

Case Study: Critical Riparian Habitat Restoration along a Perennial Reach of a Verde River Tributary & Watershed Restoration on a High-Elevation Riparian Community

Grant No.: 95-006WPF
& 98-050WPF

Project Purpose: 95-006WPF

To restore, protect and enhance a perennial section of a stream and associated riparian habitat by restoring pre-diversion hydrologic conditions.

Overall Benefits
Realized: **High**

Award Amount: \$102,535.00

Amount Spent*: \$102,189.32

Planning Cost*: \$26,906.07

Implementation Cost*: \$12,568.95

Monitoring Cost*: \$31,983.04

*Best estimate derived from project files and may not equal amount spent or awarded.

Stated Objectives: 95-006WPF

- 1) Remove diversion structure and restore natural flow conditions through the diversion ditch and monitor changes to surface and subsurface water quantity and quality
- 2) Construct fences in areas critical to the riparian restoration to mediate grazing effects on the ecosystem
- 3) ID and characterize the geology, surface/subsurface water and vegetation in area above and below the construction project.
- 4) Implement a systematic, consistent and long-term monitoring program.
- 5) Develop a nature trail and create a teachers workbook.
- 6) Create reports for AWPF, media, and publication in relevant journals.



View of The Nature Conservancy's Hart Prairie Preserve. 2007.

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Grant No.: 95-006WPF
& 98-050WPF

Project Purpose: 98-050WPF

To modify upland watershed conditions to increase and sustain water flows into the unhealthy down slope riparian community at Hart Prairie in Northern Arizona.

Overall Benefits
Realized: **Medium**

Award Amount: \$304,775.00

Amount Spent*: \$298,384.68

Planning Cost*: \$76,272.00

Implementation Cost*: \$115,752.57

Monitoring Cost*: \$78,949.00

*Best estimate derived from project files and total might not equal amount spent or awarded.

Stated Objectives: 98-050WPF

- 1) Modify watershed conditions to increase and sustain water flows into the riparian community through prescribed burning and reducing the density of pines encroaching the wet meadow toward the riparian community.
- 2) Reduce/eliminate stock tanks and an artificial dam in the watershed followed by stream channel restoration.
- 3) Continue and expand the ongoing monitoring of watershed and riparian vegetation, stream flow, and fluvial geomorphology.
- 4) Fencing to control grazing of large ungulates to expedite recovery of vegetation composition and quality and surface hydrology.
- 5) Conduct public outreach activities on the concepts of watershed and riparian restoration in order to improve public awareness and support for these types of riparian restoration activities.



The Nature Conservancy, Hart Prairie Preserve.
July 2007.

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Project Highlights and Lessons Learned:

- Prescribed fire in areas dominated with bracken fern can burn very hot, and potentially kill trees and other desirable vegetation.
- Fencing is essential for willow survival and propagation in order to stop herbivory by elk.
- Understanding the historic hydrologic/micro-topographic patterns is crucial to the success of wet meadow recovery.
- Proper removal of stock tanks allows for rapid recovery of the riparian/wetland ecosystem area. Improper removal may, but not always, lead to riparian recovery. Design and removal specifications are critical to restoration success.



Bebb's willow stand and riparian area on Hart Prairie Preserve in 1996.



Bebb's willow stand and riparian area on Hart Prairie Preserve in 2007.

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Evaluation Summary:

The project objectives were successfully completed. However, it was difficult to determine how beneficial the projects were to the riparian area. Although water quantities that reach the riparian area have undoubtedly increased, overstory riparian vegetation is not responding to these increases and there continues to be no regeneration of Bebb's willow. The current Bebb's willow cohort is healthy and produces a viable seed stock. Differing results from the removal of Unnamed Tank and Ugly Tank exemplifies the need for specific plans in technical restoration projects. The removal of Unnamed Tank was successful in reconnecting flows to the stream, mimicking historic micro-topography, and has recovered almost completely. Ugly Tank, on the other hand, was completed sloppily without plans. Ugly Tank has just started its own natural pathway to a recovered system. The slower response was due to flows not being reconnected to the stream nor micro-topography even evaluated or considered. Despite the lack of planning for the elimination of Ugly Tank the area has benefitted from its removal and is beginning to naturally heal itself. The elk enclosure has been extremely beneficial in maintaining vegetative vigor. Old headcuts to the stream now have grasses, forbs, sedges, rushes, etc. that are covering the banks and channel. This vegetation has contributed to the stabilization of the channel grade and banks. The condition of the riparian area has improved considerably compared to pre-project photos. These projects (95-006WPF and 98-050WPF) have benefitted the riparian area. Additional work could still be accomplished to further enhance the area; such as the complete removal of Snowbowl Tank. Continued work, projects, monitoring, and maintenance contribute immensely to the success of this project.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Medium**

Effective, useful example for other projects: **Medium-Low**

Lessons learned: **High**

Public education/awareness and value: **High**



Elk enclosure around Bebb's willow in the lower portion of the watershed on Nature Conservancy property. 2007.

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Ditch cutoff removal near Unnamed Tank looking north, 1996.



Area near Unnamed Tank close to ditch cutoff removal looking north, 2007.



Lowering of berm around Snowbowl Tank, 2007.



Ugly Tank removal site, 2007.

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Site where of the diversion dam prior to its removal. 1996.



Site where diversion dam was removed . 2007.



Recontoured channel where diversion dam was removed .
2007



Diversion Dam removal and recontoured channel. 2007.

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Upland meadow before thinning treatment.



Upland meadow approximately eight years after thinning treatment. July 2007.



Bebb's willow stand approximately eight years after the prescribed burn. July 2007.

Case Study: San Pedro Riparian National Conservation Area Watershed Rehabilitation/Restoration & San Pedro Riparian National Conservation Area Watershed Protection and Improvement Project

Grant No.: 95-015WPF
& 96-0001WPF

Project Purpose:

95-015: The project involves the rehabilitation and restoration of approximately 4,450 acres of eroded ephemeral washes and upland areas located within ½ to 1 mile of the San Pedro River within the San Pedro Riparian National Conservation Area. The project will: demonstrate watershed rehabilitation projects and provide long term benefits by protecting, enhancing and restoring natural processes within the San Pedro River watershed and riparian ecosystem.

Overall Benefits
Realized: **Low**

95-015:

Award Amount: \$286,000.00

Amount Spent*: \$271,057.45

Planning Cost*: \$19,600.00

Implementation Cost*: \$229,501.80

Monitoring Cost*: \$36,898.20

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives: 95-015

- 1) The objective of the project is to rehabilitate and restore approximately 4,450 acres of uplands and 2.5 miles of severely gullied ephemeral washes which are part of key drainage areas along the San Pedro River within the San Pedro Riparian National Conservation Area.



San Pedro Riparian National Conservation Area . Berm created during 95-015 to trap water and stop advancing headcut on the downstream side. July 2007.

Case Study: San Pedro Riparian National Conservation Area Watershed
Rehabilitation/Restoration & San Pedro Riparian National Conservation Area
Watershed Protection and Improvement Project

Grant No.: 95-015WPF
& 96-0001WPF

Project Purpose:

96-0001: Boundary fencing to improve, enhance, and protect the riparian and upland habitats and water quality of the San Pedro National Riparian Conservation Area on the San Pedro River.

Overall Benefits
Realized: **Low**

96-0001:

Award Amount: \$89,250.00

Amount Spent*: \$89,250.00

Planning Cost*: \$9,250.00

Implementation Cost*: \$78,000.00

Monitoring Cost*: \$0.00

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives: 96-0001

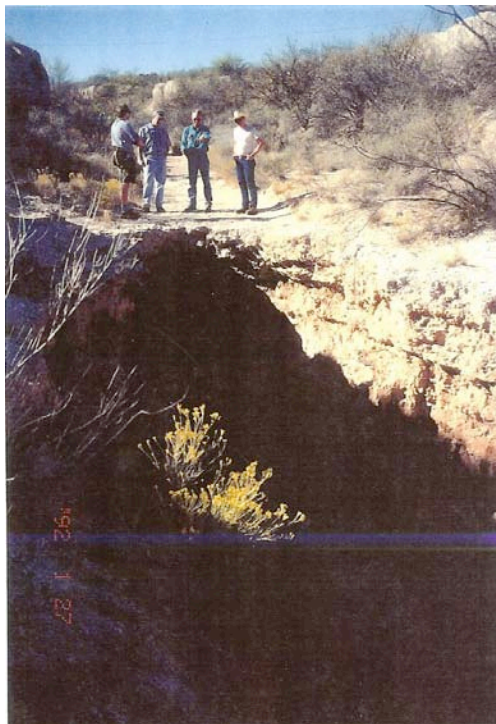
- 1) Protect current improvements and continue to improve the conditions in the RNCA.
- 2) Improve water quality of San Pedro River.



Culverts in the breached dirt berm. View from the upstream end of culverts. July 2007.

