McMillan Delta Project

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This small-scale water project had two objectives: salinity control and water salvage. At the Malaga Bend of the Pecos River, researchers found a unique situation where 420 tons of dissolved minerals—mostly salt—find their way daily into the Pecos River through seeps and springs.[1] In the McMillan Delta Project, the Bureau of Reclamation took unusual steps to control the salt buildup by constructing a levee and well drain to pump brine into a disposal basin. The project was also designed to target high water-consuming saltcedar trees that thrived on the silt-laden soils of the McMillan Delta just upstream of McMillan Dam. This phase of the project was never implemented, however, because it took Reclamation several decades to build the replacement reservoir needed to save water lost by efforts to clear the delta.

Project Location

The Pecos River originates in the Sangre de Cristo Mountains of north-central New Mexico and cuts through the semi-arid landscape of eastern New Mexico and western Texas. In all, the Pecos River basin extends some 525 miles to where it converges with the Rio Grande. The McMillan Delta is a broad, low-lying alluvial plain with a width of 1.5 to 3 miles situated between Artesia and Lake McMillan on the Pecos River. Flood-deposited sediments formed the delta at McMillan Reservoir's inlet. Further downstream, 17 miles southeast of Carlsbad, New Mexico, is the Malaga Bend of

[1] W.E. Hale, L.S. Hughes, and E.R. Cox, "Possible Improvement of Quality of Water of the Pecos River by Diversion of Brine at Malaga Bend, Eddy County, NM," Prepared by Pecos River Commission and USGS Water Resources Division, Dec. 1954, 1, in Record Group 115 (RG115), Records of the Bureau of Reclamation, Project Reports, Accession 8NN-115-85-019, Box 950, National Archives and Records Administration–Rocky Mountain Region, Denver, Colorado.

the Pecos River. Between the two landforms are several reservoirs: Kaiser Lake, Lake McMillan, Lake Avalon, and Queen Lake.[2]

Water in the project area is always in short supply. Average annual rainfall is only 11 inches—most of that coming during the monsoon season—but precipitation is erratic and departures from the average are very common. Saltcedar and saltgrass cover the riparian low land between Artesia and Major Johnson springs. The plants and shrubs grow mainly on the west side of the river; to the east the land is high and rocky.[3]

Historic Setting

For thousands of years the Pecos River has been a source of life for plants, animals, and humans. Yet for all its life-giving qualities in the dry deserts of the Southwest, the poor water quality of the Pecos River is almost legendary. Native Americans are said to have complained "about the effects of Pecos water on the human digestive system." As Lieutenant S. G. French of the U.S. Corps of Topographical Engineers described in 1849, "It is a narrow deep stream, its waters turbid and bitter, and … [it carries] more impurities than any other river of the south. The only inhabitants of its waters are catfish."[4] Indeed, high salinity levels have been responsible for numerous animal and human deaths over the years. For early settlers who wanted some certainty of drinking clean water, a good rule of thumb was to observe the spot where animals returned repeatedly to drink water. There they were sure to find a clean source.[5]

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[2] United States Department of the Interior, Water and Power Resources Service, *Project Data* (Denver, Colorado: United States Government Printing Office, 1981), 613.
[3] Cox, E.R., and J.S. Havens, *An Appraisal of Potential Water Salvage in the Lake McMillan Delta Area, Eddy County, New Mexico*, US Geological Survey Water-Supply Paper 2029-E, 1974, E2-E5.
[4] Jensen, R., C. Hart, M. Mecke, and W. Hatler, *The Influence of Human Activities on the Waters of the Pecos Basin of Texas*, TWRI technical report SR-2006-03, 2006, 8 (cited in Campbell, 1958).
[5] Stephen Bogener, *Ditches Across the Desert: Irrigation in the Lower Pecos Valley* (Lubbock: Texas Tech University Press, 2003), 15.

