Black River Wetlands Action Plan

Prepared by

CEHMM

in cooperation with the

New Mexico Environment Department (NMED)

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Acronyms

AFY	Acre-feet per year
AU	Assessment Unit
BISON-M	Biota Information System of New Mexico
BRW	Black River Watershed
BLM	United States Department of Interior Bureau of Land Management
CCA	Candidate Conservation Agreements
CCAA	Candidate Conservation Agreements with Assurances
CCNP	Carlsbad Caverns National Park
CDC	Center for Disease Control
cfs	Cubic feet per second
CHAT	Crucial Habitat Assessment Tool
CI	Certificate of Inclusion
CID	Carlsbad Irrigation District
CP	Certificate of Participation
CWD	Chronic Wasting Disease
DDT	Dichlorodiphenyltricholorethane
DO	Dissolved Oxygen
EIA	Energy Information Administration
ERT	Environmental Review Tool
ESA	Endangered Species Act
FWS	United States Department of Interior Fish and Wildlife Service
GMNP	Guadalupe Mountain National Park
HGM	Hydrogeomorphic Classification for Wetlands
HUC	Hydrologic Unit Code
IPAC	Information for Planning and Consultation
LLWW	Landscape Position, Landform, Water Flow Path, and Waterbody Type
MYA	Million years ago
NAWMP	North American Waterfowl Management Plan
NIDIS	National Integrated Drought Information System

NGO	Non-governmental organization
NM-CIS	New Mexico Conservation Information System
NMDA	New Mexico Department of Agriculture
NMDGF	New Mexico Department of Game and Fish
NMED	New Mexico Environment Department
NMISC	New Mexico Interstate Stream Commission
NMOCD	New Mexico Oil Conservation Division
NMOSE	New Mexico Office of the State Engineer
NMRAM	New Mexico Rapid Assessment Method
NMSLO	New Mexico State Land Office
NPS	United States Department of Interior National Park Service
NRCS	United States Department of Interior Natural Resources Conservation Service
NWI	National Wetlands Inventory
ONRW	Outstanding National Resource Waters
PPT	Part per thousand
QAPP	Quality Assurance Project Plan
RAPPS	Reasonable and Prudent Practices for Stabilization
SERI	Species of Economic and Recreational Importance
SSA	Species Status Assessment
SWAP	State Wildlife Action Plan
SWQB	Surface Water Quality Bureau
TXRRC	Texas Railroad Commission
USDA	United States Department of Agriculture
USGS	United States Department of Interior Geological Survey
WIFIA	Water Infrastructure Finance and Innovation Act
WRCC	Western Regional Climate Center

Executive Summary

The majority of the Black River Watershed (BRW) is located in Eddy County, New Mexico, with the highest elevation headwaters starting in Culberson County, Texas. The BRW was formed by the Guadalupe Mountains, Capitan Reef, Yeso Hills, and Castile Formation and millions of years of wind and water. The BRW encompasses parts of the Guadalupe Mountains and adjacent lowlands; the Black River itself begins as a spring-fed wetland, becoming intermittent to ephemeral stream in the Guadalupe Mountains, re-emgerges as springs then flows near the base of the Capitan Reef Escarpment, becoming perennial in its lower reaches, before emptying into the Pecos River about 20 miles south of Carlsbad, New Mexico.

The perennial stretch of the Black River begins near its confluence with Blue Springs and continues 20 river miles downstream to its confluence of the Pecos River. Downstream from where Blue Springs meets the Black River, the river flows through thinning stands of cottonwood and willows, eroded upland, and large amounts of mesquite. The river plays a vital role in supplying water for agriculture, the oil and gas industry, and recreation. The Black River is home to a wide variety of birds, reptiles, aquatic species, and plants. The perennial stretch of aquatic habitat consists of undercut riverbanks, crevices, ledges, travertine shelves, cobble riffles, and large boulders. The Black River contains many rock barriers, man-made dams, and low water crossings.

This Wetlands Action Plan is a guide for the funding and implementation of projects essential to the understanding, conservation, protection, and restoration of wetlands in the BRW, and the projects described herein are meant to ensure that watershed planning activities adequately address wetland management issues within the watershed. The plan identifies the following actions for the protection and restoration of the BRW:

1. Development and implementation of a water conservation program;
2. An integrated watershed health assessment for the BRW;
3. Improvements to current and ongoing water quality monitoring efforts;
4. Biological and functional assessments for the wetlands within the watershed;
5. Erosion and pollution preventative measures;
6. Diversion of hypersaline water from the Black River;
7. Wetland vegetation restoration;
8. Improvements to flow regime monitoring throughout the watershed; and
9. Future educational and outreach efforts.

The diverse group of stakeholders within the watershed should be invested in the management and preservation of wetlands, as wetlands likely have a positive impact on their interests in the landscape.

We recommend working closely with stakeholders as the above actions are further explored and implemented on the landscape and in the local community.

Introduction

Purpose and Need

The purpose of the Black River Wetlands Action Plan is to provide guidance for the understanding, conservation, protection, and restoration of the Black River watershed wetlands. This document emphasizes the importance of both water quality and quantity in the preservation of wildlife populations, corridors, and habitat. With the use of historical background information, plant and animal inventories, and current monitoring data, this Wetlands Action Plan addresses physical conditions of the wetland area.

Ultimately, the purpose of this document is to guide necessary actions for wetland restoration projects, outreach and education opportunities, and future funding priorities. Available data was gathered with the assistance of the Steering Committee, which was comprised of subject matter experts (including local, state, and federal agency officials; landowners; university faculty; and conservation biologists). Herein, we have also identified research and data gaps in an effort to help direct future collection efforts. Stakeholders may use the framework provided to address the specific wetland management issues impacting the BRW.

The Black River has been substantially impacted by water impoundments, oil and gas development, historical land uses and increasingly, climate change. As with most freshwater systems, the BRW provides many important ecosystem services to the residents of southeastern New Mexico. Changes to historical flow regimes and water quality, however, have negatively impacted the native species of the watershed like the Texas hornshell mussel (*Popenaias popeii*), a federally endangered mollusk and Pecos gambusia (*Gambusia nobilis*) a federally endangered fish; and thus the community at large. The development of this document is necessary to provide a snapshot of the current status of watershed health, and an historical reference and outline of observed trends in water quality and water quantity. In addition, this Wetlands Action Plan serves as a source for collected scientific understanding to inform future prioritization for restorative and protective efforts within the BRW.

Watershed Overview

Wetlands are one of the most productive habitat types within a watershed. Wetlands are common along floodplains of rivers and streams, depressions, and low lying areas that collect water. The BRW transitions from high altitude springs to well drained uplands, appearing again as springs that eventually form a perennial river system that at the terminus, converges with the main stem of the Pecos River.

The majority of the BRW is located in Eddy County, New Mexico, with the highest elevation of the BRW starting in Culberson County, Texas. It encompasses parts of the Guadalupe Mountains and adjacent lowlands; the Black River itself begins as springs the flow into intermittent and ephemeral streams in the Guadalupe Mountains, flowing near the base of the Capitan Reef Escarpment, becoming perennial in its lower reaches, before emptying into the Pecos River about 20 miles south of Carlsbad, New Mexico.

The BRW has an extensive drainage network of predominantly intermittent and ephemeral streams with a few perennial stream reaches. The watershed starts in the Guadalupe Mountains National Park, in the Upper McKittrick Canyon sub-watershed. The Black River officially surfaces in Black Water Canyon, within the Lincoln National Forest before returning to the vadose zone below ground. Frank and Black Springs are located in Black Water Canyon (Figure 2). The watershed is a dendritic set of ephemeral streams that proceed toward the northeast, converging with the Pecos River, just south of the Guadalupe Mountains. Ephemeral features are found throughout the watershed. Typically, the Bureau of Land Management (BLM) and private lands, except along the stream corridor, south of Carlsbad Caverns National Park are particularly dry.

The most upstream perennial water in the Black River is located above Headwaters Spring about 2 miles upstream from Cottonwood Day Use Area (CDUA), south southwest of Rattlesnake Springs and Washington Ranch. This area is used for public access, fishing, picnicking, birding, and other pursuits. This stretch of the river has deep exposure spring pools (Stevens et al 2021); however, the river proceeds underground at Washington Ranch.

The first settlers in the region said that the stretch of the river to the north and east of Washington Ranch flowed at times but probably not perrenially (CEHMM 2018). Like much of the Southwest, springs within the watershed have been modified for human use, and many of them have dried up or have become disconnected from any other body of water. Rattlesnake Creek once flowed from Rattlesnake Springs to the Black River, contributing to its perennial flow. However, since its diversion to serve as the primary water source for Carlsbad Caverns National Park, that no longer occurs. The old confluence of Rattlesnake Springs and the Black River contains large stones, eroded by water that show signs of many years of past erosion. There is similar evidence found at the mouth of Blue Springs, and both attest to former high flows in past years. The vast majority of the Black River drainage is ephemeral above Blue Springs, but it will occasionally flood and send water barreling down the river corridor during high flow events.

Discharge into the Black River occurs from a series of springs, the most important being Blue Springs (Figures 1 and 2). Blue Springs is a karstic limnocrene spring (Bonacci 2001, Springer and Stevens 2009) and the primary water source in the perennial lower stretch of the Black River. Blue Springs discharges on average 10 cfs (USGS 2021), although its historical flow ranges between 8 and 16 cfs in the last 20 years. Water from Blue Springs flows two miles east through Blue Springs cienega until reaching the Black River.

Figure 1. Blue Springs.

The Black River confluence with the Pecos River is located 20 miles south of Carlsbad, New Mexico. The lower perennial stretch of the Black River can be found approximately two miles upstream of the confluence of Blue Springs and the Black River traveling 20 miles to the confluence of the Pecos River. Upstream from where Blue Springs meets the

Black River, the river flows through thinning stands of cottonwood and willows, eroded highlands, and large amounts of mesquite (*Prosopis* spp) shrubland (US EPA Ecogions III). The Black River plays a vital role in supplying water for agriculture, oil and gas operations, recreation, and the Pecos River Compact. The Black River is home to a wide variety of aquatic species, plants, and mammals. The perennial stretch of aquatic habitat consists of undercut riverbanks, crevices, ledges, travertine shelves, cobble riffles, and large boulders. There are rock barriers, manmade dams, and low water crossings found throughout the lower perennial reach of the Black River.

The Black River Marsh and the Blue Springs cienegas, two high functioning cienegas, can be found within the BRW (Sivinski 2018). Cienegas can be described as marshes or wet meadows with connectivity to springs, and they are typically found in arid climates. Sivinski 2018 listed both the Black River Marsh and the Blue Springs cienegas as functional or restorable cienegas that are occupied by sensitive or endangered species. The Blue Springs Cienega is a marsh found between Blue Springs and the Black River. The Black River Marsh cienega is a marsh habitat found near Washington Ranch.

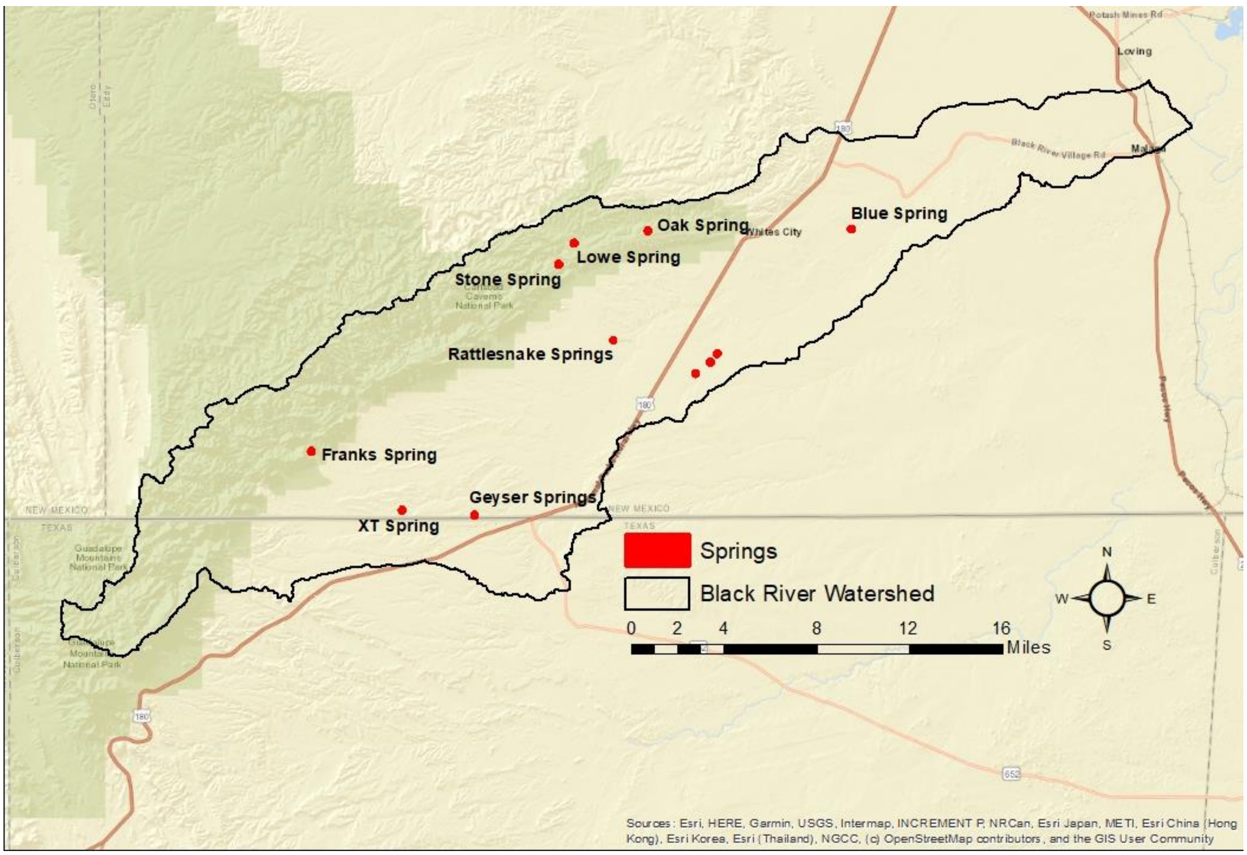


Figure 2. Documented spring locations within the BRW in New Mexico.

<u>Hydrologic Unit Code</u> — The BRW (HUC 1306001111), can be separated into nine sub-watersheds (Figure 3, Table 1).

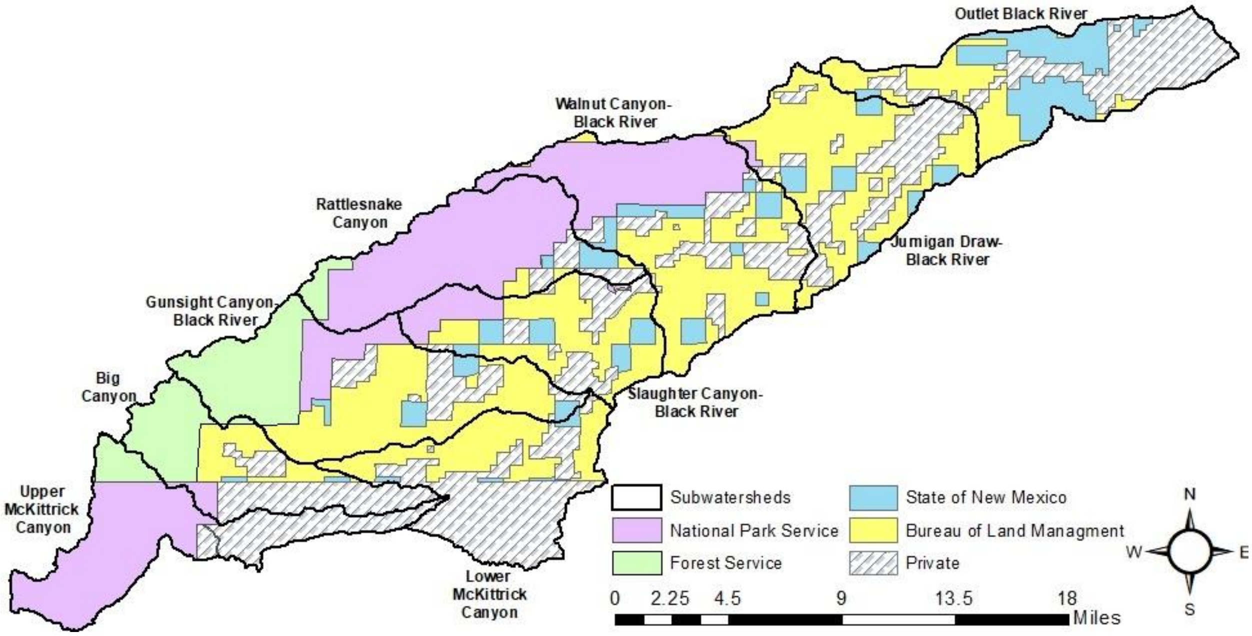


Figure 3. Land status within the Black River watershed.

Table 1. Summary of the land status of the BRW.

SUB-WATERSHED (HUC)	NATIONAL FOREST	NATIONAL PARKS	BUREAU OF LAND MANAGEMENT	NEW MEXICO STATE LAND TRUST	PRIVATE	TOTAL AREA (SQ. KM)
UPPER MCKITTRICK CANYON (130600111102)	9.83%	62.49%	0.04%	0.00%	27.63%	**94.50**
LOWER MCKITTRICK CANYON (130600111103)	0.00%	0.00%	37.89%	2.21%	59.90%	**101.42**
BIG CANYON (130600111101)	33.61%	4.67%	21.06%	1.50%	39.16%	**77.96**
GUNSIGHT CANYON (130600111104)	29.07%	12.19%	40.54%	5.01%	13.19%	**146.33**
RATTLESNAKE CANYON (130600111105)	6.28%	78.86%	3.78%	3.55%	7.53%	**105.07**
SLAUGHTER CANYON (130600111106)	0.00%	15.84%	48.02%	12.54%	23.60%	**87.25**
WALNUT CANYON (130600111107)	0.00%	35.08%	36.69%	8.85%	19.38%	**156.65**
JURNIGAN DRAW (13060011108)	0.00%	1.23%	57.51%	9.48%	31.78%	**121.63**
OUTLET BLACK RIVER (130600111109)	0.00%	0.00%	26.68%	30.19%	43.13%	**117.05**
TOTAL AREA (SQ. KM)	**84.62**	**233.67**	**318.73**	**86.14**	**284.70**	**1007.86**

Black River Resource Analysis

Black River Watershed History

Figure 4. The Illinois #3 well, one of Eddy County's first oil wells.

For thousands of years, the BRW was inhabited by relatives of the Folsom Man (Preston 1995; Eddy County 2021). The area was also home to nomadic tribes following the American bison (*Bison bison*) and other game through the Pecos River valley (Eddy County 2021). The Basket Makers, a group of Ancestral Puebloan people, likely lived in the BRW for much of the fourteenth and fifteenth centuries (Eddy County 2021). It was in the late 1500's that Spanish explorers such as Álvar Núñez Cabeza de Vaca, Antonio de Espejo, and Gaspar Castaño de Sosa followed the Pecos River north into the area (Eddy County 2021).

The cattle industry became prominent in the area in 1886 when Charles Goodnight and Oliver Loving introduced large quantities of cattle along the Pecos River into present day Eddy County (Eddy County 2021). In 1891, the first railroad car arrived in Eddy County from Pecos, Texas, opening the area to the export of agricultural goods and providing easier access for settlement (Eddy County 2021).

In 1909, oil was discovered in Eddy County approximately 40 miles north of the Black River near the town of Artesia (Eddy County 2021). Following the discovery of oil, large scale drilling operations took place throughout the Permian Basin starting in 1938 (Eddy County 2021). While searching for oil, Dr. V.H. McNutt, a geologist, discovered potash west of the Black River in 1925 (Eddy County 2021). To this day, the extraction of both oil and potash largely contribute to the economy of southeastern New Mexico.

It was in 1898 that Jim White, a local cattle hand, likely entered Carlsbad Cavern for the first time (NPS 2017). The world-famous cavern is one of 300 limestone caves formed by a shallow sea 250 to 280 million years ago (NPS 2017). The National Park that encompasses the caverns was established in 1930 and, in 1963, Rattlesnake Springs was added as a detached unit to Carlsbad Caverns National Park (NPS 2017).

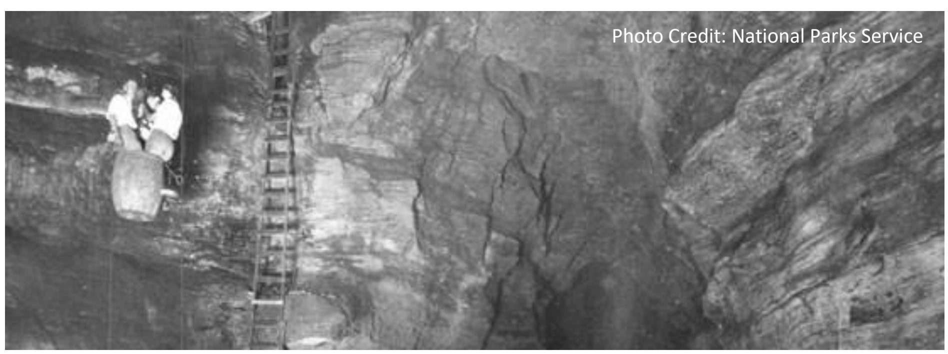


Figure 5. Men entering Carlsbad Caverns in an old guano mining bucket.

Wetlands Mapping and Classification

Wetlands are defined as areas where water saturates the soil for at least two weeks throughout the year. Wetlands act as a transition zone between upland and aquatic environments. The amount of water present in a wetland can vary greatly, from permanently flooded playas to seasonally flooded ravines that are dry the majority of the year. Wetlands are found throughout the BRW, including seasonally flooded ravines, tinajas, and riverine wetlands along stream channels and canals, playas, depressions, and slope wetlands, including springs.

Wetlands vary significantly because of local differences in soil, climate, hydrology, water chemistry, and vegetation. Because there are so many variables that affect wetlands, there are also several methods to classify them. A Hydrogeomorphic Approach (HGM Approach) to classifying wetlands includes identifying groups of wetlands that function similarly. The HGM Approach uses geomorphic settings, water sources, and hydrodynamics to classify wetlands. This approach was developed by Mark Brinson of the Army Corps of Engineers Environmental Research Laboratory in 1993 (Brinson 1993).

However, the most common and broadly used classification for mapping wetlands is the "Classification of Wetlands and Deepwater Habitats of the United States" (Cowardin et al. 1979). This classification is based on the needs of aquatic and terrestrial wildlife that utilize wetlands for habitat. This classification is used by the U.S. Fish and Wildlife Service (FWS) and stored in the National Wetlands Inventory (NWI); it is therefore referred to as the NWI Classification. The NWI can be found at: http://www.fws.gov/wetlands/data/mapper.html

LLWW Classifications — Enhanced Classification for Landscape Position, Landform, Water Flow Path, and Waterbody Type (LLWW Classification) (Tiner, 2011), aids in the utility of NWI data. The LLWW classification better characterizing wetlands and for preparing preliminary assessments of wetland functions from the NWI database, additional features had to be added to the NWI data. Key features included hydrogeomorphic features, specifically landscape position, landform, and water flow path. In addition, it was deemed important to better characterize waterbodies to identify a wide variety of pond types, and to separate natural lakes from created lakes, among other things, so waterbody type was also added to the NWI classification. Collectively, these descriptors have been referred to as "LLWW descriptors" with the letters representing the first letter of each additional descriptor (landscape position, landform, water flow path, and waterbody type). A set of dichotomous keys have been developed to define and classify these features for the Inland Wetlands of the Western United States. https://cnhp.colostate.edu/download/documents/cwic_docs/LLWW%20Key%20for%20Inland%20Western%20US_vDec10_2018.pdf

Five landscape positions for wetlands are recognized: marine (ocean intertidal shores), estuarine (estuarine intertidal shores) – these two are not found in New Mexico; lentic (lake or reservoir shores), lotic (river and stream shores and floodplains), and terrene (isolated or not subject to overflow from rivers, streams, or lakes). Landforms include basin (depression), flat (broad nearly level landform), floodplain (subject to river overflow), fringe (shallow-water wetland, bank, or tidal wetland with unrestricted flow), and slope (>2% slope). Water flow paths are defined as inflow, outflow, throughflow, vertical flow, bidirectional-tidal, bidirectional-nontidal, and isolated (geographically isolated; often surrounded by nonhydric soils). In addition, there are many modifier codes that indicate specific wetland conditions, indicators or settings such as: springfed -sf, tinaja -tj, and headwaters -hw.

