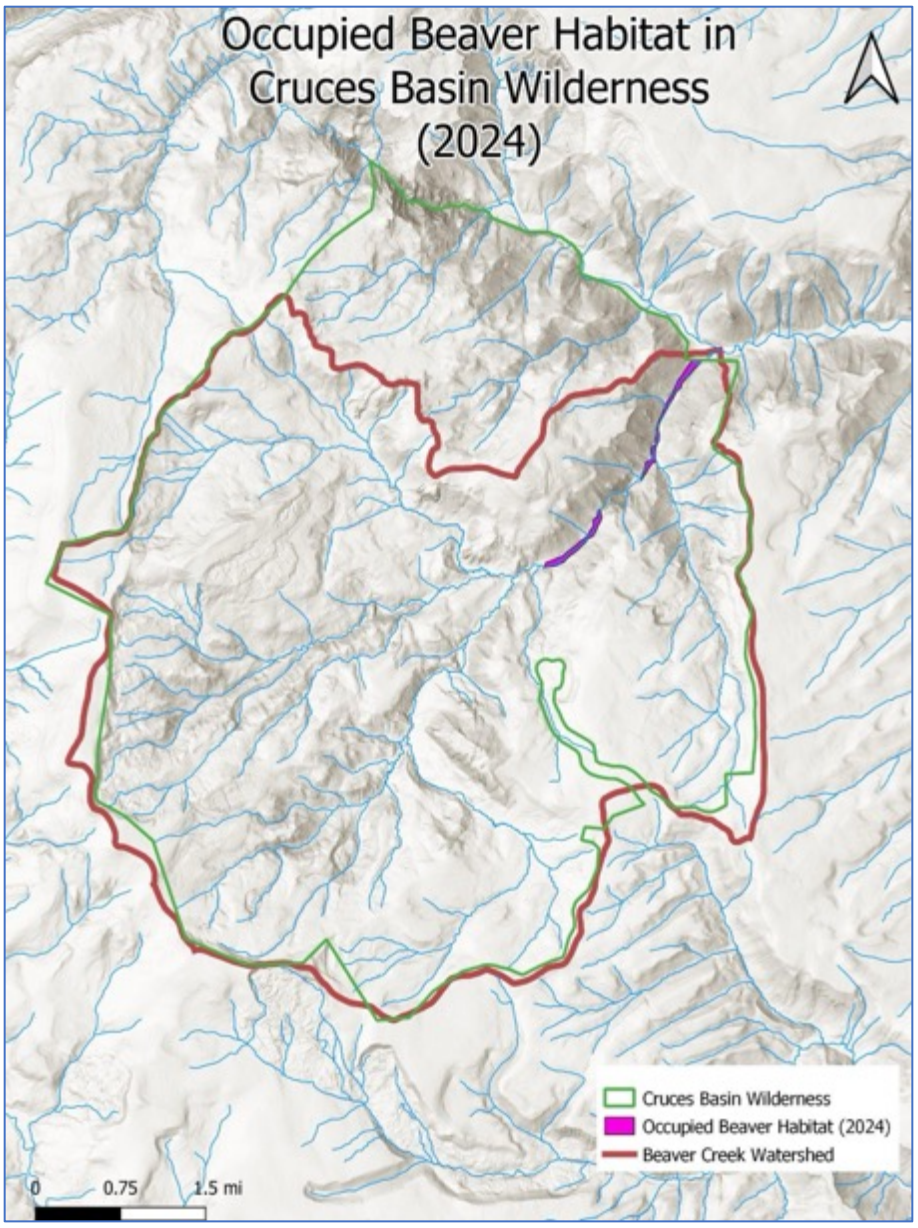
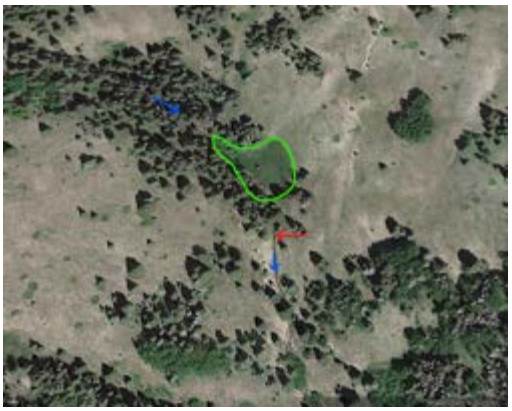


Figure 8: Occupied Beaver Habitat in Cruces Basin Wilderness based on field and geospatial survey results. From Appendix C, Rio Grande Return, 2024.

Most Upstream beaver dam in Cruces Basin Wilderness, Beaver Creek

Main Beaver Dam, Beaver Creek

Valley Wide Beaver Pond, Beaver Creek



Old beaver pond, Beaver Creek headwaters

Figure 9: Current beaver dams and ponds and evidence of beavers in the Cruces Basin Wilderness.

1.5 National Wetlands Inventory and Recent Mapping of Cruces Basin

1.5.1 Recent Mapping of Cruces Basin

On December 15, 2010 the New Mexico Water Quality Control Commission (WQCC) approved the statewide designation of Outstanding National Resource Waters (ONRW). The designation included 29 lakes, 192 perennial streams, and approximately 1,430 wetlands with a total area of 4930 acres. ONRW wetlands in New Mexico were mapped by the US Fish and Wildlife Service National Wetlands Inventory (NWI) Regional Coordinator and are available in GIS format. Wetlands identified in U.S. Forest Service (USFS) Wilderness Areas were designated as ONRW wetlands. ONRW's are considered under the Clean Water Act (CWA) as "high quality" or Tier 3 waters, and are provided the highest level of protection under the anti-degradation policy. The policy provides for protection of water quality in high-quality waters that constitute an ONRW by prohibiting the lowering of water quality. The US EPA interprets this provision to mean no new or increased discharges to ONRWs and no new or increased discharge to tributaries to ONRWs that would result in lower water quality in the ONRWs. Cruces Basin Wilderness

wetlands were mapped in 2014 by Keystone Restoration Ecology for the New Mexico Environment Department for an ONRW best practices review (Figure 10; Keystone Restoration Ecology, 2014).

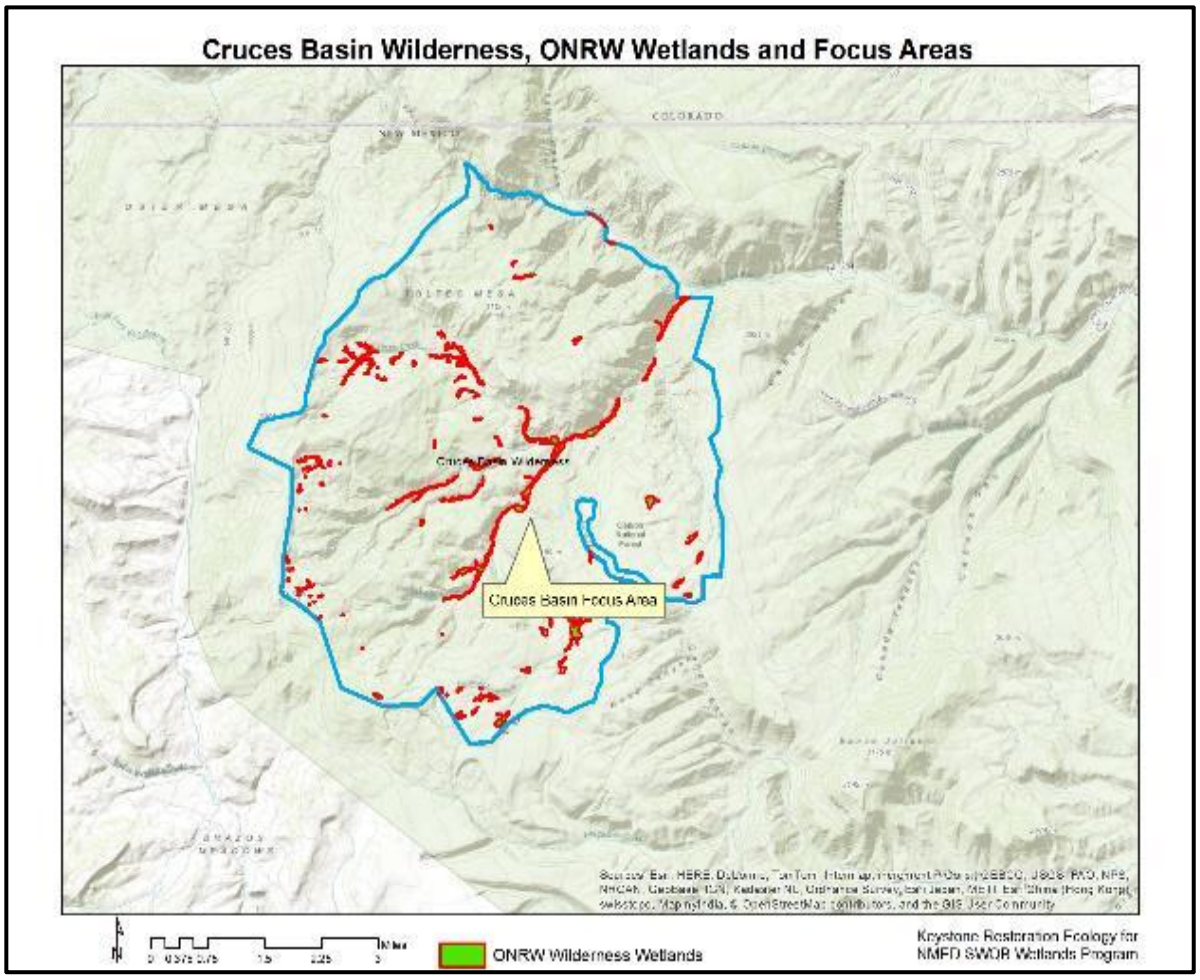


Figure 10: Cruces Basin ONRW Wetlands (Keystone Restoration Ecology, 2014). From the document: "Review of the USFS Best Management Practices for Outstanding National Resource Waters Wilderness Wetlands". The report was prepared for New Mexico Environment Department Surface Water Quality Bureau.

Interactive mapping on the Amigos Bravos Wetland Jewel Website provides a hands-on way to see photos of the different sections of wetlands and a discussion on the wetland functions including streamflow maintenance, carbon sequestration, and surface water detention (Amigos Bravos, 2015).

The Cruces Basin wetlands have also been identified by Natural Heritage New Mexico as a Riparian Conservation Opportunity Area (RCOA). They identified all of the tributaries in the Wilderness Area, as rated "A" or "B", meaning the segment has the highest or second highest rating (out of 4 categories) in terms of the amount of natural area, biodiversity, and restoration potential. The Riparian Conservation Opportunity Area mapping tool is available here: https://nhnm.unm.edu/RCOAs

1.5.2 National Wetlands Inventory

Wetlands in the Cruces Basin Wilderness were mapped for the National Wetlands Inventory (NWI) in approximately 2010. The 2010 mapping was the basis for the ONRW wilderness wetlands, and for the Amigos Bravos Wetland Jewels. The New Mexico Environment Department Wetlands Program is currently updating wetland mapping for wilderness areas with Saint Mary's University of Minnesota GeoSpatial Services. Draft NWI mapping shared by GeoSpatial Services in July 2024 indicates that the primary revisions to the 2010 mapping include an increase in wetland acreage, and recoding (Cowardin, 1979) the majority of PEM1A (palustrine emergent persistent temporarily flooded) wetlands as PEM1B (palustrine emergent persistent saturated) to reflect the understanding that they are saturated wetlands deriving moisture from snowmelt and groundwater rather than overbank flooding from creeks.

The Fish and Wildlife Service National Wetland Inventory (NWI) from 2010 shows limited wetlands in the project area (Figure 11). The Keystone Restoration mapping from 2014 shows substantially more wetlands (Figure 10, section 1.5.1 of this document) and the 2024 NWI mapping again improves upon mapping accurate levels of wetlands in the Cruces Basin (Figure 12).