Project Highlights and Lessons Learned:

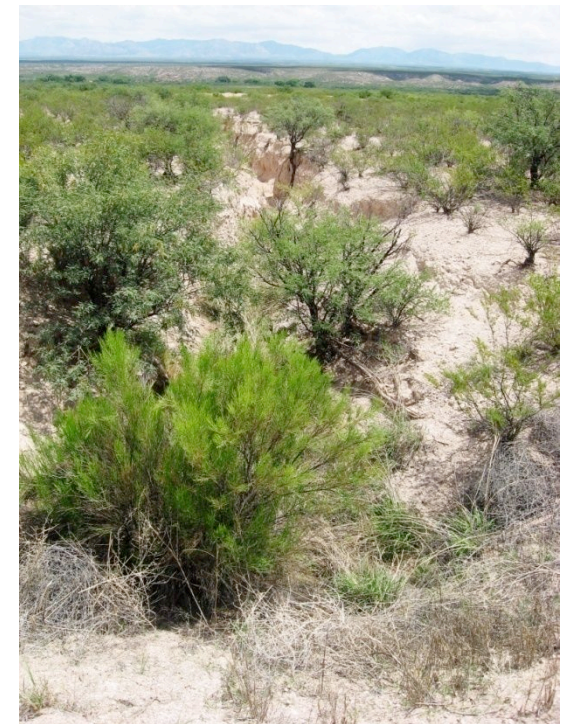
- Organic debris and sediment transport for the San Pedro River and its tributaries is high.
- Most of the water and sediment control basins (large earthen berms) failed during higher flow events due to inadequate sediment storage and spillway capacity. Installation of culvert spillways may have been compromised (inadequate compaction, location of culvert inlet/outlet, lack of anti-seep collars, etc). Watershed area is a critical limitation to the use of this practice.
- Broadcast seeding was washed into washes and downstream; perhaps, for this system, seeds should be drilled into soil.
- V-mesh spreaders (T-Bar sediment traps) are more effective when installed before water becomes concentrated in order to capture, bleed, and redirect flows. The height of the spreaders should be less than 1 ft otherwise downstream scour can occur. Adequate spreading area and slope of spreader are additional critical factors to prevent water from cutting around the structure creating new channels and inducing erosion.
- Railroad rail sediment trap structures installed in the San Pedro River failed by overturning or undermining. Caution should be taken before any structures are placed in a channel especially large river systems.



Advancing headcut in a tributary wash to the San Pedro River. January 1992.



Water and sediment control basin (earthen berm) constructed to mitigate advancing headcut . July 2007.



Headcut downstream of earthen berm. July 2007.

Evaluation Summary:

Overall, there was few benefits realized from funds spent on this project. Some of the observed structures were functioning. However, many structures failed, some were removed, and some worked for the short term, but are now failing and creating new headcuts. The BLM did share that they were disappointed in the success of the project. There were significant lessons learned from these projects.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Low**

Effective, useful example for other projects: **Low**

Lessons learned: **High**

Public education/awareness and value: **Low**



Sediment build up behind a remaining railroad rail sediment trap structure. July 2007.



V-mesh spreaders/T-Bar sediment traps. Scour on the downstream side exists. Waddles were added later to mitigate scour and downcutting. July 2007.

Project Purpose:

To enhance water quality and quantity and dependent riparian habitat in the San Pedro River by improving upland conditions in the Teran Watershed, a significant tributary. This project may serve as a model for other ranches in the San Pedro Valley.

Overall Benefits
Realized: **Low**

Award Amount: \$151,753.00

Amount Spent*: \$147,478.89

Planning Cost*: \$106.90

Implementation Cost*: \$124,249.56

Monitoring Cost*: \$16,447.68

Stated Objectives:

To enhance both stream flow and groundwater levels, water quality, and riparian habitat in both the Teran Watershed and the San Pedro River by:

- 1) Increase mountain-front recharge of groundwater.
- 2) Decrease surface runoff and peak discharge resulting from high-intensity rainstorms.
- 3) Increase perennial grass and litter cover in both upland and bottomland where present cover is below potential.
- 4) Increase woody riparian species in areas with existing potential for them, or where habitat potential is expanded as a result of proposed treatments.

*Best estimate derived from project files and total may not equal amount spent or awarded.



Uplands in the Teran Watershed in 2007. Several check dam structures were installed in the tributary drainage channels to Teran Wash and the San Pedro River.

Project Highlights and Lessons Learned:

- Lessons learned are limited due to the lack of planning, documentation, and monitoring.
- There was little documented design specifications. There appears to be inconsistencies in the structure geometry and installation technique.
- It is uncertain if these structures are effective in meeting the stated objectives, especially when used in desert stream systems.
- Check dams must be constructed with a dip in the center, keyed into the banks, with an apron on the downstream end of the structure.



A small check dam structure as constructed in 1996



Check dam remnants on remaining structures in 2007

Evaluation Summary:

There were few direct benefits to the riparian systems or stream channels within the project area. The majority of the structures have failed. There is little or no evidence of increased grass cover in these channels. Likewise the benefits to Teran Wash are not apparent. Only a small portion of the watershed was treated and the project may not have included sufficient area to create cumulative benefits even if the structures had performed as planned. The project has the potential to inform others, but it is unclear whether those lessons have been passed to other entities. The grantee did not have an alternative structure design as a result of the failures. The exclosure fences around springs and wells may have provided some benefits but they are relatively small areas. It does not appear that the project benefited the resources of concern to AWPf.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Low**

Effective, useful example for other projects: **Low**

Lessons learned: **Medium**

Public education/awareness and value: **Low**



Aerial photo of check dam structures in a tributary in Teran Watershed in 1997 just after construction.



Overview of check dam structures in a tributary wash in Teran Watershed in 2007.

Project Purpose:

A demonstration project - fencing a wet meadow/cienega area; cattle exclusion (123 acres) and elk exclusion (1 acre); trapped feral horses; created pastures for future use.

Stated Objectives:

- 1) Increase stream wide native vegetative species cover by 30% over 3 years. Stop spread of *Poa pretenses* (Kentucky bluegrass).
- 2) Restore Lofer Cienega Creek to stable, meandering, Rosgen E channel.
- 3) Increase Apache Trout biomass 50%.
- 4) Reduce number of feral horses.
- 5) Improve grazing management. Create 123 acre enclosure and establishing pastures.
- 6) Enhance aesthetics and improve water quality of Lofer Cienega.

Overall Benefits
Realized: **Medium**

Award Amount:

Amount Spent*: \$161,204.00

Planning Cost*: \$2,200.00

Implementation Cost*: \$111,900.00

Monitoring Cost*: \$43,004.00

*Best estimate derived from project files and total may not equal amount spent or awarded.



Elk enclosure fencing around Lofer Cienega

Project Highlights and Lessons Learned:

- Elk exclosures showed that livestock was not the only impact to vegetation
- Enlarged elk exclosures protected and improved approximately 1/3 of cienega
- Lower 2/3 of cienega with livestock and elk grazing has shown continued degradation
- Wet meadow hydrology has been preserved by protecting vegetation
- Continued heavy grazing is associated with channel incision and loss of wet meadow hydrology



Boggy Creek before installation of full elk/livestock exclosure 1996.



Boggy Creek near same area within elk/livestock exclosure, 2007.

Evaluation Summary:

This project was early in the learning curve for stream rehabilitation. The original goals were thwarted by not realizing that elk were a major contributor to overgrazing. However, the installation of grazing exclosures was a good idea and showed the potential of the stream. A mid project switch to elk exclosure fencing was warranted and greatly improved the stream within the exclosure even though the full project site could not be protected. The remainder of the stream (over half the project length) is currently in poor condition. The initial project has informed the landowners on the process of how to accomplish a full restoration. Plans are underway to continue restoration efforts in this area.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Medium**

Effective, useful example for other projects: **High**

Lessons learned: **High**

Public education/awareness and value: **Low**



Incised stream and un-vegetated banks outside of exclosure, 2007



Banks are well vegetated and channel is less incised within exclosure, 2007

Project Purpose:

Restore watershed health by improving management of riparian meadows and reconstructing stream crossings.

Stated Objectives:

- 1) Improve sedimentation problems. Change management practices in watershed.
- 2) Improve public perception of stream. Clean-up trash dumps and improve riparian vegetation.

Overall Benefits
Realized: **Low**

Award Amount: \$126,406.00

Amount Spent*: \$1216,406.00

Planning Cost*: \$7,000.00

Implementation Cost*: \$65,460.00

Monitoring Cost*: \$49,796.00

*Best estimate derived from project files and total may not equal amount spent or awarded.



One of multiple drinkers and fence lines installed in the Gooseberry Creek Watershed.

Project Highlights and Lessons Learned:

- Without management changes there was no improvement from installed practices.
- Many good practices were installed (drinkers, fencing, road crossing culverts).
- Fences were found open with cattle roaming freely.
- Channels and banks showed no improvement.



Grazing enclosure after installation. 1996



Same area 2007. Non-functioning exclosure is to left of photo.

Evaluation Summary:

This project provided some benefits as far as demonstrating various techniques to reduce stress from grazing and roads on stream banks and channels. However, the actual benefits to the land were not realized since the most powerful tool implemented (fencing) was not followed by an proper grazing management plan. Consequently, the fences were not utilized and stream banks remain in degraded condition. Drinker stations are utilized. However, without proper fencing they are not contributing to stream channel improvement.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Low**

Effective, useful example for other projects: **Low**

Lessons learned: **Low**

Public education/awareness and value: **Low**



Stream banks are still eroding and poorly vegetated. 2007.



Fences are intact, however gates are open allowing livestock access to sensitive areas.

Project Purpose:

To restore the pre-disturbance morphology and riparian ecosystem of a channelized portion of a perennial stream that is supplied with flow from Hoxworth Springs.

Overall Benefits
Realized: **High**

Award Amount: \$31,545.00

Amount Spent*: \$31,352.77

Planning Cost*: \$4,400.00

Implementation Cost*: \$6,400.00

Monitoring Cost*: \$16,100.00

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

- 1) Reduce accelerated streambank erosion and soil movement out of the riparian area and to re-establish adequate vegetative characteristics to provide channel stability.
- 2) Monitor changes in the riparian vegetation associated with the restoration of the perennial stream.
- 3) Quantify the amount of spring discharge and surface runoff in the proposed restoration area.



Upper end of project site looking downstream at tank/wetland. Perennial flow of springs is an important water resource.