The Pecos River basin faces other problems besides salt, silt, and dirt. The river's water is over appropriated, which means that there is a perennial shortage for even existing water users, to say nothing of new development. Add the usual southwestern droughts and floods to this equation and you get a volatile situation. The 1888-1889 drought is best known for the number of cattle dead on the western range, but other dry spells over the past century have been nearly as severe. On the other hand, major floods, such as Hurricane Alice on the lower Pecos River in 1954, caused sedimentation build-up and property damage. The basin also faces an epidemic of phreatophytes—high water-consuming plants.[6]

Some of these water problems are particularly acute in the McMillan Delta area. The spread of non-native phreatophytes, particularly the saltcedar (*Tamarisk ramosissima*), is partly responsible for poor water quality, low flow volume, silt buildup, channel degradation, and disturbed wildlife.[7] Americans first welcomed the saltcedar plant from Europe in the early 1800s as an ornamental decoration and then, in the early twentieth century, as a means of stabilizing stream banks in the Southwest. When the plant spread, however, digging its roots deep in such river systems as the Gila, Salt, Pecos, Colorado, and Rio Grande, it became clear that its vices far outnumber its virtues. The proliferation of saltcedar in the McMillan Delta at first performed a "useful function" for the Carlsbad Irrigation District because they strained out the silt in the water. By and large only clear water passed through the delta. However, over time the saltcedar contributed to a lowered water table, poor water quality, and other changes to the

[6] Jensen, et al., *The Influence of Human Activities on the Waters of the Pecos Basin of Texas*, 4.
[7] Jeffrey Lovich, "A Brief Review of the Impacts of Tamarisk, or Saltcedar on Biodiversity in the New World," http://www.invasivespeciesinfo.gov/docs/news/workshopSep96/lovich.html (accessed Feb. 6, 2008).

hydrology and environment of the Pecos River basin. The plant's deep roots are well adapted to the dry, alkali-rich soils of the desert. They not only consume a lot of water but also dig deep into the soil and gather salt from below the surface and deposit it above ground. Saltcedar reaches heights of twelve to fifteen feet and settles in dense thickets, choking out native plants and trees along riparian corridors. In the Southwest, where they occupy some one million acres, they alter local ecosystems and economies in dramatic ways.[8]

In the delta area, saltcedar exacerbated the problems of a deteriorated dam and reservoir. First built in 1892-1893 with a storage capacity of 138,000 acre feet of water, McMillan Dam was a major first step for irrigation on the Pecos River. After floods damaged it in 1893, it was improved the following year and again in 1904—making it the largest dam in the world, a quarter-mile long and 100 yards thick at the base.[9] By the time the McMillan Delta Project was authorized, the dam and reservoir suffered from seepage, sedimentation, and inadequate flood-control capabilities. The proliferation of saltcedar only contributed to decreased water levels and increased sedimentation, thereby reducing the capacity of the reservoir

The other serious water problem downstream at the Malaga Bend was brine saturated with sodium chloride. As R. J. Tipton, a consultant to the Pecos Water Commission, explained in 1951:

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[8] R.J. Tipton, "One or the Other: A Resume of Pecos River Problems," speech given in Santa Fe on February 9, 1953, 3, in RG 115, Project Reports, Accession 8NN-115-85-019, Box 950; Jensen, et al., *The Influence of Human Activities on the Waters of the Pecos Basin of Texas*, 2; "PCA Fact Sheet: Saltcedar," http://www.nps.gov/plants/alien/fact/pdf/tama1.pdf (accessed January 28, 2008); "Invasive Species Summary Project, Saltcedar," http://www.columbia.edu/itc/cerc/danoff-burg/invasion_bio/inv_spp_summ/Tamarix_ramosissima.html (accessed January 28, 2008).

[9] G. Emlen Hall, *High and Dry: The Texas-New Mexico Struggle for the Pecos River* (Albuquerque: University of New Mexico Press, 2002), 29-30.

