OVERVIEW OF THE PECOS RIVER BASIN

Peter Burck[1]
Brian Wahlin[2]

ABSTRACT

The Pecos River originates east of Santa Fe, New Mexico and flows across the eastern portion of the state and southwestern portion of Texas before it empties into the Rio Grande. Most of New Mexico's fresh water is stored in aquifers below the ground. There are three major aquifers within the Pecos River Basin: the Fort Sumner groundwater basin, the Roswell groundwater basin, and the Carlsbad groundwater basin. All three of these basins have a shallow alluvial aquifer that is highly connected to the Pecos River. In addition, the Roswell and Carlsbad basins have deep artesian carbonate aquifers. Surface water in the Pecos River Basin comes from three main sources: snow melt in the Sangre de Cristo Mountains, flood inflow from storm events, and groundwater base inflow.

The management of water resources in the Pecos River Basin is strongly driven by agriculture. There are several small-scale acequias in the northern part of the basin and three large irrigation districts in the central and southern portion of the basin: the Fort Sumner Irrigation District (FSID), the Pecos Valley Artesian Conservancy District (PVACD), and the Carlsbad Irrigation District (CID). All of these entities rely heavily on surface water and/or groundwater supplies from the Pecos River Basin. Four major reservoirs have been constructed along the main stem of the Pecos River to provide flood control for the area and to supply irrigation water for CID.

In addition to the various agricultural demands, the Pecos River Basin is subject to demands from two other sources. First, there is an environmental demand to provide enough water in the Pecos River for the Pecos bluntnose shiner, which is listed as a threatened species under the Endangered Species Act (ESA). Second, New Mexico must deliver a certain amount of water to Texas according to the Pecos River Compact and Amended Decree.

[1] Hydrologist, New Mexico Interstate Stream Commission, PO Box 25102, Santa Fe, NM 87504, 505-827-6162, peter.burck@state.nm.us
[2] Senior Hydraulic Engineer, WEST Consultants, Inc., 960 W. Elliot Road, Suite 201, Tempe AZ 85284, 480-345-2155, bwahlin@westconsultants.com

INTRODUCTION

The motivation for this paper is to provide background information about the Pecos River Basin in support of subsequent companion papers. The surface water supply in the Pecos River Basin, located in the eastern half of New Mexico, is renewed by rain, melting snow, and groundwater inflow. There are three major groundwater basins in the Pecos River Basin. A direct hydrologic link exists between the surface water sources and the groundwater sources in the Pecos River Basin. Groundwater can contribute to surface water, and surface water can contribute to groundwater. Also, depleting surface water can deplete groundwater supplies and vice versa. Because of annual variations in precipitation and snowfall, the surface water yield from the Pecos River Basin has historically been unreliable. In addition, there are many demands (e.g., agricultural, environmental) placed on the limited water supply in the Pecos River Basin.

BASIN INFORMATION

The Pecos River originates in the Sangre de Cristo Mountains in Mora County, New Mexico. It flows south across eastern New Mexico for approximately 300 miles through San Miguel, Guadalupe, De Baca, Chaves, and Eddy counties in New Mexico before it enters Texas (see Figure 1). In Texas, the river flows southeast for another 400 miles before it reaches Amistad Reservoir and its confluence with the Rio Grande. The total drainage area of the Pecos River in New Mexico and Texas is about 44,000 square miles. Most of its tributaries, which in New Mexico include the Gallinas River, the Rio Hondo, the Rio Felix, the Rio Penasco, the Black River, and the Delaware River, flow from the west. The topography of the river valley ranges from mountain pastures in the north, with an elevation of more than 13,000 feet above sea level, to grasslands, semiarid irrigated farmlands, desert with sparse vegetation, and, in the lowermost reaches of the river, deep canyons. The land surface elevation in the vicinity of the New Mexico-Texas border is about 2,800 feet above sea level.