<u>Hydrogeomorphic (HGM) Classification of Local Wetlands</u> — The HGM classification system utilizes three variables to classify wetlands: geomorphic setting, water source, and hydrodynamics. Geomorphic setting refers to the topography of the wetland within the surrounding landscape. Water sources may include factors such as precipitation, surface or near-surface flow, and groundwater discharge. Finally, hydrodynamics is the direction and energy of the flow of water within the wetlands. The HGM classification system divides wetlands into seven classes: riverine, depressional, slope, mineral soil flats, organic soil flats, estuarine fringe, and lacustrine fringe. Organic soil flats and estuarine fringe wetlands are not found in New Mexico.

Utilizing previous mapping efforts, aerial imagery, and fieldwork, Saint Mary's University of Minnesota Geospatial Services mapped and classified wetlands within the Sacramento Mountains Region of southern New Mexico utilizing the HGM classification system (Allen et al. 2017). This classification and mapping effort encompassed the BRW within New Mexico. Four of the possible five (5) HGM wetland classes were mapped within the BRW (Table 2 and Figure 6).

The HGM mapping efforts classified less than one half of one percent of the total watershed as wetlands. Of the 249,047 acres within the BRW, approximately 897 acres have been classified as wetlands. Riverine wetlands make up approximately three-quarters of the wetlands within the watershed. There are four sub-classes of riverine wetlands found within the BRW: lowland unconfined (78.06%), episodic (20.69%), lowland confined (0.78%), and montane canyon confined (0.47%, Table 3). Depressional wetlands make up nearly all of the remaining quarter of wetlands within the watershed. Playas comprise approximately 71% of the depressional wetlands within the watershed. In comparison, artificial wetlands (i.e., excavated, excavated inflow, or impoundments) make up 22%, and natural wetlands make up 6% of the remaining depressional wetlands (Table 3). Slope wetlands, including springs, and flat wetlands only make up about 2% of the wetlands found within the BRW.

Table 2. BRW wetlands HGM classification type by acreage and percentage of all HGM mapped wetlands within the New Mexico portion of the watershed (Allen et al. 2017). The total watershed area is 249,047 acres.

HGM WETLAND CLASSIFICATION	ACRES IN BLACK RIVER WATERSHED	PERCENTAGE OF WETLANDS IN BLACK RIVER WATERSHED
RIVERINE	650.07	72.44%
DEPRESSION	228.25	25.44%
SLOPE	9.65	1.08%
FLATS	9.39	1.08%
TOTAL	**897.36**	

Table 3. BRW wetlands within New Mexico. HGM sub-class types by acreage and percentage of each wetland class (Allen et al. 2017).

Wetland Class	Sub-Class	Acres	Percentage of Class
Riverine			
	Lowland Unconfined	507.46	78.06%
	Episodic	134.48	20.69%
	Lowland Confined	5.05	0.78%
	Montane Canyon Confined	3.08	0.47%
Depressional			
	Playa	162.73	71.29%
	Artificial	51.04	22.36%
	Natural	14.48	6.34%
Slope			
	Other	9.65	100%
	Headwater		
	Springfed		
Flats			
	Mineral Soil	9.39	100%

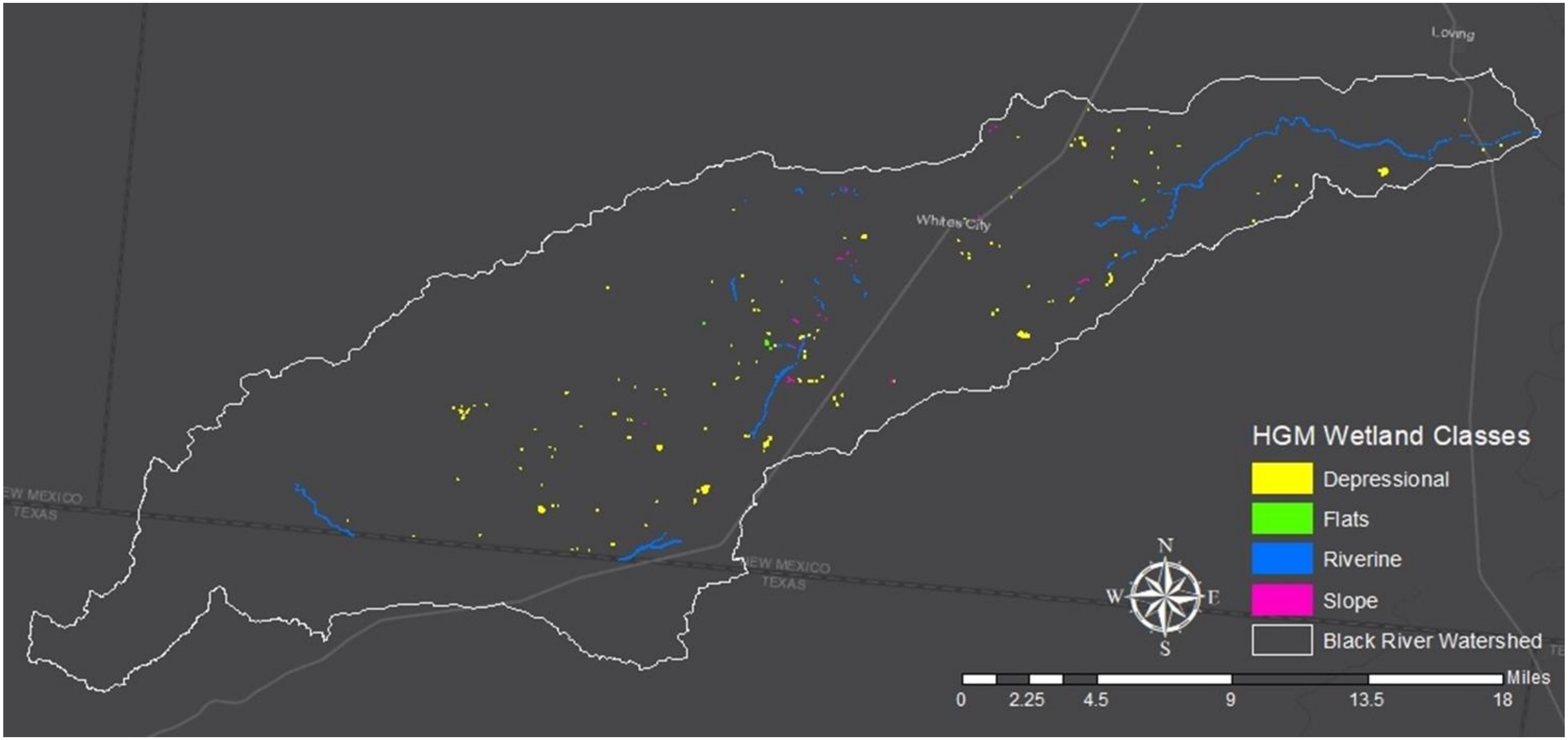


Figure 6. HGM classified wetlands mapped within the New Mexico portion of the Black River watershed.

Riverine Wetlands: The most common HGM wetland class within the BRW is the riverine wetland class (Figure 7), making up approximately 72% of the watershed's wetlands (Table 3). Many riverine wetlands within the watershed parallel the lower perennial portions of the Black River and Blue Springs. Riverine wetlands are described as riparian corridors found within active flood plains and typically parallel stream channels. There may be hydrologic connectivity between the wetlands and active stream channels (NRCS 2008b). Water sources for riverine wetlands include overbank flow from a river channel, tributary flow, flows from adjacent uplands, and precipitation.

Figure 7. Riverine wetland near Blue Springs, in Eddy County, New Mexico.

Depressional Wetlands: Depressional wetlands (Figure 8) can be described as topographic depressions that allow for the collection of water in the Chihuahuan Desert. These wetlands are seasonal and are predominantly wetted during the monsoon season in late summer. Depressional wetlands make up about 25% of the wetlands found in the BRW. Water sources for depressional wetlands include precipitation, groundwater discharge, interflow, and overland flow from adjacent uplands (NRCS 2008b). These wetlands may include multiple inlets and outlets, or they may also completely lack them all together. In depressional wetlands, water loss typically occurs through an outlet, evaporation, or infiltration. Approximately 22% of the depressional wetlands within the watershed are sub-classified as artificial wetlands originating from excavated depressions or from impounded water sources (Table 3).

Figure 8. An artificial depressional wetland at the source of Rattlesnake Springs, Eddy County, New Mexico.

<u>Slope Wetlands:</u> Slope wetlands (Figure 9) make up about 1% of the wetlands in the BRW including springs and ecosystems. These wetlands occur on gradients where groundwater discharges back onto the landscape (NRCS 2008b) (Table 2). The gradient of the slopes can range from steep drops to slight hillside inclines. Slope wetlands typically lack topographical contours capable of storing water. Water loss in slope wetlands occurs through evaporation and aquifer recharge. Most of the approximately ten acres of slope wetlands within the watershed occur on hillsides adjacent to the Black River and are springfed.

Figure 9. A slope wetland covered in vegetation near the Black River, Eddy County, New Mexico.

Springs ecosystems are some of the most important and least understood wetlands in any watershed . (Stevens, et al. 2020) "Spring ecosystems are subsurface-surface linked groundwater-dependent systems influenced by the exposure of groundwater at the Earth's surface in subaqueous as well as subaerial environments" (Stevens, et al. 2021). Springs are ecosystems influenced by the exposure of groundwater at the Earth's surface. Springs are abundant in many landscape settings and play important ecological, cultural, and socio-economic roles in arid, mesic, and subaqueous environments throughout human evolution and history. Yet, springs are widely regarded as being highly threatened by human impacts. Cantonati et al. (2020) recommended increased global awareness of springs, including basic mapping, inventory and assessment for the understanding of their distribution and the ecological integrity of springs.

Flats Wetlands: Similar to the slope wetlands, flats wetlands (Figure 10) only make up approximately 1% of the overall wetlands in the BRW (Table 2). All of the flats wetlands within the watershed are sub-categorized as mineral soil flats. These flats are described as relic lake bottoms or large historic flood plain terraces where the primary water source is precipitation (NRCS 2008b). Wetland flats are distinguished from depressional and slope wetlands because they do not receive any groundwater discharge and are not situated on slopes or in depressions. The BRW contains approximately 10 acres of mineral soil flats.

Figure 10. A flats wetland covered in vegetation in Eddy County, New Mexico.

NWI Classification of Local Wetland Types —
The National Wetlands Inventory (NWI) is a national wetlands mapping effort created and managed by the FWS. As mentioned previously, NWI utilizes the "Classification of Wetlands and Deepwater Habitats of the United States" (Cowardin et al. 1979). This classification system utilizes hydrology and hydrophytic plant communities to classify wetlands. This classification system contains five primary wetland systems. Three of these wetland systems are found in New Mexico: riverine wetlands, lacustrine wetlands, and palustrine wetlands. Riverine wetlands are described as water within a channel flowing either permanently of intermittently. Lacustrine wetlands are non-tidal and tidal freshwater wetlands in an intermittently and permanently flooded lake or reservoir larger than 20 acres and/or deeper than 2 meters. Palustrine wetlands are non-tidal and tidal freshwater wetlands in intermittently and permanently flooded open water bodies of less than 20 acres and less than 2 meters deep

Figure 11. An NWI classified streambed wetland near the Guadalupe Mountains, Eddy County, New Mexico.

The NWI utilizes image analysis to identify and classify wetlands and deep-water habitats from aerial imagery. An interactive wetland map for the United States is available through the FWS at the following website: https://www.fws.gov/wetlands/data/mapper.html.

The Wetlands and Deepwater Habitats Classification (Cowardin et al. 1979) separates wetlands into systems and organizes these systems further by separating them into subsystems, classes, subclasses, water regimes, and modifiers. The NWI has mapped almost 900 acres of wetlands within the BRW (Table 4, Figures 12–13). Descriptions for these wetlands can be found in Table 5.

Table 4. NWI wetland classification types of the BRW by acreage and percent cover.

NWI WETLAND CLASS	ACRES IN BLACK RIVER WATERSHED	PERCENTAGE OF WETLANDS IN BLACK RIVER WATERSHED
UNCONSOLIDATED BOTTOM	455.96	50.81%
EMERGENT	271.09	30.21%
STREAMBED	81.33	9.06%
UNCONSOLIDATED SHORE	60.71	6.77%
FORESTED	12.63	1.41%
SCRUB-SHRUB	8.70	0.97%
ROCK BOTTOM	6.96	0.78%
TOTAL	**897.38**	

Table 5. Description of NWI classes within the BRW.

Code	Class	Wetland Description
UB	Unconsolidated Bottom	Cobbles, sand, gravel, mud; at least semipermanently flooded; less than 30% vegetated (Cobbles-Gravel, Sand, Mud, or Organic).
EM	Emergent	Erected, rooted, herbaceous hydrophytes; all water regimes (Persistent and Nonpersistent).
SB	Streambed	All wetlands in Intermittent Subsystem of the Riverine System; seasonally flooded or less (Bedrock, Rubble, Cobble-Gravel, Sand, Mud, Organic and Vegetated Streambeds).
US	Unconsolidated Shore	Cobbles, sand, gravel, mud; seasonally flooded or less than 30% vegetated (Cobble-Gravel, Sand, Mud, organic and Vegetated (pioneer plants)).
FO	Forested	Woody vegetation greater than 20 feet tall; all water regimes (Broad-leaved Deciduous, Needle-leaved Deciduous, Broadleaved Evergreen, Needle-leaved Evergreen, and Dead).
SS	Scrub-Shrub	Woody vegetation less than 20 feet tall; all water regimes (Broad-leaved Deciduous, Needle-leaved Deciduous, Broadleaved Evergreen, Needle-leaved Evergreen, and Dead).
RB	Rock Bottom	Stones, boulders, bedrock, at least semi permanently flooded; less than 30% vegetated (Bedrock and Rubble).

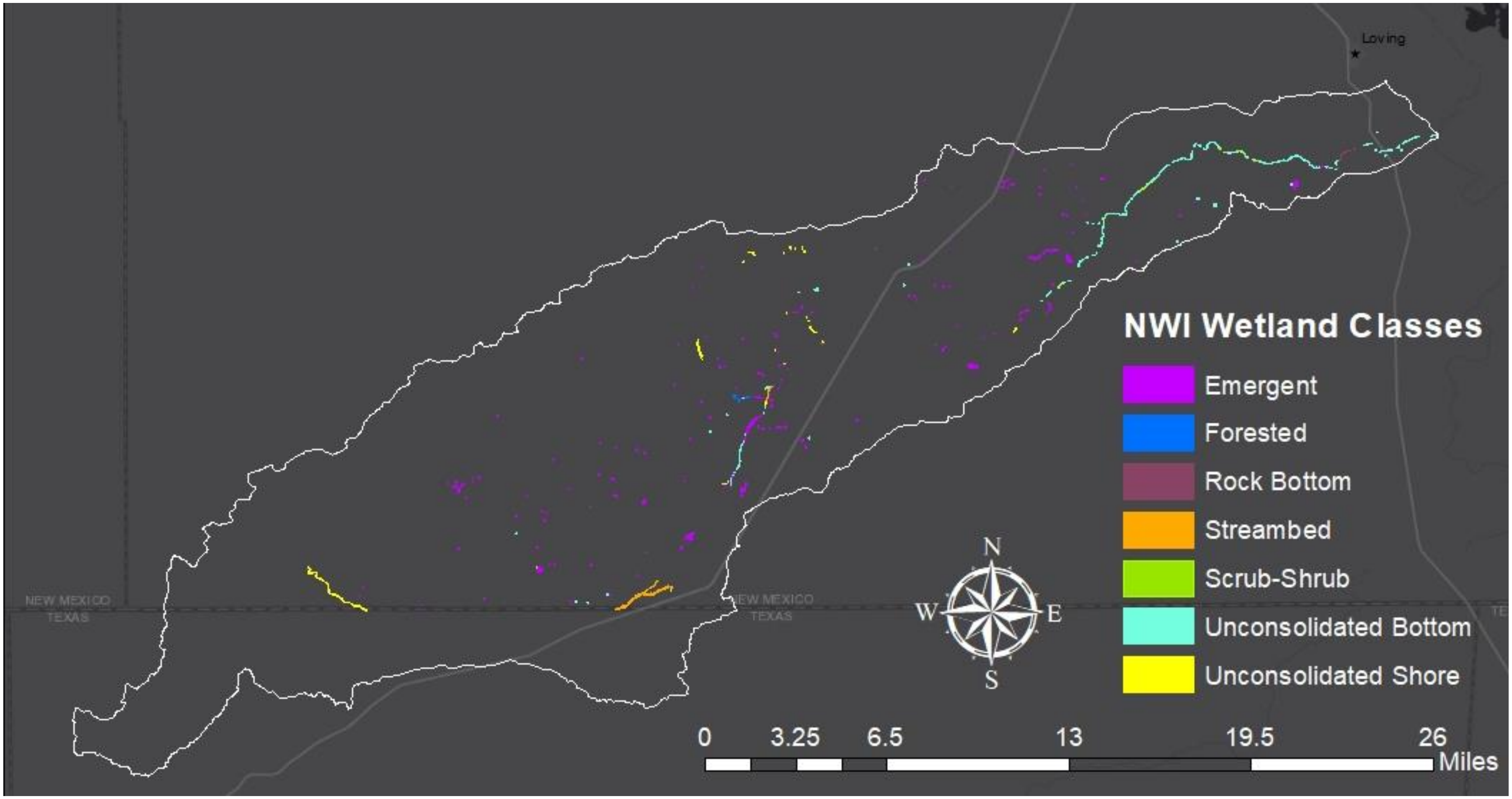


Figure 12. Mapped NWI wetlands in the New Mexico portion of the Black River watershed.

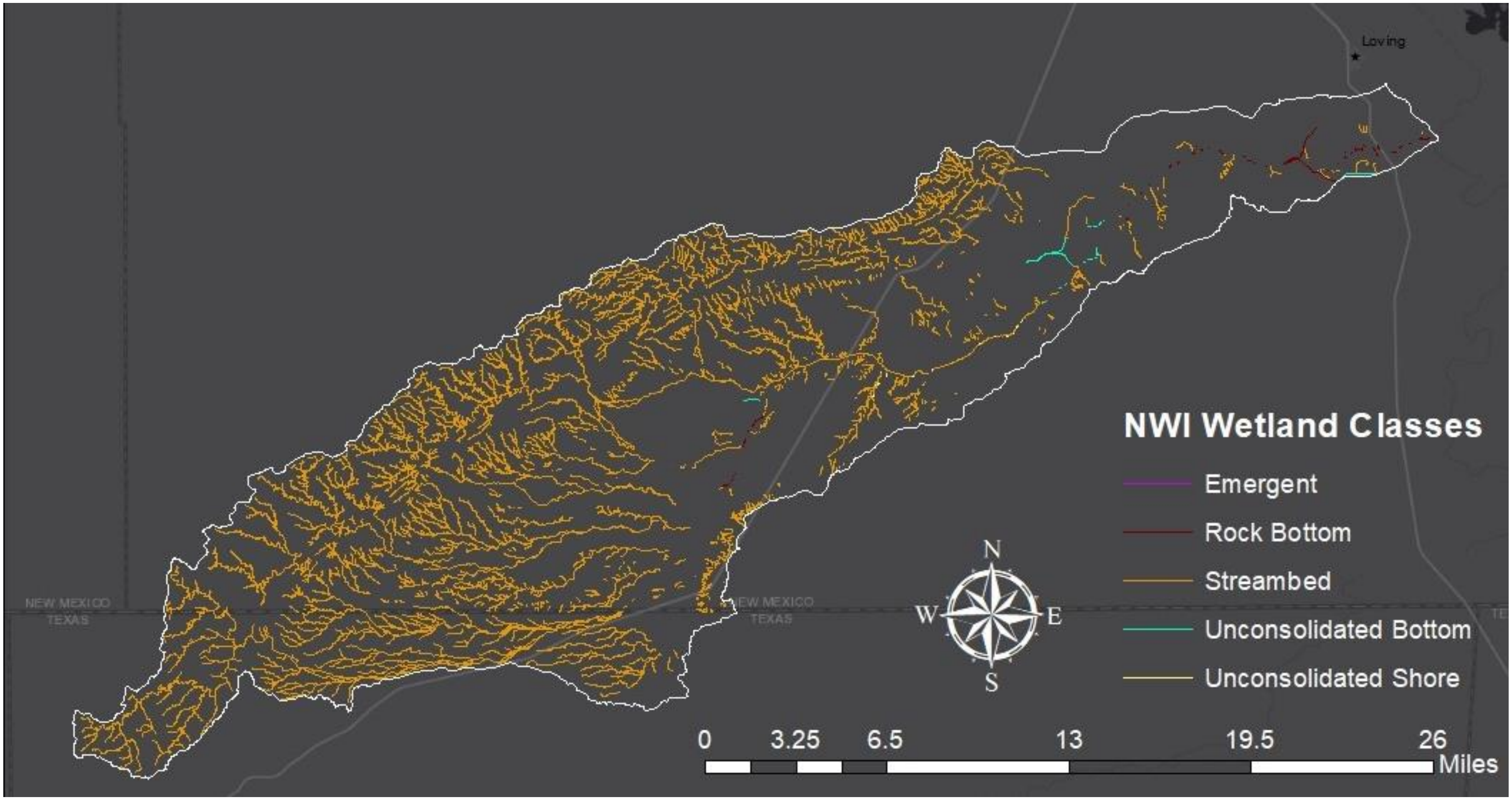


Figure 13. Mapped NWI linear wetlands of the Black River watershed.

Wetland Functions

Wetlands play a crucial role in the ecology of the landscape. Wetlands are among some of the most diverse ecosystems on the planet. They provide many physical and chemical functions that aid in maintaining healthy ecosystems. Table 6 lists some of the functions of the wetlands that have been mapped throughout the BRW (Allen et al. 2017). Although some wetlands may not be as highly functioning as others, the function they do provide may be critical to the health of the ecosystem. Therefore, it is important to protect and preserve all wetlands regardless of their known functionality.

Table 6. Wetland functions mapped within the BRW.

Functions That Improve Water Quality	Biological Functions
Surface Water Detention	Aquatic Invertebrate Habitat
Streamflow Maintenance	Fish Habitat
Groundwater Recharge	Waterfowl Habitat
Shoreline Stabilization	Other Wildlife Habitat
Nutrient Transformation	
Carbon Sequestration	
Sediment Retention	

Fish, Wildlife, and Aquatic Invertebrate Habitat — Wetlands provide habitat for many types of fish, aquatic vertebrates, shorebirds, waterfowl, reptiles, and even large mammals. Wetlands are critical to fish populations, as they provide spawning, nursery, and feeding habitat for many species. Wetlands that are high functioning for fish habitat typically have wetter water regimes. These wetlands that are key to fish habitat may also contribute to keeping optimal water temperatures for fish. Allen et al. (2017) found that over 400 acres and over 11,000 linear feet of wetlands in the BRW may function as fish habitat.

Figure 14. A population of Pecos springsnail (*Pyrgulopsis pecosensis*) utilizing wetland habitat within the Black River Watershed.

Approximately 470 acres and 34,590 linear feet of wetlands within the watershed contribute to aquatic invertebrate habitat (Allen et al. 2017). Aquatic invertebrates utilize many different wetland types. They are also vital in sustaining healthy aquatic ecosystems, as they are typically one of the largest forage sources in an ecosystem.

Wetlands also aid in sustaining populations of wildlife. They provide habitats for both residential and migratory wildlife. Within the BRW, about 80 acres and 16,300 linear feet of wetlands possibly function as a habitat for water birds (Allen et al. 2017). In addition to the water bird habitat, 848 acres and 27,257 linear feet may serve as additional wildlife habitats (Allen et al. 2017).

Bank Stabilization — Wetlands may function as a means of bank stabilization. Vegetation supported by wetlands will help to stabilize topsoil, leading to a decrease in erosion (Figure 15). Aquatic and riparian vegetation also help to dissipate energy produced by pulse floods that may cause erosion. Wetted soils are also less vulnerable to wind erosion. Allen et al. (2017) found that about 45 acres and over 500 linear feet of wetlands in the BRW may be functioning to help stabilize banks and shorelines.

Figure 15. A heavily vegetated side channel of the Black River. The vegetation has stabilized the wetland from erosion in recent flood events.