Project Highlights and Lessons Learned:

- Re-shaped the channel to increase meanders and create banks with 3:1 slope that is connected to floodplain. The results are a stable channel with functioning hydrological conditions.
- A better design was needed for the tank spillway, which is currently starting to fail. Whenever a drop is created in channel elevation, a very specific design must be included in order to decrease chance of failure and maintain stability.
- Log revetment structure along the bank increases velocities and creates local scour. Grantee reports that they should have re-aligned the channel and increased the meander, instead of armoring a sharp turn.
- Temporary fencing to exclude elk worked well. Since the fencing was removed the project site is experiencing impacts from elk. Grantee reports that elk fencing would have increased the benefits realized for this project dramatically and would still like to do so.



Photo taken in 1997. Note cutbanks next to surveyor.



Photo taken in 2007 of re-shaped channel looking upstream.

Evaluation Summary:

This project was successful at restoring a highly modified wet meadow. Old tanks were removed and banks re-shaped and meanders restored. Seeding and riparian plantings worked while temporary fencing was up, but since have been impacted by elk. The Forest Service representative on site wished that the elk fencing had been part of the grant. NAU students still visit the site an addition to a classroom exercise, and the Forest Service has built upon the AWPf grant by using funds from other sources to continue work in the wet meadow. There were lessons learned that can inform and have provided information to other projects that the Forest Service has completed. The Forest Service plans to continue similar work downstream from this project.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Medium-High**

Effective, useful example for other projects: **High**

Lessons learned: **High**

Public education/awareness and value: **High**



Lessons learned: photo of restored site with elk impacts visible. Note dead willow by log and stunted grasses.



Lessons learned: drop/spillway structure below tank starting to fail.

Project Purpose:

To improve the Eagle Creek Watershed and riparian communities on the House Springs and Baseline allotments.

Overall Benefits Realized:
Medium-Low

Award Amount: \$80,626

Amount Spent*: \$80,626

Planning Cost*: \$48,674

Implementation Cost*: \$27,952

Monitoring Cost*: \$0

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

- 1) Improve current water distribution.
- 2) Expansion of high intensity, low duration grazing program.
- 3) Replace diesel pumping system with a solar voltaic system.
- 4) Non-biased monitoring of results of project for re-planning and compliance.
- 5) Comprehensive planning.



Improved upland pasture, September 2007.

Project Highlights and Lessons Learned:

- The grantees successfully implemented an intensive grazing program which has prevented overgrazing in their riparian area as well as in upland pastures.
- Painting fiberglass holding tanks appears to discourage algae growth.
- After using several pumps, grantee discovered Grundfos pumps were by far the most reliable and maintenance free.



Water holding tank and solar array and pump. September 2007.



Grundfus pump September 2007.

Evaluation Summary:

The project greatly improved the condition of the uplands. It benefits the riparian area in that the cattle have permanent water in areas other than the creek, therefore, rancher never has to utilize the riparian area as a pasture during drought conditions. The project did not directly address issues relating to channel instability or riparian enhancement. However, ranch improvement done through this project may be an appropriate for funding based on the stated purpose and objectives of AWPf. Factors that contribute to project success is landowner commitment.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Medium-Low**

Effective, useful example for other projects: **Medium-Low**

Lessons learned: **Medium-Low**

Public education/awareness and value: **Low**



Channel instability and low riparian vegetation recruitment continue to impact the riparian area. September 2007.

Overall Benefits
Realized: **High**

Project Purpose:

96-0016: To dredge historic river channels, revegetate habitat with native species and to monitor both of these actions to further ensure their success and to provide valuable information for future backwater habitat restoration projects along the Lower Colorado River.

96-0016:

Award Amount: \$1,131,477.00

Amount Spent*: \$1,131,477.00

Planning Cost*: \$108,940.00

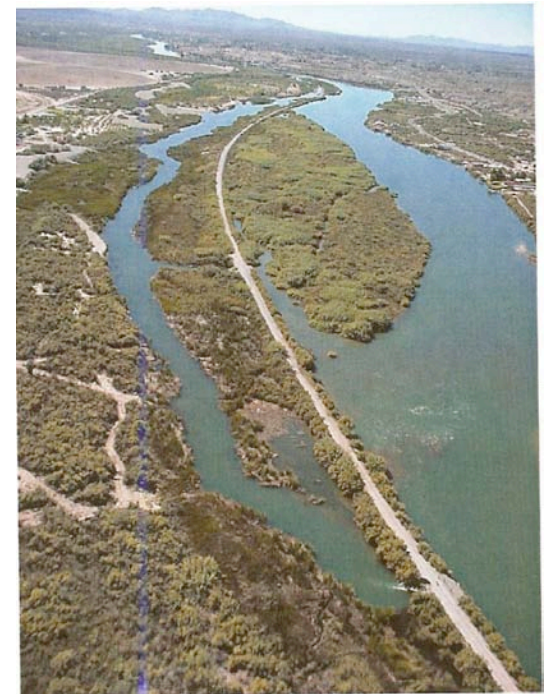
Implementation Cost*: \$699,761.00

Monitoring Cost*: \$97,776.00

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives: 96-0016

- 1) Dredging and opening of historic river and backwater channels.
- 2) Establish stands of native vegetation, including cottonwood, willow, and mesquite, in areas with otherwise low wildlife habitat value, primarily salt cedar stands.
- 3) Hydrographic mapping
- 4) Ecological evaluation
- 5) Species monitoring
- 6) Project coordination and management



Deer Island and the 'Ahakhav Tribal Preserve 2000.

Project Purpose:

97-032: The purpose of this project is to restore native riparian vegetation and to monitor the revegetated areas for optimum successful habitat enhancement at the Colorado River Indian Reservation , 'Ahakhav Tribal Preserve.

Stated Objectives: 97-032

- 1) Establish stands of native vegetation, including cottonwood, willow, and mesquite, in areas of low wildlife value, primarily salt cedar stands with an emphasis on establishing suitable willow habitat for the endangered southwest willow flycatcher Establish stands of native vegetation, including cottonwood, willow, and mesquite, in areas with otherwise low wildlife habitat value, primarily salt cedar stands.
- 2) Develop monitoring programs to determine success of revegetation efforts.
- 3) Use of revegetation areas for environmental education, low-impact recreation, and native arts.

Overall Benefits
Realized: **High**

97-032:

Award Amount: \$228,800.00

Amount Spent*: \$228,800.00

Planning Cost*: \$43,000.00

Implementation Cost*: \$165,880.00

Monitoring Cost*: \$19,920.00

*Best estimate derived from project files and total may not equal amount spent or awarded.



Water control structure, 2007.

Project Highlights and Lessons Learned:

- Planning and performing geotechnical work prior to channel excavation is very important to successful dredging.
- Plastic cages used to protect plantings from predation can girdle the tree as it grows beyond the cage.
- Understory vegetation should be part of the revegetation efforts
- Plant cottonwoods closer to the water
- Removal of temporary irrigation should be part of project tasks.



Backwater pond area prior to dredging and habitat enhancement work 1997.



Backwater pond habitat area as in looks in 2007

Sub-Categories of Benefits and Ratings: 96-0016 & 97-032

Evaluation Summary: 96-0016

The purpose of the project was to enhance backwater pond habitat through channel dredging, and to provide valuable information to similar future projects. The project also aimed to reestablish native vegetation to compete with non-native vegetation. Overall the project was successful in meeting stated purpose. Remnants of the temporary irrigation used to water upland plantings still litters the area and should have been removed once irrigation needs were met and plantings were established. The backwater area has provided excellent riparian habitat that is utilized by a variety of wildlife species. The culvert collects a lot of debris which is impeding flow. Although tamarisk is slowly growing, the native vegetation is successfully outcompeting tamarisk at this time. The understory is lacking vegetation; understory revegetation efforts could be very beneficial to the project.

Evaluation Summary: 97-032

This project purpose was to expand on 96-0016 by improving native vegetation cover to the area. A control plot lies adjacent to the invasive species removal plot and demonstrates successful tamarisk removal efforts. The control plot is a monocultural stand of tamarisk, while project plots are dominated by several species of native vegetation. Cottonwood plantings are struggling slightly, with several plantings still thriving and natural recruitment occurring. Beaver has impacted the site, but overall the project was successful. Remnants of the drip irrigation litters the area and should have been removed once irrigation needs were met. The backwater area has provided excellent riparian habitat that is utilized by a variety of wildlife species.

Direct benefits to riparian system: **High**

Effective, useful example for other projects: **High**

Lessons learned: **High**

Public education/awareness and value: **High**



Project area prior to tamarisk removal efforts 1997



Tamarisk removal and upland planting plot in 2007



Upland planting zone with irrigation and plastic cage remnants 2007.



Riparian planting zone with temporary irrigation line litter and beaver impacts 2007.



Backwater pond habitat enhancement area 2007.



Riparian planting zone with surviving cottonwoods 2007.

Case Study: Big Sandy River Riparian Project

Grant No.: 96-0017WPF

Project Purpose:

To fence cattle out of 8 miles of perennial stream; set up water drinkers in upland so that grazing can be better managed.

Overall Benefits
Realized: **Low**

Award Amount: \$92,000

Amount Spent*: \$92,000

Planning Cost*: \$71,343

Implementation Cost*: \$20,657

Monitoring Cost*: \$0.00

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

- 1) Construct additional fencing to control livestock grazing within the Big Sandy River. Keep livestock off riparian habitat during growing season to help restore riparian and aquatic habitat.
- 2) Develop additional waters on upland. Develop waters to remove livestock from riparian areas during growing season and improve livestock distribution on uplands.
- 3) Maintain current grazing system on allotment while resting overgrazed sites in uplands to improve upland sites.



