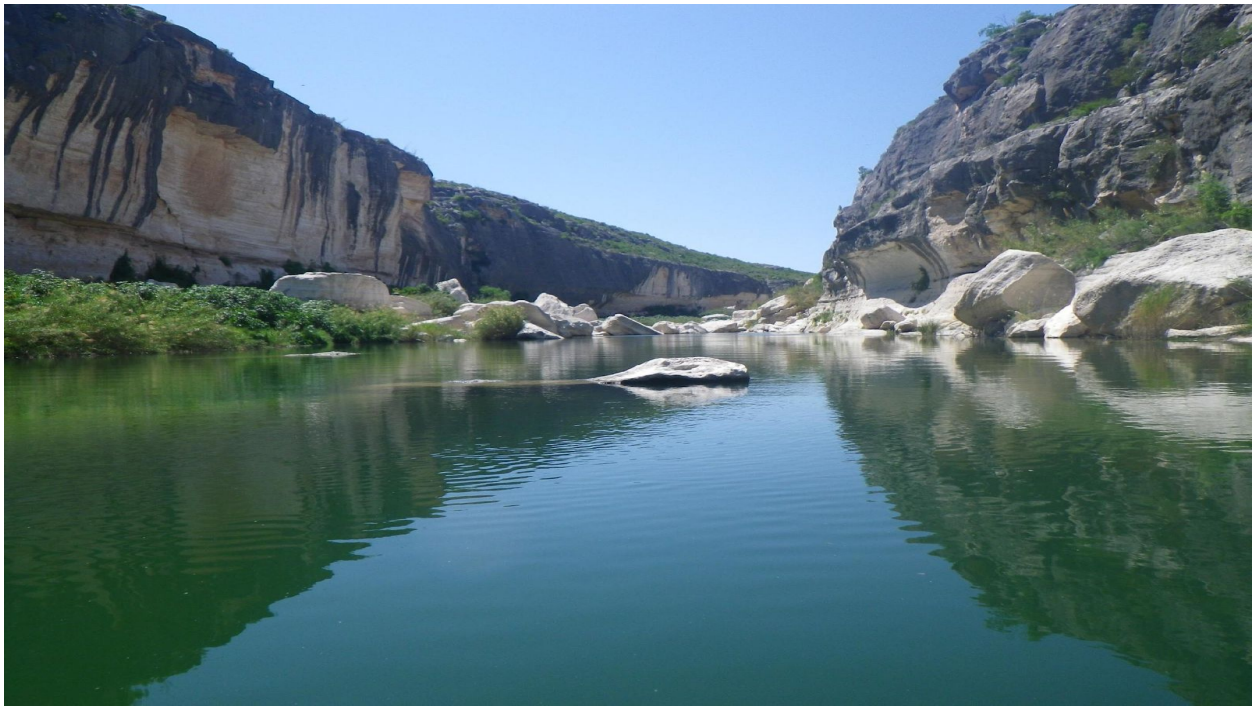
Pecos River Improvement Plan

(PRIP)



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Mission Statement

The PRIP, a plan designed for the Pecos River of New Mexico and Texas, United States, seeks to increase water flow, decrease salinity, and encourage habitat restoration by at least 30% by the end of 2050.

Background

The Pecos River is a tributary of the Rio Grande that runs for more than 900 miles through New Mexico and Texas, with a total drainage area of about 44,000 square miles (Handbook of Texas Online). Of the total 44,000 square miles, approximately 25,000 square miles are located in southeastern New Mexico and about 19,000 square miles are in western Texas (Interstate Stream Commission). The land area varies throughout the basin as the river runs through mountainous pastures, grasslands, semi-arid irrigated farmlands, deserts and canyons (Interstate Stream Commission). The river is a valuable resource for both New Mexico and Texas as a source of water for agriculture, irrigation, drinking water and recreation, but the river is not currently as useful as it once was due to the history of water management issues that have occurred.