Surface Water

The surface water in the Pecos River Basin is derived from three sources: snowmelt, flood inflow, and groundwater inflow, or base inflow (Longworth and Carron, 2003a). Runoff from snowmelt originates from snowfall in the Sangre de Cristo Mountains. Runoff from summer monsoonal storms also contributes significantly to the surface water supply of the Pecos River. These flood inflows can occur anywhere along the river and generally are the biggest source of surface water (Longworth and Carron, 2003a). Flood inflows are quite variable. Large storm events can quickly fill up the major reservoirs on the Pecos River. Extended periods of time may elapse with little to no flood inflow. There are three primary locations where groundwater inflow contributes significantly to the surface water supply: the Puerto de Luna area (Dinwiddie and Clebsch, 1973),

the Roswell-Artesia area, and the Carlsbad area. The base inflow in the Roswell-Artesia area comes from the Roswell groundwater basin. Inflows from this aquifer vary significantly. Base inflow in the Carlsbad area comes from the Carlsbad groundwater basin as well as seepage from Lake Avalon and return flows from irrigation (Longworth and Carron, 2003a).

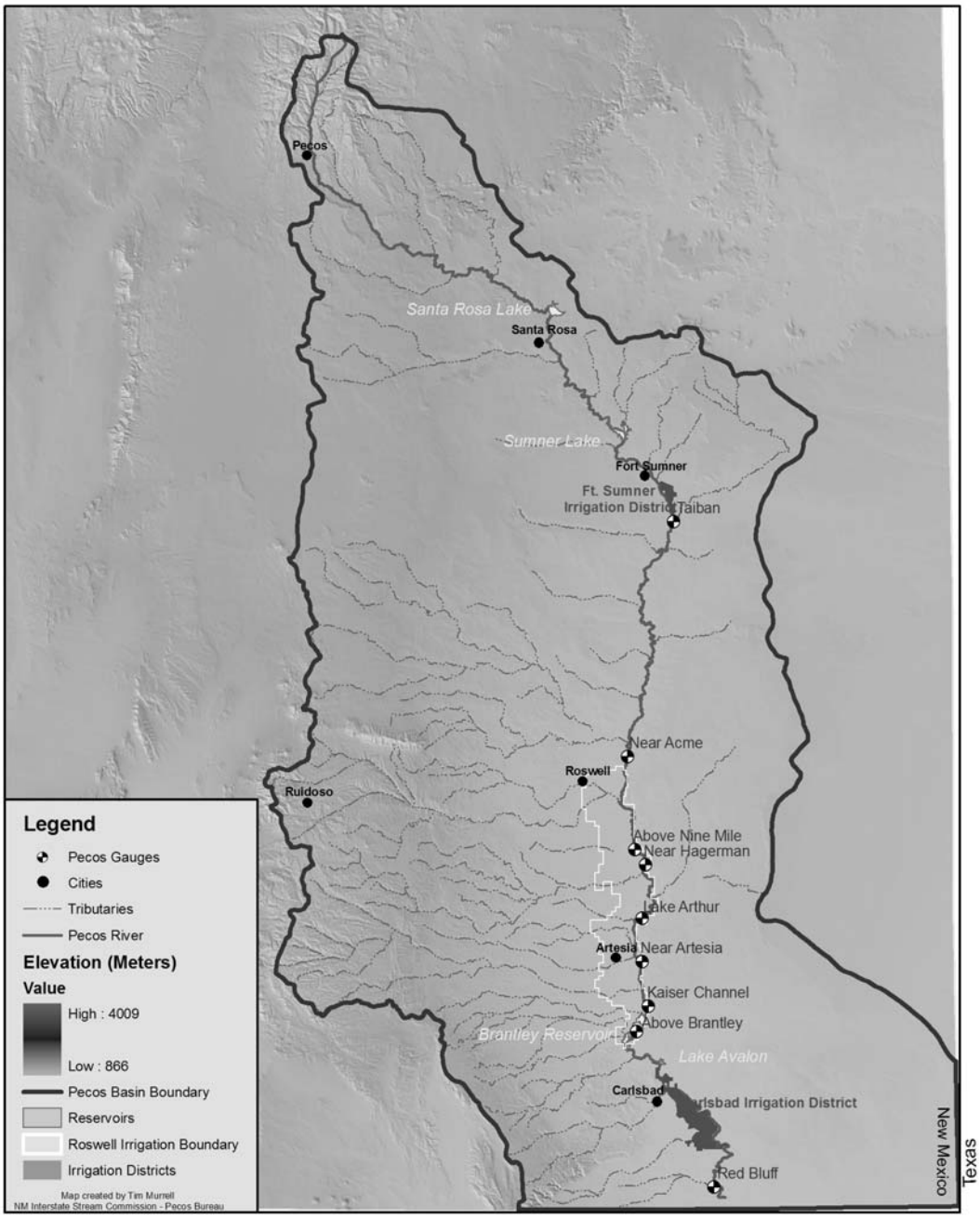

Figure 1. Map of Pecos River Basin

Groundwater

Three major water-bearing basins exist within the Pecos River Basin: Fort Sumner, Roswell Artesian, and Carlsbad. All three of these basins have a shallow alluvial aquifer that is highly connected to the Pecos River. The Roswell and Carlsbad basins also have deeper artesian aquifers.

The Fort Sumner basin is the smallest of the group. The shallow alluvial aquifer serves as the source of water for a number of irrigators in the area.