Big Sandy River at the project site. August 2007.

Project Highlights and Lessons Learned:

- Grazing Management Plan still being followed
- Project Manager says riparian corridor has experienced an increased in tree density.
- Maintenance of project purchased equipment essential for long term benefits



Fencing not completed to protect solar array and pump. August 2007.



Disrepair of pump and pipeline. August 2007

Evaluation Summary:

Despite repeated attempts, grantee was unavailable to accompany project evaluators to the site. Benefits from this project were difficult to ascertain from the site visit. Cattle were observed grazing in and along the portion of river visited and native riparian vegetation was sparse. Fencing around the solar pump was never completed; maintenance and repair does not seem to be occurring. Phone conversations with the grantee indicate better riparian conditions occur downstream in the project area and that the cattle seen were trespass cows from a neighboring allotment.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Low**

Effective, useful example for other projects: **Low**

Lessons learned: **Low**

Public education/awareness and value: **Low**



Big Sandy River looking downstream at beginning of project reach. August 2007

Project Purpose:

The purpose of the Cienega Creek Rehabilitation Project was to restore hydrologic and ecologic function to 2.5 miles of creek that has been altered by past water diversion and small scale damming.

Overall Benefits
Realized: **High**

Award Amount: \$210,700.00

Amount Spent*: \$157,892.05

Planning Cost*: \$110.81

Implementation Cost*: \$156,935.91

Monitoring Cost*: \$845.33

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

- 1) Restore flood flows and increase the base flow from an intermittent to a perennial state along 2.5 miles of intermittent stream channel.
- 2) Prevent existing erosion and resulting sedimentation from continuing in the diversion canal and dikes that are failing.
- 3) Enhance riparian function in order to benefit wildlife including the endangered southwest willow flycatcher and create perennial aquatic habitat for the federally listed endangered Gila topminnow, state listed as threatened Gila chub, Chiricahua leopard frog and Mexican garter snake.
- 4) Increase protection of Tucson from excess flooding and increase surface and subsurface flows that ultimately recharge aquifers in the Tucson AMA .
- 5) A social objective is to increase public involvement in water and riparian resources on public lands.



A portion of the restored channel at Cienega Creek in the upper reaches of the project site, just below the canal plug 2007.

Project Highlights and Lessons Learned:

- Pole plantings must be planted to ground water depth in order for them to take root.
- Willow plantings were more successful here than cottonwoods.
- If grantee could do it again he would create additional meanders to further slow flows and would have cut and sloped banks and revegetated them.



Stream channel prior to the removal of Dam #2 to be removed.



Stream channel where Dam #2 was removed. September 2007

Evaluation Summary:

The basic management, vegetative, and structural components appear to be functioning and successful. The diverted stream has been returned to its original channel and channel morphology restored. Cooperative management by the grazing permit has been successful in allowing native riparian vegetation to reestablish. There are lessons learned from the project that may or may not have been effectively transferred to other projects and practitioners. The project is on easily accessible public lands that provide an effective means of transferring the project goals/benefits to the general public. As a result the greatest benefit may be the direct restoration of riparian habitats and stream function. The project has provided benefits to the resources of concern to AWPf.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **High**

Effective, useful example for other projects: **Medium**

Lessons learned: **High**

Public education/awareness and value: **Medium-Low**



Downstream view of the advancing headcut below Dike #3 prior to implementation of grant tasks.



Upstream view of headcut remediation at Dike #3 removal site 2007.



Old road crossing at Cienega Creek.



New stream crossing location prior to construction 2000.



New low water crossing site as it appears in 2007.



New low water stream crossing constructed with AWP funds. September 2007

Project Purpose:

Develop and implement 6 watershed restoration demonstration projects with concurrent workshops to demonstrate watershed and riparian restoration strategies. Grantee will use these projects to generate community support for future projects.

Overall Benefits
Realized: **High**

Award Amount: \$152,775.00

Amount Spent*: \$140,546.43

Planning Cost*: \$21,934.05

Implementation Cost*: \$75,647.24

Monitoring Cost*: \$16,993.02

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

- 1) Plan and implement 6 watershed conservation demonstration projects, conduct workshops and develop public out reach materials to promote watershed protection projects on he Navajo Nation.
- 2) Prepare work plan.
- 3) Generate local support.
- 4) Local interaction with resource conservation professionals.
- 5) Improve selected wetland and riparian areas.
- 6) Establish restoration demonstration sites.
- 7) Demonstrate sustainable land use practices compatible with traditional activities.



Restored wet meadow at Demo Site #1 in Tsaille Watershed on the Navajo Nation, October 2007.

Project Highlights and Lessons Learned:

- Great demonstrations of resource measures that utilized local native materials and employed low cost/low tech approach to treatment.
- Most effective treatments were installed on tributaries with small watershed areas and where vertical incision did not exceed 2 feet.
- There are great challenges to keep fencing in place on traditional grazing lands. Had all sites been fenced, the vegetative response would have been greater, but the diversity and density have improved at all site. The demonstrated practices served a great educational purpose for future landowners.
- Baffle structures aid in inducing meanders (baffles) and redirecting flows and shear stress from banks.
- Worm channels lengthen the channel and wet larger area of meadow.
- Rock streambarb installed in the main stem of Tsaille Creek in Canyon Del Muerto was subject to high flows and performed well. This demonstrates a useful bank stabilization practice for large river system. However, this structure was expensive to construct, did not use local material, required high technical installation, and is not a practice that limited resource land users can replicate.



Interpretive signage at Demo Site #5, October 2007.



Lower Tsalie Watershed in Canyon Del Muerto, October 2007.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Medium-High**

Effective, useful example for other projects: **High**

Lessons learned: **High**

Public education/awareness and value: **Medium-High**

Evaluation Summary:

Project objectives were to successfully demonstrate effective low tech practices to restore channel morphology and function, and to enhance riparian vegetation and habitat. The project strove to educate the local residents on the purpose of the practices and the proper functioning of the stream systems. A variety of practices were installed in the upper and lower watersheds of Tsaile Creek. The upper watershed practices included low grade control structures of rock and/or log and small rock structures that induced meandering. Most of the practices were intact and the scour and other erosional features had silted in and repaired themselves. Lower watershed practices were intended to strengthen a road crossing and demonstrate alternative farming practices. The local outreach/involvement could have been more effective had there been funds available to hire local labor. The project directly benefited riparian resources that are of concern to AWPf. The public outreach should lead to other similar projects and the low tech nature of the successful practices provide valuable "lessons learned" for other projects. Due to their remote nature the project does not have the potential to educate the general public.



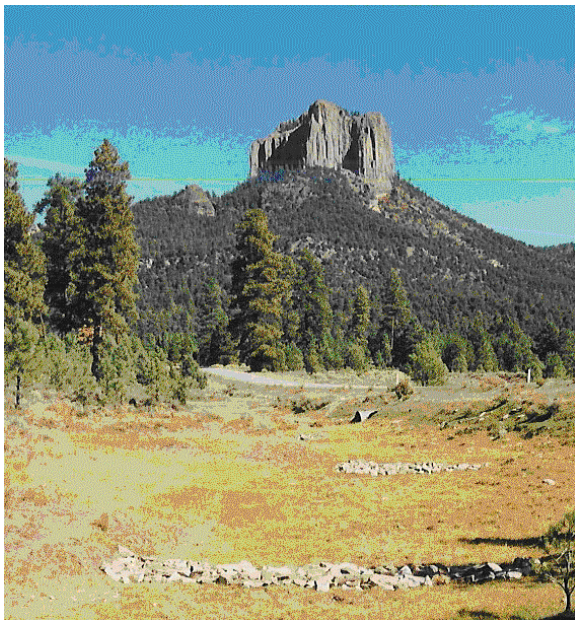
Rock inlet at culvert to hold grade, Demo Site #2, October 2007..



Dry meadow before treatment at Demo Site #1, April 2000.



Wet meadow restored with worm channel and sedge plugs at Demo Site #1, October 2007.



Rock baffle & riffle structures at Demo Site #2, July 1998.



Meanders created and structures filled in at Demo Site #2, October 2007.



Log and sandbag structures at Demo Site #3, June 2000.



Structure filled and meadow rewetted at Demo Site #3, October 2007.



Log and sandbag structure with brush at Demo Site #4, June 2000.



Channel filled and floodplain reconnected at Demo Site #4, October 2007.



Barren gully with post erosion fence at Demo Site #5, June 1999.



Channel filled with vegetation established at Demo Site #5, October 2007.



Erosion fence made from tamarisk posts, Demo Site #5, June 1999.



Erosion fence with sediment filled behind, Demo Site #5, October 2007.



Road crossing with streambarb recently installed, Demo Site #6, Sept 1999.



Stable road crossing at Demo Site #6, October 2007.



Actively cutting channel at crossing, Demo Site #6, Sept 1999.



Stable channel at crossing, Demo Site #6, October 2007.

Case Study: Riparian Restoration on the San Xavier Indian Reservation
Community

Grant No.: 96-0026WPF

Project Purpose:

Develop a resource management guide that identifies specific appropriate riparian restoration strategies; implement selected restoration strategies.

Overall Benefits
Realized: **High**

Award Amount: \$591,319.00

Amount Spent*: \$588,598.56

Planning Cost*: \$218,391.91

Implementation Cost*: \$294,030.86

Monitoring Cost*: \$23,280.87

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

- 1) Modify watershed conditions to increase and sustain water flows into the riparian community. Reduce the density of pines encroaching the west meadow toward the riparian community.
- 2) Reduce/eliminate stock tanks and an artificial dam in the watershed followed by stream channel restoration.
- 3) Continue and expand the ongoing monitoring of watershed and riparian vegetation, streamflow, and fluvial geomorphology.
- 4) Fencing to control grazing of large ungulates to expedite recovery of vegetation composition and quality and surface hydrology.
- 5) Conduct public outreach activities on the concepts of watershed and riparian restoration to improve public awareness and support for these types of riparian restoration activities.