History

The first known settlement along the Pecos River was by the Pecos Pueblo Indians at about A.D. 800. Francisco Vázquez de Coronado was the first European to cross the river in the year 1541. However, the river remained relatively undisturbed for a great deal of time, until the first known European settlers arrived in 1794. Small settlements began to arise along the river which, at the time, was said to be as much as one hundred feet wide and ten feet deep, with the water moving through a fast current. At this time the river had considerable water flow that enabled it to flow through New Mexico and Texas.

The river remained in this condition until development of the surrounding area began. An example of this was the irrigation systems that were built from 1877 through 1936. The irrigation systems were built to allow local settlers to divert water for agriculture and grow crops in an area where that was previously very challenging. During the time when the irrigation development was occurring, the very first Anglo settlers of the Pecos River had a very small settlement in 1845, followed by a larger settlement in 1881 that came about with the development of the Texas and Pacific Railway. The various settlements along the Pecos River in New Mexico and Texas created water management issues that would persist for many years, initially addressed in 1948 (Interstate Stream Commission).

The Pecos River Compact was an agreement made in 1948 between New Mexico and Texas that attempted to address the water management issues that were occurring. This agreement required New Mexico to ensure that the amount of water entering Texas through the river was equitable with the amount of water entering New Mexico naturally. However, there was the belief that not enough water remained in the Pecos River by the time it entered Texas and the state filed a

lawsuit in 1974. The Supreme Court eventually ruled on this in 1987 and required New Mexico to repay the lost water to Texas over the next decade.

Today, the river is protected by the 2003 Pecos Settlement Agreement, an agreement with New Mexico state and federal stakeholders that utilizes well fields, pipelines, and constant monitoring to ensure there is adequate water flow of the Pecos River into Texas. The river remains a valuable resource to both states for agricultural, recreational and economic reasons.

Policies and Mandates

Addressing Point Source Pollution

New Mexico has several policies and mandates in place to protect water quality and limit degradation from point source pollution. For example New Mexico Water Quality Control Commission regulations (20.6.4.8A, NMAC) include an "Anti-degradation policy" This policy regulates wastewater treatment plants, and industrial operations. They are regulated by permits under the Federal National Pollutant Discharge Elimination system. There are three types of permits within the Upper Pecos Watershed. This policy addresses point source pollution, however the majority of surface water impairments are caused by nonpoint source pollution.

In accordance with the Clean Water act, New Mexico is responsible to insure that all of its surface waters maintain standards to support the propagation of fish, shellfish, and wildlife, and recreation in and on the water. Only when waters exceed these standards can any level of degradation become allowable, and any level of degradation cannot impair beyond these standards. In these cases it is the responsibility of the property owner to implement Best management practices to minimizing the duration, magnitude, frequency and cumulative effects of such degradation. When a body of water is impared, a Total Maximum Daily Load is developed to calculate the changes that need to be made to reverse these impairments.

Addressing Nonpoint Source Pollution

The Pecos canyon is a frequently visited tourist location for camping, hiking, hunting, and fishing. Sediment is washed into the river from inappropriate vehicle tracts and lack of vegetation. The environmental concerns that list streams and surface waters within the Pecos as impared under the clean water act are likely from overuse and abuse of recreational areas. This impairment is a result of nonpoint source pollution. US and State legislators passed an approval for the Pecos Canyon State park in 2008 to address this problem. It came to the attention of legislators that a few small to medium scale projects were needed to make large changes in the amount of nonpoint source pollution from recreational uses. They agreed to create designated campgrounds to limit camping along stream banks and created a campground visitors center where recreators can obtain guidance on what is permissible where. This is but one example of a policy that has been implemented to combat nonpoint source pollution within the Pecos watershed. Nonpoint source pollution has been addressed through several other approaches including Grant funding for a total conservation impact of $5.03 million dollars in 2019. Technical assistance to landowners and ranchers to implement best management practices, and outreach activities are among other strategies used to mitigate nonpoint source pollution.