Carbon Sequestration — Wetlands contain between 20 and 30% of the world's soil carbon (Lal 2008). Wetlands work to trap atmospheric carbon in the soils through chemical and biological processes. Wetland vegetation fixes atmospheric carbon through photosynthesis, and when the foliage dies and sinks, it deposits carbon below the water's surface. Wetlands with higher concentrations of vegetation are higher functioning carbon sinks. Allen et al. (2017) found that about 188 acres and over 1,355 linear feet of wetlands in the BRW may sequester carbon.

Groundwater Recharge — Wetlands are often points of groundwater discharge, where sub-surface water makes its way onto the landscape. However, wetlands can also work as points of groundwater recharge, where water infiltration of surface water replenishes local aquifers. The ability of a wetland to aid groundwater recharge is primarily related to the surface geology of the wetland. Within the BRW, about 826 acres and 277,700 linear feet of wetlands aid in groundwater recharge (Allen et al. 2017).

Nutrient Transformation — Many wetlands function in nutrient transformation, effectively breaking down nutrients from natural sources, fertilizer, or other pollutants. Typically, the primary sources of excessive nitrates and phosphates in a wetland are due to agricultural runoff. Wetlands can consume or sequester nitrates and phosphates through various physical, chemical, and biological processes.

Wetlands with high concentrations of vegetation typically perform more efficient nutrient transformation. Within the BRW, about 159 acres and 968 linear feet of wetlands are possibly functioning to aid nutrient transformation (Allen et al. 2017).

Table 7. Area and length of mapped wetlands functions within the BRW (Allen et al. 2017).

	PLOTTED WETLANDS			LINEAR WETLANDS		
WETLAND FUNCTIONS	High Functioning (Acres)	Moderate Functioning (Acres)	**Total Acres**	High Functioning (Feet)	Moderate Functioning (Feet)	**Total Feet**
WILDLIFE HABITAT	773.21	75.76	**848.97**	10,244.64	17,012.53	**27,257.17**
GROUNDWATER RECHARGE	826.15	0.04	**826.19**	276,360.21	1,340.74	**277,700.95**
AQUATIC INVERTEBRATE HABITAT	462.23	7.52	**469.75**	34,591.80	0.00	**34,591.80**
FISH HABITAT	467.90	0.00	**467.90**	0.00	11,427.13	**11,427.13**
SEDIMENT RETENTION	46.82	261.07	**307.89**	5,836.11	0.00	**5,836.11**
SURFACE WATER DETENTION	48.11	231.52	**279.63**	484.81	396.88	**881.69**
STREAMFLOW MAINTENANCE	215.66	11.60	**227.26**	7,416.12	0.00	**7,416.12**
CARBON SEQUESTRATION	12.11	65.96	**188.07**	71.30	1,284.27	**1,355.57**
NUTRIENT TRANSFORMATION	76.58	82.88	**159.46**	71.30	897.32	**968.67**
WATER BIRD HABITAT	38.85	39.98	**78.83**	46.86	16,325.42	**16,372.28**
UNCOMMON WETLANDS PLANTS	48.11	0.00	**48.11**	2,461.69	0.00	**2,461.69**
BANK STABILIZATION	46.68	0.00	**46.68**	500.44	0.00	**500.44**
FISH SHADE	11.48	0.00	**11.48**	0.00	0.00	**0.00**

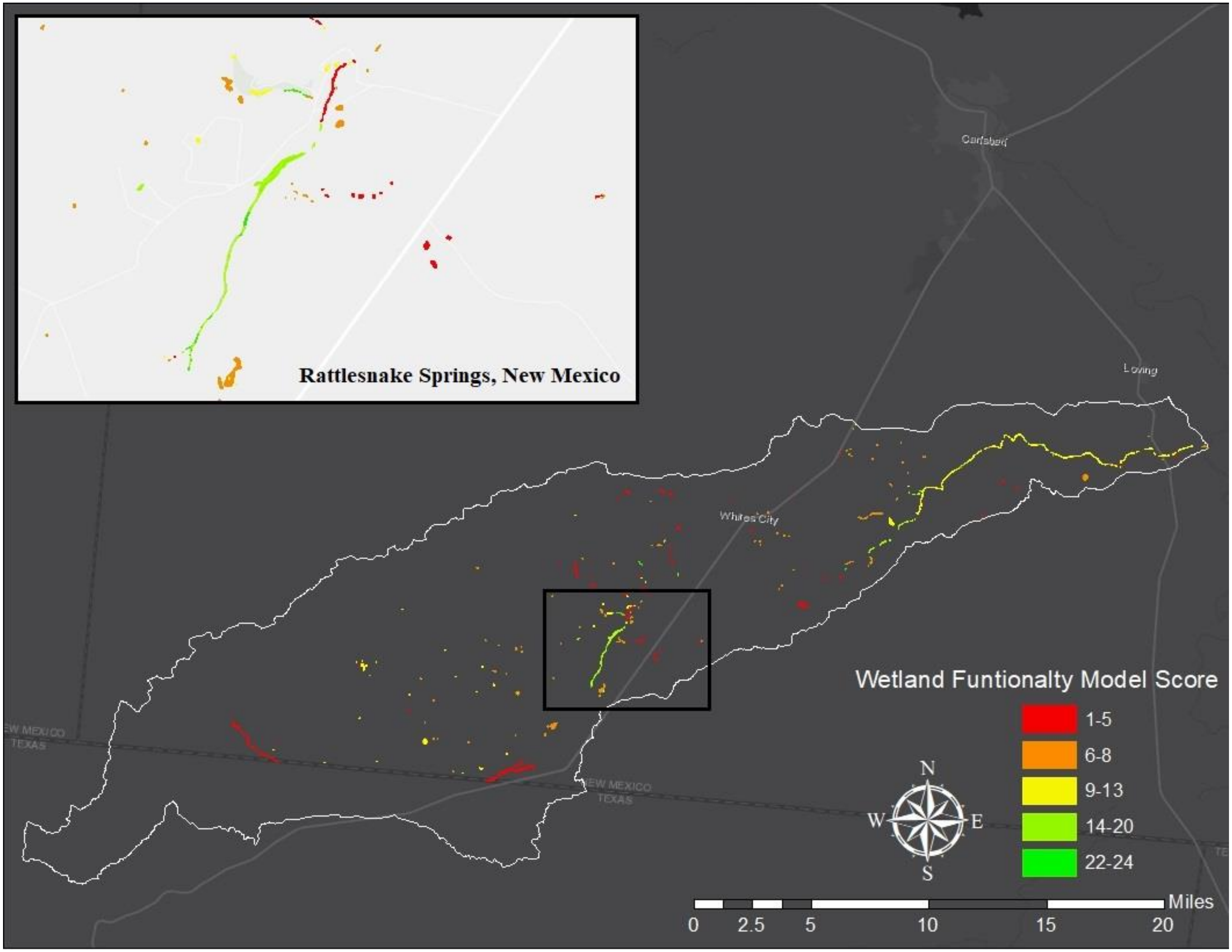


Figure 16. This is model data and may not represent reality. A wetland functionality assessment may be needed to improve the models accuracy. A model of the functionality of the wetlands within the Black River watershed. The model was created by calculating the total number of functions of each mapped wetland. Each function was also giving a weighted value based on its performance of each specific function. Wetlands were given a value of two for a high ranked function and a value of one for a moderate ranked function. The Rattlesnake Springs area is a rather diverse area for wetlands with varying degrees of functionality. Function data from Allen et al. 2017.

Wetlands Rapid Assessment – NMRAM

The Wetlands Program has developed of a rapid assessment framework to evaluate the ecological condition of riverine wetlands and their associated riparian areas throughout New Mexico. The New Mexico Rapid Assessment Method (NMRAM – McGraw et al. 2018) was developed as a part of the SWQB Wetlands Program's on-going efforts to promote effective management and protection of the state's wetland resources. The overarching goal is to provide the necessary information to help prevent the continued loss and decline of New Mexico's scarce and important wetland resources.

Significant time and funding is expended each year restoring and protecting New Mexico's river systems and associated wetland and riparian areas. Riverine wetlands and riparian areas are the focus of many of these projects because they provide important functions that also maintain water quality in adjacent stream systems. Some of the important functions that riverine wetlands and riparian areas provide include sediment filtering, flood sequestration and reduction, erosion control, aquifer recharge, maintenance of stream temperature and stream flow, nutrient transformation and recycling, hyporheic interchange, and provision of habitat and maintenance of characteristic native populations. Riverine wetlands help maintain bank stability through the extremely dense and resilient fibrous root systems of typical wetland plants. Riverine wetlands also provide nutrients and detritus that maintain the food chain in adjacent rivers and streams, and provide habitat for beaver and other species that maintain the ecological integrity of stream systems. The NMRAM modules available for use in the BRW include: Montane Riverine Wetlands, Lowland Riverine Wetlands, and Springs Ecosystems. The NMRAM modules in development that may be useful in the future for the BRW include: Playas, Confined Riverine Wetlands, Episodic Riverine Wetlands, and Depressional Wetlands.

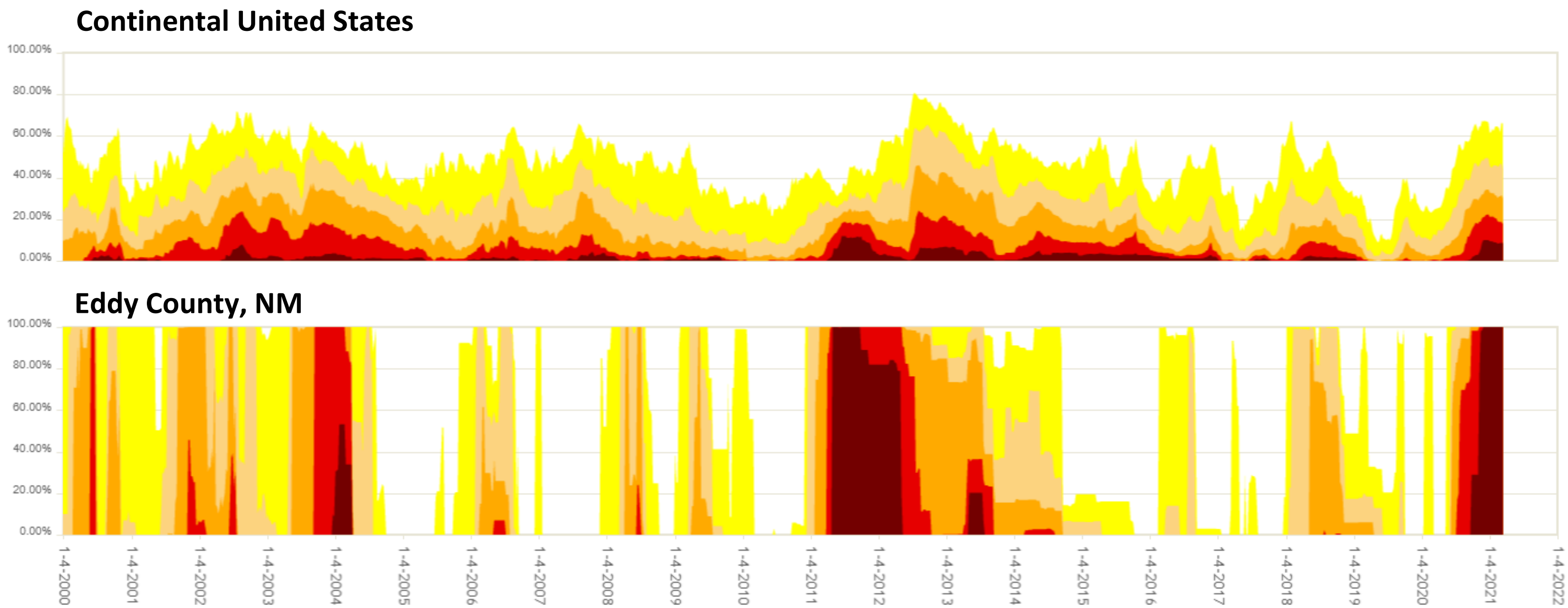
Climate

The BRW is in a semi-arid region characterized by cool winter temperatures and hot summer temperatures (Table 8). Maximum daily temperatures often reach 100°F or greater during the summer. The majority of the area's precipitation occurs from May to October annually. Monsoon-like conditions are common in summer months with heavy rainfall occurring in strong, short storm events (WRCC 2021b). The Guadalupe Mountains receive a bit more precipitation than the adjacent lowlands, over 20 inches in some of the highest parts of the watershed.   The area has historically been prone to long-term droughts. Continued impacts from climate change are likely to exacerbate already dry conditions (Figure 17).

Table 8. Climate summary from WRCC station #291480 located at Carlsbad Caverns. Values are provided as averages from 02/01/1930 through 06/06/2016. Percent of possible observations for period of record: max. temp at 74.1%, min. temp at 73.3%, precipitation at 98.8%, snowfall at 73.5%, snow depth at 72.2% (WRCC 2021a).

Climate Condition (Average)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Max. Temperature (°F)	56.3	60.2	67.1	75.6	83.4	91.1	90.8	89.5	83.2	74.9	64.7	57.5	**74.5**
Min. Temperature (°F)	33.6	36.4	42.1	49.9	57.9	64.9	66.6	65.9	60.4	52.2	42.0	35.2	**50.6**
Total Precipitation (in.)	0.5	0.5	0.4	0.6	1.5	1.7	2.1	2.3	3.0	1.4	0.5	0.5	**14.9**
Total Snowfall (in.)	1.4	1.1	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	2.2	**5.8**
Snow Depth (in.)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**

Eddy County experienced ≤ 50% normal precipitation in the years 2018 - 2020 (Figure 17; SRCC 2021). As depicted in Figure 17, Eddy County has experienced significantly worse drought conditions compared to the continental United States in recent years, with nearly the entirety of the past 20 years classified as at least abnormally dry. Lack of rainfall reduces flows and, when paired with increased temperatures, impacts both water temperatures and water chemistry (Milly et al. 2005, Djebou 2017b, Overpeck and Udall 2020). Additional watershed impacts from climate change include greater evapotranspiration rates and reduced available water for flow (Overpeck and Udall 2020). Future water source availability will be a particular concern for water resource, habitat, and fisheries managers (Milly et al. 2005, Overpeck and Udall 2020).



Category Description	USGS Weekly Streamflow (%)	Possible Impacts
D0: Abnormally Dry	21–30	Water availability and crop/pasture growth slightly impacted.
D1: Moderate Drought	11–20	Voluntary water-use restrictions requested.
D2: Severe Drought	6–10	Crop/pasture loss likely, water shortages common, and water restrictions imposed.
D3: Extreme Drought	3–5	Major crop/pasture loss, widespread water shortages and restrictions.
D4: Exceptional Drought	0–2	Widespread, severe crop/pasture loss; water shortage emergencies likely.

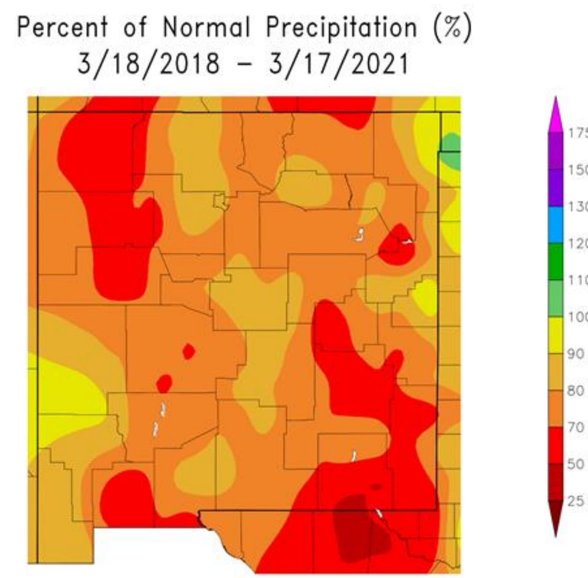


Figure 17. Top: Drought condition time series (% area) comparison between the lower 48 and Eddy County, NM from January 2000 to March 2021 (NDMC 2021). **Bottom Left:** Drought Condition Category Descriptions and Expected Impacts. **Bottom Right:** Departure from normal precipitation (%) over a 36-month period (2018–2021) in New Mexico. "Normal" refers to the 1981–2010 climate data from Applied Climate Information System (SRCC 2021).

Geography

Most of the Black River Watershed sits along the southeastern edge of the Capitan Reef Escarpment and drains from the southwest to the northeast where it meets the Pecos River. The northern portion of the BRW is located approximately 14 miles south of Carlsbad, New Mexico in the southern portion of Eddy County (Figure 18). Eddy County comprises approximately 4,200 sq. miles bordered on the south by Texas, on the west by Otero County, north by Chaves County, and on the east by Lea County. The largest city is Carlsbad, the county seat. The BRW is 249,074 acres in total, and the total stream network within the watershed is 767.53 miles. The upper portions of the drainage, above the first perennial reach of the Black River near the Cottonwood Day Use Area, are mostly dry. With Perennial waters are expressed above the Cottonwood Day Use Area as karstic exposure spring pools (Bonacci 2001, Springer and Stevens 2009) that are sustained by a series of springs along the channel in addition to flood events following seasonal storms. The perennial stretch of the Black River can be found approximately two miles upstream of the confluence of Blue Springs and the Black River traveling 20 miles to the confluence of the Pecos River. The lands surrounding the Black River in this area range from rolling foothills to nearly level rangelands with ephemeral drainages.

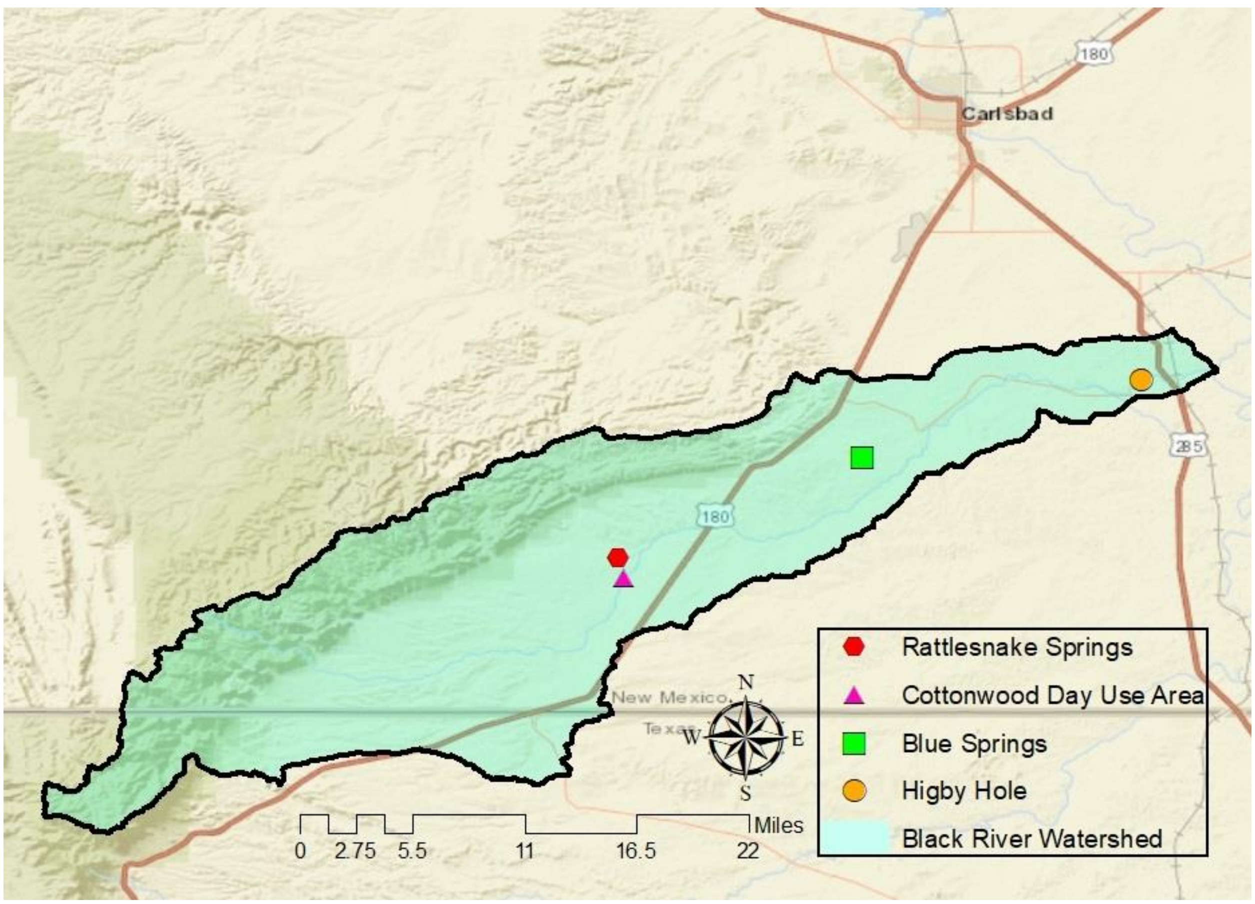


Figure 18. BRW geography and points of interest.

Geology

The geology within and surrounding the Black River drainage is comprised of four distinct bedrock deposits (listed from youngest to oldest): eolian, alluvial, evaporite, and carbonate deposits (Figure 19).

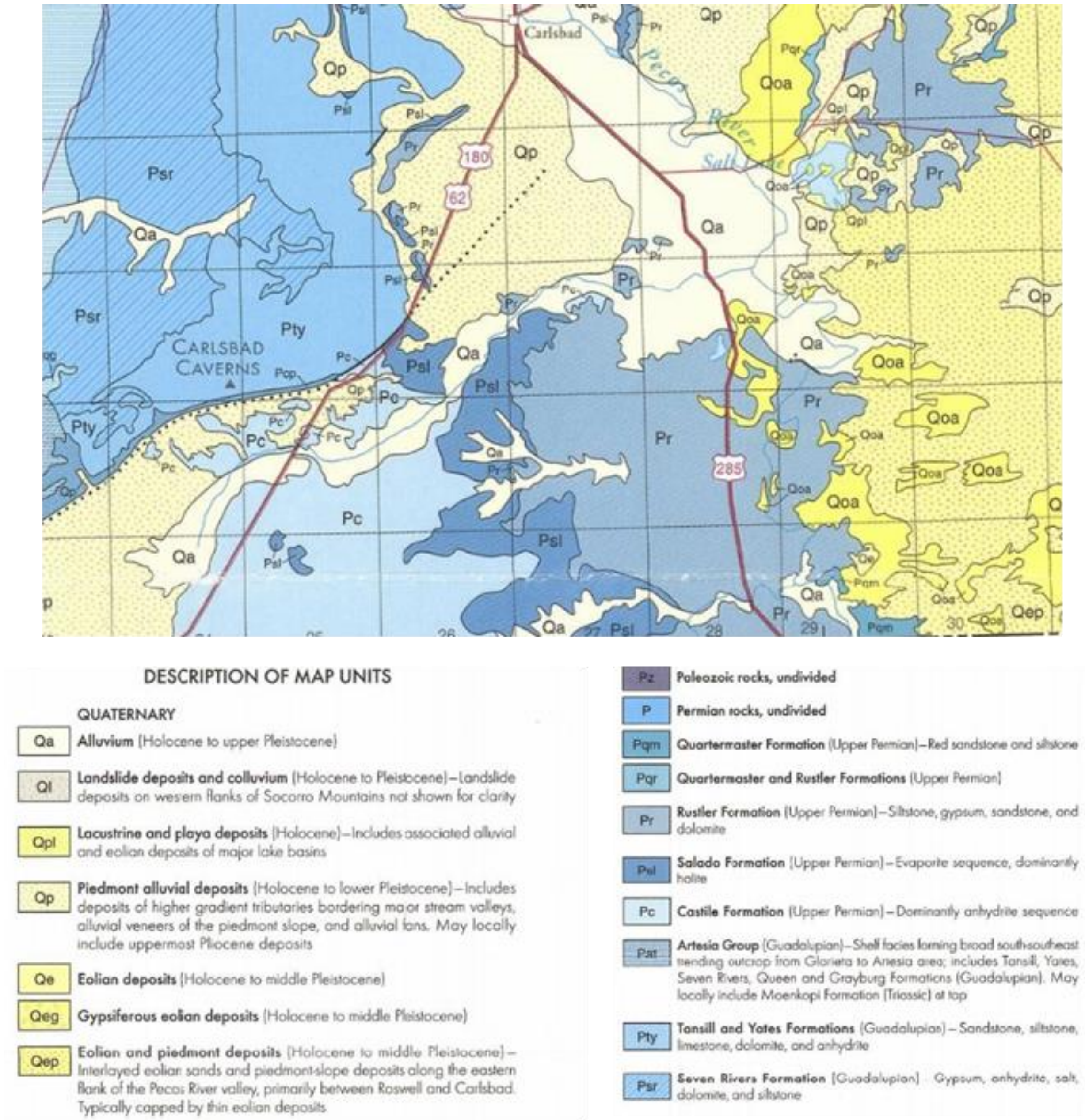


Figure 19. Map highlighting the surficial geology of the area, including rock types associated with the corresponding geologic formations (Scale 1:500,000; NMBGMRP 2021).