Upland Planting area at project site. September 2007.

Project Highlights and Lessons Learned:

- Observed changes from this project has inspired a new similar project upstream.
- This project replaced a declining ecosystem with a thriving one.



Project area prior to implementation of project tasks.



Project area approximately nine years after project implementation. July 2007.

Evaluation Summary:

The project provided a substantial area of native riparian vegetation and habitat in an area that is largely devoid of these resources. In addition, the planning and community support components appear to have provided an increased awareness of the value of these resources and the ability to create/protect them. The lessons learned from the project could be better distributed to other projects and practitioners. Because the area is generally restricted to tribal members, the influence on the general public is limited. Overall, the project has provided substantial benefits to the resources of concern to the AWPf.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Medium-High**

Effective, useful example for other projects: **High**

Lessons learned: **High**

Public education/awareness and value: **High**



Building the backwater pond . July 2007.



Backwater pond seven years after construction. September 2007.

Project Purpose:

97-027: Restore and protect the riparian areas on the Lyle Canyon Allotment. Objectives are to stabilize stream banks, increase infiltration, reduce sheet runoff and erosion, reduce peak flows and sediment concentrations in streams. Improve diversity, density, and canopy cover for wildlife habitat. Installation of fencing and upland water developments for drinkers. Implementation of a monitoring plan with photo monitoring as well as possible future management changes as needed.

99-070: Restore and protect the riparian areas and better manage livestock by constructing 3 new wells, 28 miles of pipeline, 39 water troughs, and water storage tanks. This allotment has grazing management improvements previously funded by the AWPf.

Stated Objectives: 97-027

- 1) Objectives are to stabilize stream banks, increase infiltration, reduce sheet runoff and erosion, reduce peak flows and sediment concentrations in streams.
- 2) Improve diversity, density, canopy cover for wildlife habitat.
- 3) Installation of fencing and upland water developments for drinkers.
- 4) Implementation of a monitoring plan with photo monitoring as well as possible future management changes as needed.

Stated Objectives: 99-070

- 1) Restore and maintain riparian and upland vegetation diversity, density and canopy cover for wildlife habitat. Stabilize stream banks, increase infiltration, reduce sheet runoff and erosion. Improve overall health of the riparian areas.
- 2) Protect Sonoran Tiger Salamander habitat by placing drinkers in the uplands and giving the cattle places to water other than the dirt tanks where the salamanders live.

Overall Benefits
Realized: **Medium**

97-027:

Award Amount: \$60,359.57

Amount Spent*: \$49,566.84

Planning Cost*: \$0.00

Implementation Cost*: \$48,433.80

Monitoring Cost*: \$1,133.04

*Best estimate derived from project files and total may not equal amount spent or awarded.



Uplands of the Lyle Canyon Ranching Allotment,
July 2007.

Project Highlights and Lessons Learned:

- Fencing, upland water developments, and rest rotation grazing plan is relieving pressures on the riparian area which has allowed the natural regeneration of desired species.



A stream channels in Lyle Canyon Allotment before phase II implementation, March 2007.



Same stream channels in Lyle Canyon Ranching Allotment, July 2007.

99-070:

Award Amount: \$214,211.00

Amount Spent*: \$206,883.16

Planning Cost*: \$0.00

Implementation Cost*: \$206,194.07

Monitoring Cost*: \$689.09

*Best estimate derived from project files
and total may not equal amount spent or
awarded.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Medium-Low**

Effective, useful example for other projects: **Medium-Low**

Lessons learned: **Low**

Public education/awareness and value: **Low**

Evaluation Summary: 97-027 & 99-070

It is clear that this ranch project had some direct affects to the washes on the allotments. Fencing to created a riparian pasture effectively excludes cattle from the riparian areas, which has allowed grasses, much of which is blue or black grama (bouteloua gracilis/eriopoda), to recover; grasses are grazed, but not grazed to ground. New saplings are becoming established although some were taken out with floods. An addition to the project which would have moved it toward high benefit would have been plantings in the riparian area in addition to natural recruitment. This is a good example of the type of ranch project that is appropriate to fund through AWPf.



Upland pastures of Lyle Canyon Ranching Allotment prior to water development, 1999.



Same upland pastures on Lyle Canyon Ranching Allotment after water development occurred, July 2007.

Case Study: Demonstration Enhancement of Riparian Zone and Stream Channel along Stretch of Pueblo Colorado Wash At Hubbell Trading Post National Historic Site & Continued Enhancement of Pueblo Colorado Wash at Hubbell Trading Post National Historic Site

Grant No.: 97-029WPF
& 00-104WPF

Project Purpose: 97-029

Rehabilitate and enhance the riparian environment of the stream channel of Pueblo Colorado Wash as it traverses Hubbell Trading Post National Historic Site.

Overall Benefits
Realized: **High**

97-029:

Award Amount: \$91,110.00

Amount Spent*: \$90,755.58

Planning Cost*: \$14,500.00

Implementation Cost*: \$22,100.00

Monitoring Cost*: \$44,155.58

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives: 97-029

- 1) Reintroduce/restore a sinuous, meandering channel.
- 2) To secure the riparian area from livestock trespass.
- 3) Remove invasive species (Russian olive, tamarisk) from the riparian area.
- 4) Re-vegetate stream channel and riparian environment with appropriate or historically accurate species.
- 5) Work collaboratively and cooperatively with tribal, federal, local agency partners, Apache County and local communities.
- 6) Monitor and measure changes.
- 7) Ensure the project is a model demonstration effort.



Riparian enhancement work. October 2007.

Case Study: Demonstration Enhancement Riparian Zone and Stream Channel along Stretch of Pueblo Colorado Wash at Hubbell Trading Post National Historic Site & Continued Enhancement of Pueblo Colorado Wash at Hubbell Trading Post National Historic Site

Grant No.: 97-029WPF
& 00-104WPF

Project Purpose: 00-104

To continue the stream restoration work on the Pueblo Colorado Wash initiated under AWPf Grant 97-029.

Overall Benefits
Realized: **High**

Stated Objectives: 00-104

- 1) To monitor and document changes in the fluvial geomorphology of the Pueblo Colorado Wash stream channel. To secure the riparian area from livestock trespass through fencing.
- 2) To modify in-stream structures to expedite channel evolution toward the desired, stable long-term condition. Re-vegetate stream channel and riparian environment with appropriate or historically accurate species.
- 3) To monitor and document changes, if any, in water quantity through measurements of the: crest stage gage through slope-conveyance measurements; staff plate; precipitation can; two shallow monitoring wells.
- 4) To monitor and document changes, if any, in water quality.
- 5) To monitor and document plant species composition and trend toward potential natural vegetation community and to document significance of in-stream vegetation in support of meander development.
- 6) To monitor effectiveness of new exotic species eradication technique (EZject) and reoccurrence rate of re-sprouts: re-treatment of exotic species re-sprouts in the fall and the spring; use of control areas to document differences in reoccurrence rates.
- 7) To complete a wildlife survey to document the use of Pueblo Colorado Wash and presence of indigenous wildlife. Establish a baseline wildlife inventory to compare against as the project progresses.
- 8) To continue to chronicle the expected, as well as the unexpected changes and accomplishments of this project funded by AWPf from 1998-2000.
- 9) To increase educational value of project and expand outreach effort to local and regional community.

00-104:

Award Amount: \$69,349.00

Amount Spent*: \$59,319.87

Planning Cost*: \$2,100.00

Implementation Cost*: \$50,919.87

Monitoring Cost*: \$0.00

*Best estimate derived from project files and total may not equal amount spent or awarded.



Riparian enhancement work. October 2007.

Project Highlights and Lessons Learned:

- Model demonstration showing successful restoration of sinuosity, removal of non-native invasive species, and reestablishment of native vegetation.
- The "induced meanders" reinitiated the meander processes of the natural stream channel and reconnected the floodplain by raising the level of the channel bed almost 1 meter (~3 feet) .
- Non-native species were burned and mechanically removed and native vegetation successfully planted. Management of livestock appears effective and has allowed the new vegetation to become established.
- Instead of relying of volunteers, including additional funding to employ local labor would increase the effectiveness of the implementation and knowledge by the local community.
- National Park Service, Ganado Chapter, Navajo Nation Water Resources and Navajo Nation EPA are hoping to continue similar practices downstream of project area.



Looking downstream from project. pretreatment May 1998.



Looking downstream from similar location. October 2007.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **High**

Effective, useful example for other projects: **High**

Lessons learned: **High**

Public education/awareness and value: **Medium-High**

Evaluation Summary:

97-029: Objectives were to restore sinuosity/function to stream channel, secure riparian area from livestock trespass, remove non-native invasive species, reestablish native vegetation, work with tribal, federal, local agencies, monitor changes, and create a model demonstration effort. Project practices appear to have been very successful in restoring geomorphology, assess to the floodplain, and stream functions. Non-native species were removed and native vegetation replanted. The project required effective coordination with tribal, federal, and local agencies. Many of the lessons from the project are being actively taught to other landowners and practitioners by the technical consultant (Bill Zeedyk), Navajo Nation EPA and Water Resources, and the high visibility of the project (at a NPS site) provides education to the general public. This project provides all four types of benefits for the AWPf.