	Problem	**Description**	**Causes**
P1: Decreased Flow	The quantity of water coming from the Pecos river has seen a significant decline.	The quantity of water coming from the river is decreasing, some areas have less access and downstream some areas no longer have any water flow.	The decreased flow is due to a myriad of different things, including manmade infrastructure disruptions, droughts and increased demand for water.
P2: Salinity	High levels of dissolved minerals are present in the water.	Dissolved minerals, specifically sodium chloride and calcium sulfate, are commonly found in the water of this river.	The high salinity of the river can be attributed to a decline in the number of floods, runoff from reservoirs, and the naturally high-saline groundwater present in the area.
P3: Habitat Destruction	Decline of native plant species and associated wildlife	There are some species which are listed as federally endangered such as Rio Grande silvery minnow, Pecos gambusia, and most recently Texas hornshell and others are state-listed as endangered, like Pecos pupfish and Rio Grande sucker. Plant specie such as Pecos Sunflower (Helianthus paradoxus) which was listed as threatened on October 20, 1999	Habitat loss caused by damming and dewatering of the Pecos River, excessive pumping of groundwater, amount of fine sediments accumulated in the substrate, loss of flowing water, and impairment of water quality, Human activities such as sand and oil mining, grazing, agricultural activities etc.

Problem 1

P1: A number of factors have contributed to a major decline in the water flow coming from the Pecos River.

Data collected by USGS shows that the current flow is below the average threshold. For instance, in 2018, data showed that the gauge station on the Pecos River near the town of Pecos registered the river flowing at 21.5 cubic feet per second, which is approximately 16 times below the mean average of 339 cfs for that station on May 15. Even further downstream at the gauge station at Anton Chico, recorded there was no flow at all ("Pecos River Water Quality," 2014). Two factors have contributed to the limited water quantity in the Pecos River and its watershed; drought and human activities.

The decrease in stream flows is primarily attributable to drought ("Pecos River Water Quality," 2014), which is also the impact of a low snowpack from a dry winter. Watershed encompasses some of the driest portions of the state, and yearly evaporation usually exceeds annual precipitation by a large margin. The water flow in the Pecos River is also related to seasonal changes. Usually, the high flow events begin in the spring, which originates from snow runoff and varies with the previous winter's snowpack. Furthermore, the flow events are declining in the late summer to low flow in the mid-summer which usually take place in June, fall, and winter seasons, when the stream is dependent on spring sources ("The Upper Pecos River Watershed", n.d.).

Besides the natural phenomenon that primarily causes the decrease in the water flow, uncontrolled human activities also contribute to low flows of the river. Human influences include the construction of reservoirs, agricultural irrigation using surface water and groundwater, historic over-utilization of watershed resources, and the introduction of nonnative vegetation to the watershed.

Worldwide, for at least 4,000 years, irrigation has been used for farming; In the United States, it possibly began in West Texas or New Mexico. They started by growing crops in an arid climate by collecting and diverting run-off water for irrigation. In Texas, total irrigated farming areas in 1960 was about 294,00 acres, most of which was irrigated with groundwater. New Mexico's irrigated acreage was about 191,000 acres or about 2% of all irrigation in the state. Most of the agriculture used underground water

for irrigation (of the total, 125,000 acres used groundwater). In the late twentieth century, Texas was struggling with the problem of over pumping, which causes saltwater intrusion (Baker, 2019).

An example of nonnative vegetation that negatively influences the water quantity flowing in the river is Salt cedar (*Tamarix ramosissima*). This species is known to tap into shallow groundwater supplies maintained by recharge from the river. Salt cedar has directly accessed shallow groundwater tables and used significantly more water than native trees. It is believed that Salt cedar first introduced to North America was in 1823 by horticulturists, and it appeared on the west coast. By the 1920s, Salt cedar was becoming a serious problem, spreading quickly through the watersheds of the southwest (Texas Invasive, n.d.). The combination of these factors has had a profound impact on the water availability in the watershed today.