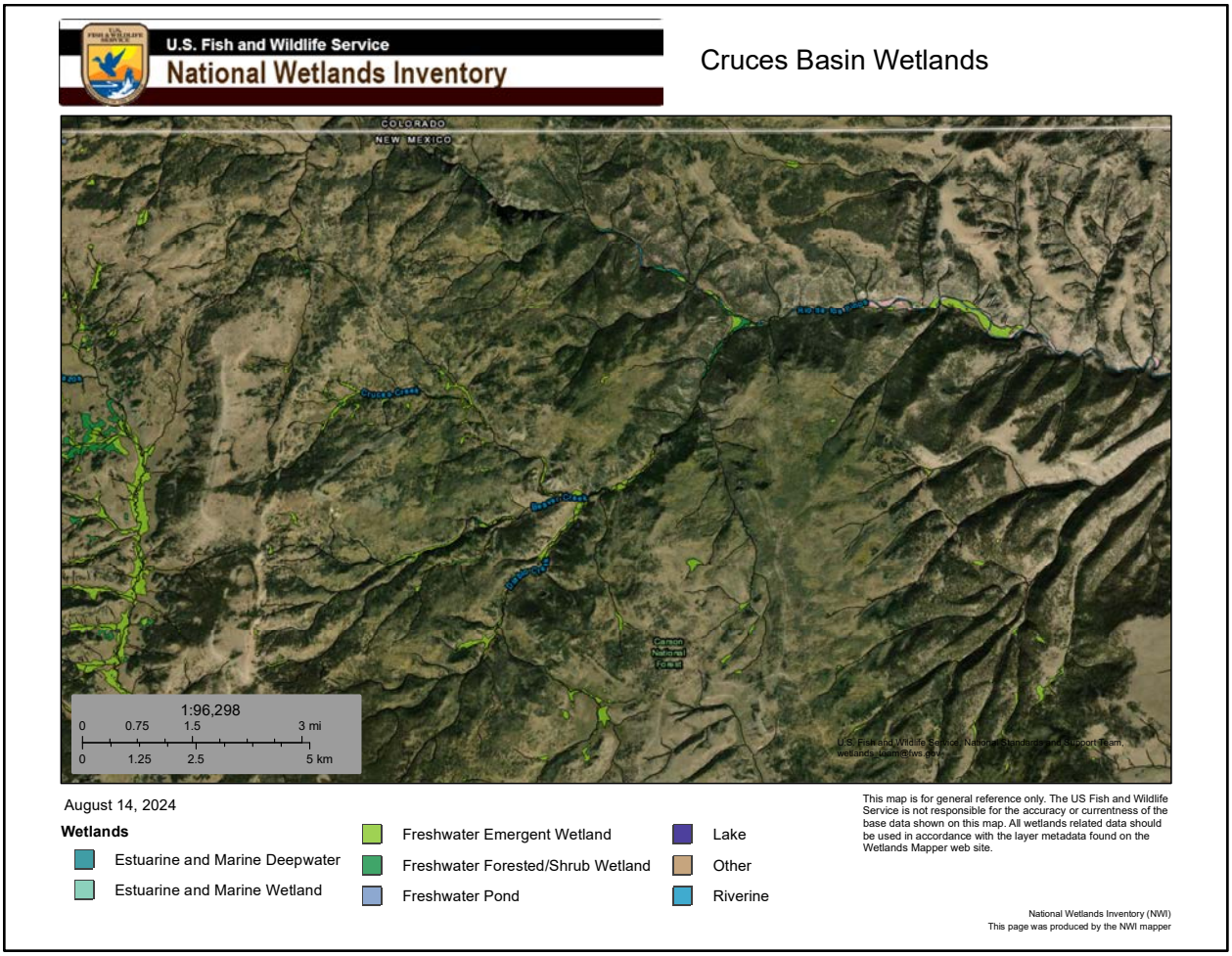
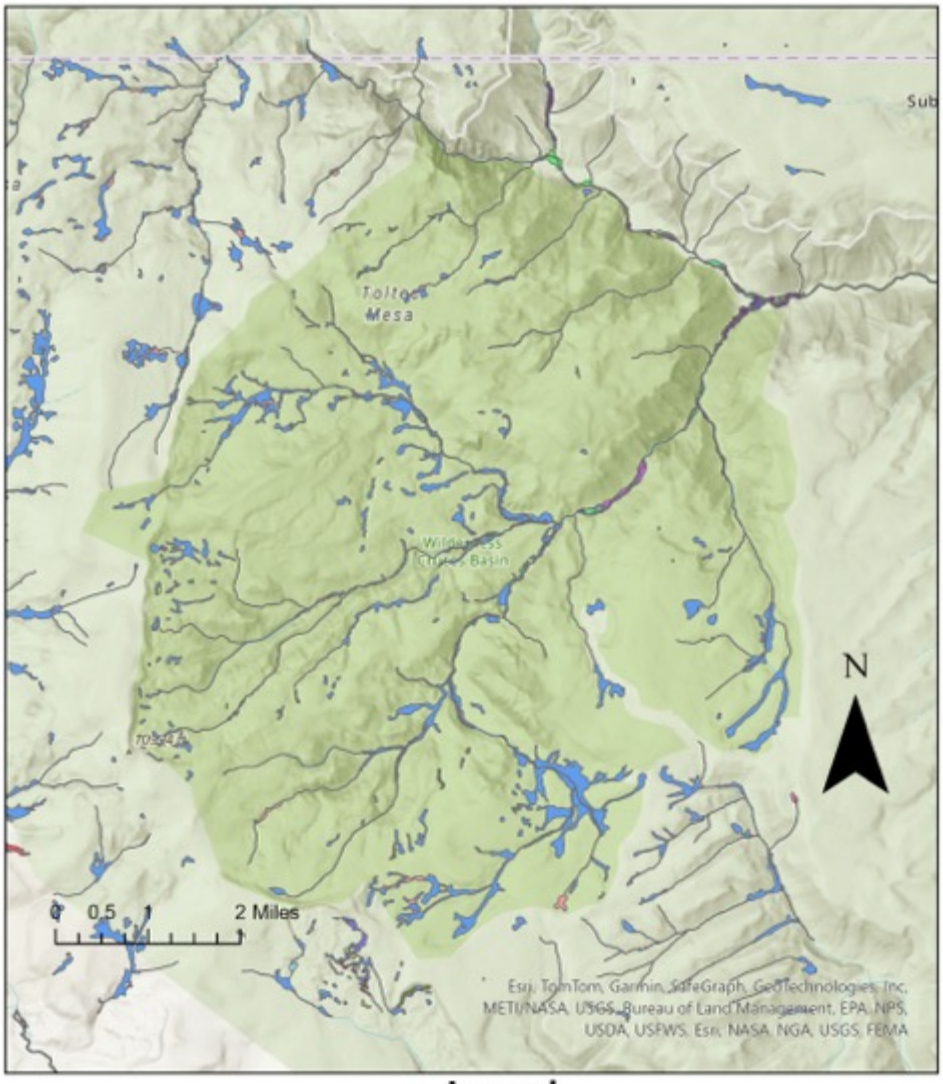


Figure 11: U.S. Fish and Wildlife Service National Wetland Inventory Map from 2010. https://www.fws.gov/program/national-wetlands-inventory

Draft NWI Wetland Update 2024



Legend

WetlandData

NWI

- PEM1A
- PEM1Ah
- PEM1B
- PEM1C
- PEM1Cb
- PEM1D
- PEM1Eb
- PEM1Fb
- PFO1A
- PFO1B
- PFO4A
- PFO4B
- PSS1A
- PSS1B
- PSS1C
- PSS1Cb
- PUBF
- PUBFb
- PUBFh
- PUBFx
- PUSCx
- R3RBH
- R3USA
- R4SB3A
- R4SB3C
- R4SB3J
- R4SB7A
- R4SB7C
- R4SB7J
- <all other values>

Figure 12: U.S. Fish and Wildlife Service National Wetland Inventory Map from 2024. Created by Rio Grande Return in 2024.

Chapter 2: Wetland Assessment

2.1 Classification of Local Wetland Types

Water resources in the basin include headwater slope wetlands and riverine wetlands along four creeks: Beaver, Cruces, Diablo and Escondido (Rio Grande Return, 2024). Draft NWI mapping shared by GeoSpatial Services in July 2024 indicates that the primary revisions to the 2010 mapping include an increase in wetland acreage, and recoding (Cowardin, 1979) of the majority of PEM1A (palustrine emergent persistent temporarily flooded) wetlands as PEM1B (palustrine emergent persistent saturated) to reflect the understanding that they are saturated wetlands deriving moisture from snowmelt and groundwater rather than overbank flooding from creeks. PEM1B is the most abundant wetland type throughout the basin. Small sections are coded as PEM1A or PEM1C (palustrine emergent persistent seasonally flooded) where the creeks provide overbank flooding during spring runoff. Lower Beaver Creek is dominated by PSS (palustrine scrub shrub) and PFO (palustrine forested) where there are beaver dams that inundate the floodplain and support the growth of riparian shrubs and trees. Beaver ponds along lower Beaver Creek are coded as PUBFb (palustrine unconsolidated bottom semi-permanently flooded beaver). There are also five small stock ponds in the Wilderness coded PUBFh (palustrine unconsolidated bottom semi-permanently flooded diked/impounded).

According to the Landscape Position, Landform, Water Flow Path, Water Body Type (LLWW) classification system (Tiner, 2011), most of the wetlands in Cruces Basin Wilderness are TESLOU (terrene slope outflow) with various modifiers, most commonly ds (discharge stream) and hw (headwater) or ST2TI (stream middle gradient throughflow intermittent). The beaver ponds PD4TI (pond beaver throughflow intermittent). The stock ponds are PD2aTHhi (pond dammed/impounded agricultural severely human-induced).

As described by the Hydrogeomorphic classification system (Brinson, 1993), most wetlands in the Cruces Basin are in the Slope Class. The second most abundant are in the Riverine class. The beaver dams and stock ponds are in the Depressional Class. HGM classes are inferred because the draft updated data was not coded yet for HGM.

2.2 Identification of Wetland functions and Ecosystem Services

The Amigos Bravos Wetland Jewel program assessed Wetland Functions in the Cruces Basin in 2015. Wetland Jewels can be comprised of either a single wetland or a complex of several wetlands occurring in a discrete geographic area of national forest lands. Single and complexes of wetlands identified by Amigos Bravos mapping in 2015 provide several important ecological functions to the terrestrial and aquatic landscape (Figure 13). The Cruces Basin was identified as one of these Jewels because it includes Wetlands that create habitat for wildlife, provide clean water for downstream communities, mitigate the risk of flooding, increase landscape resiliency in the event of wildfire, and maintain stream flow essential for irrigation along with wildlife and livestock forage.

The following wetland functions, or wetland characteristics that contribute to wetland functionality, were chosen as priority wetland functions for the Wetland Jewel project:

Wetland Functions Table

Wetland Jewels - Carson National Forest

1. Aquatic Invertebrate Habitat	Provides an indication of a wetland's capacity to support an abundance and diversity of freshwater invertebrates that spend all of part of their life cycle underwater or in moist soils.
2. Carbon Sequestration	Measures a wetland's ability and effectiveness at retaining particulate and inorganic carbon, along with converting carbon dioxide gas into organic carbon.
3. Coldwater Wetlands	Wetlands are associated with streams bearing cold water fish and invertebrate species.
4. Discharge Wetlands	Wetlands are characterized by either outflow or through-flow water paths and are contributing water to adjacent streams and rivers on a periodic or continuous basis.
5. Fish Habitat (includes Fish Shade function)	Provides an indication of a wetland's capacity to support an abundance of native fish species for functions other than spawning (e.g. cover/refugia, foraging, and connectivity).
6. Headwater wetlands	Wetlands are associated with first and second order perennial and intermittent streams according to the Strahler stream classification system.
7. Impaired Wetlands	Wetlands are associated with known impaired streams as identified through the spatial intersection of wetland boundaries with impaired streams data.
8. Spring-fed Wetlands	Wetlands where the primary water supply is from a groundwater source in the form of either springs or seeps. Springs can be wholly contained within the wetland or positioned upslope so as to provide surface flow into the wetland.
9. Streamflow Maintenance	Measures a wetland's ability and effectiveness to support the natural regime of the following four water sources: groundwater fluctuations, interflow through soil, precipitation events, and surface runoff.

10. Surface Water Detention	Measures a wetland's ability and effectiveness to store water (long or short term) or delay the down-gradient movement of surface water.

Figure 13: Priority wetland functions for the Wetland Jewel project (Amigos Bravos, 2015)

A ranking process was devised based upon whether or not a particular wetland provided a function. For each function a wetland provided, a value of "1" was assigned; a total function rank was generated by summing these individual values. Amigos Bravos, Western Environmental Law Center, and Geospatial Services at St. Mary's University of Minnesota identified priority wetland functions and conducted a spatially-based query on these priority functions on all wetlands in the Carson National Forest.