00-104: The project was a continuation of 97-029 with similar objectives and provided more time to monitor results and revise practices. The monitoring was successful and practices were improved. The success of the project has spawned many similar projects mostly in New Mexico but grantee and Navajo Tribe wish to extend project downstream. Lessons learned are being incorporated in other projects and the project has opportunity to educate a large segment of the general public.



Photo showing channel adjustments. October 2003.



Present stable condition of channel. October 2007.

Case Study: Demonstration Enhancement Riparian Zone and Stream Channel along Stretch of Pueblo Colorado Wash at Hubbell Trading Post National Historic Site & Continued Enhancement of Pueblo Colorado Wash at Hubbell Trading Post National Historic Site

Grant No.: 97-029WPF
& 00-104WPF



May 1998.



October 2003.



May 2003.

Case Study: Demonstration Enhancement Riparian Zone and Stream Channel along Stretch of Pueblo Colorado Wash at Hubbell Trading Post National Historic Site & Continued Enhancement of Pueblo Colorado Wash at Hubbell Trading Post National Historic Site

Grant No.: 97-029WPF
& 00-104WPF



Rock baffle "induced meander" structures. July 1998.



Rock, post, rock baffle structure. October 2007.



Post baffle structure. May 2003.



Post and single-rock riffle structure. May 2003.

Case Study: Demonstration Enhancement Riparian Zone and Stream Channel along Stretch of Pueblo Colorado Wash at Hubbell Trading Post National Historic Site & Continued Enhancement of Pueblo Colorado Wash at Hubbell Trading Post National Historic Site

Grant No.: 97-029WPF
& 00-104WPF



Post vane installation, November 2000.



Post vane installation, November 2000.



Post Vane, May 2003.



Post Vane, October 2007.

Case Study: Oak Tree Gully Stabilization

Grant No.: 97-034WPF

Project Purpose:

To stop the advancement of headcuts within Oak Tree Canyon and Empire Gulch on USFS lands and to promote channel stabilization.

Overall Benefits
Realized: **High**

Award Amount: \$42,491

Amount Spent*: \$38,753

Planning Cost*: \$3,788

Implementation Cost*: \$33,765

Monitoring Cost*: \$1,200

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

1. Stop the advance of headcuts within Oak Tree Canyon and Empire Gulch on lands administered by the USFS, both tributaries of Cienega Creek, a designated unique waterway.
2. Promote stabilization of existing channels within Oak Tree Canyon and Empire Gulch.



Low rock structures were installed to stabilize headcutting.
September 2007 .

Project Highlights and Lessons Learned:

- Low-tech rock structures were successful in stopping headcuts
- Re-sloping and seeding was a successful practice on small scour areas.
- Treatments are most effective on small stream channels.
- Structures should have small drops and center stream flow.
- Covering rock with dirt would speed reestablishment of grasses



Pre-project headcuts were numerous within the project area, September 1994.



Treatments were sound and covered with grasses, September 2007.

Evaluation Summary:

The structures constructed for the project have been successful in stopping the widespread headcutting in the area. Failures are very rare or non-existent despite several vigorous monsoon seasons. In many cases, the structures have filled with soil and nearly disappeared beneath naturally recruited grasses. Channel stability has been restored and sediment contributions to downstream Cienega Creek reduced. The project and its lessons would serve as a positive example for other landowners. The area is not accessible to the public so influence to the general population is limited. Overall the project provided substantial benefits to the resources of concern to the AWPf.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **High**
Effective, useful example for other projects: **High**
Lessons learned: **High**
Public education/awareness and value: **Low**



Gullies were numerous and active in 1994 photo.



Banks and bottoms stabilized in this 2007 photo.

Case Study: Watershed Improvements to Restore Riparian and Aquatic Habitat at Muleshoe Ranch

Grant No.: 97-035WPF

Project Purpose:

The objective is to restore riparian and aquatic habitat in 4 perennial streams on the Muleshoe Ranch Cooperative Management Area by restoring watershed vegetation and function. Actions are to restore fire as natural process with grazing rest and fencing of sensitive areas. Monitoring is planned after burning with baseline data collected.

Stated Objectives:

- 1) Conduct prescribed burns to improve watershed condition by changing structure and composition of vegetation.
- 2) Construct additional perimeter fencing.
- 3) Continue and expand monitoring program to evaluate benefits to watershed.
- 4) Signage to discourage ORV use.
- 5) Demonstrate how watershed management techniques can improve riparian and range habitats.

Overall Benefits
Realized: **High**

Award Amount: \$310,192.00

Amount Spent*: \$200,616.84

Planning Cost*: \$36,122.00

Implementation Cost*: \$100,770.49

Monitoring Cost*: \$65,374.42

*Best estimate derived from project files and total may not equal amount spent or awarded.



Control burn area at The Nature Conservancy's Muleshoe Ranch. August 2007.

Project Highlights and Lessons Learned:

- The grantee discovered that the optimal fire return interval for this ecosystem is eight to ten years; a fire interval that is more frequent than this inhibit the growth of native grasses. A fire interval less frequent allow for mesquite and other woody species to encroach, also inhibit native grass production.
- Hotter (>100 degrees) and drier conditions (relative humidity <5%) are best for moving fire through the system as desired.
- Presentation and demonstrations from this project have encouraged neighbors to conduct similar restoration activities.



Upland prior to prescribed fire.



Upland five years after control burn.
August 2007.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Medium**

Effective, useful example for other projects: **High**

Lessons learned: **High**

Public education/awareness and value: **High**

Evaluation Summary:

The benefits from the prescribed fire itself would render a rating of medium for this project. The area still needs some improvements, which is greatly influenced by the recent drought conditions in the area. The use of prescribed fire effectively reduced woody vegetation and increased grass production in the upland grasslands. This helps the riparian area to receive more runoff due to less uptake by upland vegetation. However, the more elaborate root system created by the grasses decreases soil loss, thereby reducing erosion and sediment that reaches streams and waterways. The amount of information disseminated from this project greatly contribute to the high rating it received. The collaboration among The Nature Conservancy and other researchers to use this project to understand the effects of fire on plants, animals, and ecosystems as a template to build upon for other fire projects also contribute to the rating received. The funded money has gone far and filled in many gaps about the use of prescribed fire in grassland restoration and the influences fire has on the overall health of ecosystems that historically had a low intensity, high frequency fire regime.



Upland control fire area. August 2007.

Case Study: Talastima (Blue Canyon) Watershed Restoration Project **Grant No.:** 97-037WPF

Project Purpose:

The purpose of this project is to restore the Talastima Watershed. Measures include removal of exotic trees, and the creation of livestock exclosures through fencing. Monitoring of results include monitoring well, drive point wells, on-ground data collection and remote sensing as well as study of road impacts on riparian health.

Stated Objectives:

- 1) Restore watershed to a healthy, fully functioning condition.
- 2) Improve surface water flow.
- 3) Improve percolation.
- 4) Improve riparian diversity and wildlife habitat.
- 5) Restore canyon for cultural and ceremonial use.

Overall Benefits
Realized: **Low**

Award Amount: \$310,192.00

Amount Spent*: \$200,616.84

Planning Cost*: \$36,122.00

Implementation Cost*: \$100,770.49

Monitoring Cost*: \$65,374.42

*Best estimate derived from project files and total may not equal amount spent or awarded.



Narrows of Talastima Canyon. Project area in background.
August 2007.

Project Highlights and Lessons Learned:

- Project included road analysis, vegetation and bird surveys combined with remote sensing techniques to assess Blue Canyon resources and stressors. Tamarisk removal project tested the effects of fire and mechanical removal.
- Tamarisk removal project did not succeed without re-vegetation component.
- Fire prescription did little to remove tamarisk.
- Mechanical removal without herbicide and re-vegetation had little effect on tamarisk control after a decade.
- Hopi Tribe has incorporated the lessons learned from removal project into wider acceptance of herbicide use with stringent regulation.



Mechanical removal of tamarisk treatment (2007).
Tamarisk has resprouted along with Russian thistle.



Prescribed fire treatment area (2007). Tamarisk has resprouted.

Case Study: Talastima (Blue Canyon) Watershed Restoration Project **Grant No.:** 97-037WPF

Evaluation Summary:

Overall, there may have been too much money spent on GIS mapping and road surveys that will not be used given the current management direction. Some of this information may have been used to change management direction; however, there was no record of how information was used. Of the on the ground activities, there was poor evaluation of the tamarisk removal treatment and poor follow through on the treatments. Some of this is likely due to changes in personnel management during the progress of the project. The project did create a better understanding of the uses and need for herbicides.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Low**

Effective, useful example for other projects: **Low**

Lessons learned: **Medium**

Public education/awareness and value: **Low**



Channel in Talastima prior to project.



Point wells were intended to monitor changes in groundwater due to tamarisk removal.

Project Purpose:

To restore channel and riparian vegetation along 2600 feet of channelized perennial stream; to determine causative factors behind aggradation and incision; to develop interpretive signs.

Overall Benefits
Realized: High

Award Amount: \$204,629.00

Amount Spent*: \$196,608.30

Planning Cost*: \$46,313.86

Implementation Cost*: \$87,013.01

Monitoring Cost*: \$42,755.00

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

- 1) Develop and implement channel stabilization and wetland protection plan for Clover Springs/Clover Creek. Protect rare upland riparian wetland meadow, stabilize degrading stream channel, control downstream headcuts. Protect springs; improve moisture storage, vegetation, and habitat. Gain knowledge to apply to other headcut sites.
- 2) Determine causes and timing of reach incision to develop long-term restoration strategy.
- 3) Educate public about ecosystem, disturbance, and restoration.



Clover Springs looking upstream.
September 2007.