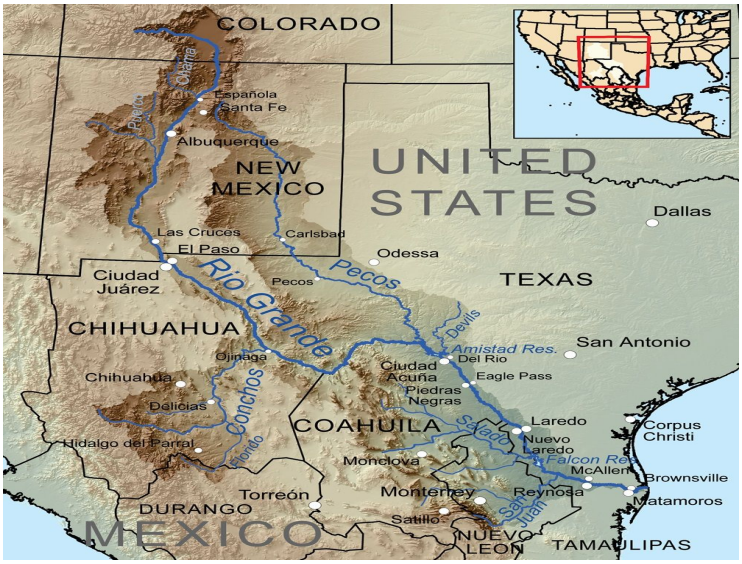
Goals:

Possible actions that could increase the streamflow in the Pecos River is by modifying the channel; switching into a ditch. Another step that we suggest is cleaning the river and wood clearing in the watersheds. Controlling the rapid growth of Salt cedar would increase the volume of water by spraying it with pesticides. Managing *Tamarix ramosissima* would also reduce the increase in salt levels.

Problem 2

P2: The high salinity currently present in the Pecos River means a decline in the quantity and quality of potable water, water for irrigation and water to support agriculture.

Salinity is perceived as the total concentration of dissolved minerals in the water (USGS, 2014). The Middle Pecos River between Malaga, New Mexico, and Girvin, Texas, is known for high salinity. Streamflow salinity during the last decade (1991-2000), for example, averaged 3,500 and 6,150 mg L-1 at Malaga and at the Red Bluff release, and upwards of 12,000 mg L-1 at Girvin (Miyamoto et al., 2008).



The Pecos River
(Source: TSHA https://tshaonline.org/handbook/online/articles/rnp02)

There are high levels of streamflow salinity that reduce the economic uses of the water and limit the biodiversity of aquatic and riparian species along the river (Miyamoto et al., 2008). Factors such as reservoir evaporation and reduced stream flows increase the concentration of salts in the Pecos River. "*The region is underlain by formations such as the San Andres, Salado, and Rustler which contain salt bearing rocks that dissolve as groundwater migrates through them and subsequently discharges to the river*" ("Pecos River Water Quality Coalition", 2014). Pecos River is a channel for huge quantities of salt that finally end up in the Amistad International Reservoir. The Pecos River accounts for nearly 30 percent of the salt loading into Amistad International Reservoir and provides approximately 10 percent of the flow, thus raising the background salinity of the reservoir (Miyamoto et al., 2008). The Pecos River entering Texas already carries an average annual salt load of 150,000 tons per year, which leads to an additional salt loading between Grandfalls and Girvin, Texas. Hence, the total average annual salt load increases to 187,000 tons per year that enters Amistad International Reservoir resulting in significant adverse economic impacts to the Rio Grande Valley (Miyamoto et al., 2008). Another potential source of salts entering the Pecos is derived from surface inflows from Salt Creek, Salt Draw, and possibly Toyah Creek.

Not only natural sources of salt throughout the watershed cause the Pecos to be salty, but also human actions have caused an impact on the pathways salt uses to enter the river. In "New Mexico Sources of salinity" (Table 1)the loading of Ca and SO4 from the northern watershed occurs due to the old or developing sinkholes and gypsum dissolution into agricultural drainage water in irrigated areas (Miyamoto et al., 2005).

