Pecos River Water Salvage Project

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Pecos River Basin Water Salvage Project

Although the Bureau of Reclamation is not usually connected to the business of vegetative eradication, the Pecos River Basin Water Salvage Project in New Mexico and Texas did just that—a large-scale attempt to control phreatophytes (high water-consuming plants) in the Pecos River basin. The consumption of water by phreatophytes, especially the invasive, nonnative saltcedar, is a continuing problem in the arid and semiarid regions of the western United States. When the clearing operations began in 1967, there were over 200,000 acres of saltcedar in the project area consuming an estimated five or six acre feet of water per year per acre.[1] In the Pecos River basin, where water is in short supply, the impact of this invasive growth was particularly acute, necessitating the need for a government-funded salvage project to rid the area of saltcedar and other phreatophytes.

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 its mouth on the Rio Grande. The area features short winters and long, hot summers. Annual rainfall averages close to thirteen inches—most of that during the monsoon season—but precipitation is often erratic and departs commonly from the average.

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[1] R. J. Tipton, "One or the Other: A Resume of Pecos River Problems," speech given in Santa Fe on February 9, 1953, 6, in RG 115, Records of the Bureau of Reclamation, Project Reports, ACC # 8NN-115-85-019, Box 950, National Archives and Records Administration–Rocky Mountain Region, Denver, Colorado; hereafter cited as RG 115.

The project area encompasses nearly the entire length of the basin. Reclamation planned to clear phreatophytes in sections along the flood plain of the Pecos River all the way from Santa Rosa, New Mexico, to Girvin, Texas. The project is roughly bounded by U.S. Highway 66 to the north and U.S. Highway 67 to the south. Along that stretch of the Pecos River are four major earth dams in four New Mexico counties (Guadalupe, DeBaca, Chaves, and Eddy) and three Texas counties (Loving, Reeves, and Ward).[2]

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 it 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." Indeed, the river's high salinity levels are responsible for numerous animal and human deaths over the years. For early settlers who wanted to be sure to drink clean water, a good rule of thumb was to observe where animals returned over and over again to drink water. There they were sure to find a clean source.[3]

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. Add the usual southwestern phenomena of droughts and floods to

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[2] 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, B-1.
[3] Quoted in R. Jensen, 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; Stephen Bogener, *Ditches Across the Desert: Irrigation in the Lower Pecos Valley* (Lubbock: Texas Tech University Press, 2003), 15.

this equation, and a volatile situation arises. The 1888-1889 drought is best know for the number of cattle deaths on the range, but other dry spells over the last century have been almost as severe. Major floods, like Hurricane Alice on the lower Pecos River in 1954, contributed to sedimentation and caused property damage.[4]

Each problem is connected in some way to the infestation of the saltcedar (*Tamarisk ramosissima*) in the Pecos River basin. The spread of non-native phreatophytes, particularly the saltcedar, is partly responsible for poor water quality, low flow volume, silt buildup, channel morphology, and disturbed wildlife.[5] Americans welcomed the 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 outnumbered its virtues. As R. J. Tipton, a consultant to the Pecos Water Commission, explained in 1951, the proliferation of saltcedar in the McMillan Delta in southeastern New Mexico initially had positive impacts that were in the long run outweighed by negative impacts:

> These cedars spread rapidly and performed a useful function for the Carlsbad Irrigation District. They effectively provided a strainer for the silty water coming down the river, thereby causing the silt to deposit in the delta area and to extend farther upstream, permitting only the fairly clear water to enter the reservoir… However, in performing this useful function for man, the salt cedars took their toll in terms of consumption of large quantities of water.[6]

The saltcedar consumes large quantities of water because its deep roots are well adaptable to the dry, desert environment and to saline soil. It contributes to salinity in the

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[4] Jensen, et al., *The Influence of Human Activities on the Waters of the Pecos Basin of Texas,* 4.
[5] 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 February 6, 2008).
[6] Tipton speech, 3, in RG 115, Project Reports, ACC # 8NN-115-85-019, Box 950.

soil and water from the salt it gathers from below the surface and deposits above ground. Saltcedars can reach heights of 12 to 15 feet and settle in dense thickets, choking out native plants and trees along riparian corridors. In the Southwest, where they occupy some one million acres of real estate, they alter, in dramatic ways, local ecosystems and economies.[7]