The Roswell Artesian groundwater basin is a productive artesian aquifer that is overlain by a thick confining unit and topped off by a shallow alluvial aquifer (Barroll and Shomaker, 2003). In the early part of the 20th century, the Roswell area was famous for its high-capacity artesian wells, which would deliver water to the surface without pumps and were thought to provide an endless source of water. The extensive use of the artesian wells has since de-pressurized the aquifer and, for the most part, water no longer flows to the surface freely (Barroll and Shomaker, 2003).

The cavernous limestone of the Capitan reef forms the Carlsbad groundwater basin, which delivers good quality water. The Capitan reef is a thick accumulation of limestone beds (Barroll and Shomaker, 2003).

MAJOR DAMS AND RESERVOIRS

Four major reservoirs store Pecos River water in New Mexico: Santa Rosa, Sumner, Brantley, and Avalon. All four reservoirs are used to store water for the Carlsbad Project, a US Bureau of Reclamation irrigation district. In general, the two upstream reservoirs (Santa Rosa and Sumner Reservoirs) are the preferred water storage locations because evaporation losses are typically lower than in the downstream reservoirs. The locations of these dams and reservoirs can be seen in Figure 1. Properties of the various reservoirs are shown in **Table 1**.

The Pecos River Compact limits the Carlsbad Project's total entitlement storage in all four reservoirs combined to 176,500 acre-feet. Total conservation storage is the sum of the entitlement storage, the minimum pool and the estimated sediment accumulation.

Santa Rosa Dam and Reservoir

Santa Rosa Dam (originally called Los Esteros Dam) impounds a drainage area of about 2,400 square miles. The dam was completed in 1980, and it is owned and operated by the US Army Corps of Engineers. The purpose of Santa Rosa Dam is to provide flood control, sediment retention, and storage of irrigation water for CID. Santa Rosa Dam and Reservoir offers 25 miles of shoreline with

recreational activities available such as boating, fishing, swimming, camping, hiking, and bird watching.