Eolian deposits are formed by windblown accumulation of sediments. These sediments are typically silts and clays; however, fine sands can also be found in these deposits. Eolian deposits in this area are from the late Holocene Epoch (less than 11,700 years before present; Hayes 1964). The alluvial deposits are characterized by deposits of silts and sands. This material is from surrounding streams removing sediment from the uplands and depositing the material within the basin. These deposits are also primarily Holocene in age (Hayes 1964). Evaporites are formed in shallow saline rich lakes. The evaporites in this area (largely consisting of gypsum, halite, and anhydrite deposits) formed during the Middle to Late Cretaceous Period (145-66 mya) (Hayes 1964). During the Pennsylvanian Period (323-298 mya), tectonic activity began causing uplift in the area and further resulting in a shallowing of the sea. This allowed the formation of carbonate reefs and lagoonal shale deposits. The most famous of these reefs is the Capitan Limestone — the later dissolution of which resulted in the formation of numerous cave systems, including Carlsbad Caverns (Hayes 1964).

The region is famous for carbonate caverns, such as Lechuguilla Cave and Carlsbad Caverns. Caverns throughout the Guadalupe Mountains were likely formed by water table depth shifts during periods of tectonic uplift (Polyak et al. 2006). Carbonic acid speleogenesis can take millions of years; area caverns were likely formed between 12 and 3 mya (Polyak et al. 2006). In addition to caves, the landscape has extensive examples of karst structures (Stafford et al. 2008), such as sinkholes and surficial channels (known as karren). These structures are commonly found in areas affected by erosion and where bedrock has been exposed (Stafford et al. 2008). Where solution is present in the subsurface, collapse features are common (Brokaw et al. 1972). Brine production is caused by the circulation of ground water through variable layers (e.g., salt, gypsum, and anhydrite).

The Capitan Aquifer is located in New Mexico and Texas (Figures 20–21). Within New Mexico, the aquifer spans widths of 10–14 miles at approximate depths between 430 feet near Carlsbad and over 4,000 feet in Lea County (Hiss 1976). The aquifer is vital to the support of municipal, agricultural, and industrial water needs throughout its reach (Hiss 1976). Production from wells is reportedly patchy and variable; this is likely due to the porosity of associated formations (Uliana 2001). Increased groundwater production in modern times has severely depleted supplies (Uliana 2001).

The oil and gas industry has dominated the local economy for decades. In January 2019, Eddy County ranked 6th in the nation producing 10 million barrels that month (Associated Press 20 May 2019). The BRW is located within the Delaware portion of the Permian Basin (Broadhead 2005). Here, petroleum is generally produced from reservoirs at depths greater than 17,000 ft. (Broadhead 2005). The Woodford Shale formation is the foremost source for production in the area (Broadhead 2005).

The Carlsbad potash district (largely located east of Carlsbad and northeast of the Black River wetland area) is the largest producing potash district in the United States (McLemore 2006) and is valued at more than $7 billion (Barker and Austin 1996). These deposits are located within Permian sedimentary rocks (McLemore 2006); the product is primarily used in fertilizer. In addition to potash, metal deposits (e.g., copper, lead, zinc, uranium, and gold) are also present; however, they are notoriously difficult to access. Even though mining areas were discovered in the 1900s, they have produced little monetary value due to poor accessibility (Thompson 1983, North and McLemore 1986, McLemore 2006).

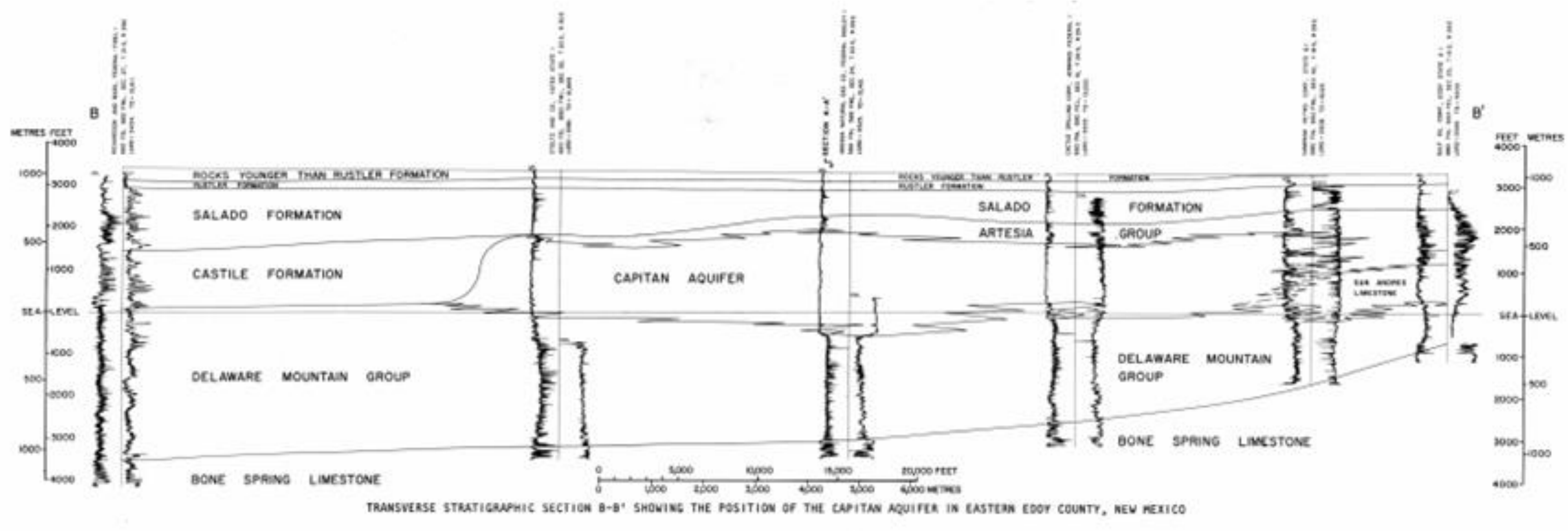
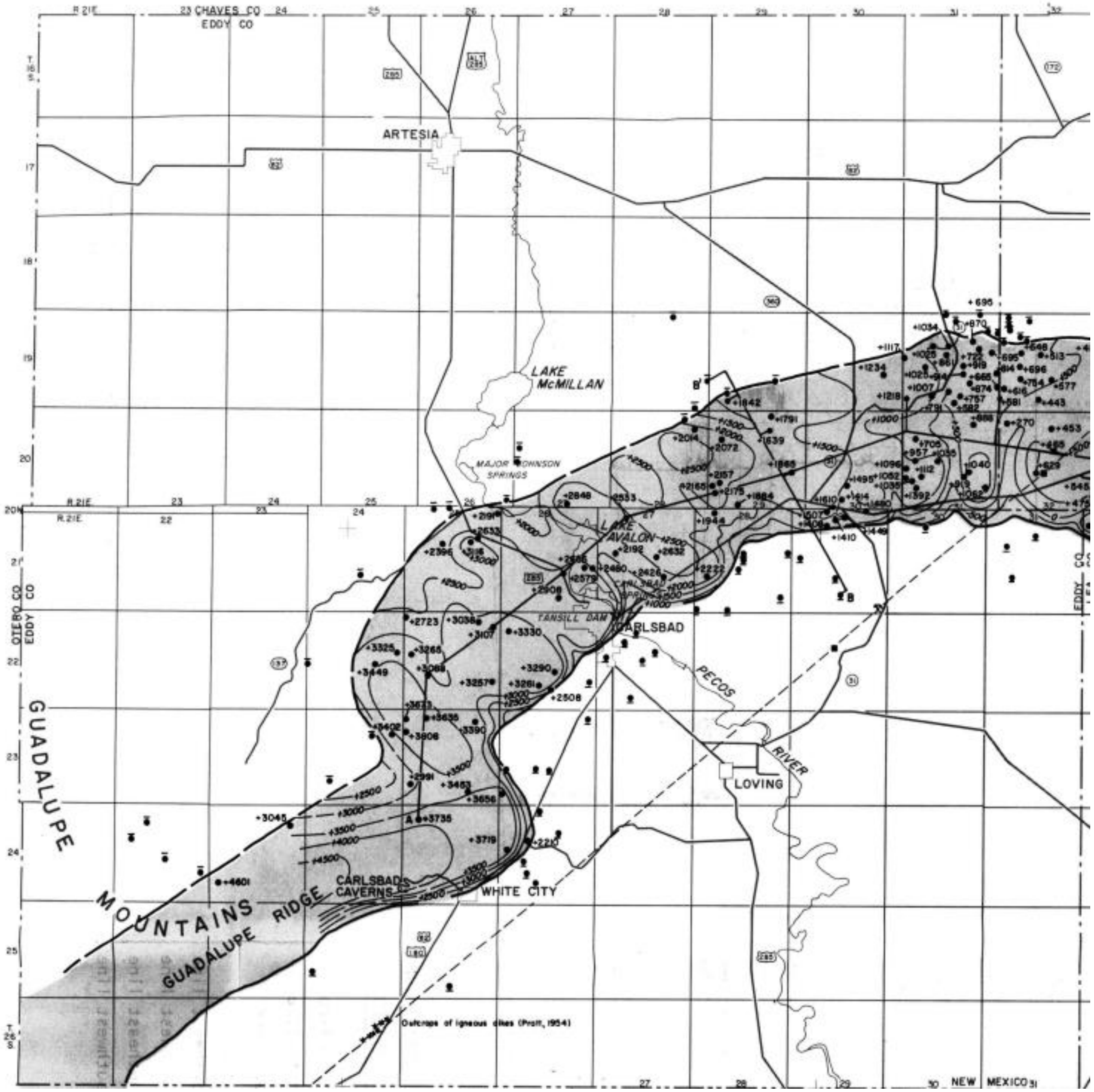
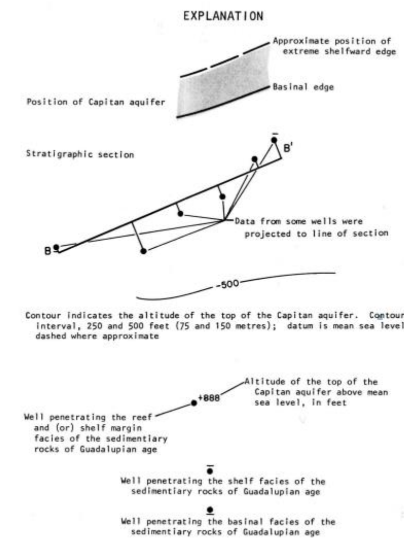


Figure 20. Stratigraphy of the Permian Capitan Aquifer (Hiss 1976).





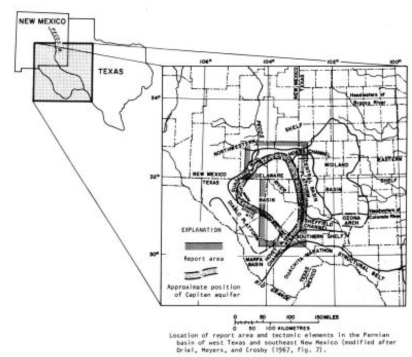


Figure 21. The Capitan Aquifer is located in New Mexico and Texas. The large map features its reach in Eddy County, New Mexico (Hiss 1976).

Current Landscape Use

Oil and Gas Production — Southeastern New Mexico has been known for its oil and gas production since the early 1920s after oil was struck near the town of Artesia, New Mexico. Following this discovery, the Permian became a hot spot for the production of oil and gas. The Permian Basin spans 86,000 square miles of southeastern New Mexico and western Texas (Ball 1995). It is comprised of three different sub-basins: Delaware Sub-Basin, Central Sub-Basin, and Midland Sub-Basin. The Delaware Sub-Basin is the westernmost of the three and covers 6.4 million acres. The majority of Eddy County and the BRW lies within the Delaware Sub-Basin.

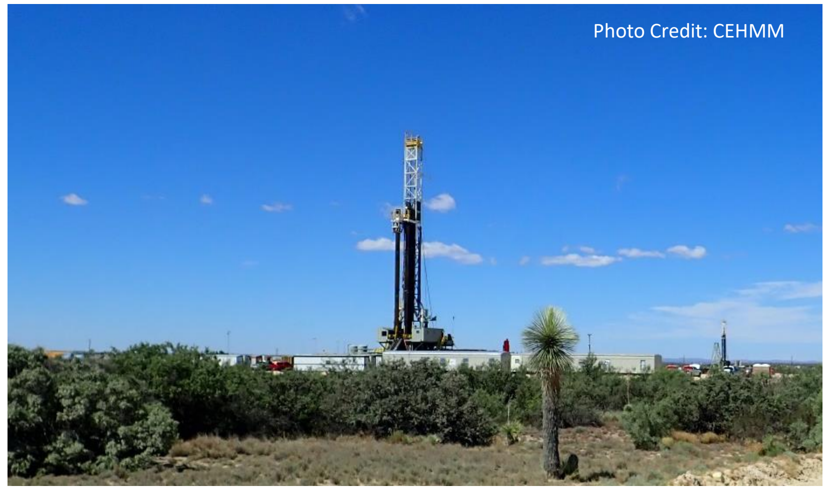


Figure 22. A new oil well being drilled in the Black River watershed during the summer of 2019.

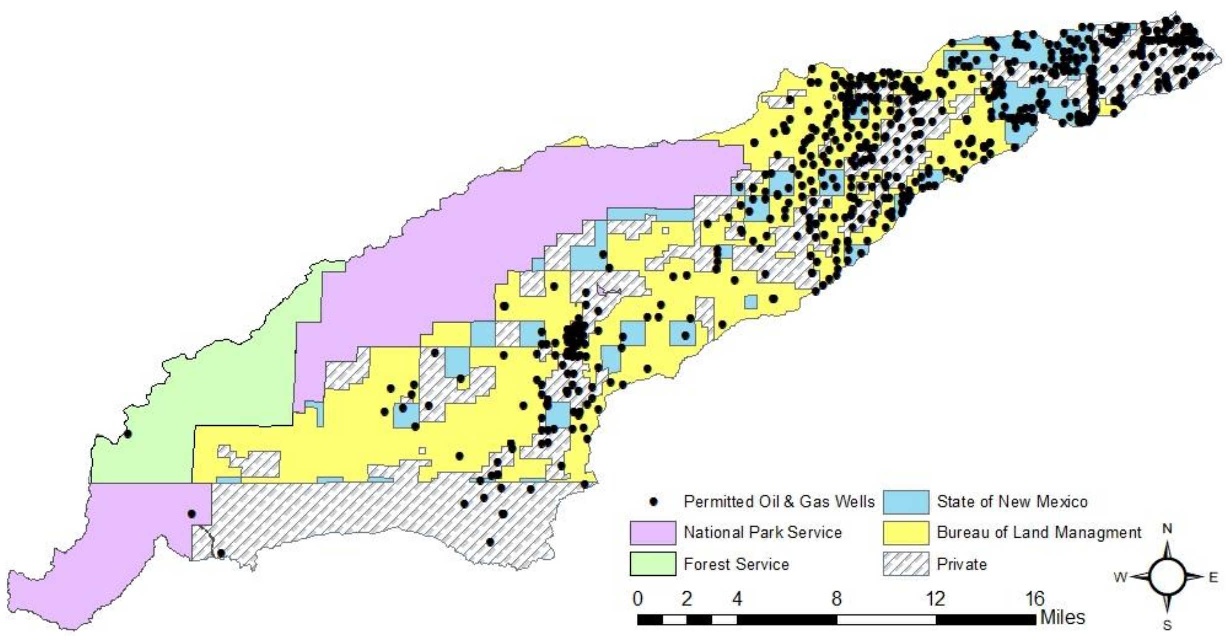


Figure 23. Oil and gas wells permitted by NMOCD and TXRRC within the Black River Watershed.

The Permian Basin was formed by an open marine area, known as the Tobosa Basin, some 325 million – 320 million years ago (Galley 1958). Over millions of years, the remains of marine plants and animals were buried deep and the enormous heat and pressure caused the formation of oil and gas deposits. The Wolfcamp Shale is found throughout all of the Permian Basin and is the most plentiful oil and gas bearing formation in the Permian (EIA 2008).

Since the first well was drilled in the Delaware Sub-Basin in July of 1920, over 30 billion barrels of crude have been recovered, with previous predictions of an estimated 20 billion barrels remaining. However, much of the oil and gas deposits within underground reservoirs were largely unobtainable until the recent developments of hydraulic fracturing and horizontal drilling. These new drilling and completion methods now enable the extraction of oil and gas from much greater depths, as well as from harder to reach oil bearing formations. The technological advances over the last 20 years have increased the estimate of fossil fuel reserves in the basin to 46.3 billion barrels of oil, 281 trillion cubic feet of natural gas, and 20 billion barrels of natural gas liquids accessible in the Delaware Sub-Basin (USGS 2018). In 2010, the oil industry was extracting an average of 923,112 barrels of oil per day in the Permian Basin (EIA 2021). In 2021, the oil industry was extracting an average of 4,398,963 barrels of oil per day in the Permian Basin (EIA 2021). The daily average oil production in the basin increased by approximately 377% from 2010 to 2020. As of 2021, there are 262 active oil and gas wells in the BRW (NMOCD 2021). There are also 232 plugged oil and gas wells within the watershed (NMOCD 2021).

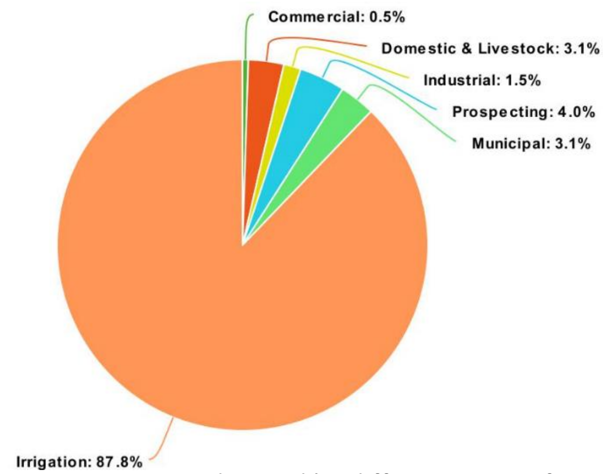


Figure 24. Water demand by differing types of use (Arm et al. 2014).

<u>**Water Use**</u> **—** Surface and groundwater within the BRW are utilized to their maximum extent. Arm et al. (2014) found that there were 310 points of diversion within the BRW. Approximately 205, or sixty-six percent, of these diversions were surface water diversions with the remaining being groundwater diversions. Utilizing New Mexico Office of the State Engineer (NMOSE) data, Arm et al. (2014) also found there are 14,874-acre feet per year (afy) allocated throughout the watershed. While most of the water that is used originates from the Black River, it is

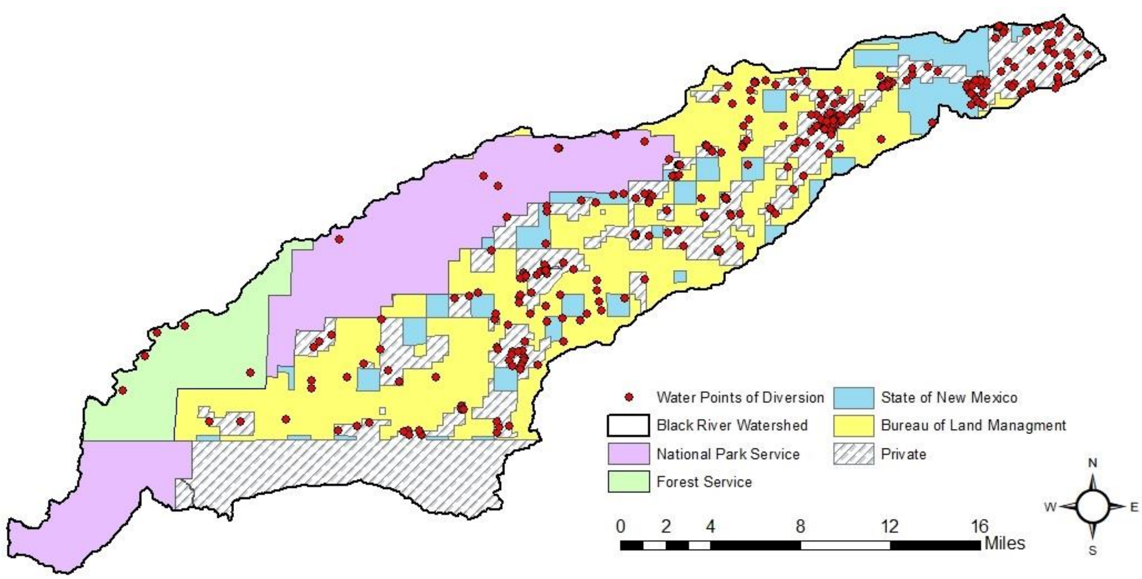


Figure 25. Permitted points of water diversion within the Black River Watershed. Note: Texas data is not included.

possible that not all of this water is from the Black River, as some of these rights may be allocated from Pecos River water via the canal systems. The majority of this water is allocated to irrigation (87.8%). The remaining 12.2% is allocated to commercial, industrial, municipal, prospection, and livestock uses.

<u>Agriculture</u> —

<u>Farming:</u> Farming became popular in the area after the arrival of the train in 1891. Today, there are still several farms located within the BRW. The top crops for the area include grass silage, cotton, pecans, and wheat (USDA 2017). Eddy County was the state's second largest producer of pecans in 2017, and fourth largest crop producing county overall (USDA 2017). From 2012 to 2017, the number of farms in Eddy County shrunk by 8%; in 2017, there were 507 registered farms in Eddy County (USDA 2017). However, during this same time period, the average farm size in Eddy County grew by 4% (USDA 2017). The practice of farming in the area plays a large economic role in the county as the net cash farm income in 2017 was $20,699,000, a 6% increase from 2012 (USDA 2017). In 2017, 5% of Eddy County's farm land was designated crop land; of these lands, 31,525 acres are irrigated (USDA 2017). Farms within the BRW utilize shallow ground water wells and direct pumping from the Black River for irrigation purposes.

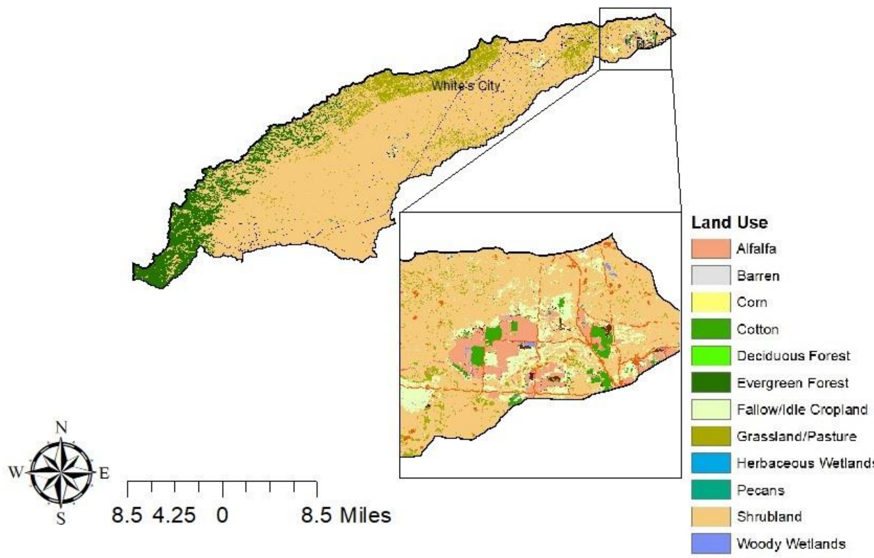


Figure 26. Crop cover type in the Black River watershed.

<u>Ranching:</u> The practice of ranching livestock in the area goes back centuries. In 2017, 94% of all agricultural lands within Eddy County were designated as pasturelands (USDA 2017). In 2017, Eddy County had approximately 40,000 cattle and calves, and the county was the 12th largest in the state for livestock sales (USDA 2017). In 2015, livestock accounted for 0.49% of all of Eddy County's water use (NMOSE 2015). In times of emergency, such as pump failure or broken water lines, the Black River provides a backup water source for cattle.