Investigations

Of all the vices of the saltcedar, the most alarming was its heavy use of precious desert water. Early on, it was by no means clear just how much water these plants consumed—perhaps one acre of saltcedar used five or six acre feet per year. No estimate was absolute, since consumptive use of water depends on any number of environmental factors. Whatever amount of water they consumed, however, was significant enough to convince water officials and users that something needed to be done about them. Their numbers in the Pecos River basin had become alarming: from the first reported sightings in the McMillan Delta area in 1912-1914 they had spread to riparian areas up and down the river and its tributaries. In 1939 there were 15,320 acres of saltcedar on the New Mexico side of the river; by 1957 there were 42,500 acres.[8]

Faced with heated interstate water disputes and a lessened stream flow as a result of shallow ground water pumping, erosion, sediment buildup, and non-native phreatophytes, the engineering advisory committee of the Pecos River Compact Commission conducted a study and, in 1948, concluded something must be done about

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[7] 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 Jan. 28, 2008); "Invasive Species Summary Project, Saltcedar," http://www.columbia.edu/itc/cerc/danoff-burg/invasion_bio/inv_spp_summ/Tamarix_ramosissima.html (accessed Jan. 28, 2008).

[8] Tipton speech, 6, in RG 115, Project Reports, ACC # 8NN-115-85-019, Box 950; "Project History, Pecos River Basin Water Salvage Project," Vol. 1, 1967, 1, in RG 115, Records of the Bureau of Reclamation,

sedimentation and the saltcedar infestation. The commission reported that the "deterioration" of McMillan Reservoir contributed mightily to poor water quality; silt from eroded river banks flowed downstream and accumulated at the head of the reservoir. The infestation of saltcedar along the Pecos River—especially in the McMillan Delta area—was a serious problem for water quality and quantity. In fact, the two problems were interlinked: silt that had deposited at the head of the reservoir provided a fertile seedbed for saltcedar to grow.

The committee rejected the idea of constructing a new reservoir to alleviate shortages in Texas or provide new irrigation in New Mexico and also declined a proposal by the Bureau of Reclamation to rehabilitate the Fort Sumner Project on the upper Pecos River. Rather, it supported the idea of a bypass channel around the delta or the elimination of saltcedar from the area. Taking either of these steps and abandoning the McMillan Reservoir would, the committee predicted, "increase the dependable water supply for the basin by an average of 39,000 acre-feet per year."[9]

The Pecos River Compact Commission tried to determine the extent of the spread of the saltcedar by using aerial photographs taken in 1950. Analyzing photographs that ranged from the Texas-New Mexico state line to Dexter crossing, the commission distinguished between heavy stands (which prevented growth of other ground cover) and

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Project Histories, ACC # 8NN-115-92-130, Box 50, National Archives and Records Administration–Rocky Mountain Region, Denver, Colorado; hereafter cited as RG 115; *Final Environmental Statement*, B-28.

[9] "Pecos River Compact," August 19, 1949, xxv, xxxi, xxxiii, in RG 115, Records of the Bureau of Reclamation, Project Reports, 1910-1995, Box 491, National Archives and Records Administration–Rocky Mountain Region, Denver, Colorado; hereafter cited as RG 115.

light brush. Field survey teams measured heights of saltcedar and the depth of their roots (about thirteen feet).[10]

As local entities chipped away at the problem of water losses, federal agencies provided aid and conducted studies of their own. Reclamation and at least seven other federal agencies played a role in the Pecos River Compact, and Reclamation and the Corps of Engineers originally had proposed constructing a bypass channel at the head of McMillan Reservoir and a new reservoir. Reclamation also conducted several preliminary tests and observations on aerial herbicide spraying, tree density (by cutting "breeches" through one-half mile intervals of saltcedar-infested land), and soil characteristics. In a major report entitled "Reconnaissance Report on the Pecos River Basin," it proposed clearing saltcedar, maintaining cleared areas to prevent regrowth, and building surface drains to eliminate stagnant, marshy areas. This effort, Reclamation claimed, would save an estimated 100,000 acre foot of water per year. In the same report, Reclamation explored the possibility of a pump storage power project near Girvin, Texas, and the Brantley Reservoir near Carlsbad, New Mexico, but recommended no action be taken.[11]