Through a visual review of the ranked wetland data, ten areas of interest, including the Cruces Basin, were identified for:

- Having multiple wetlands with a high number (>3) of wetland functions
- Containing wetlands that could provide a function within a unique landscape
- Holding a large wetland complex with varying levels of functionality
- Having strong regional significance

Wetland Functions found through the Wetland Jewels process described above in the Cruces Basin include: streamflow maintenance, carbon sequestration, headwater, surface water detention, cold-water habitat, and fish shade (Amigos Bravos, 2015).

2.3 Baseline Assessment and Photo Documentation of Wetland Condition

The 2014 ONRW report by Keystone Restoration for the NMED states: "The Tres Piedras Office provided a 2009 Riparian Assessment, Field Reconnaissance report that states Cruces Creek suffered from some ungulate trampling, livestock trailing and streambank grazing on 10% of the creek banks (Keystone Restoration Ecology, 2014). The 2012 and 2013 Annual Operating Instructions (AOIs) analyzed in the report both mention the need for rest on Cruces Creek and limiting that pasture to trailing only (no grazing).

Rio Grande Return assessed wetlands in the Cruces Basin Wilderness for this Plan to evaluate existing conditions. Rio Grande Return developed the assessment protocol in ArcGIS Survey123 in October 2023 and completed it in August 2024. The survey consisted of collecting georeferenced points which identified water resource impairments, describing them by location (upland, riverine, wetland, etc), impairment type (headcut, channel incision, browse/ graze, etc), and identifying whether restoration materials (e.g. rocks, trees) are available nearby. This data can be visualized in an ArcGIS Story Map, which is available here: https://storymaps.arcgis.com/stories/78c812f374134d08b172b1013941529f. The full wetland assessment report including detailed descriptions of the assessed reaches is available in Appendix C.

Details on the assessment of each of these reaches is described in detail in Chapter 3. River sections are shown in detail in Figure 14. The 2024 Wetland Assessment by Rio Grande Return captured the following baseline photographic documentation of the wetland condition (Figure 15).

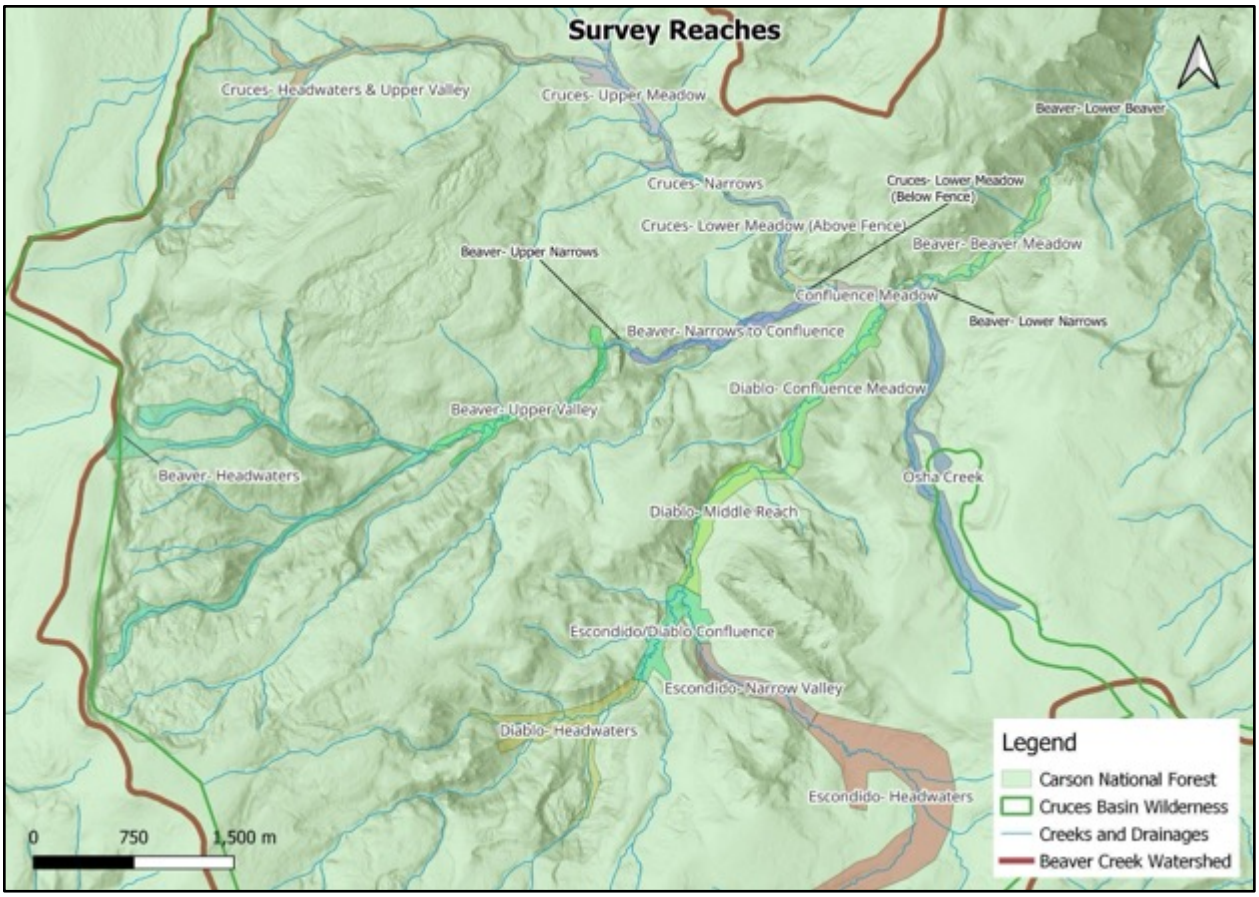


Figure 14: Map of the assessed reaches in the Cruces Basin completed by Rio Grande Return (Appendix C).

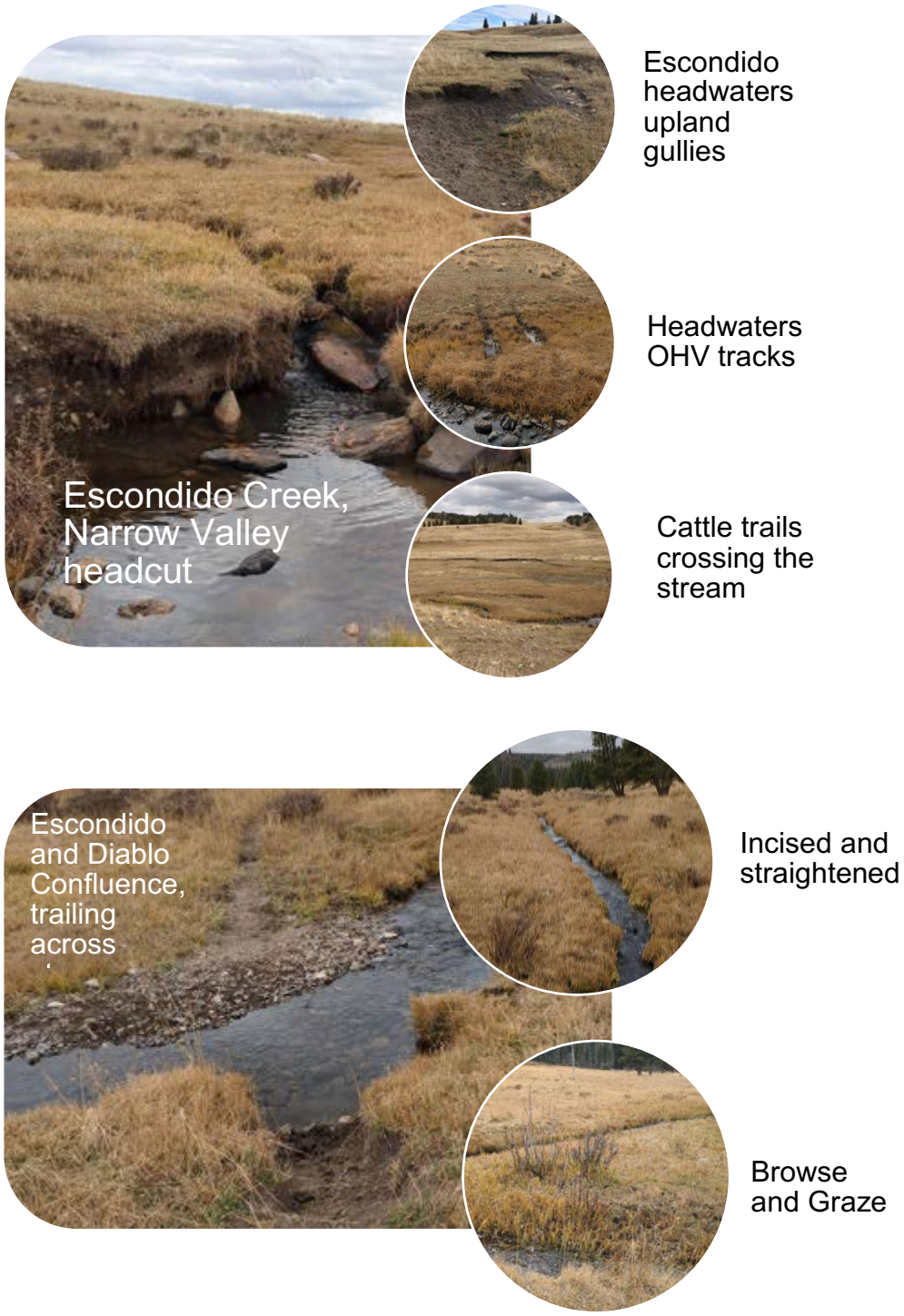


Figure 15: Photo Credit Peter Watson. Multiple photos of baseline conditions of the Cruces Basin wetlands. All photos used are available in the Cruces Basin Wilderness Story Map created by Rio Grande Return.

2.4 Location of Wetland Reference Sites

Reference conditions are considered the natural or minimally anthropogenically disturbed state of the landscape. Reference conditions for creeks and wetlands in Cruces Basin Wilderness include creeks that are connected to their floodplains rather than being incised, and slope wetlands that are vegetated with hydrophytic plants that are not channelized or eroded. The presence of beaver dams and beaver habitat comprised of riparian woody vegetation along streams is considered a reference condition. Reference conditions in the Wilderness were most commonly found in areas where ungulate access was restricted by topography (Rio Grande Return, 2024).

Lower Beaver Creek is a broad meadow that is protected from cattle grazing by a steep, impassable gorge upstream and private land boundaries downstream (Figure 16). Geospatial analysis shows that it is beaver-dominated with healthy riparian shrubland growing in the floodplain. Without collaboration with private landowners, this reach is inaccessible for restoration work but provides a suitable reference reach for the rest of the watershed.

Figure 16: Lower Beaver Creek reference site photographs taken in October 2023 by Peter Watson, Rio Grande Return during the Wetland Assessment (Appendix C).

2.5 Identification of Threats and Impairments

The Wetland Assessment by Rio Grande Return analyzed impairments to the project area. Impairments refer to the ways in which the landscape is stressed or damaged. The most common impairment identified is “channel incision” of the creeks (Figure 17). “Head cuts and active erosion” is the second most common impairment. The “None” Category was recorded where the point was mapped for another reason, such as to indicate the location of a historic or active beaver dam. “Grazing and browse” was documented where plants were observed to be eaten by ungulates (i.e. elk and cattle). Historic road or trails drainage issues were documented where the trails cause erosion at creek crossings. “Bank erosion or hoof shear” refers to sites where hoof marks were visible as the cause of degrading creek banks or wetlands. “Diversion of channel by road or trail” is where flow has been captured by a human or animal-created path. “Recreation” is a human-caused issue such as a camping spot or parking area that is causing a sediment problem. “Other” is used when an issue does not clearly fit into another category (Figure 17).