Project Highlights and Lessons Learned:

- Very successful demonstration of wet meadow restoration.
- Drop structure used is well-designed.
- Informational kiosk is made of durable material and is very informational.
- Grantee would have liked to increase meander instead of using such a large drop structure that could fail.
- Some species of rushes are harder to establish than others.
- Great example of elk enclosure fencing.
- Hydro-mulching and/or fabric for seed establishment worked well.



Clover Springs pre-restoration. Notice erosion and depth of gully.



Photo taken in September 2007 looking same direction.

Evaluation Summary:

This project successfully met its objectives and restored the gully to a wet meadow system at original grade using one large drop structure at the downstream end of the project. The elk enclosure has protected the meadow and allowed vegetation inside to become vigorous. Seeding and fabric worked well; although, over the old road the vegetation is not as robust and possibly a result of years of compaction. Sedges and rushes were planted with varied success, but natural recruitment has been high. The channel is stable and the grade stabilization structure shows no signs of failure. The interpretive signage is prominently displayed and is informative. Refined techniques and lessons learned from this project have the potential of transferring knowledge to other projects.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **High**

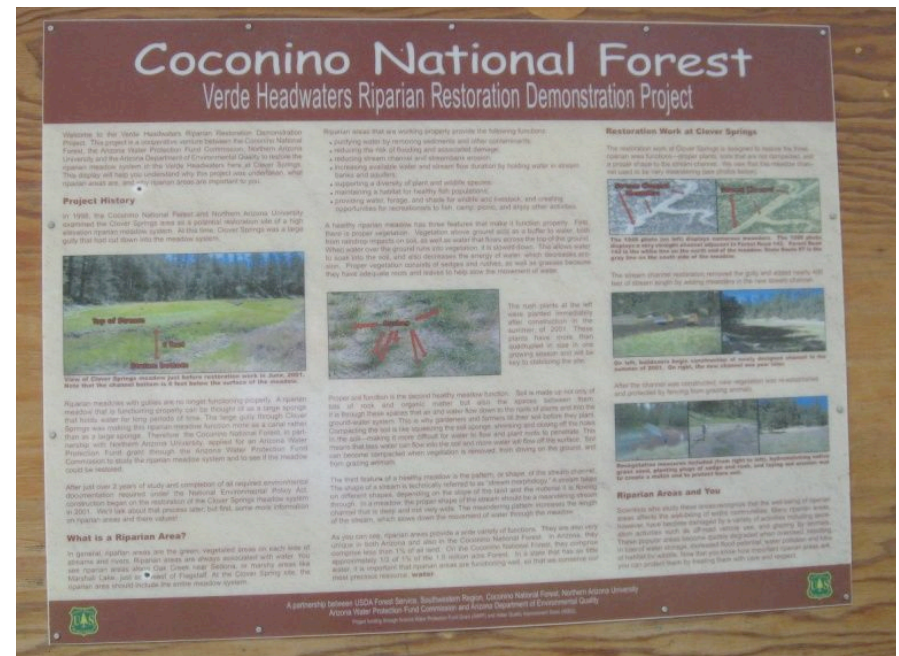
Effective, useful example for other projects: **High**

Lessons learned: **High**

Public education/awareness and value: **Medium**



Large drop structure at downstream end of project. September 2007.



Interpretive signage placed at both ends of project site. 2007.



Vegetation slowly establishing over old FS road. September 2007.



Elk enclosure fencing at project site. September 2007.

Project Purpose:

The purpose of the project is to build on the material and accomplishments produced in the previous Arizona Water Protection Fund grant by the Rincon Institute. Whereas the first grant developed educational material and introduced landowners to the importance of riparian conservation, the current grant will focus on two demonstration projects and continuation of outreach, education, and long-term conservation planning that will target several landowners who were involved in the first grant as well as additional landowners in the area. (previous grant #95-002)

Overall Benefits
Realized: **High**

Award Amount: \$54,734.55

Amount Spent*: \$54,239.55

Planning Cost*: \$14,627.87

Implementation Cost*: \$7,922.50

Monitoring Cost*: \$15,754.18

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

- 1) Singer Green Flood Control Effort
This objective/task includes the design and implementation of "green" structures to reduce bank erosion along Tanque Verde Creek. (*This objective and related tasks were later removed from project*).
- 2) Llewellyn Riparian Revegetation Project
Implement a revegetation strategy on Llewellyn property to re-establish native riparian habitat along an ecologically damaged reach of lower Rincon Creek.
- 3) Long-term riparian Conservation Planning
Continue outreach and the development of long-term conservation strategies with landowners, ranchers, and developers along Tanque Verde Creek, Rincon Creek, and Coyote Wash.



Upland plantings on the Llewellyn property project area.
August 2007.

Project Highlights and Lessons Learned:

- PVC piping is best to keep small animals from chewing through irrigation line.
- Removal of the old berm would have further enhanced this project by allowing flows to follow their natural course.
- Land owner seeded and grew own container plantings for local, well adapted vegetation.



Flood terrace planting zone before project implementation.
September 1999.



Flood terrace planting zone several years after project completion.
August 2007.

Evaluation Summary:

Overall, this project is a great template for restoration projects in the area. The Rincon Institute is interested in expanding on this project and the landowner is interested in a “Phase II” to further improvements on the land. Good lessons have been learned about the area, what vegetation works, and how to increase success of restoration efforts. Efforts to improve aesthetics and restore riparian function are important to show the general public the potential of the area; especially when the area is under the threat of development.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **High**

Effective, useful example for other projects: **High**

Lessons learned: **Medium**

Public education/awareness and value: **Low**



Flood terrace on opposite banks from Llewlyn plantings terrace.
August 2007.



Llewlyn planted flood terrace.
August 2007.

Project Purpose:

Rehabilitation of Hay Mountain Watershed. The watershed has been impacted by over grazing, loss of native vegetation, increased sheet flow and stream erosion. Project will be completed with drinkers, ripping and replanting of native grasses, repair of erosion control structure and building flood control structures. Grantee will also implement a local educational program aimed at high school students. Work will be done in conjunction with federal and state agencies as well as conservation NGOs.

Overall Benefits
Realized: **Medium**

Award Amount: \$116,525.00

Amount Spent*: \$89,119.15

Planning Cost*: \$2,511.98

Implementation Cost*: \$84,209.97

Monitoring Cost*: \$515.04

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

- 1) Increase water retention.
- 2) Convert rill flow to sheet flow using low cost erosion control structures.
- 3) Restore and repair large erosion control spillway.
- 4) Improve grazing management by improving water supply to different pastures.
- 5) Establish monitoring program.
- 6) Establish educational program.



Hay Mountain Ranch during summer monsoons, upper drainage washes. August 2007.

Project Highlights and Lessons Learned:

- Small earthen berms do not function in a watershed of this size.
- V-mesh spreader structures worked well in upper drainage washes, to trap sediment and spread flows.
- Seeding must be done just before monsoons to be effective, retreatment will increase success.
- Concrete drop spillway is a significant structure that protects a gas line upstream and requires constant maintenance.



Abandoned floodplain on Hay Mountain Ranch prior to project completion.



Abandoned floodplains on Hay Mountain five years after project completion. August 2007.

Evaluation Summary:

This ranch project was a combination of direct ranch improvement and watershed restoration. The efforts to reduce rills and increase sheet flow worked well and deemed worthwhile practices. Some of the earthen berms are holding and allowing more water to soak into the ground. The major issue of cut-bank erosion in the channel needs to be more directly addressed. Fencing was effective in controlling grantee's cattle and eliminating trespass cattle.

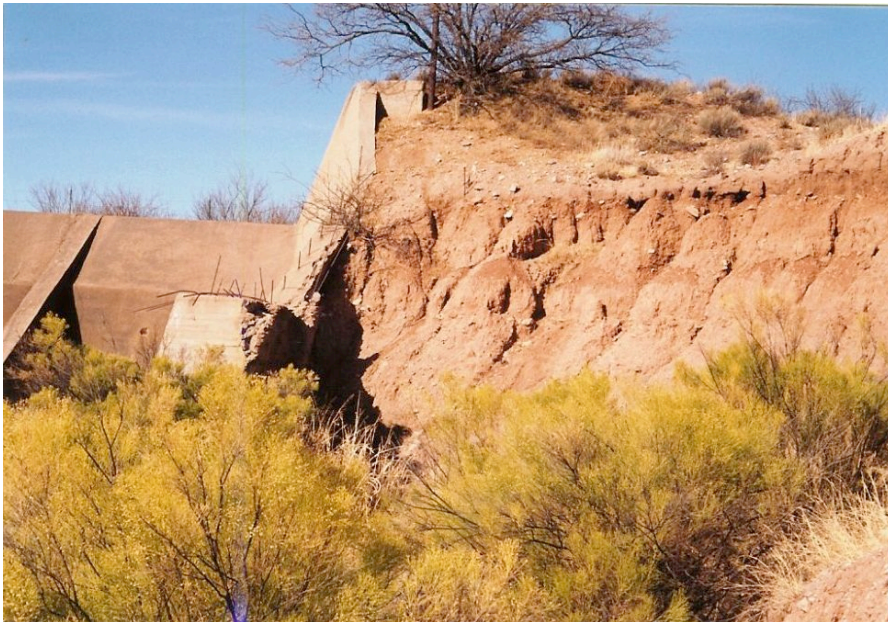
Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Medium**

Effective, useful example for other projects: **Low**

Lessons learned: **Medium**

Public education/awareness and value: **Low**



Spillway before stabilization construction began.



Spillway five years after project completion. August 2007.



Pasture above the spillway before project completion.



Pasture above the spillway five after project completion.
August 2007.