The U.S. Geological Survey, in cooperation with the New Mexico State Engineers Office, produced a significant report on water salvage between Acme and Artesia on the Pecos River. It made a strong argument to eradicate or at least control saltcedar growth before it spread further. It suggested using herbicides (2, 4-D and 2, 4, 5-T), mechanical

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[10] Progress Report No. 3 "Study of Aerial Photographs for Pecos River Compact Commission," August 9, 1951 through October 15, 1951, in RG 115, Project Reports, ACC # 8NN-115-85-019, Box 950.
[11] "Pecos River Compact," August 19, 1949, xxvi, 1, in RG 115, Project Reports, 1910-1995, Box 491; Tipton speech, 7, in RG 115, Project Reports, ACC # 8NN-115-85-019, Box 950; "Reconnaissance Report on Pecos River Basin, New Mexico-Texas," June 1960, Region 5, Amarillo, Texas, Bureau of Reclamation, 151, 152, 170, 171, in RG 115, Project Reports, 1910-1995, Box 491.

clearing, and lowering of non-artesian water levels as possible solutions. Lowering non-artesian water levels was problematic, however, because a lowered water table would impact surface river flows.[12] Today scientists recognize biocontrol (the use of insects) as a means of fighting saltcedar, but no one ever considered it as a strategy in the years leading up to the authorization of the Pecos River Basin Water Salvage Project.

All of these studies pointed to a federal water salvage plan, for which there had been some recent precedent. Just west of the Pecos River, along the Rio Grande stretching from Velarde to Truth or Consequences, New Mexico, Reclamation cleared saltcedar, cottonwood, willow, mesquite, and tornillo on an estimated 12,639 acres between 1958 and 1966. Another 4,900 acres were cleared in the early 1970s in the Elephant Butte Reservoir Area.[13] There were good reasons why the federal government undertook salvage operations in the Pecos River basin, just as it had in the Rio Grande basin. The Pecos River was perennially over allocated, and water shortages in New Mexico and Texas hit hard. To make things more difficult, a long-standing water conflict between the two states persisted. The Pecos River Compact in 1948 was intended to ensure that both states received their fair share of water from the Pecos each year, but that did not end the struggle over the river's water. In addition to sending Texas its required allotment, New Mexico needed all the water it could get for its own agricultural,

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[12] R. W. Mower, et al., *An Appraisal of Potential Ground-Water Salvage along the Pecos River between Acme and Artesia, New Mexico*. U.S. Geological Survey Water-Supply Paper 1659 (Washington, D.C.: United States Government Printing Office, 1964), 82-85; see also E. R. Cox and J. S. Havens, *An Appraisal of Potential Water Salvage in the Lake McMillan Delta Area, Eddy County, New Mexico*, Geological Survey Water-Supply Paper 2029-E (Washington, D.C.: United States Government Printing Office, 1974).
[13] *Final Environmental Statement*, A-22-A-23; Reclamation estimated that in the Rio Grande River Basin, water salvage efforts saved 50,000 acre-feet per year for a total savings of 700,000 acre feet; United States House of Representatives, Committee on Appropriations, *Hearings before the Subcommittee on Public Works Appropriations*, Part 2, 88th Cong., 2nd sess. (Washington, D.C.: United States Government Printing Office, 1964), 132.

industrial, and municipal needs.[14] These concerns justified the project in order to alleviate some of the basin's water shortages.

Authorization

Congress passed Public Law 88-594, dated September 12, 1964, authorizing the secretary of the interior, as he deemed necessary, to "carry out a continuing program to reduce the non-beneficial consumption of water in the basin, including that by salt cedar and other undesirable phreatophytes." However, the law also stated that no saltcedar would be cleared from the McMillan delta area until provisions were made to replace the terminal storage that might be lost through the clearing of saltcedar.[15]

The Plan

Pecos River water interests met and hammered out the basic procedure to be followed. At these meetings they established guidelines for clearing, right of way procurements, and the general plan of tackling the problem. In December 1965 Reclamation, in its Albuquerque planning office, began preparation of the definite plan report. Reclamation would operate the project on a non-reimbursable basis, since it was nearly impossible to estimate the distribution of project benefits. According to the plan, New Mexico and, until 1995, Texas were to grant right-of-ways on land not federally owned to carry on with the removal work. (Since New Mexico did not have the staff to secure the easements, it arranged to have Reclamation do much of the work.) Clearing was limited to about 78,000 acres on each side of the river where the depth to water table was no more than 10 feet. Since much of the adjacent land belonged to other federal