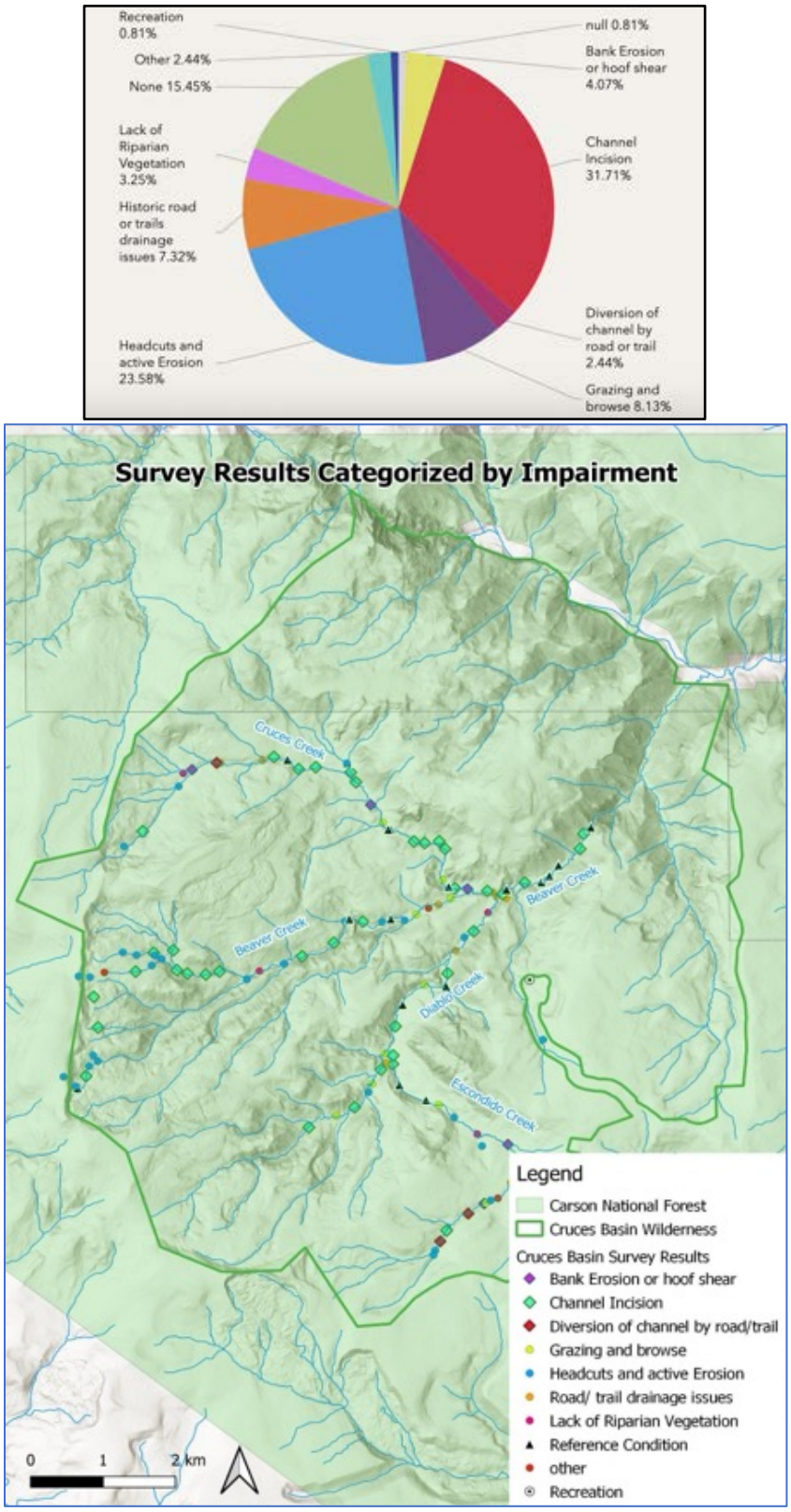


Figure 17: Impairments by percentage and in map form in the Cruces Basin Wilderness documented by Rio Grande Return during the Wetland Assessment (Appendix C).

Chapter 3: Wetland Restoration Prioritization and Actions

3.1 Prioritization of Sites for Restoration

Rio Grande Return assessed wetlands in the Cruces Basin Wilderness and evaluated possible restoration techniques to address impairments and available materials that could be used to conduct restoration in a Wilderness setting (Appendix C). Options for wetland and river restoration are limited in a Wilderness area by the prohibition of motorized vehicles and the creation of permanent structures. Restoration activities must either rely on locally sourced materials that are administratively cleared to allow harvesting, or materials must be transported in by humans, pack animals, or helicopter. Restoration must be conducted using human labor, without heavy equipment. Fortunately, low tech process-based restoration methods (PBR) are compatible with these limitations. Low tech PBR can be implemented with rocks, sediment, sod and logs, using hand tools such as shovels and axes. The map below (Figure 18) shows where these materials are available in Cruces Basin Wilderness. In addition to the impairments identified, the availability of materials is an important consideration in deciding which sites to prioritize for restoration.

Another consideration when employing process-based restoration techniques that involve beaver mimicry (Beaver Dam Analogs, large woody debris) is proximity to active beaver colonies that can colonize project sites. Beavers are active in the Beaver Meadow reach of Beaver Creek, as well as in Lower Beaver. Beaver sign (e.g. beaver dam or chew) from the last 10-15 years was documented as far upstream as the Narrows reach of Cruces Creek. Additionally, the presence of intact willow stands is a key factor when prioritizing areas to implement beaver mimicry work because colonizing beavers will need a sufficient food source to establish a self-sustaining colony. In a non-wilderness setting, this is accomplished through riparian planting and exclosures.

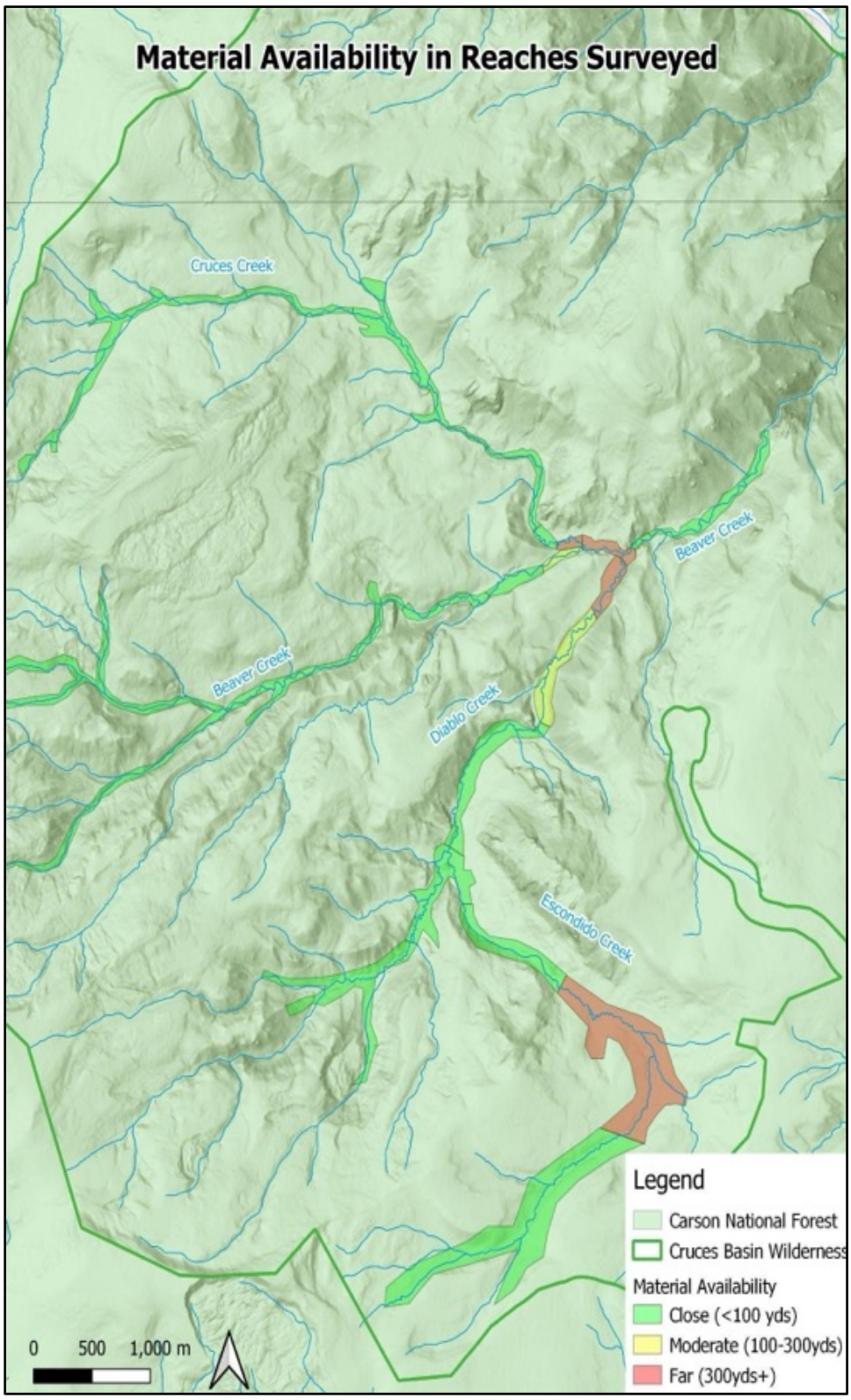


Figure 18: Material Availability (rocks, trees, sediment, etc) in the Cruces Basin Wilderness, for use in prioritizing restoration locations. Source: Rio Grande Return Wetland Assessment Report 2024, Appendix C.

3.2 Development of Measures to Protect Wetlands (Restoration Toolbox)

Restoration techniques listed below could be used in the Cruces Basin Wilderness to restore slope wetlands by arresting erosion and spreading water, and to restore riverine wetlands and creek channels by raising the water table to reconnect the creeks with their floodplains. Techniques listed below will also add complexity and structure to streams to improve fish, invertebrate, and amphibian habitat. Three examples of detailed restoration techniques with photos are shown below. Assisted Log Structures, One-Rock Dams, and Log Flow Splitters will be the most abundant techniques used and therefore are shown in detail below. For full descriptions of each technique in the list, see Appendix C.

Restoration Techniques Recommended:

- *Beaver Dam Analogs (BDAs)*
- *Assisted Log Structures (ALS)*
- *Log Flow Splitter*
- *Zuni Bowl*
- *One-Rock Dam (ORD)*
- *Log Step Falls*
- *Media Luna*
- *Grazing management*
    - *Pasture fence repair, drift fences*
- *OHV barriers*
- *Road Drainage Improvement*
- *Stream Crossing improvement/Armoring*

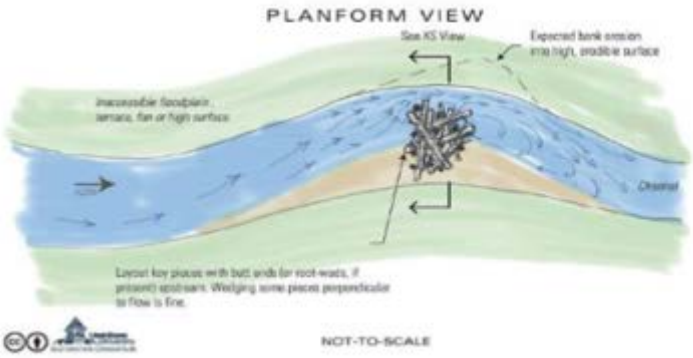
Process-Based Restoration for Wilderness Applications

Restoration Tool Fact Sheet: (p.1/3)

Assisted Log Structure (ALS)

Restoration Tool Name and Purpose:

Assisted Log Structures or Post-Assisted Log Structures (ALS/PALS): Low-tech process-based restoration to enhance floodplain connectivity.



Planform view of a Bank-Attached ALS (Wheaton et. al. 2019)

Application & Function:

These structures are used to address lack of complexity, lack of large woody debris, incision, and straightened channels in wadeable streams. They mimic the accumulation of large woody debris which induces anabranching and meandering, increases channel complexity, and promotes floodplain connectivity.

Technical Description:

ALS/PALS consist of large woody material such as tree crowns, saplings, and root wads that are tangled together and placed in the channel. The structure can be anchored to the bed by use of untreated wooden posts (PALS) or wedged into the stream channel, boulders, or streamside trees and roots (ALS) They can be built in a variety of sizes and channel locations. These include mid-channel and bank-attached.