Table 1. Pecos River Basin Reservoir Properties

Reservoir & Year Completed	Storage Capacity (acre-feet)	2006 Entitlement Storage (acre-feet)	Minimum Pool (acre-feet)	Estimated Sediment Accumulation (acre-feet)	Total Conservation Storage (acre-feet)
Santa Rosa (1980)	439,900	92,398	0	3,853	96,251
Sumner (1937)	94,750	40,236	2,500	190	42,926
Brantley (1988)	1,008,000	40,000	2,000	788	42,788
Avalon (1907)	4,466	3,866	600	0	4,466
Total		**176,500**			

Sumner Dam and Reservoir

Sumner Dam (formerly known as Alamogordo Dam) is an earthfill dam that was completed in 1937. The dam is owned by the US Bureau of Reclamation and operated by CID. The total drainage area above Sumner Dam is about 3,900 square miles, with about 2,400 square miles located above Santa Rosa Dam and 1,500 square miles of drainage area located between the two dams. The purpose of Sumner Dam is to provide flood control and to store irrigation water for CID. Santa Rosa and Sumner Dams are operated jointly to provide optimal flood control in the Pecos River Basin. Sumner Dam and Reservoir offers 60 miles of shoreline and a variety of recreational activities.

Brantley Dam and Reservoir

Brantley Dam is a concrete gravity dam that was completed in 1988. Brantley Dam is owned by the US Bureau of Reclamation and operated by CID. The drainage area above Brantley Dam is about 18,000 square miles, which includes the drainage area above Santa Rosa Dam and Sumner Dam. This dam was built to replace McMillan Dam, which was declared unsafe. The US Bureau of Reclamation drained and breached McMillan Dam in 1991. The purpose of Brantley Dam is to provide flood control, to store irrigation water for CID, to enhance fish and wildlife, and to provide recreation. Brantley Dam and Reservoir offers recreational activities such as boating, fishing, swimming, hunting, camping, hiking, and bird watching.

Avalon Dam and Reservoir

Avalon Dam was initially completed in 1891. This dam was destroyed twice by floods and reconstructed. Construction was completed on Avalon Dam in its present form in 1907. Avalon Dam is a small dam that is operated primarily as a diversion structure for CID and provides only incidental benefits in the event of minor floods. Avalon Dam is owned by the US Bureau of Reclamation and operated by CID. Avalon Dam and Reservoir offers limited recreational activities.

IRRIGATION DISTRICTS

The Pecos River Basin is home to three irrigation districts: the Fort Sumner Irrigation District (FSID), the Pecos Valley Artesian Conservancy District (PVACD), and the Carlsbad Irrigation District (CID). Several small acequias are situated in the northern part of the basin. The locations of the various irrigation districts can be seen in Figure 1.

Fort Sumner Irrigation District

Fort Sumner was established in 1862 when the U.S. Government detained Apache and Navajo Indians there. As an experiment, 6,000 acres of land were farmed in the area. In spite of efforts to farm the land, hardships suffered by the Indians were so great that the irrigation experiment was abandoned in 1868. The Fort Sumner Land and Canal Company was formed in 1906 and development of an irrigation system began soon after. The system was sold to FSID in 1918 (Shomaker, 2003).

FSID, which now covers about 6,500 acres of land, holds a superior diversion water right (1903) for not more than 100 cfs from the natural flow of the Pecos River. Water is released from Sumner Dam to FSID in amounts equal to the reservoir inflow, but not exceeding 100 cfs. No water can be stored behind Santa Rosa Dam or Sumner Dam for FSID. FSID's diversion delivery is set every two weeks using a procedure developed by the New Mexico Office of the State Engineer (NMOSE).

Pecos Valley Artesian Conservancy District

The Pecos Valley Artesian Conservancy District (PVACD) was formed in 1932 in order to conserve water from the Roswell Artesian groundwater basin located between Roswell and Artesia. Initially, it was thought that the Roswell Artesian groundwater basin provided a limitless supply of water. However, by 1925 it became apparent the pressure in the artesian aquifer was declining. Since its formation, PVACD has plugged more than 1,500 wells, installed water meters, and undertaken other water conservation measures (Shomaker, 2003). PVACD

does not have rights to any of the surface water stored behind Santa Rosa Dam or Sumner Dam or flowing in the river itself. Instead, PVACD irrigators rely entirely on groundwater. Today, approximately 120,000 acres of land are irrigated within the district.