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

[15] 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.

agencies, Reclamation coordinated its work with the Bureau of Land Management and, in the case of the Bitter Root Lake Refuge, the Bureau of Sports Fisheries and Wildlife. The estimated operation and maintenance cost was $610,000 or $8.71 per acre, for a projected annual water savings of 87,100 acre feet for a 40,000 acre plot of land.[16]

Still, a few questions remained: how much land ought to be cleared for optimal water saving, should debris be eliminated from the cleared land, and should the land be cleared using mechanical or chemical means? Each of these questions would eventually be answered as a result of planning, budget constraints, or simply through trial and error.

Construction and Rehabilitation Program

Reclamation began clearing the saltcedar and other phreatophytes as soon as Congress provided the funds. For five years Reclamation awarded contracts to clear nine distinct sites stretching between Lake Sumner, New Mexico, and Pecos, Texas, a distance of about 370 miles, on about 53,950 acres. Contractors used various methods and equipment for the initial clearing operations: plowing, tree crushers, mowing, bulldozing, chaining, and chemicals. Results varied for each application. It turned out that burning was not very effective because it failed to kill the roots. The success of mechanical clearing varied depending on the equipment used. Mowing or shredding sometimes left roots untouched, while root plowing or bulldozing did not. Chemical application was also effective, though that too depended on the type of herbicide and the number of applications.[17]

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[16] "Definite Plan Report: Pecos River Basin Water Salvage Project, New Mexico-Texas," Volume 1, June 1966, 25, 26, 29, 33, in RG 115, Project Reports, ACC # 8NN-115-85-019, Box 491; "Project History, Pecos River Basin Water Salvage Project," Vol. 1, 1967, 1, in RG 115, Project Histories, Accession 8NN-115-92-130, Box 50.

[17] In 1968 Congress appropriated $700,000 to the project, in addition to the $50,000 for advanced planning that had previously been allocated, see United States House of Representatives, Committee on Appropriations, *Hearings before the Subcommittee on Public Works Appropriations*, Part 2, 89th Cong., 1st

The central office carrying out these operations was in the Federal Building in Carlsbad. In no time, however, Reclamation obtained other buildings to carry on clearing over a large area. In Carlsbad a metal building previously owned by the Atomic Energy Commission became a maintenance shop. In 1970 two other Operation & Maintenance field offices opened, one in Carlsbad and one in Cumberland City.[18]

Reclamation began awarding contract in in 1967; the first going to Joe Starr of Albuquerque who received two contracts to clear saltcedar at Bitter Lake between US Highway 70 and US Highway 380; also to clear the Dexter area which extended from US Highway 380 to NM State Highway 31. The contractor had on-site three crawler tractors, a tractor dozer, a roller chopper, a heavy duty mower, a tree crusher, a D8 cat, and a Holt root plow. Starr used the Holt root plow to clear and put the saltcedar into piles where it could be burned. In moderately dense areas the saltcedar was root plowed; light growth was simply chopped with a rotary mower. All in all, first year operations proceeded smoothly. Sometimes sand dunes or rocky terrain made it difficult to run the rotary mower, but by November 1967 work had become standardized.[19]

In 1968 four contracts to clear were in operation; aside from Starr's work on Dexter area, there was clearing in the Rio Hondo area, the Lake Arthur area, and the Carlsbad reach that continued into 1969. The Rio Hondo contract went to Adams and

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sess., (Washington, D.C.: United States Government Printing Office, 1965), 155-56; see also United States House of Representatives, Committee on Appropriations, *Hearings before the Subcommittee on Public Works Appropriations*, 90th Cong., 1st sess., (Washington, D.C.: United States Government Printing Office, 1965), 501; United States Department of the Interior, Water and Power Resources Service, *Project Data* (Denver: United States Government Printing Office, 1981), 776; "Project History, Pecos River Basin Water Salvage Project," Vol. 1, 1967, 18, in RG 115, Project Histories, ACC # 8NN-115-92-130, Box 50.