PALS that has accumulated woody debris after several years. Note sandbar development and side channel pool habitat forming downstream (P. Watson 2023)

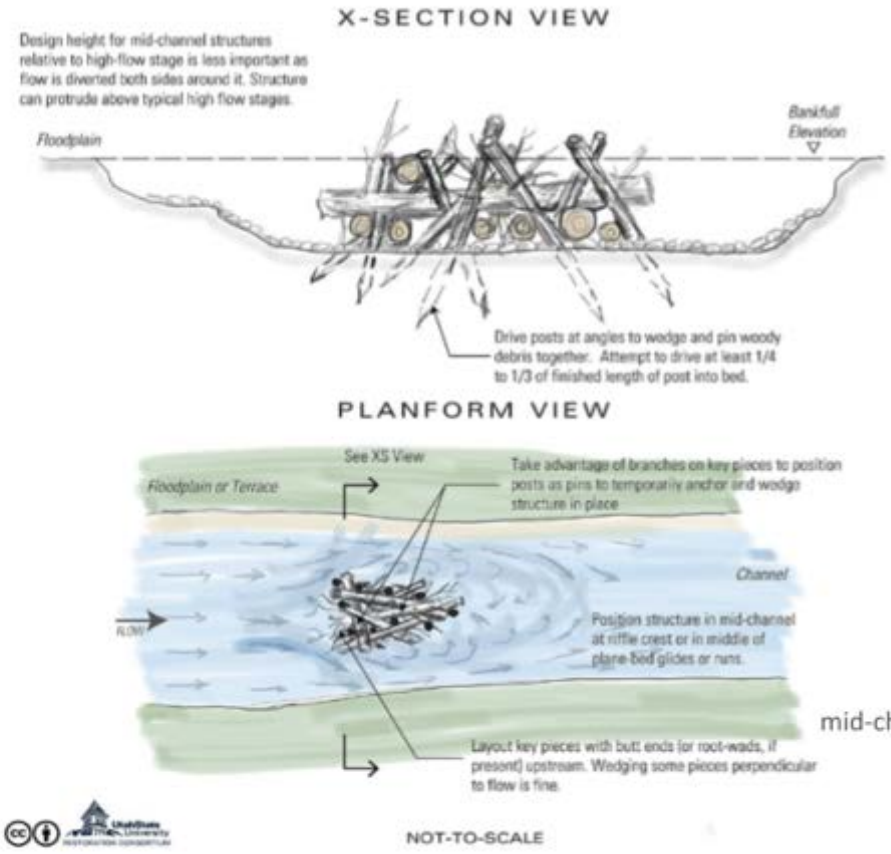
Restoration Tool Fact Sheet: (p. 2/3)

Assisted Log Structure (ALS)

Mid-channel ALS promote anabranching, bar development, and plunge pool formation. Bank-attached ALS increase meander radius and form scour pools. Bank-attached ALS are constructed on developing point bars at a width of 80-95% of low-flow channel width, to constrict water and create hydraulic pressure against the opposite bank. They do not exceed bankfull height. Mid-channel ALS are constructed at or above bankfull height and direct water around either side to encourage bar formation and anabranching. If posts are used to create a PALS, they should be driven into the bed up to ⅓ their length, and at an angle to pin down the woody material. These structures may naturally float away over time and rack up on a downstream log jam, which is within design parameters to increase woody debris accumulation.

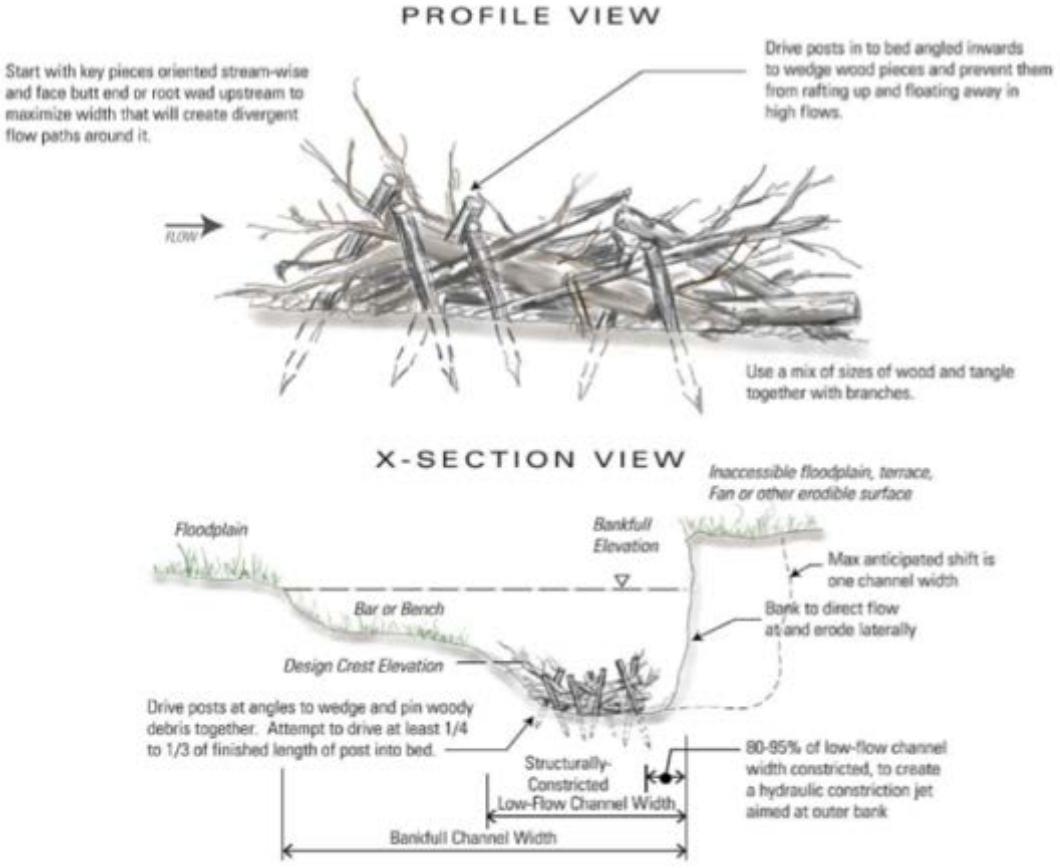
Installation and Staging:

Materials are sourced on-site. Installation will be performed as specified by Wheaton et. al. 2019: Low-Tech, Process-Based Restoration of Riverscapes.



Schematic of a mid-channel ALS (Wheatc et. al. 2019)

Assisted Log Structure (ALS)



Schematic of a bank attached ALS
(Wheaton et. al. 2019)

References:

NRCS. 2023. Conservation Enhancement Activity E643D. United States Department of Agriculture. https://www.nrcs.usda.gov/sites/default/files/2023-10/E643D-Apri-_2023-fy24-new.pdf

Wheaton J.M., Bennett S.N., Bouwes, N., Maestas J.D. and Shahverdian S.M. (Editors). 2019. Low-Tech Process-Based Restoration of Riverscapes: Design Manual. Version 1.0. Utah State University Restoration Consortium. Logan, UT. 286 pp. DOI: 10.13140/RG.2.2.19590.63049/2.

Process-Based Restoration for Wilderness Applications

Restoration Tool Fact Sheet: (p. 1/2)

Log Flow Splitter

Restoration Tool Name and Purpose:

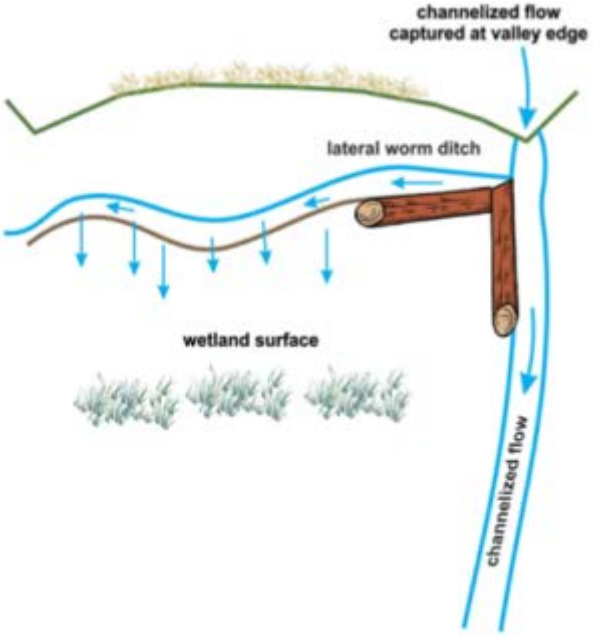
Where the channel is not deeply incised, log flow splitters spread water across the landscape instead of flowing only in the channel.

Application & Function:

Log flow splitters are used to divert flow around an active headcut, re-wet a drying slope wetland, or to spread flow across the landscape in the context of keyline design. Zeedyk et. al. (2014) identifies them as good structures to use in conjunction with worm ditches.

Technical Description:

The logs used to construct the flow splitter are set into a trench dug in the desired orientation. They are reinforced with rocks or sod that was dug up when constructing the trench. An important consideration is creating a gently sloped lead out from the flow splitter that does not cause new channelization.



A log flow splitter being used in conjunction with a worm ditch to re-wet a wetland surface (Zeedyk et al. 2014)

Process-Based Restoration for Wilderness Applications

Restoration Tool Fact Sheet: (p. 2/2)

Log Flow Splitter

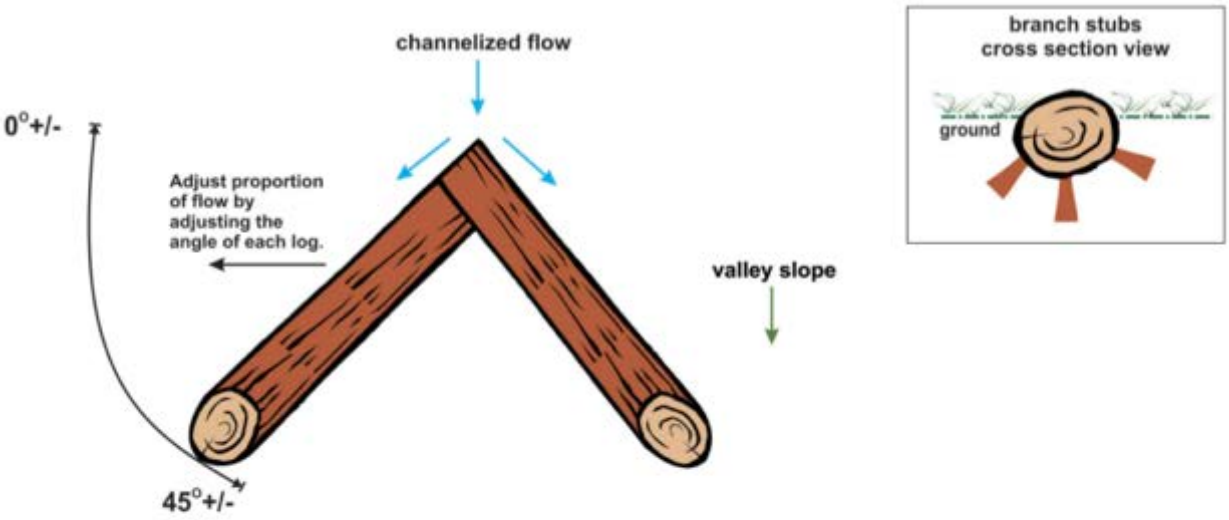


Diagram of the construction of a log flow splitter (Zeedyk et. al 2014)

Installation and Staging:

Onsite materials are used for these structures. Logs can be harvested near the site with proper permission and clearances.

References:

Zeedyk, B., Walton, M., Gadzia, T. 2014. Characterization and Restoration of Slope Wetlands in New Mexico. Quivira Coalition: Santa Fe

Process-Based Restoration for Wilderness Applications

Restoration Tool Fact Sheet: (p. 1/2)

One Rock Dam

Restoration Tool Name and Purpose:

A One Rock Dam is a grade control structure used to prevent a gully from becoming eroding deeper.

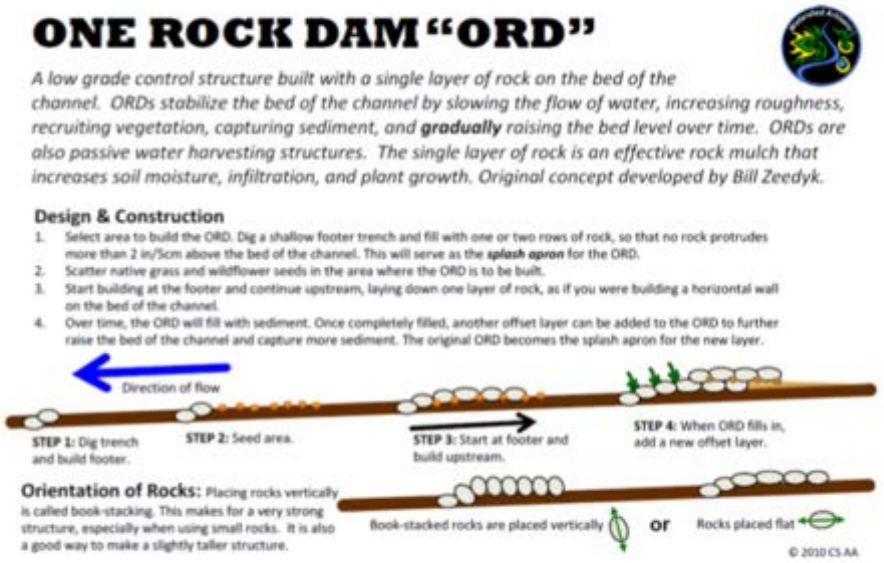
Application & Function:

One rock dams are typically used in ephemeral channels to stabilize the grade. By armoring and raising the channel by a height of one rock, they harvest water and sediment, providing substrate for vegetation that further stabilizes the channel.