> Sink holes can be observed throughout the basin below the mountain area. The dissolution which is at present taking place can be observed at such locations as the Bottomless Lakes. Through the process of dissolution both the surface and ground-water supplies become contaminated with soluble salts. The use of water for irrigation has aggravated the problem. Super-imposed on top of this already bad water area about 109,000 tons per year of practically pure salt which is being brought to the river in a four-mile reach at Malaga Bend by leakage of concentrated brine which is under an artesian head.[10]

By the mid-twentieth century, the water passing through the delta was of extremely poor quality. In addition, the McMillan Delta faced groundwater and surface depletion due to both saltcedar infestation and seepage. Readings at the USGS gauging stations at Artesia and Kaiser Channel showed an average mean monthly loss of 2.6 cubic feet per second of water between 1955 and 1964.[11]

Investigations

Allowing the saltcedar and salinity problem to go unchecked would likely make it necessary to retire lands that had been irrigated since the late nineteenth century. The issue did not go unnoticed, however, as local, state, and federal agencies conducted several studies to determine the problem and what needed to be done about it.

The first detailed study was by Robinson and Lang who, in 1938, used the findings of the U.S. Potash Company to conclude that the brine originated in the basal part of the Rustler formation, percolated through a thin, confining bed into the alluvium, and seeped into the river near the Malaga Bend. In the years between 1939 and 1952, additional studies tested the brine, water quality, chemical levels, and seepage at Queen Lake.[12]

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[10] Tipton speech, RG 115, Project Reports, Accession 8NN-115-85-019, Box 950.
[11] Cox and Havens, E7.
[12] Hale, et al, 6-7, in RG 115, Project Reports, 8NN-115-85-019, Box 950.

The most significant report was "Possible Improvement of Quality of Water of the Pecos River by Diversion of Brine at Malaga Bend, Eddy County, New Mexico," produced through a cooperative agreement between the U.S. Geological Survey and the Pecos River Commission. It reported the findings of tests of existing brine wells and new shallow observation wells at Malaga Bend, as well as gauge and shallow wells at Queen Lake. It also measured the quantity and quality of the river flows. The report found that "if brine is prevented from entering the alluvium by diverting it through wells penetrating the basal brine aquifer, improvement in the quality of the river water moving past the Malaga Bend should occur within a few years. The efficiency of any pumping system in eliminating the flow of brine into the river may never reach 100 percent."[13]

In 1950 Reclamation proposed constructing a channel to bypass the Malaga Bend to eliminate brine seepage into the Pecos River. The channel would only be about one mile in length, but studies showed that to retain and evaporate the brine was prohibitively costly. Project engineers needed to find another avenue to allow the brine and water runoff to evaporate, while preventing the brine from overflowing into the river channel. Instead of a bypass channel, the Pecos River Commission proposed a drainage channel and a cleared floodway. The brine would be pumped and transported by pipeline to a natural drainage area near Queen Lake where it would evaporate. To insure keeping brine out of the river, the pumps would need to work fast enough to keep the brine below surface water levels.[14] The engineering advisory committee of the Pecos River Compact estimated that draining the brine would add enough water to irrigate 1,000 acres of land

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[13] Ibid., 3, 5, 7-8.
[14] Ibid., 2, 5; U.S. Department of the Interior, Bureau of Reclamation, *McMillan Delta Project, New Mexico: Preconstruction Plan of Study*, January 1983, I-2.

in Texas. While not a large amount, this was still significant for a river like the Pecos where water is in perennial short supply.[15]

Project Authorization

On February 20, 1958, Congress authorized the McMillan Project with Public Law 85-333 (72 Stat. 17) at an estimated cost of $2.75 million. The project authorization was essentially in two parts. The first was McMillan Delta, but this could not proceed until "provisions shall have been made to replace any Carlsbad irrigation district terminal storage which might be lost by the clearing of the floodway." Moreover, the law required New Mexico to secure rights-of-way and access to project sites, called for the Pecos River Commission or other agencies to operate and maintain the project after its completion, and allowed water districts fifty years to repay the costs of construction. The second part of the authorization was the reduction of salinity in the Malaga Bend of the Pecos River, mandating that similar requirements were in place before construction began.[16]

The Plan

The McMillan Delta Project would accomplish its two major purposes—water salvage and salinity control—in two phases. The first involved constructing a levee and 16-mile-long channel though the delta to increase water flows. Part two, salinity control, included a brine drain and pump downstream at the Malaga Bend Division to "lower the head of the brine aquifer and to reduce the flow of brine into the river from springs and

[15] According to Reclamation, the project was designed to recoup 24,500 acre feet of water, see *Project Data*, 613.