[18] "Project History, Pecos River Basin Water Salvage Project," Vol. 2, 1968, 1, in RG 115, Project Histories, ACC # 8NN-115-92-130, Box 67; "Project History, Pecos River Basin Water Salvage Project," Vol. 4, 1970, 1, 2, 4, 19, in RG 115, Project Histories, ACC # 8NN-115-92-130, Box 92.

[19] "Project History, Pecos River Basin Water Salvage Project," Vol. 1, 1967, 6, 26, 28, in RG 115, Project Histories, ACC # 8NN-115-92-130, Box 50.

Chumbley. In 1969 Ryan and Son received the contract to clear the area from McMillan Dam to the New Mexico-Texas state line. In 1970 contractors completed the area from the state line to Orla, Texas. For a time in 1970, due to a lack of funds, there were no new contracts awarded, but with the new fiscal year a contract was awarded to Armstrong and Armstrong of Roswell to clear the Mentone Area in Texas. By the end of 1972 only the area from Girvin, Texas to Interstate Highway 20 near Pecos, Texas, and Fort Sumner to the reach above Alamogordo Reservoir remained to be cleared.[20]

Like any project of this sort, work crews ran into problems. There were the usual delays and slow progress from the late arrival of equipment. For example, when the Bates Incorporated and Thad Sanford finally began clearing the area at Lake Arthur, after several months of waiting for shipments, over sixty-eight percent of the allotted time had elapsed. Additional equipment had to be obtained to make up for lost time. Then there were other mechanical mishaps that delayed progress further. Sometimes machinery got snagged in dense stands or stuck in a channel or depression. This happened to Bates Incorporated and Thad Sanford, requiring seven days of tedious work removing the tree crusher from the "old channel" it had fallen into.[21]

Heavy rains and other natural occurrences also caused unavoidable delays. In January 1968 slow progress was made as a result of "unusually" heavy rain and snowfall, making for a difficult time for mechanical vehicles. Heavy rains combined with the extra release of water from Alamogordo Reservoir contributed to the rise of the river and

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[20] "Project History, Pecos River Basin Water Salvage Project," Vol. 2, 1968, 3-4, 6, in RG 115, Project Histories, ACC # 8NN-115-92-130, Box 67; "Project History, Pecos River Basin Water Salvage Project," Vol. 4, 1970, iv, 14, 19, 21, in RG 115, Project Histories, ACC # 8NN-115-92-130, Box 92; "Project History, Pecos River Basin Water Salvage Project," Vol. 6, 1972, in RG 115, Project Histories, ACC # 8NN-115-92-130, Box 152.

[21] "Project History, Pecos River Basin Water Salvage Project," Vol. 2, 1968, 22, 25, 27, in RG 115, Project Histories, ACC # 8NN-115-92-130, Box 67.

flooding of much of the lowland, forcing Starr to stop operations in the lowland area until water drained. For the contractors working in the Rio Hondo area, wet surfaces made it difficult "to doze a part of the debris into the abandoned channel and cover it with earth obtained adjacent." A non-flood related incident occurred in 1974 when on August 11 a tornado caused $4,000 in damages to the new Cumberland maintenance shop. Repairs were made to the building the following year.[22]

Operation & Maintenance

After 1971, no new areas were cleared. Reclamation directed its resources to maintaining the acreage already cleared. The saltcedar grew back quickly in riparian areas along the bank of the Pecos River, where the risk of erosion was minimal and where the depth to groundwater was less than ten feet. At one point, Reclamation considered reseeding the land with native plants, but instead it used a combination of mechanical and chemical methods to control regrowth. The rolling brush cutters were quite effective in this effort. Herbicides were even more so, though they were also more expensive and potentially dangerous.[23]

In 1968, Helicopters sprayed 2,000 acres of regrowth near Roswell, New Mexico. Reclamation cleared with brush cutters two other areas totaling 2,500 acres. But the

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[22] "Project History, Pecos River Basin Water Salvage Project," Vol. 1, 1967, 13, in RG 115, Project Histories, ACC # 8NN-115-92-130, Box 50; "Project History, Pecos River Basin Water Salvage Project," Vol. 2, 1968, 13, 15, 17, in RG 115, Project Histories, ACC # 8NN-115-92-130, Box 67; "Project History, Pecos River Basin Water Salvage Project," Vol. 3, 1969, 48, in RG 115, Project Histories, ACC # 8NN-115-92-130, Box 79; "Project History, Pecos River Basin Water Salvage Project," Vol. 8, 1974, in RG 115, Project Histories, ACC # 8NN-115-92-130, Box 152.