<u>Recreation</u> —

<u>National Parks:</u> Portions of the Guadalupe Mountain National Park (GMNP) and the Carlsbad Caverns National Park (CCNP) can be found within the BRW. The GMNP lies at the westernmost portion of the BRW and contributes to the river's headwaters. In 1966, Congress authorized the creation of the park, and in 1972 the park was established (NPS 2017). The park contains 76,293 acres of land, of which 46,850 is deemed wilderness (NPS 2019). A variety of animals can be found in the park from elk to rodents, most of which rely on small springs throughout the park for watering sources (NPS 2019). The people utilize the park for activities such as hiking, horseback riding, back packing, and scientific research (NPS 2019). For the last five years, the park has averaged approximately 184,000 visitors per year.

The CCNP is approximately 46,766 acres of land in the Guadalupe Mountains and Permian Basin (NPS 2019). Of the 46,766 acres within the park, 33,000 are designated as wilderness. While 17 species of bats call CCNP home, it is also home to a large population of Brazilian free-tailed bats (*Tadarida brasiliensis*) at an estimated 400,000 individuals (NPS 2019). The park receives an annual visitation of 500,000 people each year and, since 1924, the park has received a total of 44,000,000 visitors (NPS 2019).

Rattlesnake Springs, a desert oasis owned by CCNP, is a 1,000-meter wetlands system rich in biodiversity. The spring and surrounding land were obtained by CCNP in 1934 from William Henry Harrison (NPS 1988). The spring was a large marsh until it had to be anthropologically altered to deliver water for the development of CCNP (NPS 1988). Rattlesnake Springs is possibly home to the second largest population of Bell's vireos (*Vireo bellii*) in New Mexico (Audubon). The area is also highly utilized for hiking, picnicking, birding, and general wildlife viewing.

Public Recreation Areas: The Black River Recreation Area, owned and managed by the BLM, is an approximately 1,200-acre area that provides low-impact recreation and environmental education opportunities. The Black River runs through this public recreation area that is a transition zone between the foothills of the Guadalupe Mountains and the Chihuahuan Desert to the east (BLM). The clear waters of the Black River attract a wide variety of flora and fauna to the area, many of which are sensitive species (BLM). The recreation area is open to fishing, hiking, picnicking, and wildlife viewing, and includes several wildlife viewing platforms and picnic tables (BLM).

Plant Inventory

Ecoregion — The BRW encompasses parts of the Chihuahuan Desert Ecoregion, specifically within the Chihuahuan Basins and Playas subregion, and the Arizona and New Mexico Mountains Ecoregion (Griffith et al. 2006). The land cover of the Chihuahuan Desert is largely composed of grasses and shrubs, however vegetation trends since the 1800s have demonstrated landscape-level shifts from grass to shrub coverage (Ruhlman et al. 2012, Unnasch et al. 2017). This has been attributed to climate change, overgrazing, and changes to historical fire regimes (Unnasch et al. 2017). Efforts to combat shrub encroachment from species like honey mesquite (*Prosopis glandulosa*) and creosote bush (*Larrea tridentata*) are prime directives throughout the region. Historic vegetative transitions have occurred within the riparian areas of the Chihuahuan Desert, as well. Widespread invasion of Russian olive (*Elaeagnus angustifolia*) and saltcedar (*Tamarix chinenis*) have altered riparian communities and impacted water system hydrology (Tamarisk Coalition 2005, Unnasch et al. 2017). Significant changes to historical flow regimes have occurred with the construction and management of impoundments and diversions throughout the Pecos River watershed. Resulting reductions in historic floodplains and wetlands have significantly reduced former stands of riparian vegetation (Unnasch et al. 2017).

Dominant Vegetation Communities — Five dominant vegetation communities within the BRW encompass more than 85% of the land cover, approximately 212,000 acres (Lowry et al. 2005). The remaining acreages are classified among 41 different communities (Figure 27). In descending order of percent land cover, the 5 dominant vegetation communities are as follows: Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe (39.1%); Chihuahuan Creosotebush, Mixed Desert and

Thorn Scrub (31.0%); Apacherian-Chihuahuan Mesquite Upland Scrub (7.5%); Madrean Pinyon-Juniper Woodland (4.2%); and Coahuilan Chaparral (3.2%). The Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe class is typically characterized by perennial grasses, succulents, cacti, and woody shrubs (Lowry et al. 2005). Much of this community occurs across mesas and along foothills. Historically, these areas supported frequent fires (Lowry et al. 2005). Chihuahuan Creosotebush, Mixed Desert and Thorn Scrub occurs within the Chihuahuan Desert; it is considered a xeric zone commonly covered by scrub brush (Lowry et al. 2005). Some perennial grasses may occur here, however grass density and coverage are significantly lower than that of shrubs (Lowry et al. 2005). The next most common land cover is Apacherian-Chihuahuan Mesquite Upland Scrub. It is quite similar to the Mixed Desert and Thorn Scrub, however it is dominated by mesquite species, such as honey mesquite. These areas have expanded over the last 100 years due to increased occurrences of drought, overgrazing, and decreasing frequency of fire (Lowry et al. 2005). The Madrean Pinyon-Juniper Woodland is characterized by growth of piñons and junipers in dry and rocky soils. Lastly, at just 3.2% of the watershed's land cover, there is the Coahuilan Chaparral cover class, which is generally located along transition areas between the Chihuahuan Desert and mountain ranges (Lowry et al. 2005). Dominant vegetative species include shrub oaks and sage shrubs (Lowry et al. 2005).

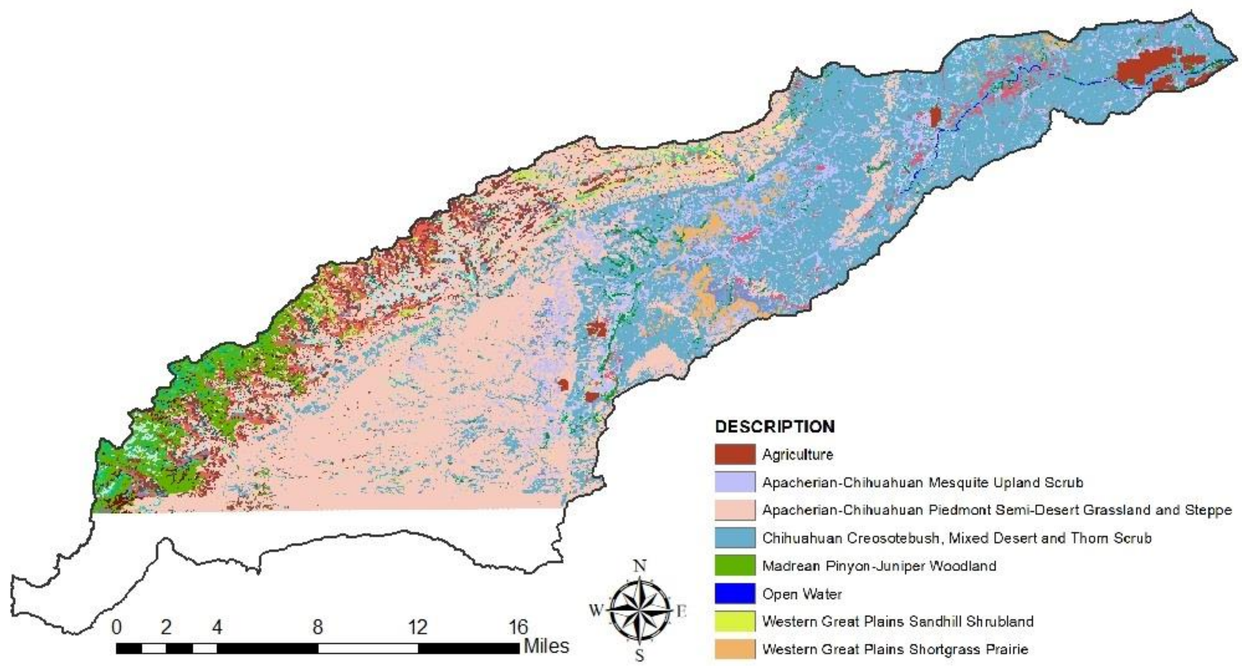


Figure 27. A map highlighting the distribution of dominant vegetation communities across the watershed in New Mexico. See Appendix A for full legend of dominant vegetation communities in the BRW.

Plant Inventory — The Black River wetland area is expansive and, therefore, a comprehensive plant inventory has not been completed. Appendix B includes the results of a plant inventory conducted at Blue Springs that included 79 species and 41 families of plants (CEHMM 2018). Results from vegetative sampling determined that the Blue Springs area is highly diverse; however, this level of diversity may not be representative of the entire wetland area. Surveys should be completed elsewhere in the wetland area to gain a comprehensive understanding of the range of vegetation throughout, as well as prioritizing areas for invasive species management.

Dominant Soil Types — The five dominant soil types within the Black River wetland area are Reagan-Upton association, Karro loam, Reeves-Gypsum land complex, Gypsum land-Cottonwood complex, and Upton gravelly loam (NRCS Web Soil Survey 2021). These soil types range from Hydrologic Soil Groups B through D, which refer to the soil's water infiltration capacity or runoff potential due to texture (NRCS 2020). Soils within Group B have moderate water infiltration capacities. Groups C and D, respectively, have slow to very slow infiltration rates. Group D soils are largely composed of clay and, therefore, have very high potential for runoff. Available water capacity categories are also reported (Table 9) with approximate capacity values. Available water capacity is the water held in soil between its field capacity and permanent wilting point (NRCS 2008a). Field capacity refers to the moisture remaining in soil after thorough saturation and subsequent drainage, while permanent wilting point refers to the water content of soil at which plants are unable to recover and ultimately fail (NRCS 2008a). Understanding the available water capacity of soil is imperative in areas impacted by low rainfall and/or drought conditions as the soil's available water capacity provides nutrients to plants between rainfall events (NRCS 2020). Best practices, such as prescribed grazing, cover crop planting, and soil management, can improve and/or maximize available water capacity (NRCS 2008a). The land capability classifications of the dominant soil types range from 6e to 8s (NRCS Web Soil Survey 2021). The numerical value within the classification refers to limitations to land use due to soil condition (NRCS 2020). Soils classified between 6 and 8 are not considered suitable for cultivation. Class 6 soils are potentially suitable for pasture, range, forestland, or wildlife. Soils classified as 7 are generally restricted to grazing, forestland, or wildlife. Class 8 soils should be largely limited to recreation, wildlife, or esthetic purposes. Land capability classifications may change for soil types with available irrigation. The subclass refers to the type of condition limiting the land use. Subclass "e" refers to soils impacted by erosion. If an "s" is included in the soil classification, this refers to limitations present within the rooting zone (NRCS 2020). An exhaustive list of soil descriptions within the wetland area may be generated from the Custom Soil Resource Report by the Web Soil Survey (NRCS 2021).

Table 9. Dominant soil types in the Black River wetland areas with relevant soil classifications (NRCS Web Soil Survey 2021). Available Water Capacity is reported as depth (inches) for the total depth of soil.

Dominant Soil Types of the Black River Wetland Area				
Soil Type	**Hydrologic Soil Group**	**Available Water Capacity**		**Land Capability Classification**
Reagan-Upton Association	B	Moderate	8"	6e
Gypsum Land-Cottonwood Complex	D	Very Low	1"	8s
Reeves-Gypsum Land Complex	B	Low	4"	7s
Karro Loam	C	High	10"	6s
Upton Gravelly Loam	D	Very Low	1"	7s

Wildlife Communities

Wetlands supply important habitat, water sources, and travel corridors for semi-aquatic, terrestrial, and avian species. Herein, we reflect on the array of wildlife within the Black River wetland area. This section does not provide an exhaustive species inventory; however, it is intended to highlight the great biodiversity that the wetland currently supports. While it is important to note that all wildlife species face threats and stressors, this section will focus on species that are not currently classified as threatened or endangered by the FWS or NMDGF. Species of concern and their threats are addressed in the Threatened and Endangered Species section (page 35).

Amphibians — Wetlands provide necessary habitat for the life cycle of most amphibians. Protecting and restoring wetlands is, therefore, a priority for many amphibian species in order to alleviate major threats of habitat loss and degradation (Houlahan and Findlay 2003, Brown et al. 2012). In addition to habitat impacts, these species will be largely reliant upon available populations of insect and invertebrate prey (Degenhardt et al. 1996). Amphibians found within the watershed include the barking frog (*Eleutherodactylus augusti*), the Rio Grande leopard frog (*Rana berlandieri*), the southwestern woodhouse toad (*Anaxyrus woodhouii australis*), and the barred tiger salamander (*Ambystoma mavortium mavortium*) (Degenhardt et al. 1996, CEHMM 2018).

Figure 28. A Swainson's hawk in flight.

Birds — For both migratory species and resident populations, the BRW is essential for shelter and food (Stewart 1996). The wetland area is located within the Central Flyway migratory corridor. It supports a number of migratory bird species, including mourning dove (*Zenaida macroura*), white-winged dove (*Zenaida asiatica*), and sandhill crane (*Antigone canadensis*) (NMDGF 2020b). To be expected, the area also supports a variety of migratory waterfowl species, such as northern pintail (*Anas acuta*), mallard (*Anas platyrhynchos*), American widgeon (*Mareca americana*), and Canada goose (*Branta canadensis*) (NMDGF 2020b). Upland game birds like scaled quail (*Callipepla squamata*), northern bobwhite (*Colinus virginianus*), and Eurasian collared-dove (*Streptopelia decaocto*) may all be found near the Black River and within its adjacent lands (NMDGF 2020c). The Rio Grande turkey (*Meleagris gallopavo*) is the only avian big game species present within the watershed area (NMDGF 2021). Raptors, such as the American kestrel (*Falco sparverius*) and Swainson's hawk (*Buteo swainsoni*) (Figure 28), are keen predators and likely to use the large trees present within the riparian area for nesting. Other common non-game species, like the Chihuahuan raven (*Corvus cryptoleucus*), greater roadrunner (*Geococcyx californianus*), and cactus wren (*Campylorhynchus brunneicapillus*), represent a wide array of diversity in life history traits, size, and morphology (CEHMM 2018).

Invertebrates — Riparian areas, even in the arid American Southwest, are teeming with aquatic and terrestrial invertebrate life (Ellis et al. 2000). Arthropods impact vegetation through defoliation and pollination and provide nutrition to higher trophic level organisms at all life stages (Foster et al. 1981, Ellis et al. 2000). Common insects in the area include species of damselflies (e.g. the desert firetail, *Telebasis salva*), robber flies (e.g.. *Microstylum galactodes*), bees (e.g. the faithful leafcutting bee, *Megachile fidelis*), beetles (e.g. the festive tiger beetle, *Cicindela scutellaris*), grasshoppers (e.g. the creosote bush grasshopper, *Bootettix argentatus*), and crickets (e.g. the Jerusalem cricket, *Stenopelmatus fuscus*) (Beckemeyer and Charlton 2000, Milne and Milne 2011). Arachnids, such as spiders (Figure 29), ticks,and of course the poster children of the American Southwest – tarantulas and scorpions, abound. In order to better understand the excellent invertebrate diversity along the Black River, comprehensive inventory surveys will be necessary (CEHMM 2018).

Figure 29. A species of wolf spider (Family: Lycosidae).

Mammals — The Black River wetland area is largely within the NMDGF's Priority Zone 4 for Terrestrial Species of Economic and Recreational Importance (SERI), which refers to the overlapping of either general or priority habitat of big game animals (specifically, bighorn sheep (*Ovis canadensis*), elk (*Cervus canadensis*), mule deer (*Odocoileus hemionus*), pronghorn (*Antilocapra americana*), cougar (*Puma concolor*), and black bear (*Ursus americanus*)). The SERI score of 4, developed by NMDGF, indicates overlapping of general, year-round, or wintering habitat for 3–4 species and ultimately informs areas of Crucial Habitat along with other factors, such as species of concern (NMCHAT 2013). A number of game species call the BRW home: pronghorn, mule deer, barbary sheep (*Ammotragus lervia*), javelina (*Tayassu tajacu*) (Figure 30), and cougar (NMDGF 2011, NMDGF 2021). While found in cervids elsewhere in New Mexico, tests have not confirmed the presence of Chronic Wasting Disease(CWD) (a transmissible spongiform encephalopathy) in the region (CDC 2019, NMDGF 2021). If CWD were to spread into the area, it is likely the watershed would be a significant location for further transmission and may require monitoring (Silbernagel et al. 2011, Walter et al. 2011). Watershed protection is important for both the habitat and its endemic wildlife. The following species are protected furbearers with recent recorded harvests in Eddy County (NMDGF 2018, NMDGF 2019, NMDGF 2020a):

Figure 30. The javelina is commonly mistaken for a pig. They can be distinguished from feral hogs by their white collar, lack of tail, and small stature.

swift fox (*Vulpes velox*), kit fox (*Vulpes macrotis*), gray fox (*Urocyon cinereoargenteus*), bobcat (*Lynx rufus*), badger (*Taxidea taxus*), raccoon (*Procyon lotor*), and ringtail (*Bassariscus astutus*). The coyote (*Canis latrans*) and striped skunk (*Mephitis mephitis*) are unprotected furbearer species with records in the BRW (CEHMM 2018). Additional mammalian species to consider include the black-tailed jackrabbit (*Lepus californicus*), North American porcupine (*Erethizon dorsatum*), Ord's kangaroo rat (*Dipodomys ordii*), and feral hogs (*Sus scrofa*). Feral hogs are a nuisance animal that cause damage to the landscape, contaminate water sources, and compete with native wildlife (Moffat 2012). They are an unprotected species with an expanding range in New Mexico (Moffat 2012).

Reptiles — The state of New Mexico has a great assortment of reptiles and the Black River wetland area is widely representative of this diversity. The watershed supports a range of lizards, skinks, snakes, and turtles. For many reptiles, wetland areas are vital for foraging opportunities (Semlitsch and Bodie 2003). The lizards of the watershed represent a wide array of morphologies and life history traits. Among others, the following lizards can be found within the area: lesser earless lizard (*Holbrookia maculata*) (Figure 31), Texas spotted whiptail (*Cnemidophorus gularis*), roundtail horned lizard (*Phyrnosoma modestum*), and tree lizard (*Urosaurus ornatus*) (Degenhardt et al. 1996). The watershed also provides habitat for two diurnal, semi-aquatic skinks, the many-lined skink (*Eumeces multivirgatus*) and the Great Plains skink (*Eumeces obsoletus*) (Degenhardt et al. 1996). Wetlands and the adjacent upland areas are prime locations for snakes to forage, bask, and nest. A number of non-venomous snakes call the watershed home, including the western ribbon snake (*Thamnophis proximus*), blackneck garter snake (*Thamnophis cyrtopsis*), mountain patchnose snake (*Salvadora deserticola*), and plainbelly water snake (*Nerodia erythrogaster*) (Degenhardt et al. 1996). Additionally, the rock rattlesnake (*Crotalus lepidus*), western rattlesnake (*Crotalus viridus*), western diamondback rattlesnake (*Crotalus atrox*) and blacktail rattlesnake (*Crotalus molossus*) are all venomous snakes endemic to the area (Degenhardt et al. 1996). This description of the wide diversity of reptiles is not complete without listing some of the turtles found here: snapping turtle (*Chelydra serpentina*), painted turtle (*Chrysemys picta*), yellow mud turtle (*Kinosternon flavescens*), and spiny softshell turtles (*Trionyx spiniferus*) (Degenhardt et al. 1996).

Figure 31. A lesser earless lizard in breeding season colors.

Fisheries Communities

Figure 32. A state endangered gray redhorse, sampled in the Black River by the NMDGF.

<u>Fishes</u> — The BRW is home to one of the most diverse fish communities in the state of New Mexico. The community is comprised of 14 different families of fishes, which can be further broken down into approximately 50 different species. Appendix C shows an exhaustive list of the fishes of the Upper Pecos – BRW (HUC13060011, BISON-M 2021). As discussed later in this document, several of the native fish species are listed as threatened or endangered by both the NMDGF and FWS. On an annual basis, the NMDGF utilizes electrofishing and netting to collect Black River fish population data. Threats to many of these species include golden algae blooms, fish barriers, competition from nonnative species, and reductions in water quantity due to both drought and water withdrawal.

Figure 33. Relic shells of Asian clams found in the Black River.

<u>Mollusks</u> — Mollusks can be excellent indicators for monitoring disturbed areas of a watershed and detecting pollution in aquatic environments. Three species of aquatic mollusk can be found in the BRW (Table 10). Considered threatened in the state, the Pecos springsnail is the smallest of the mollusks in the watershed and is endemic to two springs along the Black River. The Texas hornshell is a bivalve mollusk of the family Uniondae that can be found in the Black River. The Pecos springsnail and the Texas hornshell are discussed in greater detail within the Threatened and Endangered Species section of this document. As with many other water bodies in New Mexico, the invasive Asian clam (*Corbicula fluminea*) has found its way into the BRW.

Table 10. Aquatic mollusks of the Black River Watershed.

Mollusks of the Upper Pecos – Black River Watershed (HUC 13060011)		
Family	**Common Name**	**Scientific Name**
Hydrobiidae, the Springsnails		
	Pecos Springsnail	*Pyrgulopsis pecosensis*
Unionidae, the River Mussels		
	Texas Hornshell	*Popenaias popeii*
Corbiculidae, the Basket Clams		
	Asian Clam	*Corbicula fluminea*

Threatened and Endangered Species

The state of New Mexico defines an endangered species as a species of plant or animal of concern that has the potential of becoming extinct (NMDGF 2016). Threatened species, as defined by New Mexico, are species of plants or animals of concern that have the potential of becoming endangered (NMDGF 2016). The federal government (FWS) has similar definitions within the ESA (as amended 16 U.S.C. § 1531, et seq.), however each includes the clause "throughout all or a significant portion of its range." Eddy County and the Black River are home to a number of imperiled species. It is vital that these species are considered within the restorative and protective priorities for the Black River Wetlands Action Plan. In Appendix D, we provide a listing of imperiled species within Eddy County (BISON-M 2021) and detailed descriptions of imperiled species with known populations or a range that includes the Black River (IPaC 2021).

Aplomado falcon — Listed in 1986, the endangered aplomado falcon's (*Falco femoralis*) historic range includes Central America and the American Southwest (FWS 1985). Originally, the listing was attributed to pesticide exposure and habitat degradation from overgrazing and shrub encroachment (FWS 1985). This assertion has, however, been questioned (Truett 2002). Overgrazing conditions (in some areas) and habitat encroachment of both mesquite (*Prosopis spp.*) and creosote bush (*Larrea tridentata*) persist today. Additional pressure from predation is also cited as a concern (Sweikert and Phillips 2015). As of 2007, the FWS reported the aplomado falcon would largely be suited for current habitat availability and land-use practices in New Mexico (FWS 2007). A non-essential population of captive-bred breeding pairs has been re-introduced to Texas and New Mexico.

Mexican spotted owl — The Mexican spotted owl (*Strix occidentalis lucida*) was listed as endangered under the ESA in 1993. Their range includes forest stands and riparian areas of the American Southwest and Mexico (Gutiérrez et al. 1995). Individuals disperse throughout their range to occupy breeding, wintering, and nesting habitats that support their foraging needs (Ganey et al. 2014). Current threats to the population are related to nesting habitat loss, largely attributed to wildland fire (FWS 2013). Impacts from climate change are likely to exacerbate threats to its habitat loss and survival (Seamans et al. 2002, FWS 2013). Conservation measures to support the Mexican spotted owl include placing 40+ ha buffers around nesting sites during habitat disturbances, such as prescribed fires (Ward and Salas 2000); reducing fuel for wildland fires through proper forest management (FWS 2013); and reclaiming habitat lost to wildfire and development (FWS 2013).

Piping plover — The piping plover (*Charadrius melodus*) is a migratory bird with historical breeding records in Eddy County, New Mexico (Carlson and Skaar 1976, FWS 2020b). The current breeding distribution, however, does not include New Mexico. This species' listing occurred in 1985 with an endangered status in eight states and a threatened status in 29 states (FWS 1984). Threats to the piping plover on southern United States rivers include habitat disturbance and degradation, energy development, agricultural practices, invasive vegetation, predation, and climate change (FWS 2020b).