[16] U.S. Department of the Interior, Bureau of Reclamation, *Federal Reclamation and Related Laws Annotated*, Vol. II of three volumes through 1958, Richard K. Pelz, editor (Washington, D.C.: United States Government Printing Office, 1972), 1392-3; "Project History, McMillan Delta Project," Vol. 1, 1963, 14, in RG 115, Accession 8NN-115-88-053, Box 102.

seeps." The Red Bluff Water Power Control District of Texas would operate and maintain the features at its own expense.[17]

Reclamation tackled the salinity control problem first with a plan that proposed using a well and pump that would deliver brine through a pipe into a storage basin. The original plan, as reported to the secretary of the interior in April 1961, was to pump the brine at a rate of about 450 gallons per minute through a pipeline two miles in length to Queen Lake. At first it was believed that the Queen Lake depression, with a storage capacity of 5,500 acre feet—even more if a dam were built on the west end—was the ideal site to store the brine. The question was whether the site was impermeable. As the 1954 report noted, "If the depression were used for storage of brine, deposition of salt together with in wash of silt along the margins probably will make the depression tighter than it now is." However, Reclamation encountered problems in obtaining the rights-of-way to Queen Lake, and instead opted to use a smaller basin with only a 1,300 acre feet capacity. Reports noted that it would take three to seven years to fill the smaller basin, though it was possible to prolong its life by building dikes along the rim of the natural depression.[18]

By any measure, this was an unusual method of reducing salinity concentration. Since Reclamation openly stated that the project was experimental, unlike anything attempted before, it legally absolved itself from liability in case of failure. Still a project of this type needed close monitoring; Reclamation hoped that the federal government, the

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[17] "Project History, McMillan Delta Project," Vol. 1, 1963, 38-40, in RG 115, Accession 8NN-115-88-053, Box 102

[18] Hale, et al, in RG 115, Project Reports, Accession 8NN-115-85-019, Box 950, 2-4; "Project History, McMillan Delta Project," Vol. 1, 1963, 4, 38-40, in RG 115, Accession 8NN-115-88-053, Box 102; "Project History, McMillan Delta Project," Vol. 2, 1964, 1, in RG 115, Accession 8NN-115-92-130, Box 6.

conservancy district, the Pecos River Commission, and the state of New Mexico would take active roles in project evaluation.[19]

Construction History

Construction began on the salinity alleviation works when J. A. Vitor and Sons received the contract in September 1962. The contractor dug the hole for the pipeline and drilled the observation holes. In one week it laid 25 percent of the pipeline; it completed the rest by the end of the year. Workers enlarged an old U.S. Geological Survey test well near the edge of the Pecos River at Malaga Bend, installed a pump, and laid an eight-inch-diameter disposal pipeline to a natural depression 1.3 miles southeast of the brine well.[20]

At the brine settling basin, the contractor cleared 22 acres, compact lined 8.5 acres, and covered with mulch another 8.5 acres. Workers found water in the soil where they planned to lay the lining, making it necessary to plow down 18 inches in depth prior to irrigation and compaction. Instead of using a six-inch lining, the contractor decided to compact the soil by deep-plowing. The method chosen used a vibratory roller to compact the ground, determining through trial and error that 22 passes of the roller was just right "to obtain optimum density." As often happens during spring months, rainfall delayed operations and crews were unable to complete their work until the depression was completely dry. Later in the year crews installed an evaporation pan near the brine disposal area, a fence to keep out livestock, gages to mark brine levels, markers to measure salt levels, and dirt trails to access the ten observation wells.[21]

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[19] "Project History, McMillan Delta Project," Vol. 1, 1963, 5, 31, in RG 115, Accession 8NN-115-88-053, Box 102.
[20] Ibid., 15-17.
[21] Ibid., 21, 22, 23, 24, 42.