[23] *Final Environmental Statement*, A-1; see also"Project History, Pecos River Basin Water Salvage Project," Vol. 1, 1967, 18, in RG 115, Project Histories, ACC # 8NN-115-92-130, Box 50.

resilience of the saltcedar was phenomenal: in some of the areas first treated, the plant grew as much as eighteen inches by the end of the growing season.[24]

The cost of O&M was originally projected at less than $10 per acre. In 1969, spraying 2,000 acres, chopping 11,750 acres, and mowing 1,715 acres totaled $148,564.38, or $9.14 per acre. In 1970 the cost was $7.88 per acre. But the various methods bore uneven costs. Of the 37,080 acres maintained in 1970, 26,961 were chopped at $6.55 per acre, 3,944 mowed at $9.13 per acre, and 6,175 sprayed with herbicide at $12.93 per acre.[25]

Ecology and Hydrology

The effectiveness and impact of salvage efforts prompted officials and scientists to take a long, hard look at the data. In 1971 Reclamation, in partnership with the U.S. Geological Survey, initiated a herbicide monitoring program to track water contamination. The monitoring revealed that contamination levels never peaked above "safe" levels set by the Environmental Protection Agency. In addition to this program, other ecologic and hydraulic studies examined changes in the landscape since clearing began and the impact of clearing on water supply in the basin.[26]

One significant study was headed by a joint-agency team to measure flows and compute water data to determine success of the salvage program. Researchers, however, came to no major conclusions after the program's first year in 1968 because first-year regrowth was quite heavy and groundwater pumping had just been altered. The water

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[24] "Project History, Pecos River Basin Water Salvage Project," Vol. 2, 1968, 7, in RG 115, Project Histories, ACC # 8NN-115-92-130, Box 67.
[25] "Project History, Pecos River Basin Water Salvage Project," Vol. 3, 1969, in RG 115, Project Histories, ACC # 8NN-115-92-130, Box 50; see also "Project History, Pecos River Basin Water Salvage Project," Vol. 4, 1970, 5, in RG 115, Project Histories, ACC # 8NN-115-92-130, Box 92.
[26] "Project History, Pecos River Basin Water Salvage Project," Vol. 6, 1972, 35, in RG 115, Project Histories, ACC # 8NN-115-92-130, Box 152; *Final Environmental Statement*, C-30.

table reportedly rose eight feet in places, though how much of this was due to salvaging is unknown. Nevertheless, managers remained optimistic that with each passing year, as vegetation control reduced dense regrowth, substantial water savings would result.[27]

In 1969 the Agricultural Research Service and Reclamation recommended doing ecological studies of "phreatophyte clearing, regrowth control, and replacement vegetation." Over a four-year period, these studies included annual site visits tracking changes in the landscape. Here is a sample of the findings: in one area originally cleared using dozers and burning, twelve saltcedars grew back within ten months to heights between one to six feet. In addition to saltcedar there were Russian thistle, bull nettle, yellow composite, and some salt brush. The next year, 1971, there were fifteen saltcedar, and some salt brush, pig weeds, careless weeds, alkali weeds, and sunflowers. The year following, after the area had been spade plowed and grubbed, there were two saltcedars and some weeds. In 1973, the area was again spade plowed with the results being one saltcedar, sacaton, and some scattered weeds. In contrast, in an area near Mentone, Texas, which had been cleared using a chain towed between two tractors, the number of areas, failed to make a difference. Likewise, clearing by using a rolling brush chopper was similarly ineffective in preventing the return of saltcedar.