Table 1: Average flow, annual mean salinity and salt load of the Pecos River from USGS data collected from 1959-2002 (Miyamoto et al., 2005)

Gauging Stations	***Annual Average Flow (Acre-Feet)***	***Annual Salinity (ppm)***	***Salt Load (1,000 ton/year)***	***Load Changes (1,000 ton/ year)***	***Girvin (% of the Salt Load As Measured*)***	***Langtry (% of the Salt Load As Measured*)***
New Mexico Sources						
Santa Rosa	70,532	675	42	+42	6	5
P. Luna	136,200	1527	221	+179	26	24
Sumner	131,336	1494	218	-3	Net loss in reach (irrigation)	Net loss in reach (irrigation)
Acme	111,878	1722	228	+10	2	1
Artesia	128,903	3171	489	+261	38	35
Malaga	68,857	4111	265	-224	Net loss in reach (irrigation)	Net loss in reach (irrigation)
P.C Crossing	65,668	7128	437	+172	25	23
Red Bluff	68,100	7028	456	+19	3	2
Texas Sources						
Girvin	23,511	12849	351	-105		Net loss in reach (irrigation)
Langtry	189,707	1995	426	+75		10

*****Percentage of the positive salt loading total above Red Bluff (683,000 tons/year) and that of the total above Langtry (758,000 tons/year)*

High salinity concentrations (i.e. salts of sodium chloride and calcium sulfate) in the Pecos River Basin affect water quality, water quantity, and ecosystems in the basin. More specifically, high salinity concentrations have caused "*environmental degradation, reduction of potable and reclaimed water supplies, damage to urban and rural distribution systems and appliances, increases in infrastructure costs, reductions in crop yields and profitability, deterioration in the quality of urban landscapes, loss of wildlife habitat, and soil and groundwater deterioration as there is reduction of usable surface water*" ("Pecos River Water Quality Coalition", 2014). Additionally, high salinity concentrations in the basin have resulted in low dissolved oxygen in the river which impairs aquatic biota resources. Also, the high-salt conditions are perfect for a

species of coastal algae toxic to freshwater fish. A very known kind of fish, the Pecos pupfish whose main habitat is located in particular areas of the river and its tributaries, has been affected by the algae blooms ("Ecological Shifts Spell Challenges for the Pecos River, 2013"). That puts in danger the diverse aquatic life of the Pecos River.

Goals

The interception of salinity in source areas before it impacts surface-water supplies is very important. Targeted strategies can be developed from the Federal Government and the states of Texas and New Mexico by combining resources in order to achieve this goal. The volume of flow in a river plays a significant role in the overall effects of salt loading into a stream. Therefore, the reduction of the streamflow salinity, could increase the freshwater inflow into the Pecos River. Also, the maintenance of a steady flow level in the river could probably decrease the entry of saline groundwater in the river. Lastly, the control of salt sources in the river among Coyanosa and Girvin is of critical importance ("A Watershed Protection Plan for the Pecos River in Texas", 2008).

Problem 3

P3: Several reasons are contributing to the decline of native plant species and its associated wildlife along the Pecos River watershed.

Human activities causing habitat loss along Pecos river watershed are oil and gas development, agriculture and urbanization, which are the most and significant threats to this landscape. Long harmed by habitat loss from energy development, the dunes sagebrush lizard is one of the most imperilled lizards in the United States (Skolos et al., 2019)

Dunes Sagebrush Lizard (*Sceloporus arenicolus*)
(Source: https://www.fws.gov/southwest/es/DSL.html)

The cause of Pecos pupfish declines within its habitat is because of dams construction. Moreover, factors such as the dewatering of the Pecos River and the inordinate pumping of groundwater contribute to the decline of this fish species("Fish and Wildlife Service, Interior", 2000).

Another endangered species in the Pecos River Watershed is the Horn shell mussels. Freshwater mussels require an enduring river flow, sufficient water quality, and appropriate substrates. The alteration of stream habitat from land uses including agriculture, water pollution, water diversion and groundwater pumping, contamination from oil and gas operations, and siltation - sedimentation are significant factors that put in danger the horn shells ("Fish and Wildlife Service", 2016).