Carlsbad Irrigation District

The Spanish started irrigating the lower Pecos Valley around 1600. Irrigation in the early 19th century flourished under the Spanish land grant colonization system and was continued after 1850 by the American settlers. The early irrigation systems were community ditches, which diverted the normal flow of the river without the benefit of permanent diversion structures. In 1888, a large ranch was located near Carlsbad. The ranch manager initiated the first large-scale irrigation attempt. Since the natural characteristics of the area required a more comprehensive treatment than the enterprise could afford, it failed. For the next 17 years, various private interests attempted unsuccessfully to make this project financially profitable (USBR, 2006).

The US Bureau of Reclamation took over the project in 1906, made significant improvements to the system, and constructed Sumner Dam. In 1932, the Carlsbad Irrigation District (CID) was formed. The newly established CID had the authority to operate the US Bureau of Reclamation's dams, issue bonds for improvements to the system, and collect fees from landowners for use of the system. CID includes 25,055 acres of irrigable land. These lands extend for 20 miles along the Pecos River, three to five miles in width. The project's irrigation system serves more than 700 persons on 155 farms. CID has the senior storage water right (1888, 1915, and 1919) on the lower reach of the Pecos River in New Mexico. Water can be stored behind Santa Rosa Dam, Sumner Dam, Brantley Dam, and Avalon Dam for use by CID.

Acequias

Acequias, or community ditches, are recognized under New Mexico law as political subdivisions of the state. Many of New Mexico's acequia associations have been in existence since the Spanish colonization period of the 17th and 18th centuries. Historically, they have been a principal local government unit for the distribution and use of surface water. The associations have the power of eminent domain and are authorized to borrow money and enter into contracts for maintenance and improvements. Acequia associations do not have the power to tax, so the expenses of maintenance and improvements are the responsibility of the individuals served by the irrigation system (NMOSE, 2005).

ENDANGERED SPECIES

The Pecos River Basin contains a wide variety of wildlife. One of these animals, the Pecos bluntnose shiner (Figure 2), has been the center of much controversy. This small minnow has been classified as threatened by the US Fish and Wildlife Service (Service). Many of the operational procedures for the dams and reservoirs have been changed in an effort to improve the habitat for the Pecos bluntnose shiner. Specifically, efforts have been made to avoid drying of the Pecos River in the upper critical habitat north of Roswell and to avoid prolonged releases of irrigation water from Sumner Dam.

Figure 2. The Pecos bluntnose shiner

PECOS RIVER COMPACT AND AMENDED DECREE

In 1948, New Mexico and Texas entered into the Pecos River Compact, which dictated the amount of water that New Mexico was legally obligated to deliver to the Texas state line on the Pecos River. In 1988, as a result of a lawsuit filed by Texas, the US Supreme Court entered an Amended Decree, which appointed a federal River Master on the Pecos River and established an accounting system to verify water deliveries to the New Mexico-Texas state line (King and Sims, 2005). The terms of the Amended Decree allow New Mexico to deliver a surplus to Texas, but a net deficit delivery during a three-year accounting period is not permitted. The responsibility of meeting the state line delivery requirements fell to the New Mexico Interstate Stream Commission (NMISC), a companion agency to the NMOSE. New Mexico's failure to comply with the terms of the Compact and Amended Decree could result in federal intervention, whereby the state would lose its ability to manage its water on the Pecos River (King and Sims, 2005). Since this time, New Mexico has tried aggressively to meet the requirements of the Pecos River Compact and Amended Decree by examining and implementing a variety of short-term and long-term programs aimed at conserving water.

CONCLUSION

The Pecos River provides water for a variety of uses in southeastern New Mexico. Many demands are placed on the limited resource. Among these demands are interstate stream delivery obligations, irrigated agriculture, and threatened and endangered species.

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