Herbicide spraying achieved more satisfying results, though not entirely successful. For example, in a small area near Red Bluff Reservoir range scientists counted twenty-six saltcedar, three mesquite, and a few scattered weeds in 1969, but the next year after herbicide had been applied, there were fifteen live saltcedar, alkali weeds, three salt brush, and some wild millet. The year after that, in 1971, there were eight live

[27] "Project History, Pecos River Basin Water Salvage Project," Vol. 3, 1969, 7d, in RG 115, Project Histories, ACC # 8NN-115-92-130, Box 79; "Project History, Pecos River Basin Water Salvage Project,"

saltcedar, ten dead saltcedar, and scattered grasses and weeds. In 1972, after receiving a dose of the herbicide Silvex, only two saltcedar plants and a few scattered grasses and weeds survived. In 1973, after yet another application of Silvex, only scattered grasses and weeds and some signs of wildlife—a badger hole and some rabbit tracks—were evident.[28]

In 1972 the Central New Mexico Society, et al., filed a lawsuit against the federal government because no environmental statement (ES) had yet been prepared for the Pecos River Basin Water Salvage Project. U.S. District Judge E. L. Mechem ruled that Reclamation could continue to maintain cleared lands, but ordered that no new land cleared until the environmental impacts were assessed. Reclamation released the draft ES in 1977. Reclamation completed the final ES in 1979 after receiving input from the Bureau of Land Management, the Fish and Wildlife Service, New Mexico Department of Game and Fish, along with other government agencies and private organizations that weighed in at public hearings in Santa Rosa and Roswell, New Mexico, and Pecos, Texas. Among other things, the report assessed potential impacts of salvage efforts on esthetics, access roads, air quality, noise from machinery, disturbance of vegetation and wildlife, and soil erosion (and thus river turbidity).[29]

The Bureau of Land Management and others criticized the ES for lack of site-specific data collected by qualified scientists. For instance, of all the land cleared since 1967, BLM maintained that "few results from this clearing are presented to help quantify

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Vol. 4, 1970, 5-6, in RG 115, Project Histories, ACC # 8NN-115-92-130, Box 92.

[28] Reclamation, "Joint Ecology Observations and Studies," October 1969-1973, 1-A – 1-F, in RG 115, Project Reports, 1910-1995, Box 491. The precise location is NE1/4NE1/4 Sec. 21, T-1 Township 1.

[29] *Final Environmental Statement*, A-2; "Project History, Pecos River Basin Water Salvage Project," Vol. 11, 1977, 5-6, in RG 115, Project Histories, ACC # 8NN-115-92-130, Box 152.

impacts." Moreover, Reclamation was unclear about just how much more water saltcedar used as opposed to native vegetation. BLM questioned whether transpiration occured during hot or wet seasons, or in single- or mixed-tree communities? The Bureau of Land Management argued that Reclamation had to factor in these variables to determine where plant removal was necessary, or where it produced minimal returns.[30]

Others expressed concern about the environmental impacts of water salvage operations. The Fish and Wildlife Service voiced concern about the impact of clear-cutting on diverse populations of wildlife—especially birds who thrive in the well-watered wetlands, grasses, and woody vegetation of the Pecos River basin. It inquired about possible impacts on the 278 bird species known to use the Bitter Lake National Wildlife Refuge? According to the ES, the impact on bird populations was negligible, and, in fact, they markedly increased on the refuge between 1965 and 1977. Although it was unclear whether salvaging operations produced the increase, the ES confidently stated that it did not "adversely affect waterfowl populations."

A report attached to the ES stated that "many questions remain unanswered about TCDD," a dioxin found in Silvex. Tests on the herbicide found that the dioxin caused birth defects in laboratory animals and human fetuses "when the chemical is administered during the time of pregnancy when fetal organs are forming." The ES suggested spraying the herbicide "on a limited basis" and no longer by helicopter. The ES did not put an end to the debate, but it provided useful information and a forum for public discussion. Most importantly, the ES, and the litigation brought by the Audubon Society, permanently

[30] *Final Environmental Statement*, CC-40, CC-44; R. R. McGuire, R. L. Scott, E. P. Glenn, and M. S. Moran, "Native versus non-native tree competition for water resources along an intermittent reach of the San Pedro River, Arizona," 2007 Regional Water Symposium, Tucson, Arizona, August 29 - September 1, 2007.

reduced the acreage slated for clearing. Reclamation deleted plans to clear 24,000 new acres of saltcedar-infested land, and only considered maintaining previously cleared stands.[31]