One Rock Dam Schematic. Figure from Sponholtz and Anderson (2013)

Technical Description

A One Rock Dam is constructed of many rocks but is only one-rock high. Rocks are not not stacked. Rocks are placed in several, parallel rows across a gully floor or channel and packed tightly together. A row of rocks should be of equal height and appear relatively flat or level from bank to bank. Rocks should be selected, sized, and placed so that the completed structure ends up relatively level from bank to bank and flat from the upstream edge to the downstream edge. This can be accomplished by placing larger rocks in the deepest part of the channel, and smaller ones to either side.



One Rock Dam Guidelines for Construction. Figure from Sponholtz and Anderson (2013)

Installation and Staging:

All material is sourced on site and can be transported and placed by hand. Installation will be done according to Sponholtz and Anderson (2013).

References:

Zeedyk, B. and J. W. Jansens. 2009. An introduction to erosion control. 3rd edition. Joint publication from Earth Works Institute, The Quivira Coalition, and Zeedyk Ecological Consulting.

Zeedyk, B. & Clothier, V. 2009. *Let the Water do the Work*. Quivira Coalition, Santa Fe, New Mexico.

Sponholtz, C. and A.C. Anderson. 2013. Erosion Control Field Guide. Quivira Coalition and Watershed Artisans

3.3 Development of Measures to Reduce Chronic and Cumulative Impacts to Wetlands

OHV Management: Multiple instances of OHV trespass into the wilderness were observed during the Wetland Assessment. The wilderness is bordered by roads and large, broad meadows, making it easy for OHV users to intrude inside its boundaries. Work has recently been done to address OHV incursion issues, including installing a vehicle barrier at the main trailhead and improving signage at various locations. Based on where OHV incursion was observed, a follow-up step to this work would be installing more vehicle barriers on old roads leading off Forest Road 87 in the Escondido drainage.

Road and Trail Drainage Improvement: Several poorly drained, livestock and user-created trails exist in riparian areas inside the Wilderness. These drainage issues are causing sedimentation and gullying across the Wilderness. The Wilderness is surrounded on three sides by a dirt road (Forest Road 87), and there is a dirt road (Forest Road 572) leading to a trailhead within the wilderness. Both of these roads have severe drainage issues in places which are causing gullying of slope wetlands at the headwaters of Osha Creek and Beaver Creek. Road drainage work would be impactful in multiple areas surrounding the Wilderness, but ease of access for machinery is a consideration. For example, drainage work on Forest Road 87, while desirable due to its high potential to improve gullying in the Beaver Creek Headwaters, may not be practical due to the difficulty of transporting a machine on many miles of rough road. Road work on Forest Road 527 may be more feasible and would reduce runoff velocity onto the wet meadows forming the headwaters of Osha Creek. Trail drainage issues could be addressed by a hand crew.

Stream crossings damaged by user and livestock trails were observed to be ubiquitous in the Wilderness. These could be addressed by installing bridges, armored crossings, or in cases where the trail is in an undesirable location, drift fences to disperse livestock movement. The main Wilderness trailhead is located adjacent to an intact wet meadow, which is slowly being compacted by users parking their cars on it. A vehicle barrier could be installed to protect this wetland.

Livestock Grazing: Every pasture fence in the wilderness was observed to be severely damaged where cattle were drawn to water, leading to heavy impacts in riparian areas. Grazing pressure in wide, open riparian meadows preferred by cattle is severe. Repairing grazing infrastructure like pasture and drift fences as well as close collaboration with local ranchers and US Forest Service range personnel will be critical to the success of any restoration project.

3.4 Proposed Projects to Protect and Restore Wetlands

Concept Design for riparian wetland expansion to identify priority reaches for arresting head cuts and slowing gully formation, wetland acreage threatened by the head cut was weighed against difficulty to arrest the head cut. The headwater reaches of all the streams in Cruces Basin present opportunities to preserve wetland acreage by arresting numerous head cuts under three feet deep.

Rio Grande Return staff identified nine high priority reaches for treatment to expand riparian wetlands and halt incision of existing wetlands. These reaches are Beaver: Confluence Meadow, Beaver: Narrows to Confluence, Beaver: Headwaters, Diablo: Confluence Meadow, Escondido/ Diablo Confluence, Diablo, Headwaters, Cruces: Lower Meadow, Cruces: Upper Meadow, and Cruces: Headwaters. Our recommendation is to fund and implement a high resolution, watershed

scale project design focusing on these reaches. The table below lists reaches by name, recommended actions and whether they are a high, medium, or low priority for riparian wetland expansion. The table is organized alphabetically by name rather than by priority.

Reach Name	**Recommended Action**	**Priority**
Beaver: Lower Beaver	No Treatment	L
Beaver: Beaver Meadow	No Treatment	L
Beaver: Lower Narrows	No Treatment	L
Beaver- Confluence Meadow	Extend riparian wetland, beaver habitat expansion	H
Beaver: Narrows to Confluence	Extend riparian wetland, beaver habitat expansion	H
Beaver: Upper Narrows	No Treatment	L
Beaver: Upper Valley	Stabilize incision and head cuts in existing wetlands, extend riparian wetland, beaver habitat expansion	M
Beaver: Headwaters	Stabilize incision and head cuts in existing wetlands	H
Cruces: Lower Meadow	Stabilize incision and head cuts in existing wetlands, extend riparian wetland, beaver habitat expansion, address trailing damage to wetlands	H
Cruces: Narrows	No Treatment	L
Cruces: Upper Meadow	Stabilize incision and head cuts in existing wetlands, extend riparian wetland, beaver habitat expansion	H
Cruces: Upper Valley	Stabilize incision and head cuts in existing wetlands, address trailing damage to wetlands	M
Cruces: Headwaters	Stabilize incision and head cuts in existing wetlands	H
Diablo: Confluence Meadow	Extend riparian wetland, beaver habitat expansion	H

Reach Name	Recommended Action	Priority
Diablo: Middle Reach	Extend riparian wetland, beaver habitat expansion	M
Diablo: Escondido/Diablo Confluence	Stabilize incision and head cuts in existing wetlands, extend riparian wetland, beaver habitat expansion	H
Diablo: Headwaters	Stabilize incision and head cuts in existing wetlands, extend riparian wetland where applicable	H
Escondido: Narrow Valley	Stabilize incision and head cuts in existing wetlands	M
Escondido: Upper Meadow	Stabilize incision and head cuts in existing wetlands	M
Escondido: Headwaters	Stabilize incision and head cuts in existing wetlands	H
Osha Creek	No Treatment	L

Figure 19: Table outlining the priority for treatment of each reach in the watershed.

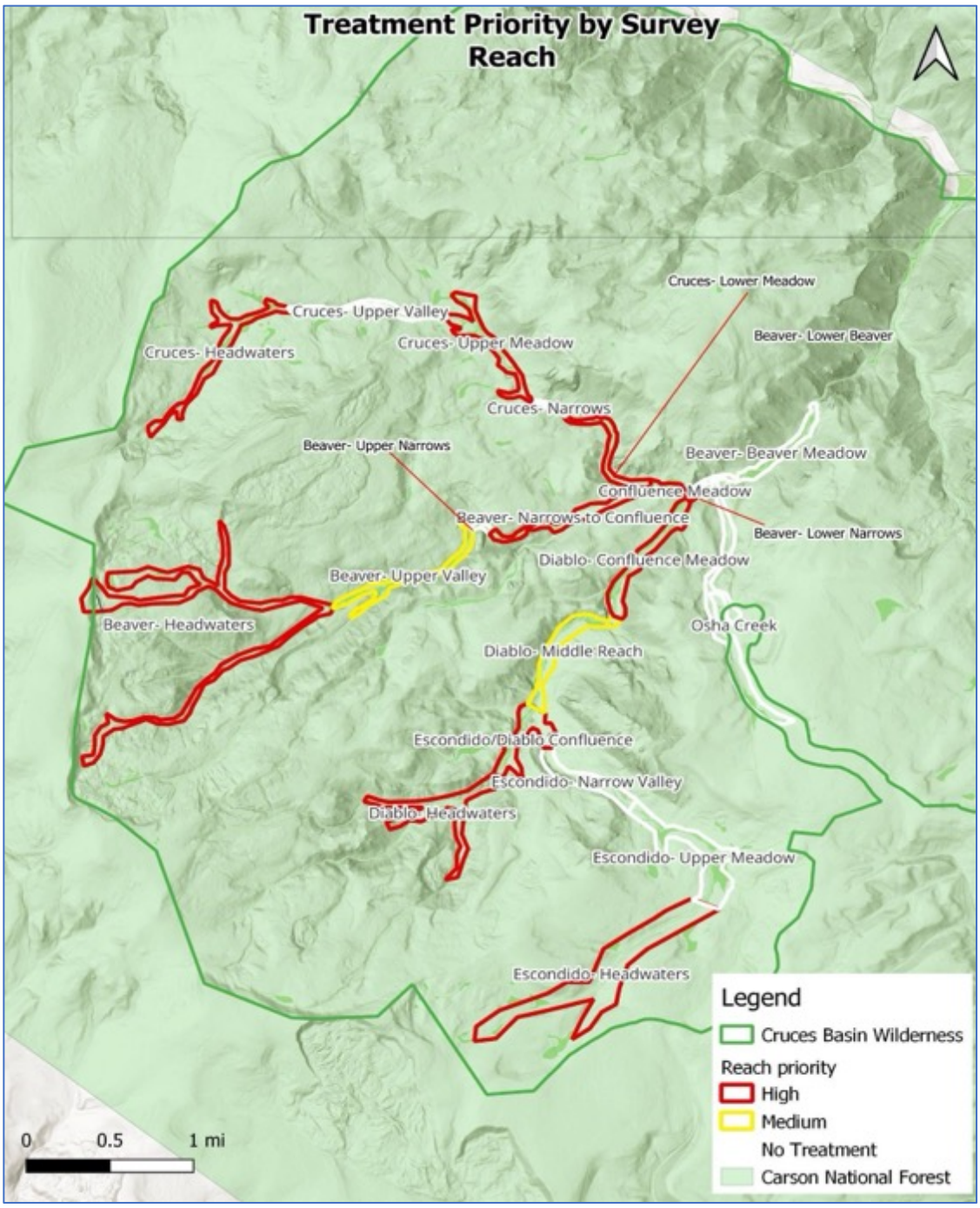


Figure 20: Map showing priority reaches for restoration treatment.

Concept designs for the reaches identified as high priority are detailed below (red areas in Figure 20). Note that costs for implementation include all costs for construction: personnel, travel, per diem, materials harvesting, mobilization/de-mobilization, administrative costs, monitoring and overhead. Implementation does not include costs for planning, detailed design, and compliance/permitting. It is recommended that prioritized actions (project reaches) are bundled to increase the economy of scale.

Beaver: Confluence Meadow

Goal: *Expand riparian wetland and encourage beaver habitat expansion.*

Recommended Techniques: *Using a phased approach over multiple years, construct targeted beaver dam analog (BDA) and Assisted Log Structure (ALS) complexes with high structure density where material is locally available, hardened stream crossings.*

Types of Materials: *Logs, branches, rocks, gravel, sod, harvested on-site.*

Approximate Volumetric Measurements: *Up to 20 BDAs at approximately 30-45 cubic feet each, up to 20 ALS structures at 30-70 cubic feet each, 2 hardened stream crossings at 12 cubic feet each.*

View showing the confluence of Diablo Creek (left) and Beaver Creek (right). Note the presence of willow along Beaver Creek and the absence of willow along Diablo Creek.

Cost Estimate: *Up to $28,000.00 for implementation.*

Beaver: Narrows to Confluence

Goal: *Expand riparian wetland and encourage beaver habitat expansion.*

Recommended Techniques: *Using a phased approach over multiple years, construct targeted beaver dam analog (BDA) and Assisted Log Structure (ALS) complexes with high structure density where material is locally available, hardened stream crossings, construct Log Flow Splitters, Worm Ditches, Log Step Falls, Zuni Bowls, One-Rock Dams (ORD), Rock*

Beaver Creek as it flows through the Narrows to Confluence Reach is incised and straightened.

Rundowns, and/or Log Mattresses (LM) to halt incision of slope wetlands.