The contractor completed the work on June 24, 1963, at a total cost of $276,000, minus land acquisition and operation and maintenance costs. Unlike the water salvage works at McMillan Delta, the salinity alleviation project was non-reimbursable, except for the rights-of-way which the Red Bluff Water Power Control District reimbursed.[22]

The water salvage project in the McMillan Delta stalled indefinitely. The details are unclear, but reportedly Reclamation had rerouted the river channel almost five miles in 1948-49, and after that the Carlsbad Irrigation District built a crude channel from a bridge near Artesia to Lake McMillan, again for the purpose of minimizing water losses on the delta. Now, however, the water salvage had to wait until Reclamation satisfied the provision in the authorization.

Around the same time, Reclamation began to take up large-scale efforts to eradicate saltcedar in the Rio Grande and Pecos River basins. In September 1964 Congress approved the Pecos River Basin Water Salvage Project, which cleared 53,950 saltcedar-infested acres using a combination of herbicides and mechanical equipment such as bulldozers, mowers, and tree crushers. When this project was authorized, it also contained the provision that the McMillan Delta area could not be cleared before an additional storage reservoir had been built.[23]

Post Construction History

From July 1963 to October 1976 the Red Bluff Water Power Control District of Texas, managed by John Hayes, operated and maintained the brine drain and salinity

[22] "Project History, McMillan Delta Project," Vol. 2, 1964, 2, in RG 115, Accession 8NN-115-92-130, Box 6.

[23] U.S. Department of the Interior, Bureau of Reclamation, *Federal Reclamation and Related Laws Annotated*, Volume III of Three Volumes, 1959-1966, Richard K. Pelz, editor (Washington, D.C.: United States Government Printing Office, 1972), 1800-01; U.S. Department of the Interior, Bureau of Reclamation, *Final Environmental Statement, Pecos River Basin Water Salvage Project, New Mexico-Texas*, Southwest Regional Office, Amarillo, Texas, 1979, A-1.

reduction works. To defray some of the costs of maintenance, the district sold some of the brine to "well-servicing companies." While the U.S. Geological Survey and the Pecos River Commission shared the responsibility of evaluating the salinity alleviation works, Reclamation's only role was to examine the project and issue a short report outlining maintenance recommendations as specified in the Review of Maintenance program.[24]

With the salinity alleviation project completed, pumping began almost immediately. The pumps at Malaga Bend pumped about 560 gallons per minute for four months starting in 1963. Then samples were collected that showed some measure of success. Chloride levels in the river had decreased from 200 tons per day to about 100 tons per day in some places. For the next three years, pumping continued at a rate of 405 to 470 gallons per minute.[25]

The background of the project always carried the possibility that something would go wrong—like the storage area leaking and contaminating land and water. Although nothing of great magnitude occurred, the project experienced some minor issues. A small amount of brine reportedly did leak from the depression basin, but this was not a serious issue. In 1964 a pump at USGS Well No. 8 failed and required pumping with a 50-horsepower electric motor, and repairs made on a well meter that had stopped reading. Another setback came on August 22-23, 1966, when floods "inundated the pump installation to the eaves of the pumphouse and interrupted the pumping of brine." The

[24] "Project History, McMillan Delta Project," Vol. 3, 1965-67, 2, 3, in RG 115, Accession 8NN-115-92-130, Box 47.
[25] "Project History, McMillan Delta Project," Vol. 1, 1963, 4, in RG 115, Accession 8NN-115-88-053, Box 102; "Project History, McMillan Delta Project," Vol. 3, 1965-67, 2, in RG 115, Accession 8NN-115-92-130, Box 47.

floods forced the project to shut down but luckily produced little, if any damage to project equipment.[26]