Southwestern willow flycatcher — Approximately 92% of southwestern willow flycatcher (*Empidonax traillii extimus*) territory in the United States is located within Arizona, California, and New Mexico (Durst 2017). Generally, migration from wintering habitats in Central and South America to breeding habitats in North America occurs in May and June (Sogge et al. 1997). The species has been listed as endangered since 1995 with petitions and efforts to de-list having been deemed unwarranted (FWS 2017a). Historically, the species has utilized areas dominated by cottonwood and willow vegetation (Sogge et al.

1997), however breeding in saltcedar has also been observed in other regions, and salt cedar could potentially serve as habitat in the Black River as well. (Sogge et al. 2006). Significant reclamation and restoration of riparian wetlands will be necessary to mitigate threats to this species (Finch 1999).

Blue sucker — Historical information on the range of the blue sucker (*Cycleptus elongatus*) is limited, however its current range includes the Pecos River drainage in New Mexico (Dombrosky et al. 2016). The primary concern for this fish species is habitat fragmentation from river impoundments (Zymonas and Propst 2007, Dombrosky et al. 2016, NMDGF 2016). One potential solution would be with the construction of fishways to enhance passage between fragmented habitats (Dombrosky et al. 2016).

Gray redhorse — Based on a 2006 NMDGF report, the gray redhorse (*Moxostoma congestum*) was common in the Black River and between Bataan and Six Mile Dams on the Pecos River (Zymonas and Propst 2007). Collection of gray redhorse diminished elsewhere in the sample area. The primary concern for this species is habitat fragmentation from river impoundments (Zymonas and Propst 2007, Dombrosky et al. 2016, NMDGF 2016). As with threat mitigation for the blue sucker, fishway infrastructure would be helpful for the gray redhorse (Dombrosky et al. 2016). Additionally, the gray redhorse is a known host fish for the larval stage of the Texas hornshell mussel (Levine et al. 2012).

Pecos bluntnose shiner — The Pecos bluntnose shiner (*Notropis simus pecosensis*) was listed as threatened in 1987 (FWS). Its historic range included 329 miles of the Pecos River watershed, which has been reduced to a 190-mile section today due to the construction of impoundments and associated reservoirs (FWS 2020a). The southern limit of the species' current range is Brantley Reservoir in Eddy County (FWS 2020a). The installation of impoundments has not only fragmented their habitat, but also changed the historical flow regime of the Pecos (Hoagstrom et al. 2008, Costigan and Daniels 2012). Altering seasonal flows through prolonged high discharge releases negatively impacts recruitment due to the Pecos bluntnose shiners' pelagic spawning reproductive strategy (Hatch et al. 1985, Hoagstrom et al. 2008).

Pecos gambusia — The Pecos gambusia (*Gambusia nobilis*) is a short-lived, live-bearing cyrprinid that was listed as endangered in 1970 (Bednarz 1979, Hubbs et al. 2002, FWS 2018c). Currently, there are two main populations in New Mexico at Bitter Lake National Wildlife Refuge and Blue Springs (FWS 2018c). Conservation measures for the species include: habitat initiatives, reestablishment throughout historic range, education, and hatchery production (FWS 2018c). Hybridization and climate change pose threats, as well as the potential for population collapse due to their small numbers (FWS 2018c).

Pecos springsnail — The Pecos springsnail's (Figure 34) range is located within the Pecos River drainage (Hershler 1994) with known populations at Blue Springs and Castle Springs in Eddy County (NMDGF 1996). Issues resulting from decreased water quantity and quality, as well as competition with invasive species, pose threats to the species (NMDGF 1996, NMDGF 2016, Johnson et al. 2019). According to the State Wildlife Action Plan (NMDGF 2016), the Pecos springsnail is a declining and vulnerable endemic species with disjunct populations, limited habitat, and research gaps.

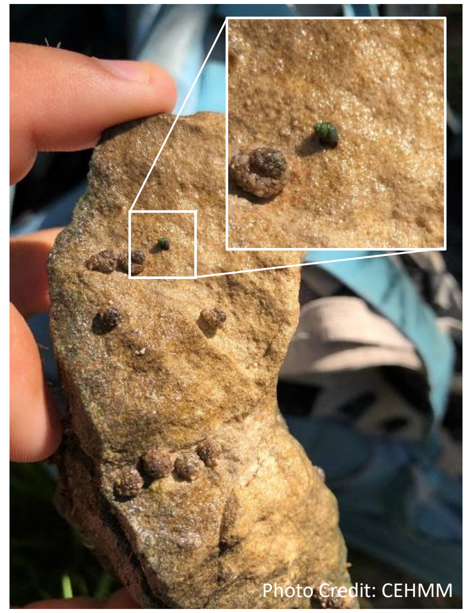


Figure 34. One Pecos springsnail on a rock (green), highlighting the species' small overall size (<3 mm in length) (Hershler 1994).

Texas hornshell mussel — The Texas hornshell (*Popenaias popeii*, Figure 35) is a bivalve mollusk native to the Pecos River and Rio Grande watersheds of New Mexico and Texas. On February 9, 2018, the Texas hornshell mussel was listed as federally endangered under the ESA (FWS 2018a). Primary conservation concerns for the mussel include declines in both water quantity and water quality (Williams et al. 1985, Carman 2007, Randklev et al. 2018). Habitat degradation and fragmentation are particularly concerning for the mussel as they rely on host fishes for recruitment and spend the majority of their lives somewhat immobile (Carman 2007, FWS 2018a). Historically, the mussel occupied a range throughout the Rio Grande drainage in New Mexico, Texas, and Mexico (FWS 2018a). Currently, there are five known populations of Texas hornshell in the United States with one population occurring on the Black River in Eddy County, New Mexico (FWS 2018a). Today, anthropogenic impacts, such as impoundments and water withdrawals for agriculture, energy development, and municipal needs, have disturbed the natural flow regime, native species, and water chemistry (Hoagstrom 2009, Costigan and Daniels 2012). The three main concerns the Texas hornshell face are impacts from drought, climate change, and water withdrawal. With drying expected to increase due to climate change, water source availability will be a continual challenge in future water resource, habitat, and fisheries management (Milly et al. 2005, Overpeck and Udall 2020). Increasing temperatures due to climate change increase rates of evaporation, decreasing available water for flow (Overpeck and Udall 2020). Additionally, increased temperatures

Figure 35. A tagged Texas hornshell mussel. FPN shellfish tags help biologists monitor populations and individual growth and survival.

and lack of rainfall will reduce flows and impact both water temperatures and water chemistry (Milly et al. 2005, Djebou 2017b, Overpeck and Udall 2020). Reduced discharge is likely to result in Texas hornshell mortality as rates of survivorship are positively correlated with discharge (Inoue et al. 2014, FWS 2018a). Increased sedimentation due to climatic and physical changes in the river system can fragment habitat and smother Texas hornshell, causing death (Carman 2007, FWS 2018a). Low flow events increase the risk of predation on Texas hornshell, especially when mussel beds are left exposed (FWS 2018a).

Rio Grande cooter — The Rio Grande cooter (*Pseudemys gorzugi*) is a long-lived turtle found within the Pecos and Rio Grande drainages in New Mexico, Texas, and Mexico (Degenhardt et al. 1996). The Rio Grande cooter faces impacts from habitat degradation and fragmentation. Documented accounts of additional human impacts to the species include fish hook ingestion, shooting, and the pet trade (Bailey et al. 2008, Suriyamongkol et al. 2019). The NMDGF (2016) lists the turtle as declining and vulnerable with the need for immediate priority. The FWS is currently drafting a Species Status Assessment (SSA) for the Rio Grande cooter, which will be followed by a 12-month finding.

Gypsum wild-buckwheat — Listed as threatened since 1981, gypsum wild-buckwheat (Figure 36, *Eriogonum gypsophilum*) is currently proposed for delisting (FWS 2017b). There are three known populations with one occurring on the Black River (FWS 2016). Upon listing, the threats to the species were impacts from oil and gas development and mining; they are no longer considered significant (FWS 2016). The recommendation for species classification is to be delisted due to species recovery (FWS 2016, FWS 2017b).

Figure 36. A gypsum wild-buckwheat plant in bloom.

Kuenzler's hedgehog cactus — The Kuenzler's hedgehog cactus (*Echinocereus fendleri* var. *kuenzleri*) was listed as endangered in 1979 with a reclassification to threatened in 2018 (FWS 2017c, FWS 2018b). There are four populations within New Mexico; each characterized by spotty distribution (Sivinski 2007, FWS 2017c). The Guadalupe population areas (including Eddy County) have the highest acreage of potential habitat, however the populations are very low (FWS 2017c). Impacts from climate change, wildfire, and overgrazing of livestock threaten the species (FWS 2017c). Additional effort is needed to monitor population trends; additional data is needed regarding pollinators; and public outreach is needed for awareness (FWS 2017c).

Lee pincushion cactus — The Lee pincushion cactus (*Escobaria sneedii* var. *leei*) is currently found within the area of, and adjacent acreage to, the Carlsbad Caverns National Park (Roth 2018). This species was originally listed as threatened in 1979, with the largest threat being specimen collection (FWS 2015). Today, discussion over whether the *leei* and *sneedii* varieties are distinct both genetically and morphologically are ongoing (Baker and Johnson 2000, Baker 2007, Porter et al. 2012, FWS 2019).

Current threats include trampling from invasive barbary sheep (*Ammotragus lervia*), climate change, wildfire, and development (Roth 2018, FWS 2019). It will be necessary to do additional research and monitoring in order to establish better life history background and to identify trends.

Sneed pincushion cactus — The Sneed pincushion cactus (*Escobaria sneedii* var. sneedii) faces similar threats as the Lee pincushion cactus. This species was listed as endangered in 1979 (FWS 2015) and is currently found in Eddy and Doña Ana counties in New Mexico and El Paso County in Texas (FWS 2019). While former threats from over collection have been alleviated, the species is currently facing threats from climate change, wildfire, and drought (FWS 2015). Additional research to better understand any differentiations or similarities (genetic and/or taxonomic) between the Sneed and Lee varieties, as well as to identify further life history background information, is necessary (Baker and Johnson 2000, Baker 2007, Porter et al. 2012, FWS 2019). Further monitoring efforts to understand and identify population trends will also be needed (FWS 2015, FWS 2019).

Erosion

Wind and water erosion are a concern for the BRW. Sedimentation is one of the leading threats to the Texas hornshell within the watershed. In areas with high disturbance along or near the river, erosion rates become particularly concerning due to high frequency flood events and lack of soil stabilization from impaired riparian vegetation. Many of the soils within the area have a high sand content and, therefore, are more susceptible to erosion. Due to the diverse nature of riparian areas and their prevalence as habitat corridors, impacts from erosion and vegetation loss may lead to loss of habitat for critical species within the wetlands.

Figure 37. Completed erosion mitigation project on the Black River with silt fence and filter socks installed.

Wind erosion causes the transport of nutrient-dense top soil and, in turn, can impact the potential for germination in reseeding efforts (Schlesinger et al. 1990, Li et al. 2007). Erosion is an issue for areas with low vegetative cover, particularly in relation to storm runoff (Schlesinger et al. 1990). Wind and water erosion can cause sediment deposition into the river, bank destabilization, and channelization of the river. Increased sedimentation from erosion can fragment habitat and smother Texas hornshell, causing death (Carman 2007, FWS 2018a).

Erosion mitigation practices, such as silt fence and filter sock wattle installation (Figure 37), will benefit both the area species and their habitat. Long-term solutions are achievable when readily paired with reseeding efforts. Establishing buffer areas to reduce instances of erosion and bank destabilization is ideal. However, when development within the riparian area is unavoidable, the implementation of land-use best practices known as Reasonable and Prudent Practices for Stabilization (RAPPS; Horizon Environmental Services 2004) is essential. These practices include consideration of physical and biotic site characteristics (e.g., slope and annual precipitation) and aim to reduce the occurrence of erosion during and after the land-use disturbance. Additional options for necessary development would include reducing the footprint and/or moving the project site to less ecologically vulnerable areas when possible.

Water Quality and Quantity

Water Quality — In 1996, the perennial reach of the Black River was listed as an impaired water by the New Mexico Environment Department (NMED) due to high concentrations of metals (aluminum), depletion of riparian vegetation, bank destabilization, and high salinity concentrations (NMED 2018). In 1998, the river remained on the Clean Water Act 303(d) list (impaired waters) due to the impacts of aluminum concentrations (NMED 2018). The reach was sampled again in 2003; the water quality summary report for the Lower Pecos River watershed considered the Black River “impaired” based on toxicological data that showed the river was not designated for aquatic life use (Hopkins 2003). The 2003 test results were believed to be false positives due to a lack of information indicating any potential cause of impairment in the 2003 chemical data (NMED 2018). For that reason, in 2007, NMED repeated the ambient toxicity testing from 2003. The 2007 test showed no signs of acute toxicity (NMED 2018). Also in 2007 and 2008, NMED sampled the river on multiple occasions to support the Outstanding National Resource Waters (ONRW) nomination of the Black River by the NMDGF. The results from the 2007 and 2008 tests showed there was no exceedance on any parameter tested (ions, nutrients, semi-volatile and volatile organics) (NMED 2018). In 2013, the perennial reach of both the Black River and Blue Springs were sampled by NMED as part of the Lower Pecos River watershed survey. No impairments were found in either the Black River or Blue Springs during the 2013 testing (NMED 2018). Although no impairments are currently listed, a low flow system with regular flood events such as the Black River is still very susceptible to minor spills of significant sediment impairments.

Table 11. Stream reach impairments in the BRW. NMED water quality and monitoring locations can be found at: https://gis.web.env.nm.gov/oem/?map=swqb.

Stream Reach	Impairments
Black River (Double Canyon to headwaters)	No impairments listed
Black River (Perennial prt Blue Springs to Double Canyon)	No impairments listed
Black River (Perennial prt Pecos River to Blue Springs)	No impairments listed
Blue Springs (Black River to headwaters)	No impairments listed

Water Quantity — For the last 74 years the Black River has averaged a daily average discharge of 9.5 cubic feet per second (cfs) (USGS 2016). However, for the last several years the average discharge has been considerably below the 74-year average of 9.5 cfs (Figure 38). The average discharge of the Black River in 2020 was 6.25 cfs and 8.74 cfs in 2019 (USGS 2016). In August and September of 2020, the Black River reached one of its lowest discharges in history at 1.13 cfs (USGS 2016; Figure 38).

The quantity of water in the Black River faces impacts from drought, climate change, and water withdrawal. Eddy County, New Mexico has recently experienced exceptional drought conditions (NIDIS 2020). Exceptional drought conditions are characterized by “widespread crop/pasture losses and shortages of water creating water emergencies (NIDIS 2020).” The area has historically been prone to long-term droughts. With drying expected to increase due to climate change, water source availability will be a continual challenge in future water resource, habitat, and fisheries management (Milly et al.

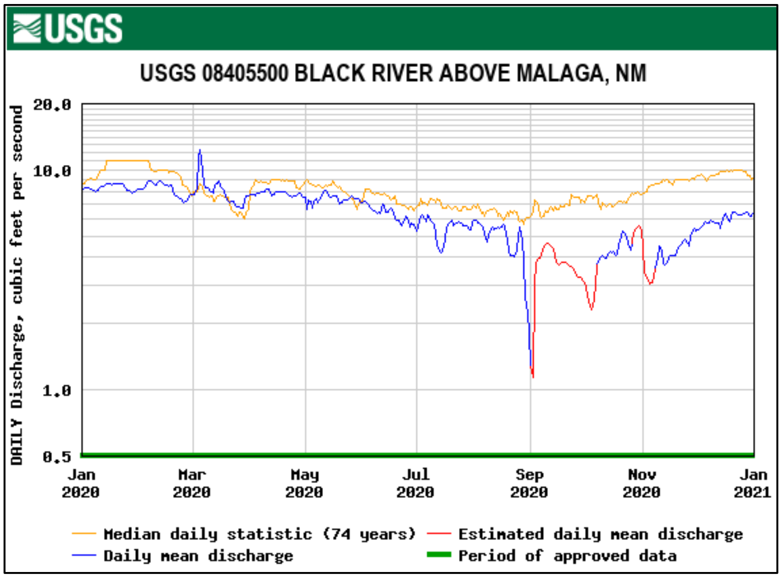


Figure 38. USGS gage 08405500 daily average flow hydrograph during 2020.

2005, Overpeck and Udall 2020). Increasing temperatures due to climate change increase rates of evapotranspiration, thus decreasing available water for flow (Overpeck and Udall 2020). Additionally, increased temperatures and lack of rainfall will reduce flows and impact both water temperatures and water chemistry (Milly et al. 2005, Djebou 2017b, Overpeck and Udall 2020). Short-term impacts from drought and long-term impacts of aridification are expected for the region (Jones 2014) and will cause water shortages increasing the need for water withdrawal (Djebou 2017a).

Changes in water quantity also contribute to changes to the water chemistry and quality. Increased salinization of the Pecos River watershed has been attributed to water withdrawal activities, including irrigation return flows (URGBBEST 2012, Hart et al. 2019). Increased sedimentation can lead to increased salinization, increased levels of ammonia, and decreased dissolved oxygen (DO). Water quality issues can be exacerbated with climatic changes, including temperature increases (FWS 2018a). Overall, impacts from drought, climate change, and water withdrawal are contributing to water quality and quantity changes that threaten the ecological integrity of the BRW.

Candidate Conservation Agreements

Freshwater mussels, such as the Texas hornshell mussel, are filter feeders that are sensitive to contamination of water and sediment that gets filtered through their bodies. Since freshwater mussels are relatively immobile, they are especially sensitive to changes in quality of water, changes in sedimentation, and prolonged drought. Due to this, ecosystem health is critical for their survival, and freshwater mussels are considered indicators of ecosystem health and stability. Because the Texas hornshell mussel is native to New Mexico, specifically to the Black River, below we discuss conservation agreements that are in place to protect the species and the BRW.

The Candidate Conservation Agreement (CCA) and Candidate Conservation Agreements with Assurances (CCAA) program represents a partnership between CEHMM, landowners, industry operators, the FWS, and the BLM. Candidate Conservation Agreements are voluntary conservation agreements that facilitate a long-term landscape-based approach to eliminate or reduce threats to species that are candidates for federal listing as threatened or endangered. Participants are provided assurances (CCAA enrollees) or a high degree of certainty (CCA enrollees) that lawful activities may continue without additional water or land use restrictions in exchange for engaging in voluntary conservation under the Endangered Species Act (ESA) listing. Enrollees voluntarily sign a Certificate of Participation (CP) in the CCA program for any federal lands. All non-federal lands are voluntarily enrolled into the CCAA program with a Certificate of Inclusion (CI). The CCA/A program facilitates conservation measures for the endangered Texas hornshell mussel and four additional imperiled species while affirming and supporting multiple traditional land and water uses. Covered species under the CCA/A program also include the Rio Grande cooter, gray redhorse, blue sucker, and Pecos springsnail.

The purposes of the CCA/A program are to fund conservation measures or scientific research, to maintain viable populations in occupied habitat, and to support ongoing efforts to re-establish populations within suitable habitat in an effort to reduce or remove threats to the covered species or their habitat. Specifically, CCA/A goals aim to protect the existing populations of the covered species in the Black River and to support efforts to reestablish populations of the covered species in the Delaware River. Additional conservation goals of the CCA/A include protecting and restoring habitat to prevent the need for future ESA listings.

The primary benefit of the CCA/A program is the coordination of efforts between all participants for the betterment of the covered species and their habitat. The cooperation among agencies, landowners, industry, and CEHMM allows for landscape-based approaches to address conservation issues. Additionally, revenue-generating activities can continue for the benefit of the participants while habitat may be maintained or improved for the benefit of the covered species. This program serves the community, the region, and the state through cooperative conservation, educational outreach, job creation, and research leading to the resolution of important technical and environmental challenges. CEHMM's leadership and sustained efforts in cooperative conservation are a testament to the viability of this program and its objectives.

Data Gaps

There are a number of data gaps that may aid in the prioritization of future research, conservation and restoration projects. Comprehensive wetlands inventory efforts are lacking across the watershed. Multiple inventories were conducted for the Blue Springs area (CEHMM 2018), however, complete watershed-wide inventories are unavailable. Previous inventory efforts at the Blue Springs site are helpful as it is a notably diverse area, however findings from this report cannot be assumed for areas throughout the watershed. An invasive species survey is needed to identify invasive species present in the watershed, their densities, and ranges are largely absent. The Blue Springs Inventory report (CEHMM 2018) also cites a need for additional effort on insect, amphibian, and fish surveys, including within the Blue Springs area.

Riparian vegetation data is lacking for the area. Wetlands in the Texas portions of the watershed have not been classified the LLWW nor HGM classifications which would enable wetland functions modeling to be performed. Current efforts to map the major river basins across the state have not released information for the Lower Pecos/Tularosa basins (NMRipMap; Muldavin et al. 2020). The results of the NMRipMap efforts will better inform state projects, such as the Conservation Information System (NM-CIS), State Wildlife Action Plan (SWAP), Environmental Review Tool (ERT), and the Crucial Habitat Assessment Tool (NMCHAT), for restoration projects, conservation initiatives, and wildlife management tools (Muldavin et al. 2020).

Water quality checks should be conducted regularly. With the increasing impacts from climate change and current water usage, rising temperatures and decreasing water flow are expected to decrease overall water quality. According to NMED (2018), chemical testing has not been reported since 2016 as part of the official 2013 watershed survey. Surface water quality monitoring is, however, scheduled to reoccur in the Lower Pecos region between 2021 and 2022 (NMED 2021b). One NMED Assessment Unit (AU), Pecos River: Black River to Six Mile Dam, had one impairment listed for *E. coli* exceedance during the 2013 watershed survey (NMED 2021a). In 2020, NMED (2021a) reported a new DDT-Fish Consumption Advisory for this AU. Continual testing for contaminants due to land use byproducts should be prioritized to mitigate pollution events. Such events are particularly concerning for imperiled native species, such as the Texas hornshell mussel. Additionally, gaining a greater understanding of water quality sensitivities among native species throughout the watershed will be of utmost importance. Use of rapid assessment methodology to evaluate wetland condition is currently underutilized. Rapid assessment tools, such as the New Mexico Rapid Assessment Method (NMRAM) developed by the SWQB Wetlands Program (NMED 2021c), may be helpful to monitor and assess water quality parameters and habitat condition.

Resource Management

Protection, conservation, restoration and preservation of the wetlands within the BRW is imperative, as the wetlands provide necessary functions to the surrounding ecosystem and the community at large. This is especially true in the BRW, as wetlands are one of the primary water sources on the landscape. The diverse group of stakeholders within the watershed should be invested in the management and protection of wetlands, as wetlands likely have a positive impact on their interests in the landscape. With such a diverse group of stakeholders and so many unique wetlands, there must be guidance for managing these wetlands. The resource management section of this WAP will serve as a tool to guide future wetlands management within the BRW. Resource Management refers to a wide range of activities and projects, including planning, monitoring, assessments, protection, prevention, restoration, maintenance, and policy development.

Wetland Management and Prioritization

With over 800 acres of wetlands in the watershed, it is vital to prioritize restoration and management efforts to maximize available funding and resources to benefit the BRW. Efforts should be made to maintain and protect valuable and high-functioning wetlands and restore degraded wetlands to recover essential ecosystem functions. Prioritization of management and restoration efforts is essential, as restoration and management projects are often multi-tiered and can require years of planning.

Since wetlands within the BRW function as habitats to several threatened and endangered species, we suggest the wetlands that are functioning as a refuge for these species should be given the highest priority. Due to the constant threat of drought in the Chihuahuan Desert, the second priority for wetland management and restoration should be given to wetlands that have groundwater recharge, surface water detention, and streamflow maintenance functions. These wetlands will help to ensure there is sufficient water within the wetland for both anthropogenic and ecological needs. Due to the lack of vegetation and the presence of highly erodible gypsum soils throughout the landscape, the third priority should be given to wetlands that function for sediment retention and bank stabilization. Finally, wetlands that function as carbon sinks and areas of nutrient transformation should be given the fourth management and restoration priority.