Pecos River pupfish (*Cyproinodon Pecosensis*)
(Source: Fish and Wildlife Service, Interior, 2000)

Endangered Mussels
(Source: Fish and Wildlife Service, 2016)

The Pecos sunflower is a wild annual plant that grows on wet, alkaline soils at spring seeps, wet grassland and pond margins in New Mexico and Texas. In west-central and eastern New Mexico, and next to Trans-Pecos Texas there are existing seven well known populations of this plant. A number of factors such as unsuitable land uses, the destruction of the natural habitat, and groundwater pumping contribute to the contemporary threats concerning the survival of Pecos sunflower. Other factors that must be taken into account for the decrease of Pecos' sunflower density and growth are as follows ("U.S. Fish and Wildlife Service", 2005):

- water availability,
- competition with other plant species,
- grazing,
- other disturbances

Pecos Sunflower (*Helianthus paradoxus*)
(Source: U.S. Fish and Wildlife Service, 2005)

Goals

Wildlife and native species conservation and restoration will improve the riparian and in-channel habitat, extending the reach of connected good-quality habitat for the benefit of native aquatic and riparian plant and animal communities. Maintaining the natural habitat will prolong the existence of plant and animal species which are listed within the Endangered Species Act by the states of New Mexico and state of Texas. This will provide additional advantages to the state and all users within the Pecos River watershed

PRIP Summary of Goals

G1: Increasing the water flow of the Pecos River would give people better access to water for drinking, irrigation and agriculture.

G2: Controlling and reducing salt loads in the Pecos River

G3: Habitat protection and restoration will improve biodiversity along the Pecos River.

Conclusion and Recommendations

The overall goal of the Pecos River Improvement Plan (PRIP) in Texas is the health improvement of the river and watershed. The Pecos Basin of Texas is faced with several water resources challenges including water quality concerns and water supply shortages. By working with stakeholders and carrying out research and demonstration projects in association with agency partners and the private sector, the Pecos Basin Assessment Program is developing a watershed management plan that will provide a guide for how the limited waters of this region can be preserved, protected and used most effectively.

StreamStats Report

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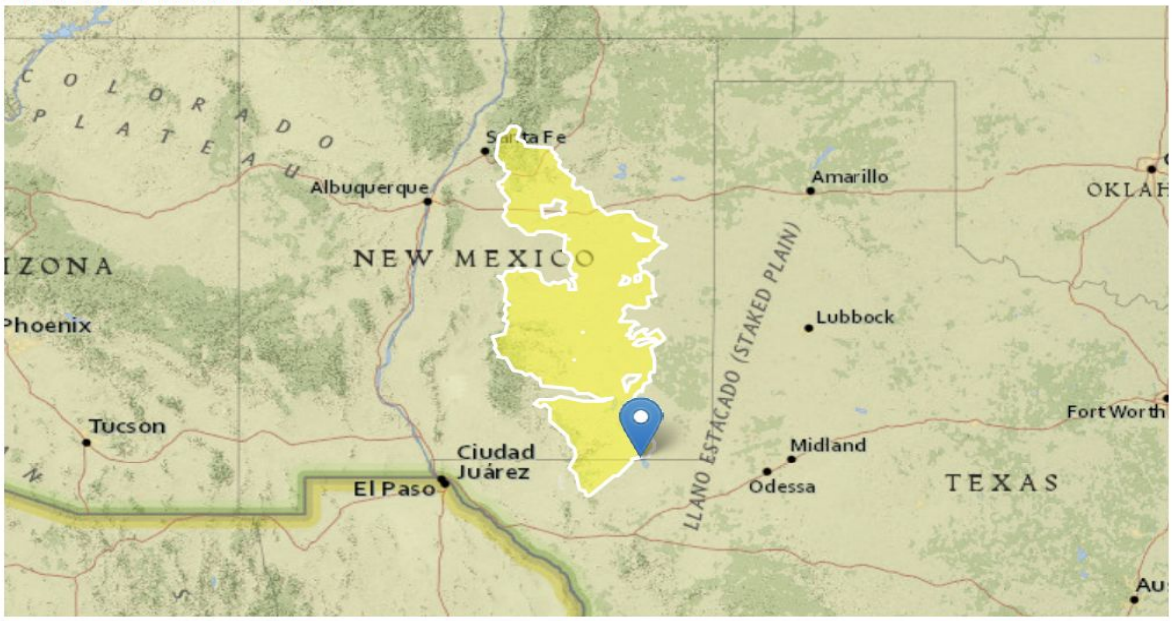

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