Types of Materials: *Logs, branches, rocks, gravel, sod, harvested on-site.*

Approximate Volumetric Measurements: *Up to 66 BDAs at approximately 30-45 cubic feet each, around 60 ALS structures at 30-70 cubic feet each, 4 hardened stream crossings at 12 cubic feet each, 10 Log Step Falls at 12 cubic feet each.*

Cost Estimate: *Up to $94,000.00 for implementation.*

Beaver: Headwaters

Goal: *Protect existing wetlands from further incision and support baseflow elevation. Note: There are several high-gradient, destabilized, confined reaches of the Beaver Headwaters where no treatment is recommended. Priorities in this reach are to treat head cuts threatening wetlands at the top of the watershed.*

Recommended Techniques: *Using a phased approach over multiple years, construct Log Flow Splitters, Worm Ditches, Log Step Falls, Zuni Bowls, One-Rock Dams (ORD), Rock Rundowns, and/or Log Mattresses (LM) to halt incision of slope wetlands.*

Types of Materials: *Logs, branches, rocks, gravel, sod, harvested on-site.*

There are several large head cuts in the Narrows to Confluence Reach.

There are numerous head cuts of varying sizes eatening wetlands in the Headwaters Reach.

Approximate Volumetric Measurements: *Up to 30 Log Step Falls at 12 cubic feet each, 20-30 Rock Rundowns at 6 cubic feet each, 80-100 ORDs/ LMs at 3 cubic feet each.*

Cost Estimate: *Up to $21,700.00 for implementation.*

Head cuts near forested areas are good candidates for Log Step Fall treatments because logs are nearby.

Diablo: Confluence Meadow

Goal: *Expand riparian wetland and encourage beaver habitat expansion.*

Recommended Techniques: *Using a phased approach over multiple years, construct targeted beaver dam analog (BDA) and Assisted Log Structure (ALS) complexes with high structure density where material is locally available, hardened stream crossings, targeted lead-out construction to reconnect old channels, and assist willow propagation by harvesting from local populations and planting at low densities around initial BDA complexes.*

Types of Materials: *Logs, branches, rocks, gravel, sod, willow poles, harvested on-site.*

Diablo is straightened and incised in the Confluence Meadow Reach, a great candidate for riparian wetland expansion.

Approximate Volumetric Measurements: *Around 60 BDAs at approximately 30-45 cubic feet each, 60-70 ALS structures at 30-70 cubic feet each, 2 hardened stream crossings at 12 cubic feet each.*

Cost Estimate: *Up to $89,300.00 for implementation.*

Diablo: Escondido/ Diablo Confluence

Goal: *Protect existing wetlands from further incision and support baseflow elevation; expand riparian wetland and encourage beaver habitat expansion.*

Recommended Techniques: *Using a phased approach over multiple years, construct targeted beaver dam analog (BDA) and Assisted*

Both streams are incised in this reach and are good candidates for riparian wetlands expansion.

Log Structure (ALS) complexes with high structure density where material is locally available, hardened stream crossings, targeted lead-out construction to reconnect old channels, Log Step Falls, Zuni Bowls, One-Rock Dams (ORD), and/or Log Mattresses (LM) to halt incision of slope wetlands, and assist willow propagation by harvesting from local populations and planting at low densities around initial BDA complexes.

Types of Materials: *Logs, branches, rocks, gravel, sod, willow poles, harvested on-site.*

Approximate Volumetric Measurements: *Over 50 BDAs at 30-45 cubic feet each, and around 60 ALS structures at 30-70 cubic feet each, 1 hardened stream crossing at 12 cubic feet, 5-10 Log Step Falls at 12 cubic feet each, 15-20 ORDs/ LMs at 3 cubic feet each.*

Cost Estimate: *Up to $89,800.00 for implementation.*

Diablo: Headwaters

Goal: *Protect existing wetlands from further incision and support baseflow elevation.*

Recommended Techniques: *Using a phased approach over multiple years, construct Log Flow Splitters, Worm Ditches, Log Step Falls, Zuni Bowls, One-Rock Dams (ORD), Rock Rundowns, and/or Log Mattresses (LM) to halt incision of slope wetlands.*

Types of Materials: *Logs, branches, rocks, gravel, sod, harvested on-site.*

Diablo's headwaters contain numerous incised slope wetlands.

Approximate Volumetric Measurements: *10-15 Log Step Falls at 12 cubic feet each, 10-15 Rock Rundowns at 6 cubic feet each, 20-30 ORDs/ LMs at 3 cubic feet each.*

Cost Estimate: *Up to $9,750.00 for implementation.*

Cruces: Lower Meadow

Goal: *Protect existing wetlands from further incision and support baseflow elevation; expand riparian wetland and encourage beaver habitat expansion.*

Recommended Techniques: *Using a phased approach over multiple years, construct targeted beaver dam analog (BDA) and Assisted Log Structure (ALS) complexes with high structure density where material is locally available, hardened stream crossings, One-Rock Dams (ORD), and/or Log Mattresses (LM) to halt incision of slope wetlands, French Drains to harden trail crossings of slope wetlands, and assist willow propagation by harvesting from local populations and planting at low densities around initial BDA complexes.*

Types of Materials: *Logs, branches, rocks, gravel, sod, willow poles, harvested on-site.*

Approximate Volumetric Measurements: *Up to 60 BDAs at 30-45 cubic feet each, 40-60 ALS structures at 30-70 cubic feet each, 5-6 French Drains at 4 cubic feet each, 15-20 ORDs/ LMs at 3 cubic feet each.* ***Cost Estimate:*** *Up to $91,000.00 for implementation.*

Cruces Creek is incised and straightened in the Lower Meadow Reach, making it a good candidate for riparian wetlands expansion.

Livestock, elk, and recreational trailing is damaging slope wetlands in the Lower Meadow Reach.

Cruces: Upper Meadow

Goal: *Protect existing wetlands from further incision and support baseflow elevation; expand riparian wetland and encourage beaver habitat expansion.*

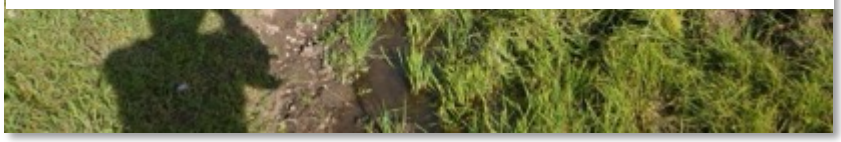
Recommended Techniques: *Using a phased approach over multiple years, construct targeted beaver dam analog (BDA) and Assisted Log Structure (ALS) complexes with high structure density where material is locally available, hardened stream crossings, One-Rock Dams (ORD), and/or Log Mattresses (LM) to halt incision of slope wetlands, and assist willow propagation by harvesting from local populations and planting at low densities around initial BDA complexes.*

Types of Materials: *Logs, branches, rocks, gravel, sod, willow poles, harvested on-site.*

Approximate Volumetric Measurements: *Up to 73 BDAs at 30-45 cubic feet each, 50-70 ALS structures at 30-70 cubic feet each, 1 hardened stream crossing at 12 cubic feet, 10-15 Log Step Falls at 12 cubic feet each, 20-30 ORDs/ LMs at 3 cubic feet each.*

Cruces Creek is incised in the Upper Meadow Reach, making it a suitable candidate for riparian wetland expansion.

The Upper Meadow Reach contains numerous wetlands threatened by head cuts.



Cost Estimate: *Up to $113,000.00 for implementation.*

Cruces: Headwaters

Goal: *Protect existing wetlands from further incision and support baseflow elevation.*

Recommended Techniques: *Using a phased approach over multiple years, construct Log Flow Splitters, Worm Ditches, Log Step Falls, Zuni Bowls, One-Rock Dams (ORD), Rock Rundowns, and/or Log Mattresses (LM) to halt incision of slope wetlands.*

Types of Materials: *Logs, branches, rocks, gravel, sod, harvested on-site.*

Approximate Volumetric Measurements: *15-20 Log Step Falls at 12 cubic feet each, 25-35 Rock Rundowns at 6 cubic feet each, 3 hardened stream crossings at 12 cubic feet each, 60-80 ORDs/ LMs at 3 cubic feet each.*

Wetlands in the Cruces Headwaters Reach are incised. Note the change in vegetation upstream versus downstream. Upland vegetation is becoming dominant downstream of the head cut

Cost Estimate: *Up to $18,600.00 for implementation.*

3.5 Additional Restoration Considerations

Trail drainage and water crossing improvements would be appropriate and impactful throughout the watershed. These should be implemented wherever trail drainage is causing gullying or poor stream crossings are leading to widening and sedimentation. For example, the user/ livestock trails in the Beaver and Cruces valleys cross the creek multiple times, and these crossings should be addressed to reduce fine sediment from entering the creeks and mitigate widening.

Road drainage work would be impactful in multiple areas surrounding the Wilderness, but ease of access for machinery is a consideration. For example, drainage work on Forest Road 87, while desirable due to its high potential to improve gullying in the Beaver Creek Headwaters, may not be practical due to the difficulty of transporting a machine on many miles of rough road. Road work on Forest Road 527 may be more feasible and would reduce runoff velocity onto the wet meadows forming the headwaters of Osha Creek.

The full report that includes the concept design shown here and complete details on the wetland assessment and its findings is available in Appendix C.

3.6 Monitoring Recommendations for Implemented Projects

Assessing the effectiveness of wetland restoration treatments requires photo points that show landscape level views in addition to photo points at treatment structures (Zeedyk 2014). The Wetland Assessment performed for this Wetland Action Plan provides baseline photos.

Monitoring should occur one full year of exposure to the hydrologic cycle (Zeedyk, 2014). Army Corp of Engineer permitting requires 5 years of post-construction monitoring. Since the land is managed by the U.S. Forest Service, the Carson Forest will be required to conduct this permit-required monitoring, and submit yearly reports to the Army Corp. Amigos Bravos has assisted the Forest Service by conducting this monitoring and writing these reports in other wetlands in the Forest.

If funding is available for organizations conducting the restoration, or the Forest Service has the staff capacity to perform more detailed monitoring efforts in addition to repeat photo-points, we recommend performing the NM Environment Department's Rapid Assessment Method (NMRAM) at least once a year for as long as possible. The NMRAM provides a cost-effective and consistent evidence-based tool for assessing wetland ecological condition and an associated database system to track outcomes (McGraw, Muldavin, and Milford 2018). The NMRAM Manual Version 2.0 (December 2021) provides background information, methods and metrics for NMRAM Riverine and Playa wetlands. This manual is available at the following link: https://www.env.nm.gov/surface-water-quality/wetlands-rapid-assessment-methods/

Chapter 4: Wilderness Area Restoration Roadmap

Summary: The purpose of this Chapter is to provide the information needed and detailed steps for proposing ecosystem restoration inside Wilderness Areas. While examples focus on the Carson National Forest in New Mexico, this chapter is intended to be applicable to all States with Wilderness Areas.

Section 1: Overview of The Wilderness Act

In 1964, Congress acknowledged the "immediate and lasting benefits of wild places" by passing The Wilderness Act of 1964 that permanently protected some of the most undisturbed places in America from human-caused development and disturbance. These included the Pecos, San Pedro Parks, Wheeler Peak, and White Mountain Wilderness in New Mexico. On December 19, 1980, the New Mexico Wilderness Act of 1980, originally introduced by Representative Manuel Lujan Jr., was signed by President Jimmy Carter. The Act authorized the establishment of a number of designated Wilderness Areas on National Forest land in New Mexico, added additional lands to the four existing Wilderness Areas in New Mexico, and named several National Forest areas for study as potential Wilderness Areas.

Section 4(c) of the Wilderness Act prohibits certain uses in wilderness to prevent disturbance and development. The law strictly prohibits permanent roads and commercial enterprise in Wilderness Areas. The other prohibited uses may be used only if they are deemed necessary to meet minimum requirements to administer the area as wilderness. The prohibited uses within Wilderness areas include the use of temporary roads, use of motorized vehicles, motorized equipment, or motorboats, landing aircrafts, use of any other form of mechanical transport, and use of structures or installations.

Management of Wilderness Areas emphasizes the maintenance of wilderness values consistent with the Wilderness Act section 2(c), including:

- A general appearance of being affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable.
- Outstanding opportunities for solitude or a primitive and unconfined type of recreation.
- At least 5,000 acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition.
- Ecological, geological, or other features of scientific, educational, scenic, or historical values.

The Minimum Requirements Decision Guide by the US Forest Service (Arthur Carhart National Wilderness Training Center, 2008) described how to determine Minimum Requirement in a way that is helpful to understand what it is.