Wetlands Impairments and Measures to Reduce Impacts on Wetlands

Table 12. Black River Harmful Conditions and Protective Measures

Harmful Condition	Degraded Condition	Protective Measures
Pollution Inputs	High salinity levels in the most downstream portions of the watershed	• Identify, monitor and eliminate the source of pollution • Create buffer areas to protect vulnerable wetlands
	High risk of chemical contamination to the wetlands adjacent to the Black River from vehicle accidents	• Lower the speed limits • Install barrier systems • Install caution lights, signs, , reflective markers, and calming structures
Hydrologic Alterations	Lower average flows of the Black River	• Reduce the number of points of diversion with the Black River • Curtail water pumping from the river during times of low flow • Create water programs such as bank/drought storage, aquifer storage and recovery, and water conservation program • Restore and protect springs
Erosion	Sediment loading due to significant erosion events	• Improve upland range health • Target sources of sediment inputs for reduction, restoration, improvements to soil cover, and monitoring
	Significant head cuts and unstable banks along the river	• Improve upland range health • Minimize and manage livestock grazing use of the river/riparian corridor • Develop erosion control measures starting in ephemeral drainages with connectivity to wetlands • Restore hydrologic connectivity of the river to adjacent wetlands/ riparian areas through stream restoration measures

		• Identify unstable banks and restore natural bank stability

Harmful Conditions and Protective Measures (Continued)		
Harmful Condition	**Degraded Condition**	**Protective Measures**
Vegetation Damage	Loss of riparian vegetation, bank erosion, compaction, and reduced water infiltration	• Create a grazing plan to implement timely grazing rotation and management of livestock • Develop proper infrastructure that minimizes grazing impacts and bank destabilization • Develop upland water sources to minimize use of the river for cattle • Monitor and minimize other activities which damage riparian vegetation (e. g. offroad vehicle use)

Potential Projects to Protect and Restore Wetlands

A full prioritized list of potential projects can be found in Appendix E.

Figure 39. Water being pumped from the Black River for energy development.

Water Conservation Program — Wetlands face three main water quantity concerns within the BRW: impacts from drought, climate change, and water withdrawal. Eddy County, New Mexico has recently experienced exceptional drought conditions (NIDIS 2020). Exceptional drought conditions are characterized by "widespread crop/pasture losses and shortages of water creating water emergencies (NIDIS 2020)." The area has historically been prone to long-term droughts. With drying expected to increase due to climate change, water source availability will be a continual challenge in future water resource, habitat, and fisheries management (Milly et al. 2005, Overpeck and Udall 2020). Increasing temperatures due to climate change increase evapotranspiration rates, decreasing available water for flow (Overpeck and Udall 2020). Additionally, increased temperatures and lack of rainfall will reduce flows and impact water temperatures and water chemistry (Milly et al. 2005, Djebou 2017b, Overpeck and Udall 2020). Also, anthropogenic impacts, such as impoundments and water withdrawals for agriculture, energy development, and municipal needs, have disturbed the natural flow regime, native species, and water chemistry (Figure 39) (Hoagstrom 2009, Costigan and Daniels 2012).

Projects should be developed to help conserve water for the wetlands of the BRW. These projects may be accomplished through the purchase or lease of water rights or alternative mechanisms such as forbearance agreements in the watershed. Contingent agreements or strategies that make water available for instream flow during otherwise dry periods would be the most cost-effective approach. Approval of a water conservation plan by the NMOSE, coordination with the NMOSE's Water Master for the Lower Pecos basin, and monitoring of water withdrawals will be essential to ensure that any water dedicated for instream flow is being accounted for as a beneficial use and is not merely appropriated by another water user. Acquired water rights could be placed in New Mexico’s Strategic Water Reserve, which was established by the state for the purposes of complying with interstate compacts and benefitting threatened and endangered species.

Biological and Functional Wetland Assessments — The development of biological and functional wetland assessment projects will provide stakeholders with a tool to better manage and preserve the wetlands of the BRW. Biological and functional wetland assessments will allow stakeholders to establish baseline wetland conditions and functions, compare and improve on previous wetland function assessments, detect changes to wetlands, and identify wetlands trends over time. These assessments will be critical for making management decisions for future wetland restoration projects and watershed planning. These assessments will also aid in the establishment of water quality standards for wetlands in the BRW.

<u>Development of a Long-Term Water Quality Monitoring Program</u> — There are several threats to the water quality of wetlands within the Black River. These threats include high salinity levels, risk of point source pollution, and increased turbidity due to sedimentation. A water quality monitoring program could be used to evaluate overall health of aquatic ecosystems, monitor for long term trends in water and habitat quality, identify wetlands that should be targeted for habitat or water quality improvement projects, and evaluate whether projects have led to improvements in wetland water quality and functionality.

<u>Integrated Watershed Health Assessment</u> — The integrated health assessment will identify poor watershed conditions that can be targeted for restoration and habitat improvement projects. An integrated watershed health assessment for the BRW should include: landscape condition, habitat condition, hydrology, geomorphology, water quality, biological condition, and vulnerability. The assessment will also help stakeholders to identify how human activities such as recreation, energy extraction, mining, and agriculture may be affecting the watershed. As a watershed is ever-changing, a successful health assessment could evaluate expected future changes such as climate, demography, and resource management

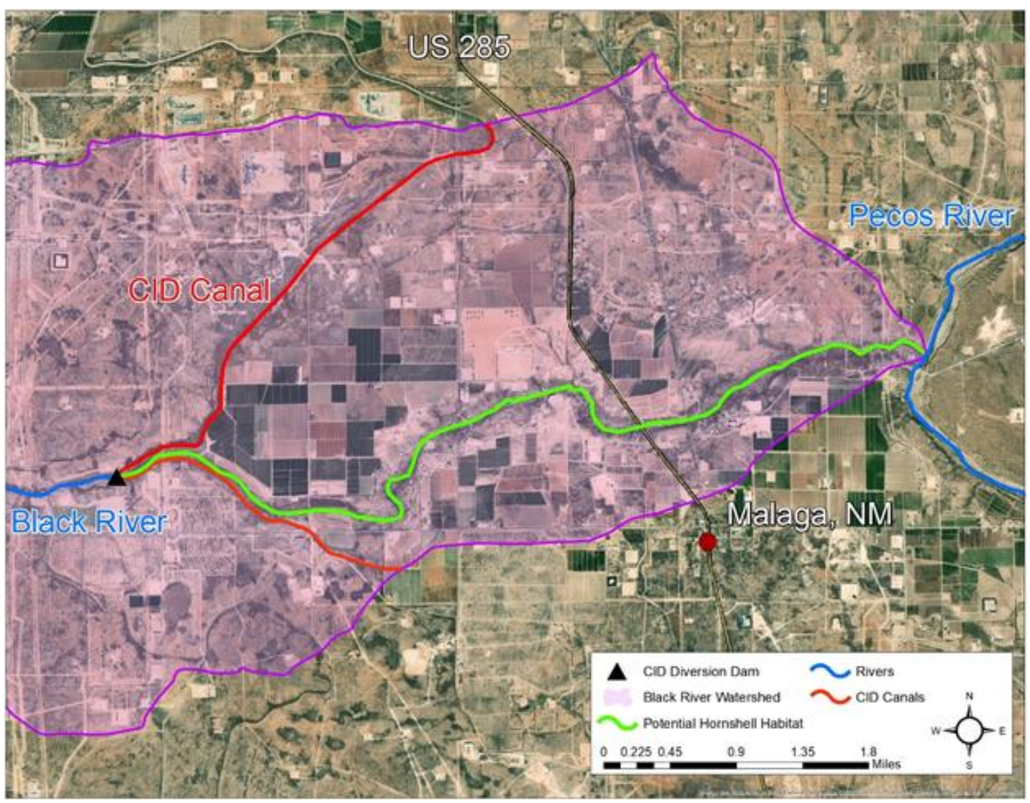


Figure 40. The 6.5 miles of the Black River from the CID Diversion Dam to the Pecos River is potential Texas hornshell habitat with the removal of hypersaline waters introduced by CID irrigation canals.

<u>Brackish Water Diversion</u> — Approximately six and a half miles upstream of the Black River's convergence with the Pecos River, the Carlsbad Irrigation District's (CID) main canal discharges water into the Black River. While the Black River's upper reaches have relatively low salinity, the neighboring Pecos River is significantly saltier. Significant inflows of brackish water in the Bitter Lakes and Bottomless Lakes area near Roswell result in the Pecos River having fairly high salinity even before it reaches Avalon Reservoir, just north of Carlsbad. The CID main canal distributes water from Avalon Reservoir through the irrigation and releases its excess waters into the Black River (Figure 40). This water is significantly more brackish than the native Black River water. The canal supplies a large portion of the water for crops for Eddy County farms. However, the water that makes it into the Black River from the canal, along with salinized return flows from the irrigation district downstream of the canal outfall, has severe ecological consequences.

The increased salinity downstream of the CID main canal adversely affects the Texas hornshell. As the mussel is an indicator species, it requires relatively pristine water quality to persist. The mussels are somewhat sensitive to high levels of salinity. Lang (2001) found in laboratory studies that Texas hornshell could not survive salinity levels greater than 7.0 ppt. Salinity levels in the Black River above the CID aqueduct are around 0.8 ppt (USGS 2016). Downstream of the CID aqueduct on the Black River, salinity levels rise to 2.8 ppt, and in the Pecos River downstream of the Black River, confluence salinity levels are more than 6.0 ppt (Carman 2007). Texas hornshell is not observed downstream of the main canal outfall. Between Carlsbad and the Texas border, the Pecos River becomes increasingly saline, partly as the result of return flows, but mostly due to natural inflows of saline groundwater east of Malaga, New Mexico, and no part of the Pecos near its confluence with the Black River is of suitable water quality for the hornshell.

A potential project to divert the CID canal water across the Black River and back into a pre-existing canal south of the river would reduce the salinity levels to appropriate range for the endangered hornshell. The diversion of the canal water would create an additional 6.5 miles of suitable habitat for Texas hornshell, more than doubling the available habitat for hornshell in the BRW.

Figure 41. A semi-truck that lost control and crashed into the Black River.

Vehicle Crossings — With high volumes of industrial, agricultural, and recreational activities within the BRW, wetlands adjacent to high traffic areas are put at additional risk of degradation. Vehicles entering an aquatic system can release harmful contaminants that could affect both aquatic vegetation and wildlife. In a flowing system such as the Black River, contaminates could travel miles downstream from the source causing extensive damage to the ecosystem. There have been several instances in the last five years of vehicles losing control and winding up in the Black River (Figure 41). Currently there are few to no preventative measures in place to help avoid these incidents.

Projects that address preventative measures at the high traffic areas near wetlands will reduce the number of vehicular incidents that affect the wetlands within the BRW. The preventive measures should not be limited to, but could include, lowering speed limits, installing calming structures and devices, caution lights and signs, utilizing reflective markers, and introducing barrier systems. Projects that lead to engineered design road improvements would also reduce the possibility of incidents within the watershed.

Erosion Reduction — The stream banks of the Black River tend to be highly eroded due to lack of surrounding riparian vegetation, reduced vegetation from cattle grazing, and soil composition (Figure 42). Increased sedimentation from erosion can fragment habitat and smother Texas hornshell, causing death (Carman 2007, USFWS 2018a). As previously mentioned, erosion mitigation practices, such as silt fence and filter sock wattle installation, will benefit both the area species and their habitat. Long-term solutions are achievable when readily paired with planting and reseeding efforts. When development within the riparian area is unavoidable, the implementation of land-use best practices known as Reasonable and Prudent Practices for Stabilization (RAPPS; Horizon Environmental Services 2004) are essential. These practices include consideration of physical and biotic site characteristics (e.g., slope and annual precipitation) and aim to reduce erosion during and after land-use disturbance.

Figure 42. A blow out on the banks of the Black River after a larger rain.

Wetland Vegetation Restoration Projects — Wetlands function as a form of erosion control, especially in areas such as the BRW where highly erodible gypsum soils are prevalent. Wetlands with higher concentrations of vegetation typically function better in the prevention of erosion, increased groundwater recharge and improved streamflow maintenance.

Vegetation along wetland banks prevents soils from being washed or blown away. The vegetation around degraded, lower functioning wetlands with reduced vegetative cover is less effective at erosion prevention and can to be restored through wetland vegetation restoration projects. The establishment of buffers that allow for increased density of wetlands vegetation will improve water retention in the landscape and subsurface, should be prioritized.

Livestock Infrastructure Improvement Projects — Cattle operators within the BRW utilize wetlands adjacent to the Black River as a source of drinking water and food for their cattle (Figure 43). When grazing livestock in riparian areas, several factors should be considered, including the time of year,

Figure 43. Cattle utilizing the Black River for both forage and a drinking source.

precipitation, stage of vegetation, and livestock needs and behaviors. Overgrazing may damage wetlands when plants are grazed repeatedly and not given time to recover. There are cattle operators within the watershed that may have difficulty implementing rotational grazing, due to poor infrastructure (e.g., fences, water sources, water lines, and water storage). Due to the possibility of some operator's inability to properly implement rotational grazing, wetlands that are over-utilized by cattle are at increased risk of degradation. Ranching infrastructure improvement projects, such as drinkers outside of wetland areas, can reduce wetland degradation and facilitate a rancher's ability to manage their cattle with a positive impact on wetlands.

Trash and Litter Removal Projects — Wetlands within the BRW face degradation from large quantities of litter and trash (Figure 44). For the last several years, southeastern New Mexico has been experiencing one of the largest oil and gas industrial booms in the world. The industrial boom has not only led to a large volume of industrial activity within the BRW, but has also increased the number of individuals visiting the wetlands for recreational purposes. With the increased exposure to the wetlands of the BRW and the lack of trash disposal facilities, the amount of litter in the watershed has increased over time. Litter has the potential to negatively affect the local wildlife populations as well as the water quality of the wetlands. In discussions with stakeholders along the river, a major concern for water quality is the trash left due to industrial and recreational use of the river. Projects should be developed to address the damage posed to the wetlands by this increased amount of trash and litter. See Appendix E for the full list of potential projects to protect and restore wetlands.

Figure 44. Large amounts of trash along the banks of the Black River.

Potential Funding Options

One of the most challenging tasks when establishing and performing wetlands restoration and protection projects is securing funding sources. Funds for these projects can come from multiple sources such as federal agencies, state agencies, local governments, and private organizations. Funding sources will also vary significantly in amount and match requirements. The list below should be used to identify potential funding sources for wetland improvement projects within the BRW (Table 13). As funding availability is ever-changing, the list should not be the only instrument used to identify funding sources. There are many more funding opportunities outside of the list outlined in this Action Plan.

Table 13. Potential Project Funding Sources

Source	Agency	Grant
Federal	Bureau of Land Management	Fisheries and Aquatic Partnerships
	Natural Resources Conservation Service	Environmental Quality Incentives Program
		Wetlands Reserve Program
	U.S. Fish and Wildlife Service	Partners for Fish and Wildlife Program
		North American Wetlands Conservation Act Grants
		National Fish Passage Program
	U.S. Environmental Protection Agency	5 Star Wetland and Urban Waters Restoration Grants
		Clean Water Act Section 319 Watershed Planning and Restoration Grants (via NMED)
		Environmental Education (EE) Grants
		Wetland Program Development Grants
State	New Mexico Department of Game and Fish	Share with Wildlife
		Habitat Stamp Program
	New Mexico Water Trust Board	Water Trust Board Grant
	New Mexico Environmental Department	River Stewardship Program Grant
		Clean Water State Revolving Loan Fund
		Brownfield Clean-up Revolving Loan Fund
	New Mexico Energy, Mineral, and Natural Resources Department	Youth Conservation Corps
NGO	National Fish and Wildlife Foundation	Five Star and Urban Waters Restoration Grant Program
		Pecos Watershed Conservation Initiative
	Desert Fish Habitat Partnership	Support available for habitat improvement projects

	CEHMM	Support available for habitat improvement projects
	National Environmental Education Foundation	Support available for habitat improvement projects

Monitoring Component to Measure Success of Implemented Projects

Implemented projects can have immediate effect on reducing threats, stressors, and degraded habitat within a wetland. However, the maintenance and monitoring of projects are typically not as detailed in the development of projects. Monitoring a project through time allows for improved adaptive management to be incorporated. The Hornshell Candidate Conservation Agreements have an Implementation Committee composed of scientists and land managers from state and federal agencies as well as NGOs. The Implementation Committee would be an excellent resource when developing monitoring plans for wetlands projects within the BRW.

Specific monitoring requirements and measurement criteria should be included as part of the overall scope of work of conservation projects to ensure that any needed baseline data are gathered before implementing the project. Monitoring of conservation and protection projects within the watershed should include:

- Approved Quality Assurance Project Plan (QAPP)
- Monitoring Plan
    - Monitoring Schedule
    - Data Collection Methods
    - Data Management Methods
    - Measures for Evaluating Project Effectiveness
    - Adaptive Management Measures
- Report of Findings
- Determination of Effectiveness of Implemented Projects

Programs Focusing on Wetlands

The following is a description of state, federal, and internationally funded programs that focus on the rehabilitation, restoration, and improvement of our wetlands. While this is not an exhaustive list of the eligible programs, it does represent a wide berth of programming available for efforts in protecting these valuable (and often fragile) resources.

The New Mexico Wetlands Program supports the development of Wetlands Action Plans like this one and a number of education and outreach programs to better inform New Mexicans of all ages. The Wetlands Program goals center around planning, restoration, enhancement, protection, education and outreach on behalf of the state's wetlands. https://www.env.nm.gov/surface-water-quality/wetlands/

The New Mexico River Stewardship Program provides funding opportunities to address water quality and habitat issues. The program helps municipalities, NGOs, nations, pueblos, and tribes support enhancement initiatives for their local watersheds. https://www.env.nm.gov/surface-water-quality/river-stewardship-program/

The Clean Water Act also supports **the Clean Water State Revolving Loan Fund** (EPA 2021). This program appropriates federal and state funding to mitigate pollutants and contaminants from watersheds, construct water infrastructure projects, initiate water quality efforts, conserve water, and protect fragile wetlands. The Clean Water State Revolving Loan Fund was established in 1987.

The New Mexico **Brownfield Clean-up Revolving Loan Fund** was established under the CERCLA Act of 1987. A brownfield property often has contamination or perceived contamination. Examples include old gas stations, vacant motels, former industrial sites or abandoned dumps. Cleaning up and reinvesting in these properties can restore the environment, reduce health risks, eliminate blight, revitalize downtowns, create jobs, increase local tax bases, and create a sense of community pride. View the program brochure for more information about the resources available for brownfields redevelopment.

The Water Infrastructure Finance and Innovation Act of 2014 (WIFIA) works in conjunction with eligible borrowers to provide enhancements to wetlands and water-related projects, such as drought prevention, aquifer recharge, and water facility infrastructure.

The EPA's Healthy Watersheds Program includes an assessment of the health and vulnerability of the watershed. Projects are prioritized to take initiative in protecting the watershed among six key essential ecological attributes: landscape condition, biotic condition, chemical and physical characteristics, ecological processes, hydrologic and geomorphic condition, and natural disturbance regimes (EPA 2021).

The North American Waterfowl Management Plan centers around migratory bird conservation, however the program's habitat restoration initiatives have worked to enhance wetlands in the U.S., Canada, and Mexico since 1986. This program is centered on international collaborative conservation among governments, citizens, and wetlands stakeholders (NAWMP 2018).

Local and Public Involvement Strategies

Because of CEHMM's work administering and implementing nationally recognized conservation programs (the Candidate Conservation Agreements for the Lesser Prairie-Chicken and Dunes Sagebrush Lizard and the Texas Hornshell Mussel), we are poised to serve as a coordinator for Black River wetland protection and restoration activities, given funding availability. We are well-respected among both public and private stakeholders, agencies, and community members in southeastern New Mexico, and we have a proven track record of implementing on-the-ground conservation projects over the last 10 years. We believe this track record and our methods for accomplishing the goals set out in the CCAs will work well for long-term restoration and protection of the Black River as well.

Giving funding availability, numerous tools can be utilized or created to increase the knowledge base of our objectives and initiatives. Tools may include, but are not limited to:

- Educational watershed signs
- Educational programs
- Brochures
- Website content
- Social media content
- Workshops
- Media presentations

Tools for Reaching the Public

Educational Watershed Signs — Educational watershed signs can be created to include information on important watershed features, species that can be found within the watershed, and a map of the watershed. These interpretive signs can provide simple yet useful information to teach visitors the importance of the watershed and also create memorable experiences, thus generating longer-term positive impressions of the area. One to two of these signs should be placed at highly trafficked areas, such as Cottonwood Day Use Area, Higby Hole, Rattlesnake Springs, or Washington Ranch.

Educational Programs — Educational programs could be designed for children of all ages, involving both indoor and outdoor aspects. Given funding, local school districts could be contacted to initiate these programs. Interactive exhibits, including displays of organisms found in the watershed or field trips to the wetlands, may prove to be useful in building student interest in the wetland areas.

Brochures — Full color brochures detailing the geographical boundaries of the watershed, wetland functions, values, and threats may be developed for dissemination to interested parties. These may contain more detailed information than the information provided via educational watershed signs such as details about what individuals can do to protect wetlands within the watershed.

Website Content — Given appropriate funding, a website may be developed to include a description of the wetland, wetland functions, values, and threats, along with descriptions of current projects. This platform may also be utilized for announcements pertaining to the wetlands. A Story map could also be developed for online interaction with the public.

Social Media Content — These days, social media is of utmost importance when considering outreach/marketing options. Social media accounts, including Facebook and Instagram, YouTube, etc., could be developed to provide regular updates pertaining to ongoing work throughout the watershed. Social media is also an excellent platform for educational posts, detailing the importance of the watershed.

Workshops — To provide community outreach, many avenues of approach are recommended in order to effectively distribute information to the public. Workshops are a potential way to involve other conservation organizations who may be interested in wetland protection and restoration efforts detailed within the Action Plan. Because of involvement with various organizations, these may also facilitate other possibilities for project funding. Workshops could include both presentations and poster displays detailing on-going work within the watershed, and both can be utilized as a means to inform the public in a more personal setting.

Media Presentations — Media outreach is an excellent way to further provide information to the general public on the Action Plan. These outlets include articles in newspapers and magazines, as well as radio interviews.

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Appendix A

Full legend of dominant vegetation communities in the BRW (Figure 27).

DESCRIPTION

- Agriculture
- Apacherian-Chihuahuan Mesquite Upland Scrub
- Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe
- Chihuahuan Creosotebush, Mixed Desert and Thorn Scrub
- Chihuahuan Gypsophilous Grassland and Steppe
- Chihuahuan Mixed Salt Desert Scrub
- Chihuahuan Sandy Plains Semi-Desert Grassland
- Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub
- Chihuahuan Succulent Desert Scrub
- Coahuilan Chaparral
- Colorado Plateau Mixed Bedrock Canyon and Tableland
- Colorado Plateau Mixed Low Sagebrush Shrubland
- Developed, Medium - High Intensity
- Developed, Open Space - Low Intensity
- Inter-Mountain Basins Montane Sagebrush Steppe
- Inter-Mountain Basins Semi-Desert Grassland
- Inter-Mountain Basins Semi-Desert Shrub Steppe
- Madrean Encinal
- Madrean Juniper Savanna
- Madrean Pine-Oak Forest and Woodland
- Madrean Pinyon-Juniper Woodland
- Madrean Upper Montane Conifer-Oak Forest and Woodland
- Mogollon Chaparral
- North American Arid West Emergent Marsh
- North American Warm Desert Active and Stabilized Dune
- North American Warm Desert Bedrock Cliff and Outcrop
- North American Warm Desert Lower Montane Riparian Woodland and Shrubland
- North American Warm Desert Playa
- North American Warm Desert Riparian Woodland and Shrubland
- North American Warm Desert Volcanic Rockland
- North American Warm Desert Wash
- Open Water
- Rocky Mountain Bigtooth Maple Ravine Woodland
- Rocky Mountain Cliff and Canyon
- Rocky Mountain Gambel Oak-Mixed Montane Shrubland
- Rocky Mountain Lower Montane Riparian Woodland and Shrubland
- Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland
- Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland
- Rocky Mountain Ponderosa Pine Woodland
- Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland
- Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland
- Rocky Mountain Subalpine-Montane Riparian Shrubland
- Southern Rocky Mountain Juniper Woodland and Savanna
- Southern Rocky Mountain Montane-Subalpine Grassland
- Southern Rocky Mountain Pinyon-Juniper Woodland
- Western Great Plains Cliff and Outcrop
- Western Great Plains Foothill and Piedmont Grassland
- Western Great Plains Saline Depression Wetland
- Western Great Plains Sandhill Shrubland
- Western Great Plains Shortgrass Prairie

Appendix B

Plant inventory results from the Blue Springs Bioinventory survey sorted by family and common species name (CEHMM 2018). If applicable, invasive status is included (New Mexico Noxious Weed Classification = N, Introduced Species = I) (USDA 2021). None of the species listed are classified as threatened or endangered at the state or federal level.