Continued Challenges

Under the authority of Public Law 88-594, Reclamation continues to control saltcedar growth from the Sumner Dam area to the New Mexico-Texas state line. This excludes the area between the bridge at Artesia and the northern boundary of Reclamation's Brantley lands. Of the 33,200 acres maintained in New Mexico, about thirty-six percent of the land is federal land and sixty-four percent is private land that requires annual cooperative agency agreements from private landowners. The Carlsbad Irrigation District, through Reclamation contracts, performs the mechanical removal work using primarily caterpillars and rubber-tire tractors with root plows. Fiscal Year 2007 expenditures for maintaining the cleared areas of saltcedar was $287,720, or $8.66 per acre. The New Mexico Interstate Stream Commission funded $150,000 of these costs.[32]

Conserving water continues to be a high priority for New Mexicans faced with drought conditions, low river flow, and demand for water in Texas. A 1987 U.S. Supreme Court ruling charged New Mexico with failing to deliver 340,100 acre feet to Texas of its obligated quantity between 1950 and 1983. The court not only required New Mexico to deliver the full supply and makeup the water deficit over a 10-year period but pay Texas $14,000,000 for losses incurred. Most of that money went to the seven

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[31] *Final Environmental Statement*, B-37a – B-38, B-44, CC-59, Appendix C, CC-68, CC-113.
[32] U.S. Department of the Interior, Bureau of Reclamation, Albuquerque Area Office, *Calendar Year 2007 Report to the Pecos River Commission*, March 2008, 14.

irrigation districts that developed Red Bluff Dam. Because the flow in the Pecos River is finite, this has presented a hardship to New Mexican farmers who have retired 18,000 acres of irrigated farmland since the court ruling.[33]

The Bureau of Reclamation is one of several organizations working to improve stream flow, vegetation, and water quality in the Pecos River. The Texas Cooperative Extension leads the Pecos Basin Assessment Program, which was initiated in 2005. Several cost-sharing programs allow private landholders to remove saltcedar from their property. Between 1999 and 2003 multiple interests launched a restorative plan that included aerial spraying of herbicide on land infested with saltcedar. The herbicide killed off more than 85 percent of the saltcedar in the initial application, though the eradication's impact on salinity and water levels remains inconclusive.[34]

The application is extensive, but the saltcedar problem remains. Only about twenty-five percent of the infested lands have been treated in the Pecos River basin drainage. For that reason, efforts will likely be ongoing to find new ways to solve the problem as long as funding is available. In recent years, Senator Pete Domenici, R-New Mexico, supported a $50 million river restoration bill, and much of that will go toward saltcedar control. These and other efforts will increasingly become important as demand for clean water continues.[35]

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[33] Jensen, et al., *The Influence of Human Activities on the Waters of the Pecos Basin of Texas*, 25.
[34] Jensen, et al., *The Influence of Human Activities on the Waters of the Pecos Basin of Texas*, 29; Hart, et al., *Water Issues Facing the Pecos Basin of Texas*, Texas Water Resources Institute, http://pecosbasin.tamu.edu/docs/Pecos3.6.07.pdf; Hart, et al., "Saltcedar Control and Water Salvage on the Pecos River, Texas, 1999-2003," *Journal of Environmental Management* 75 (2005): 399-409.
[35] Paul Krza, "It's 'bombs away' on New Mexico saltcedar," *High Country News*, Nov. 10, 2003.

Conclusion

By the mid-twentieth century, saltcedar stands had spread to such an extent that it was necessary to take immediate action. Indeed, saltcedar and other non-native plants have wreaked havoc on the river systems and ecosystems of the American Southwest. In the 1960s, Reclamation undertook a large-scale salvage project in the Pecos River basin; in ensuing decades, continued federal, state, and local efforts have joined forces to meet the challenge of the invasive saltcedar, with decidedly mixed results. In all likelihood, such efforts will continue as long as the non-native saltcedar and other phreatophytes infest the riparian areas of the West.

Reclamation contracts with the Carlsbad Irrigation District to maintain the approximately 33,200 acres of saltcedar removed in New Mexico. This acreage is less than originally planned but, according to the 2007 Pecos River Basin Water Salvage report, the project "is, to date, the largest and most successful effort to control the growth of saltcedar in the Pecos Valley." How much water the project saved is difficult to calculate. The ES claimed there was "ample evidence" that some water had saved went not to new water users but to uphold existing water rights in a water-short region.[36]

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[36] Report on Pecos Water Salvage Program for 2007; *Final Environmental Statement*, C-9, Appendix B-61, CC-66.

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