> *The determination that an administrative action is necessary in wilderness and the selection of the minimum method or tool to be used is made within the constraints of law and agency policy. Once a determination has been made that action is necessary, Forest Service policy sets conditions under which exceptions to the prohibited uses (motorized equipment, mechanical transport, etc.) may be considered and guidelines for when the exceptions should be applied. The policy leaves room for interpretation and requires a thorough analysis of the need for action and alternatives for taking action to avoid using the minimum requirements decision process to justify the use of a generally prohibited piece of equipment due to the need to get the job done in a safe and efficient manner."*

A Minimum Requirements Analysis (MRA) is used to evaluate whether a prohibited use that is proposed to be used in wilderness is the "minimum requirement" from the Wilderness Act (Wilderness.net). The Minimum Requirements Analysis Framework (MRAF), layed out in Workbook form, is the tool used to help managers prepare the Minimum Requirements Analysis (Available as Appendix E and from https://wilderness.net/practitioners/minimum-requirements-analysis/minimum-requirements-analysis-framework/default.php). Instructions for filling out this Workbook are available in Appendix D.

The MRAF consists of two steps: Step 1 evaluates whether administrative action may be "necessary" in Wilderness. If the answer to step 1 evaluation is yes, step 2 provides guidance for determining the minimum technique, timing, or amount of a prohibited use necessary to address the wilderness stewardship issue. The goal of the MRAF is to provide consistency in the way wilderness-managing agencies consider actions proposed in wilderness.

MRAF also guarantees that "wilderness character," is preserved by agencies through their on-the-ground decisions. While Wilderness character is mentioned several times, it not defined in the original Wilderness Act itself. However section 4(b) provides the following language that help us to understand what it means: *"Except as otherwise provided in this Act, each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area and shall so administer such area for such other purposes for which it may have been established as also to preserve its wilderness character. Except as*

otherwise provided in this Act, wilderness areas shall be devoted to the public purposes of recreational, scenic, scientific, educational, conservation, and historical use."

To provide guidance to fulfill the Wilderness Act's legal mandate of preserving wilderness character, an interagency team (*Keeping It Wild 2*, 2015) defined it as: *"Wilderness character is a holistic concept based on the interaction of (1) biophysical environments primarily free from modern human manipulation and impact, (2) personal experiences in natural environments generally free from the encumbrances and signs of modern society, and (3) symbolic meanings of humility, restraint, and interdependence that inspire human connection with nature. Taken together, these tangible and intangible values define wilderness character and distinguish wilderness from other all lands."*

This interagency team also defined five tangible "qualities" of wilderness character (Keeping it Wild 2, 2015):

- Untrammeled—wilderness ecological systems are unhindered and free from intentional actions of modern human control or manipulation.
- Natural—wilderness ecological systems are substantially free from the effects of modern civilization.
- Undeveloped—wilderness is essentially without structures or installations, the use of motors, or mechanical transport.
- Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation—wilderness provides outstanding opportunities for solitude or primitive and unconfined recreation.
- Other Features of Value—wilderness may have unique ecological, geological, cultural or other features of scientific, educational, scenic, or historical value.

Wilderness managers have long protected specific elements of wilderness from degradation (e.g., trails from becoming braided, campsites from becoming trashed). Wilderness character provides an effective way to communicate among agency staff and with the public about the goals of wilderness stewardship. The Wilderness Character Toolbox from Wilderness.net is a valuable tool for understanding this aspect of Wilderness Area management (https://wilderness.net/practitioners/toolboxes/wilderness-character/).

Section 2: Desired Conditions in Wilderness Areas

National Forest Plans often lay out specific Desired Conditions, Wilderness Standards, and Wilderness Guidelines to be followed by managers of a specific Forest. For example, the Carson Forest Plan Revision 2022 (Chapter 3 page 161) describes in detail the desired wilderness conditions, standards, and guidelines to be followed in the Carson National Forest. This detailed language can be used to make a strong case for the use of certain kinds of ecosystem restoration in the Wilderness Areas, and show that they meet the Forest's management goals. The language describing Desired Conditions, Wilderness Standards, and Wilderness Guidelines in the Carson National Forest is provided below as an example that would be useful when proposing restoration activities in Wilderness Areas in the Carson. Source of the below information is from the Carson Forest Plan 2022, page 171. Link:

https://www.wilderness.net/MRDG/documents/MRDG_FS_guidelines.pdf. Land Management Plan. Chapter 3. Plan Components for Designated Areas and Management Areas)

Wilderness Desired Conditions (DA-WILD-DC):

1. Wilderness contributes to ecosystem services such as clean air and water, wildlife habitat enhancement, and outstanding opportunities for solitude or primitive and unconfined recreation.
2. Natural processes (e.g., insects, disease, blowdown, and fire) are maintained and function in their natural ecological role, and species are predominantly native.
3. The environment within a wilderness is essentially unmodified. Naturally occurring scenery dominates the landscape. Human-made features are rare and use natural or complementary materials.
4. They are present when needed to provide for public safety or resource protection.
5. Wilderness provides recreation opportunities where social encounters are infrequent and occur only with individuals or small groups so that there are opportunities for solitude. Visitors experience self-reliance, challenge, and risk while enjoying opportunities to pursue non-motorized or non-mechanized activities.

Wilderness Standards (DA-WILD-S)

1. No more than 15 persons and 15 pack stock [(e.g., mules or horses)] are permitted within a single group, unless otherwise noted in a wilderness management plan. Exceptions may include special use permits, formal agreements, emergency services, and management activities for maintaining wilderness character.
2. Outfitter-guide activities in wilderness must include appropriate wilderness practices, such as Leave No Trace principles, and incorporate awareness for wilderness values in their interaction with clients and others.
3. Research conducted in wilderness must not adversely affect wilderness character.
4. Nonnative invasive species must be treated using methods and in a manner consistent with wilderness character, to promote natural values in designated wilderness.
5. Unpermitted goats or sheep are prohibited within wilderness.
6. A minimum requirements analysis must be used when considering nonconforming or prohibited uses in designated wilderness.
7. When maintenance of fixed anchors for rock climbing is necessary, it must be accomplished without using mechanized drills and other mechanized equipment.

Wilderness Guidelines (DA-WILD-G)

1. Intervention in natural processes through management actions should only occur when this would move the area toward desired conditions, preserve wilderness character, protect public health and safety within and adjacent to wilderness, or uphold other Federal laws and regulations.

2. Management activities should be consistent with the scenic integrity objective of very high in designated wilderness, to maintain wilderness character.

Section 3: Steps to Conducting Restoration in Wilderness Areas

1) Review the Wilderness Act of 1964 (https://wilderness.net/learn-about-wilderness/key-laws/wilderness-act/).
2) Review in detail the National Forest Plan or other Federal agency document that includes your Wilderness Area of interest.
3) Research and understand the Wilderness Character Toolbox (https://wilderness.net/practitioners/toolboxes/wilderness-character/).
4) Ensure that you thoroughly understand the Minimum Requirements Analysis Framework Instructions (Appendix D).
5) Work with the appropriate Forest Service Staff to discuss the project and ask their thoughts on the proposed project in the Wilderness Area. Work with these staff on timelines and determining who needs to approve the MRAF Workbook forms.
6) Fill out Minimum Requirements Analysis Framework – Minimum Requirements Analysis Workbook. See Appendix E for the Minimum Requirements Analysis Workbook forms.
    a. For example, in the Cruces Basin Wilderness Area, to implement wetland restoration proposed in the Wetland Action Plan, we would use the Restoration Toolbox for Wilderness Applications in Appendix C (and Chapter 3 of this document) of the Wetland Action Plan for the description of activities proposed. We would then delete any activities from the list that the Forest does not approve upon discussions with them.
7) If the project is approved, work with the Forest Service on implementing the project following all agreed upon measures.

Section 4: Expected Challenges

1. Different National Forests and different district staff will interpret the Wilderness Act, "Wilderness Character", and what is "necessary" differently.
2. For wetland restoration structures, language in the Wilderness Act around "no structure or installation within any such area" and language in Forest Plans like "Human-made features are rare" may be problematic. In these cases, it will be important to thoroughly understand Wilderness Character, and make the case that the project proposed is needed to maintain the Wilderness Character of the Area.
3. Transporting or gathering materials in Wilderness Areas without machinery will limit the activities proposed. However, volunteers lead by wetland contractors using low-impact erosion control structures have a large-scale positive impact on wetland health in Wilderness Areas.
4. Building strong relationships with Forest Service Staff will be vital to this process.

Chapter 5: Local Public Involvement Strategy

5.1 Technical Tools for Reaching the Public

Wilderness Areas are special to all of those who visit them, discover them, and value them. This makes is vitally important to reach the public before, during, and after any planning and

restoration work in a Wilderness Area. The remote location of the Cruces Basin can make reaching stakeholders difficult. Generally, Taos, Tres Piedras, Chama, Tierra Amarilla and Antonito, Colorado are the closest municipalities and therefore have the most stakeholders. Our organization, Amigos Bravos, also communicates with the Forest Service to reach the grazing permittees, with whom forming relationships will be necessary for any restoration implementation performed in the future. Recommended tools for reaching the public specific to the Cruces Basin area include:

- Newspaper advertisements in the Taos News, Antonito, and other local Newspapers
- Entry in local online calendars
- Posting flyers at local grocery stores and other public locations
- Radio advertisements
- Social media paid, geographically focused advertising

5.2 Informational Programs Focusing on Wetlands

Amigos Bravos performs yearly volunteer restoration weekends in the Questa area in collaboration with the Albuquerque Wildlife Federation. Using our relationships with volunteers and the Albuquerque Wildlife Federation, the Carson Forest, and grazing permittees, we have the capacity to conduct volunteer restoration weekends in the Cruces Basin, pending approval from the Forest Service. These weekends are educational and open to all ages. Other organizations that provide educational programs about wetlands and wetland restoration in New Mexico include The New Mexico Wetlands Program, the Albuquerque Wildlife Federation, the Quivira Coalition Educational Program, and the Society of Wetland Scientists, Rocky Mountain Chapter.

5.3 Steering Committee and Partnerships

Prior to this Plan, Wildland Network fostered a collaborative called the Greater Cruces Basin Collaborative. Amigos Bravos was part of this group and reached out them to join the Cruces Basin Wilderness Area Steering Committee. The Committee includes the New Mexico Department of Game and Fish, NM Wild, Wildland Network, the Carson Forest Service, Trout Unlimited, and Hispanics Enjoying Camping, Hunting and the Outdoors (HECHO). We will continue to attend the Greater Cruces Bain Collaborative following the creation of this Plan and communicate with all the members about implementation. We also worked with a local anthropologist, Mark Henderson on formulating and editing the history section in Chapter 1.

5.4 Funding Opportunities and Grant Writing

Amigos Bravos will continue to seek grant funds for ongoing assessment and restoration work in the Cruces Basin. Amigos Bravos has employed Shannon Romeling, one author of this Plan, as their Grant Writer for 12 years. Shannon is in the unique position to both write this plan, garner funding, and then manage implementation of restoration projects in the Cruces Basin. The work described here will be eligible for NMED Watershed Implementation 319 Funds, and those funds will be a priority for restoration activities. We will also pursue private funding as a top priority. Figure 21 describes all the possible funding opportunities.

	Potential Funding Sources	
Sources	**Agency**	**Grant/Funds**

Federal	Environmental Protection Agency	
		Clean Water Act Section 319 Watershed Restoration Grants
		5 Star Restoration Challenge Grant Program
		Environmental Education Grants
	Natural Resource Conservation Service	
		Environmental Quality Incentive Program
		(private lands cost-matching)
		Wildlife Habitat Incentive Program
		Wetland Reserve Program
	U.S. Fish and Wildlife Service	
		Fish Passage
		North American Wetland Conservation Act
	U.S. Forest Service	
		Collaborative Forest Restoration Program
		Collaborative Forest Landscape Restoration Program
	Bureau of Reclamation	
		WaterSMART FY24 Environmental Water Resources Projects funding opportunity
		WaterSMART Cooperative Watershed Management Program funding opportunity.
State	State of New Mexico	
		New Mexico Environment Department (NMED) Surface Water Quality Bureau (SWQB) River Stewardship Program
		NM Department of Game and Fish Habitat Stamp Program
		New Mexico State Forestry New Mexico Forestry Division Watershed Restoration Project
County	Taos Soil and Water Conservation	
Private	New Mexico Water Trust Board	
	Grants	

	Patagonia 1% for the Planet Grant	
	Western Native Trout Initiative	
	American Rivers	
	National Fish and Wildlife Foundation	
	Wildlife Conservation Society	
	Private Donors/Foundations	
	Volunteer Labor	

Figure 21: Summary of potential funding sources.

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Appendices