Plant Inventory			
Family	**Common Name**	***Scientific Name***	**Invasive Status**
Acanthaceae, the Acanthus Family			
	Shaggytuft	*Stenandrium barbatum*	
Acardiaceae, the Sumac Family			
	Littleleaf Sumac (Skunkbush Sumac)	*Rhus trilobata*	
Agavaceae, the Agave Family			
	Banana Yucca	*Yucca baccata*	
	Soaptree Yucca	*Yucca elata*	
Asteraceae, the Sunflower Family			
	Bull Thistle	*Cirsium vulgare*	N
	Broom Snakeweed	*Gutierrezia sarothrae*	
	Common Cocklebur	*Xanthium strumarium*	
	Dwarf Desertpeony (Desert Holly)	*Acourtia nana*	
	Greeneyes (Lyreleaf Greeneyes)	*Berlandiera lyrata*	
	Green Prairie Coneflower	*Ratibida columnifera*	
	Largeflower Tickseed	*Coreopsis grandiflora*	
	Longstalk Greenthread	*Thelesperma longipes*	
	Mariola	*Parthenium incanum*	
	Mexican Hat	*Ratibida tagetes*	
	Malta Starthistle	*Centaurea melitensis*	N
	Prickly Lettuce	*Lactuca serriola*	I
	Seepwillow Baccharis (Mule Fat)	*Baccharis salicifolia*	
	Tarbush	*Flourensia cernua*	
	Texas Skeleton Plant	*Lygodesmia texana*	
	Threadleaf Groundsel	*Senecio flaccidus*	
	Yellow Salsify	*Tragopogon dubius*	I

Plant Inventory, Continued			
Family	**Common Name**	***Scientific Name***	**Invasive Status**
Berberidacea, the Barberry Family			
	Algerita	*Berberis haematocarpa*	
Brassicaeae, the Mustard Family			
	Mountain Pepperweed	*Lepidium montanum*	
Cactaceae, the Cactus Family			
	Cane Cholla	*Cylindropuntia imbricata*	
	Christmas Cholla	*Cylindropuntia leptocaulis*	
	Eagle-claw Cactus (Devilshead)	*Echinocactus horizonthalonius*	
	Englemann's Prickly pear (Texas Prickly Pear)	*Opuntia engelmannii*	
	Horse Crippler	*Echinocactus texensis*	
	Purple Prickly Pear	*Opuntia macrocentra*	
	Spiny Hedgehog Cactus (Rainbow Cactus)	*Echinocereus dasyacanthus*	
	Tulip Prickly Pear	*Opuntia phaeacantha*	
Chenopodiaceae, the Goosefoot Family			
	Four-winged Saltbush	*Atriplex canescens*	
Convolulaceae, the Mourning-Glory Family			
	Field Bindweed	*Convolvulus arvensis*	N
Cucurbitaceae, the Gourd Family			
	Buffalo Gourd	*Cucurbita foetidissima*	
Cupressaceae, the Cypress Family			
	Pinchot's Juniper	*Juniperus pinchotii*	
Cyperaceae, the Sedge Family			
	Unidentified sedge species	*Carex spp.*	
Elaeagnaceae, the Oleaster Family			
	Russian Olive	*Elaeagnus angustifolia*	N
Ephedraceae, the Joint-Fir Family			
	Mormon Tea (Torrey's Jointfir)	*Ephedra torreyana*	
Equistaceae, the Horsetail Family			
	Smooth Horsetail	*Equisetum laevigatum*	

Plant Inventory, Continued			
Family	**Common Name**	***Scientific Name***	**Invasive Status**
Euphorbiceae, the Spurge Family			
	Leatherweed (Doveweed)	*Croton pottsii*	
	Whitemargin Sandmat (Rattlesnake Weed)	*Chamaesyce albomarginata*	
Fabaceae, the Pea Family			
	Hog Potato	*Pomaria jamesii*	
	Honey Mesquite	*Prosopis glandulosa*	
	Roundflower Catclaw	*Senegalia roemeriana*	
	Screwbean (Tornillo)	*Prosopis pubescens*	
	White-thorn	*Vachellia vernicosa*	
Juglandaceae, the Walnut Family			
	Little Walnut (Mexican Walnut)	*Juglans microcarpa*	
Koeberliniaceae, the Crucifixion-Thorn Family			
	Crucifixion-Thorn	*Koeberlinia spinosa*	
Lamiaceae, the Mint Family			
	Horehound (White Horehound)	*Marrubium vulgare*	I
Linaceae, the Flax Family			
	Berlandier's Yellow Flax	*Linum berlandieri*	
Loacaceae, the Strickleaf Family			
	Grassland Blazingstar	*Mentzelia strictissima*	
Malvaceae, the Mallow Family			
	Copper Globemallow	*Sphaeralcea angustifolia*	
Oleaceae, the Olive Family			
	Rough Menodora	*Menodora scabra*	
Onagraceae, the Evening Primrose Family			
	Hartweg's Sundrops	*Oenothera hartwegii*	
	Scarlet Beeblossom	*Oenothera suffrutescens*	
Papaveraceae, the Poppy Family			
	Hedgehog Pricklypoppy	*Argemone squarrosa*	
Phytolaccaceae, the Pokeweed Family			
	Humble-weed (Rouge Plant)	*Rivina humilis*	

Plant Inventory, Continued			
Family	Common Name	***Scientific Name***	Invasive Status
Poaceae, the Grass Family			
	Alkali Sacaton	*Sporobolus airoides*	
	Bermuda Grass	*Cynodon dactylon*	I
	Low Woollygrass	*Dasyochloa pulchella*	
	Saltgrass	*Distichlis spicata*	
Polygonaceae, the Buckwheat Family			
	Havard's Buckwheat	*Eriogonum havardii*	
Pteridaceae, the Brake Family			
	Maiden-hair Fern	*Adiantum capillus-veneris*	
Ranunculaceae, the Buttercup Family			
	Old Man's Beard (Drummond's Clematis)	*Clematis drummondii*	
Rhamnaceae, the Buckthorn Family			
	Javelina-bush	*Condalia ericoides*	
	Lotebush	*Ziziphus obtusifolia*	
Salicaceae, the Willow Family			
	Gooding's Willow	*Salix gooddingii*	
	Rio Grande Cottonwood	*Populus deltoides*	
Sapindaceae, the Soapberry Family			
	Wingleaf Soapberry (Western Soapberry)	*Sapindus saponaria*	
Scrophulariaceae, the Figwort Family			
	Common Mullein	*Verbascum thapsus*	I
Solanaceae, the Potato Family			
	Buffalobur Nightshade	*Solanum rostratum*	
	Purple Ground-Cherry	*Quincula lobata*	
	Silverleaf Nightshade	*Solanum elaeagnifolium*	
Tamaricaceae, the Tamarisk Family			
	Saltcedar	*Tamarix chinenis*	N
Typhaceae, the Cattail Family			
	Broadleaf Cattail	*Typha latifolia*	

Plant Inventory, Continued			
Family	**Common Name**	***Scientific Name***	**Invasive Status**
Verbenaceae, the Vervain Family			
	Davis Mountain Mock Vervain (Desert Verbena)	*Glandularia bipinnatifida*	
Vitaceae, the Grape Family			
	Virginia Creeper	*Parthenocissus inserta*	
Zygophyllaceae, the Caltrop Family			
	African-rue	*Peganum harmala*	N
	Creosote-bush	*Larrea tridentata*	

Appendix C

Fishes of the Upper Pecos – Black River Watershed (HUC 13060011) (BISON-M 2021).

Fishes of the Upper Pecos – Black River Watershed (HUC 13060011)		
Family	**Common Name**	**Scientific Name**
Cyprinidae, the Carp or Minnow Family		
	Goldfish	*Carassius auratus*
	Grass Carp	*Ctenopharyngodon idella*
	Red Shiner	*Cyprinella lutrensis*
	Common Carp	*Cyprinus carpio*
	Roundnose Minnow	*Dionda episcopa*
	Rio Grande Chub	*Gila pandora*
	Plains Minnow	*Hybognathus placitus*
	Speckled Chub	*Macrhybopsis aestivalis*
	Golden Shiner	*Notemigonus crysoleucas*
	Arkansas River Shiner	*Notropis girardi*
	Rio Grande Shiner	*Notropis jemezanus*
	Pecos Bluntnose Shiner	*Notropis simus pecosensis*
	Sand Shiner	*Notropis stramineus*
	Fathead Minnow	*Pimephales promelas*
	Longnose Dace	*Rhinichthys cataractae*
Lepisosteidae, the Gar Family		
	Longnose Gar	*Lepisosteus osseus*
Clupeidae, the Shad Family		
	Gizzard Shad	*Dorosoma cepedianum*
	Threadfin Shad	*Dorosoma petenense*
Catostomidae, the Sucker Family		
	River Carpsucker	*Carpiodes carpio carpio*
	White Sucker	*Catostomus commersoni*
	Blue Sucker	*Cycleptus elongatus*
	Smallmouth Buffalo	*Ictiobus bubalus*
	Gray Redhorse	*Moxostoma congestum*

Fishes of the Upper Pecos – Black River Watershed, Continued		
Family	**Common Name**	**Scientific Name**
Characidae, the Characin Family		
	Inland Silverside	*Menidia beryllina*
Ictaluridae, the Catfish Family		
	Headwater Catfish	*Ictalurus lupus*
	Channel Catfish	*Ictalurus punctatus*
	Flathead Catfish	*Pylodictis olivaris*
Salmonidae, the Salmon Family		
	Rainbow Trout	*Oncorhynchus mykiss*
	Brook Trout	*Salvelinus fontinalis*
Poeciliidae, the Live Bearers Family		
	Western mosquitofish	*Gambusia affinis*
	Pecos Gambusia	*Gambusia nobilis*
Percichthyidae, the Temperate Perch Family		
	White Bass	*Morone chrysops*
Centrarchidae, the Sun Fish Family		
	Rock Bass	*Ambloplites rupestris*
	Green Sunfish	*Lepomis cyanellus*
	Warmouth	*Lepomis gulosus*
	Bluegill	*Lepomis macrochirus*
	Longear Sunfish	*Lepomis megalotis*
	Spotted Bass	*Micropterus punctulatus*
	Largemouth Bass	*Micropterus salmoides salmoides*
	White Crappie	*Pomoxis annularis*
	Black Crappie	*Pomoxis nigromaculatus*
Percidae, the True Perch Family		
	Greenthroat Darter	*Etheostoma lepidum*
	Bigscale Logperch (Native pop.)	*Percina macrolepida*
	Walleye	*Sander vitreus*

Appendix D

Imperiled species sorted by taxon group with listed state and federal statuses (BISON-M 2021).

Imperiled Species of Eddy County, New Mexico				
Taxon	**Common Name**	**Scientific Name**	**State Status**	**Federal Status**
Amphibians				
	Western Narrow-mouthed Toad	*Gastrophryne olivacea*	Endangered	None
Birds				
	Aplomado Falcon	*Falco femoralis*	Endangered	Endangered
	Baird's Sparrow	*Centronyx bairdii*	Threatened	None
	Bald Eagle	*Haliaeetus leucocephalus*	Threatened	None
	Bell's Vireo	*Vireo bellii*	Threatened	None
	Broad-billed Hummingbird	*Cynanthus latirostris*	Threatened	None
	Common Black Hawk	*Buteogallus anthracinus*	Threatened	None
	Common Ground Dove	*Columbina passerina*	Endangered	None
	Gray Vireo	*Vireo vicinior*	Threatened	None
	Least Tern	*Sternula antillarum*	Endangered	Endangered
	Lucifer Hummingbird	Calothorax lucifer	Threatened	None
	Mexican Spotted Owl	*Strix occidentalis lucida*	None	Threatened
	Neotropic Cormorant	*Phalacrocorax brasilianus*	Threatened	None
	Northern Beardless-Tyrannulet	*Camptostoma imberbe*	Endangered	None
	Peregrine Falcon	*Falco peregrinus*	Threatened	None
	Southwestern Willow Flycatcher	*Empidonax traillii extimus*	Endangered	Endangered
	Thick-billed Kingbird	*Tyrannus crassirostris*	Endangered	None
	Varied Bunting	*Passerina versicolor*	Threatened	None
Fish				
	Bigscale Logperch	*Percina macrolepida*	Threatened	None
	Blue Sucker	*Cycleptus elongatus*	Endangered	None
	Gray Redhorse	*Moxostoma congestum*	Endangered	None
	Greenthroat Darter	*Etheostoma lepidum*	Threatened	None
	Mexican Tetra	*Astyanax mexicanus*	Threatened	None
	Pecos Bluntnose Shiner	*Notropis simus pecosensis*	Endangered	Threatened
	Pecos Gambusia	*Gambusia nobilis*	Endangered	Endangered

Imperiled Species of Eddy County, New Mexico, Continued				
Taxon	**Common Name**	**Scientific Name**	**State Status**	**Federal Status**
Fish, Continued				
	Pecos Pupfish	*Cyprinodon pecosensis*	Threatened	None
Mammals				
	Least Shrew	*Cryptotis parvus*	Threatened	None
	Spotted Bat	*Euderma maculatum*	Threatened	None
Mollusks				
	Ovate Vertigo Snail	*Vertigo ovata*	Threatened	None
	Pecos Springsnail	*Pyrgulopsis pecosensis*	Threatened	None
	Texas Hornshell Mussel	*Popenaias popeii*	Endangered	Endangered
Reptiles				
	Arid Land Ribbonsnake	*Thamnophis proximus*	Threatened	None
	Dunes Sagebrush Lizard	*Sceloporus arenicolus*	Endangered	None
	Gray-banded Kingsnake	*Lampropeltis alterna*	Endangered	None
	Mottled Rock Rattlesnake	*Crotalus lepidus lepidus*	Threatened	None
	Plain-bellied Water Snake	*Nerodia erythrogaster*	Endangered	None
	Rio Grande Cooter	*Pseudemys gorzugi*	Threatened	None

Appendix E

A List of Proposed to Protect and Restore Wetlands

* **1** = Very High Priority, **2** = High Priority, **3** = Moderate Priority

****$** = < $10K, **$$** = $10K-$50K, **$$$** = $50K-$100K, **$$$$** = $100K-$500K, **$$$$$** = > $500K

List of Proposed Projects to Protect and Restore Wetlands				
Priority Level*	**Potential Project Name**	**Project Details**	**Project Location**	**Estimated Cost Magnitude****
1	Water Conservation Program Development	Development of an a water conservation program to protect and preserve water for wetlands within the Black River watershed. Water is a highly utilized recourse with in the watershed and without protections, wetlands face degradation and even extirpation in the watershed. The program should focus on the purchase or lease of water rights or alternative mechanisms such as forbearance agreements in the watershed to dedicate water to the wetlands of the watershed.	Black River Watershed	$$$$
1	Integrated Watershed Health Assessment	An integrated Watershed Health Assessment should be developed for the Black River Watershed with special consideration in the anthropological degradation of the Watershed. The assessment should include: landscape condition, habitat condition, hydrology, geomorphology, water quality, biological condition, and vulnerability. The integrated health assessment will identify poor conditions within the watershed that can be targeted for restoration and habitat improvement projects. The assessment will also help stakeholders to identify how anthropological activities such as recreations, energy extraction, mining, and agriculture may be affecting the watershed.	Black River Watershed	$$$
1	High Frequency Non Invasive Valvometry	HFNI Valvometry is a tool used to record mollusk bivalve activity and enables a population of bivalves to be monitored for their reactions to stress and pollutants. HFNI Valvometry detects bivalve activity and can detect abnormal movements that indicate changes in water quality. HFNI Valvometer could be utilized on populations of Corbicula (freshwater clam) in the Black River to aid in the detection of pollutants or stress events and act as a real time bio-alarm. Typically, when chemical spills happen in aquatic environments environmental managers are notified post incident after the environmental damage is done. This bio-alarm would aid in the protection of the endangered Texas hornshell by notifying environmental managers of real time changes in water quality.	Perennial Black River Reaches	???

List of Proposed Projects to Protect and Restore Wetlands (Continued)				
Priority Level*	**Potential Project Name**	**Project Details**	**Project Location**	**Estimated Cost Magnitude****
1	Development of a Long Term Water Quality Monitoring Program	There are several threats to the water quality of wetlands within the Black River. These threats include high salinity levels, risk of point source pollution, and increased turbidity due to sedimentation. A water quality monitoring program could be used to evaluate overall health of aquatic ecosystems, monitor for long term trends in water and habitat quality, identify wetlands that should be targeted for habitat or water quality improvement projects, and evaluate whether projects have led to improvements in wetland water quality and functionality.	Black River and Blue Springs	$$
2	Biological and Functional Wetland Assessments	The development of biological and functional wetland assessment projects will provide stakeholders with a tool to better manage and preserve the wetlands of the BRW. Biological and functional wetland assessments will allow stakeholders to establish baseline wetland conditions and functions, compare and improve on previous wetland function assessments, detect changes to wetlands, and identify wetlands trends over time. These assessments will be critical for making management decisions for future wetland restoration projects and watershed planning. These assessments will also aid in establishment of water quality standards for wetlands in the BRW.	Black River Watershed	$$
2	Vehicle Crossing Improvement Project	Projects that address preventative measures at the highly trafficked areas near wetlands will reduce the number of vehicular incidents that affect the wetlands within the BRW. The preventive measures shouldn’t be limited to, but could include, lowering speed limits, installing caution lights and signs, utilizing reflective markers, and introducing barrier systems. Projects that address the engineered design improvement would also reduce the possibility of incidents within the watershed.	Forehand, Harkey, and Higby Hole Low Water Crossings	$$

List of Proposed Projects to Protect and Restore Wetlands (Continued)				
Priority Level*	**Potential Project Name**	**Project Details**	**Project Location**	**Estimated Cost Magnitude****
2	Livestock Infrastructure Improvement Projects	Overgrazing may damage wetlands when plants are grazed repeatedly and not given time to recover. There are cattle operators within the watershed that may have difficulty implementing rotational grazing, due to poor infrastructure (e.g., fences, water sources, water lines, and water storage). Due to the possibility of some operator's inability to properly implement rotational grazing, wetlands that are over utilized by cattle are at risk of degradation. Ranching infrastructure improvement projects that improve a rancher's ability to rotationally graze their cattle will positively impact the watershed's wetlands and lower the risk of their degradation.	Black River Watershed	$$
2	Brackish Water Diversion	A potential project to divert the CID canal water across the Black River and back into a pre-existing canal south of the river would reduce the salinity levels within an appropriate range for the endangered hornshell. The diversion of the canal water would create an additional 6.5 miles of suitable habitat for Texas hornshell. The diversion of this saline water has the potential to double the available habitat for hornshell in the BRW.	Black River CID Diversion Dam	$$$$$
2	Erosion Reduction	The stream banks of the Black River tend to be highly eroded due to lack of surrounding upland vegetation, reduced vegetation from cattle grazing, and soil composition. As previously mentioned, erosion mitigation practices will benefit both the areas species and their habitat. Long-term solutions are achievable when readily paired with reseeding efforts. When development within the riparian area is unavoidable, the implementation of land-use best practices known as Reasonable and Prudent Practices for Stabilization (RAPPS; Horizon Environmental Services 2004) is essential. These practices include consideration of physical and biotic site characteristics (e.g., slope and annual precipitation) and aim to reduce erosion during and after the land-use disturbance.	Black River, Blue Springs, and Ephemeral Drainages with connectivity to Black River	$$$

List of Proposed Projects to Protect and Restore Wetlands (Continued)				
Priority Level*	**Potential Project Name**	**Project Details**	**Project Location**	**Estimated Cost Magnitude****
2	Trash and Litter Removal Projects	Wetlands within the BRW face degradation from large quantities of litter and trash. With the increased anthropogenic exposure to the wetlands of the BRW and the lack of trash disposal facilities, the amount of litter in the watershed has increased over time. This litter had potential to negatively affect the local wildlife populations as well as the water quality of the wetlands. In discussions with stakeholders along the river, a major concern for water quality is the trash left due to industry and recreational use of the river. Projects should be developed to address the damage posed to the wetlands by this increased amount of trash and litter.	Black River Watershed	$
2	Wetland Vegetation Restoration Projects	Wetlands function as a form of erosion control, especially in areas such as the BRW where highly erosive gypsum soils are prevalent. Wetlands with higher concentrations of vegetation typically function better in the prevention of erosion. Vegetation along wetland banks prevents soils from being washed or blown away. The vegetation around degraded wetlands that are lower functioning as erosion prevention may need to be restored through wetland vegetation restoration projects.	Black River Watershed	$$
2	Blue Springs Invasive Plant Removal	There are several invasive plant species found in the Blue Springs riparian area that threaten the biological richness of the area. Invasive plants have the potential to cause harm to the environment, economy, and human health. It may be worth looking to the environmental benefits of removing these invasive plants. These invasive species include saltcedar (Tamarix chinensis) (Fig 1), Russian olive (Elaeagnus angustifolia), Malta Starthistle (Centaurea melitensis), and African-rue (Peganum harmala). Likely, all of the invasive plant species will need to be mapped within the Blue Springs area, as aerial treatments will not be possible with such close proximity to the water. The majority of the treatments will require chemical hand treatments and mechanical removal. Also, some time stipulations for the removal of Russian olive and tamarisk may need to be put into place and to avoid the potential of disturbing Southwestern willow flycatcher (Empidonax trailii) nests.	Blue Springs	$$$

List of Proposed Projects to Protect and Restore Wetlands (Continued)				
Priority Level*	**Potential Project Name**	**Project Details**	**Project Location**	**Estimated Cost Magnitude****
2	Wetland Flow Regime Monitoring	The low flows in the Black River and throughout the whole watershed in recent years has shown us the need for improved monitoring of flow regimes. The Steering Committee identified the need for an additional USGS gage in the head waters of the Black River. Adding a live streaming camera to one or more existing USGS gages may also prove helpful in identifying river conditions during flood and low flow events. Additionally, the installation of multiple staff gauges in the Black River would allow better insight as to what the river's water levels look like at different rates of discharge.	Black River	$$$
3	Educational Exhibits	Thousands of people from Eddy county and the southeastern New Mexico community utilize the recreational opportunities within the BRW every year. This is an excellent opportunity to better our community by providing education about multiple aquatic species of concern that rely on local wetlands to survive. The creation and installation of one to two educational exhibits addressing the aquatic species of concern and wetlands would help to educate the public on these organisms and the wetlands that they call home. The more people know about how extraordinary and amazing the local aquatic community is in the BRW, the more likely they might be to practice better environmental stewardship when utilizing the river's resources.	Higby Hole, Cottonwood Day Use Area, Rattlesnake Springs, Blue Springs	$$
3	Blue Springs Fish Inventory	In 2018 CEHMM conducted a biological inventory for Blue Springs. Due to time constraints and logistics, fishes and aquatic invertebrates were not taken into account during the inventory. Historically, there are several threatened and endangered fish species found in Blue Springs, such as the Pecos gambusia and the greenthroat darter. CEHMM is currently funding the equipment use and time needed to complete a fish inventory in Blue Springs.	Blue Springs	$$

List of Proposed Projects to Protect and Restore Wetlands (Continued)				
Priority Level*	**Potential Project Name**	**Project Details**	**Project Location**	**Estimated Cost Magnitude****
3	Mapping Texas Hornshell Habitat	A project should be designed and implemented to identify key habitat characteristics of the Texas hornshell and to create digital maps showing suitable mussel habitat in the Black River. Doing so will help secure the existing population in the Black River and also will aid in the re-establishment of the species in the Delaware River.	Texas Hornshell Occupied Habitat in the Black River	$$$$
3	Installation of Data Loggers in the Black River	These are ongoing studies identifying the lethal and sub-lethal thermal and dissolved oxygen thresholds of Texas hornshell in the Black River. The studies involve continuously measuring stream flow, temperature, and dissolved oxygen concentrations in the Black River, along with laboratory studies of Texas hornshell to determine whether water temperatures are in exceedance of estimated lethal and sub-lethal limits in the Black River. There is room to expand on these studies and install additional water quality data loggers throughout the hornshell occupied reaches of the Black River.	Texas Hornshell Occupied Habitat in the Black River	$$
3	Texas Hornshell Propagation and Research Facility	A project to identify, build, and maintain a Texas hornshell propagation and research facility in close proximity to the Black River would lead to considerable advances in the protection and understanding of the endangered mussel.	N/A	$$$$$