The district stopped operating the salinity alleviation works at Malaga Bend in 1976 and abandoned them altogether by 1981. Before then, a few minor repairs or replacements had to be made to the evaporation pan at the weather station, a pump meter, a pump shaft, and other pieces of equipment. In addition, the district needed to remove salt buildup from the brine evaporation pan. Over time, this operation incurred further problems as trucks hauling brine from the site caused damage to the discharge pipeline, fences, gates, and vents. The same month the district stopped pumping, it inspected the evaporation site for adverse impacts on wildlife. It found the carcasses of three coots, a duck, a gar, a toad, and a turtle shell, but whether cause of death was due to the concentration of brine is unknown since no further tests were done.[27]

For phase two, the site selected for the new dam and reservoir was about four miles downstream of McMillan Dam and about 14 miles upstream of Carlsbad. Public Law 92-514 (Reclamation Project Authorization Act of 1972) authorized construction of Brantley Dam and Reservoir for the purpose of flood protection and storage, fish and wildlife "enhancement," and water storage to replace losses in the delta area due to sedimentation. Although the final EIS on the dam had been completed in 1972, the final design and construction did not move forward until 1984.[28]

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[26] "Project History, McMillan Delta Project," Vol. 2, 1964, 3, 17, 21, 25, in RG 115, Accession 8NN-115-92-130, Box 6; "Project History, McMillan Delta Project," Vol. 3, 1965-67, 2, 3, in RG 115, Accession 8NN-115-92-130, Box 47.
[27] "Project History, McMillan Delta Project," Vol. 4, 1968-80, 2-7, in RG 115, Accession 8NN-115-93-213, Box 98.
[28] *Final Environmental Statement*, A-20, A-21; U.S. Department of the Interior, Bureau of Reclamation, *Seed Report on McMillan Dam, McMillan Delta Project, New Mexico*, Denver, Colorado, 1985.

In 1974 a USGS report on water salvage potential in the delta area concluded that saltcedar control would certainly save water but noted that, as the water table rose, there would be greater evaporation and thus heavy water losses. It concluded that clearing saltcedar for a floodway would likely mean more sediment buildup when floods hit the Lake McMillan area.[29] Indeed, since the original authorization in 1958, much had changed on the river and the delta area to necessitate a reevaluation of original project features. Reclamation believed saltcedar control would be beneficial to wildlife and mosquito control as well, but needed more studies to ascertain environmental impacts. The final EIS (1979) on the Pecos River Basin Water Salvage Project was a major step forward in this direction; it recommended abandoning the plan to clear an additional 24,000 acres of land in the basin—10,000 of that in the McMillan Delta area—until more information was known.[30] In the 1980s, Reclamation led a planning team to determine what needed to be done at McMillan Delta. The team proposed a plan with a projected cost of $766,000 over four years.[31]

In 1988, just as Brantley Dam was nearing completion, a report estimated that a channel to Brantley Reservoir would yield about 11,000 acre feet of water per year. A new lined channel or ground water drains would lower the water table by eliminating infiltration due to flooding and seepage. McMillan Dam was finally breeched in 1991.

Conclusion

The McMillan Delta Project was not a typical water project, but it did play a significant yet modest role in a larger effort to improve the quality and quantity of the flows in the Pecos River. The brine pump and basin performed their function until they

[29] Cox and Havens, E23-E24.
[30] *Final Environmental Statement*, CC-121.
[31] *Preconstruction Plan of Study*, I-3 - I-5

were discontinued in 1976. Reportedly, according to current personnel in the Carlsbad, New Mexico office, there were never any water salvage operations on the delta after the construction of Bentley Dam and Reservoir.[32] Nevertheless, Reclamation expended considerable resources to help find solutions to one of the Pecos River's most formidable challenges—to produce a clean and healthy river system.

About the Author

Jedediah S. Rogers had degrees in history from Brigham Young University and is currently pursuing a Ph.D. in history at Arizona State University.

[32] Wes Able, email message to author, Feb. 19, 2008.

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