Case Study: Riparian And Watershed Enhancement on the A7 Ranch- Lower San Pedro River

Grant No.: 99-069WPF

Project Purpose:

Construct fencing and upland water developments to facilitate use of the A7 Ranch as a grass bank while protecting riparian habitat and enhancing upland vegetative production.

Stated Objectives:

- 1) Statistically analyze and assess changes over time in land conditions and degradation of riparian areas. Aid riparian areas in recovery.
- 2) Maintaining or decreasing the depth to ground water levels. Reintroduce prescribed fire into management plans. Decrease soil loss and increase groundwater levels over time.
- 3) Improve range conditions and exclude livestock from sensitive perennial riparian areas.
- 4) Reduce soil loss and sediment transport.
- 5) Use A7 Ranch as a Grass Bank facility. Implement rules: 1) No expansion of herd size; 2) Participants shall be cooperators of the NRCD; 3) Cooperators' conservation plans will be updated; 4) Archaeological assessments will be an element.

Overall Benefits
Realized: **Low**

Award Amount: \$521,197.45

Amount Spent*: \$521,197.45

Planning Cost*: \$55,150.49

Implementation Cost*: \$446,046.96

Monitoring Cost*: \$0.00

*Best estimate derived from project files and total may not equal amount spent or awarded.



Perennial spring fed stream in the canyon on the A7 Ranch Allotment.
August 2007.

Case Study: Riparian and Watershed Enhancement on the A7 Ranch- Lower San Pedro River

Grant No.: 99-069WPF

Project Highlights and Lessons Learned:

- Straw bales and waddles are not recommended because javelina and deer eat them, brush and woody debris is more appropriate.
- Sediment traps do not work well in high sediment systems. Design criteria should include adequate storage of sediment for at least 10-years.
- Seeding should be conducted just before monsoon season.
- Above ground piping made water too hot for cattle to drink, must have a tank to cool water before it is delivered to drinkers, or bury piping. Burying pipe line also helps to reduce vandalism.
- A zigzag fence design is a waste of time and money. Fencing should be done in straight lines unless blocked by unmovable barrier.



Upland vegetative cover at the time of fencing installation.



Upland vegetative cover August 2007.

Case Study: Riparian and Watershed Enhancement on the A7 Ranch Lower San Pedro River

Grant No.: 99-069WPF

Evaluation Summary:

In general, the project was a ranch improvement project, rather than riparian improvement project. Fencing was the most direct practice utilized to help riparian areas, but fencing was also observed plainly crossing the channel rather than fencing specifically around it to control grazing in washes. The perennial spring is naturally protected by steep, rocky terrain and is a beautiful asset to the ranch. Little treatment was needed there. Providing reliable water to the uplands keeps cattle from needing to use the riparian area. Reducing water evaporation is a great strategy and pumping the water to all pastures for improved water distribution improved the grazing management, but did not notice any direct stress relief in riparian areas.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Low**

Effective, useful example for other projects: **Low**

Lessons learned: **Medium-Low**

Public education/awareness and value: **Low**



Dirt tank in the uplands of A7 Ranch. Tank leaks into drainage channel. August 2007.



Drainage channel that stock tank leaks into. August 2007.

Project Purpose:

The purpose of the project is to restore 10 acres of native cottonwood/willow habitat along the Colorado River at Lees Ferry and eradicate tamarisk from 63 tributaries of the Colorado River in the Grand Canyon. Ten acres of cottonwood/willow habitat will be re-vegetation

Overall Benefits
Realized: **High**

Award Amount: \$371,285.00

Amount Spent*: \$370,642.63

Planning Cost*: \$10,500.00

Implementation Cost*: \$185,132.80

Monitoring Cost*: \$127,312.71

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

- 1) Evaluate ecological role of tamarisk and potential success of its control in the Colorado River ecosystem between Glen Canyon and Separation Canyon on Lake Mead.
- 2) Establish a 10-acre stand of native vegetation, including cottonwood, willow, and saltbush at Lees Ferry.
- 3) Remove tamarisk from 63 tributaries of the Colorado River in the lower section of Glen Canyon and Grand Canyon.
- 4) Monitor the overall environmental health of the 10-acre riparian revegetation project.
- 5) Monitor the success of the 63 tributaries tamarisk removal.



Cottonwood and willow trees established along Colorado River at Lees Ferry. 2007.

Project Highlights and Lessons Learned:

- Monoculture tamarisk stand was replaced with structurally diverse stand of multiple native species
- Significant avifauna response to treatment (Diversity and Abundance)
- Irrigation was required to establish stand and irrigation infrastructure was removed after 3 years
- All plantings required individual wire cages to protect them from beavers
- Tributary removal is successful, ongoing and expanding to new tributaries throughout Grand Canyon
- Successful, high profile project that has helped initiate tamarisk removal throughout Grand Canyon



Pre-restoration view of project site at Lees Ferry showing monoculture tamarisk forest. 2004.

Evaluation Summary:

Good demonstration project in a high visibility area. Given the current hydrology and known vegetation conditions, this is probably a good mix of vegetation and a proper planting scheme. Project has spurred National Park Service interest in tamarisk removal throughout the park as well as another re-vegetation project upstream.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **High**

Effective, useful example for other projects: **High**

Lessons learned: **High**

Public education/awareness and value: **High**



Salt bush and ink weed were planted on the high terrace away from river. Notice decaying tamarisk brush pile in center of photo. 2007.



New cottonwoods and willows are approximately 20-feet tall and set seed for the first time in 2007.

Project Purpose:

The purpose of the project is to demonstrate that the stability of a stream reach can be improved using methods based on hydro-geomorphic principles and that this can have a beneficial effect on the structure and function of the entire riparian ecosystem

Overall Benefits
Realized: **High**

Award Amount: \$263,225.00

Amount Spent*: \$227,661.21

Planning Cost*: \$25,670.40

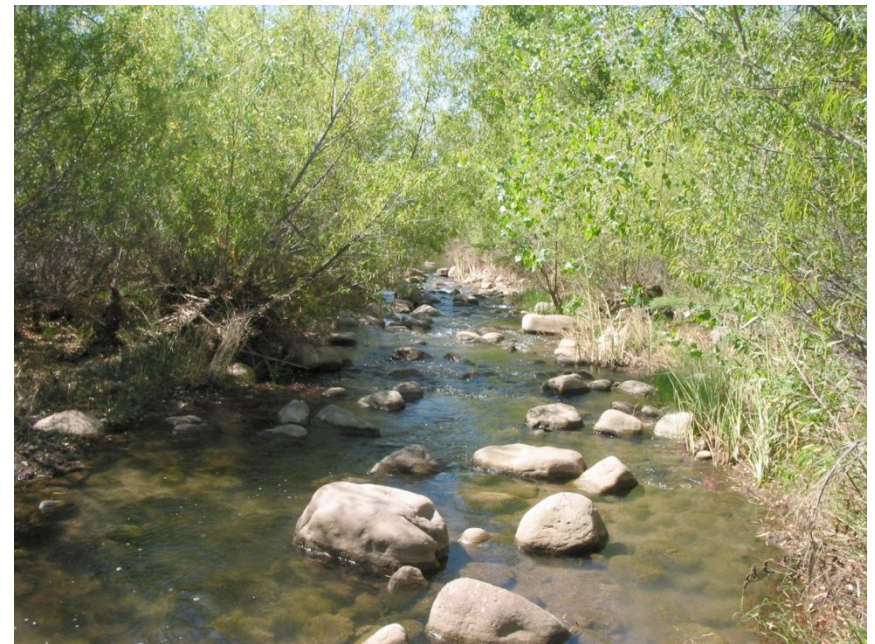
Implementation Cost*: \$189,816.58

Monitoring Cost*: \$14,308.02

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

- 1) Increase the stability of the stream channel while maintaining the natural dynamic stream processes
- 2) Enhance the quality and quantity of riparian vegetation communities along this reach of Cherry Creek as measured by improvement in structural diversity and vegetative cover over time.
- 3) Provide integrated water sources for wildlife outside the active channel and to design the project to withstand low impact recreation and camping.
- 4) To assist in educating other land and natural resource managers (both public and private) about these techniques for stream and riparian restoration.



Riparian vegetation has become well established along Cheery Creek.

Project Highlights and Lessons Learned:

- Vegetation practices were largely successful and are contributing to improved stream habitat. Bioengineering practices such as brush revetments, baccharis fascines were very effective.
- Weirs were washed out during 7000 cfs flood. However channel has stabilized and does not endanger road crossing or road along river bank.
- Extensive, thoughtful monitoring program will yield lots of information to educate future projects
- Perched groundwater below active channel may inform other hydrologic studies in the southwest.
- Cherry Creek exhibited a complex (generally positive) response to practices and flooding which occurred after practices were installed



Cherry Creek during 2003 monitoring before large flood event.



Similar view of Cherry Creek in 2007. Stream has migrated to right of photo, but vegetation is well established along channel.

Case Study: Cherry Creek Riparian Enhancement Demonstration Project

Grant No.: 99-083WPF

Evaluation Summary:

Many lessons were learned during the course of this project as the result of thoughtful monitoring and follow up studies by the grantee. Future projects will be well informed by the successes and failures at Cherry Creek. However, this was a large multifaceted project, with a complex goal of increasing vegetation density and extent over a long period of time. As a result of significant flooding, the stream did not react in a straightforward manner to many of the practices. As such the benefits gained and lessons learned will not be appreciated without thorough, long-term study. Even though the two major grade control structures failed during a large flood they seem to have helped stabilize the stream and prevent further down cutting. The major goal of the project, to establish and expand riparian vegetation, has been achieved. Aquatic and riparian habitats are improving as a result of practices used in this project.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **High**

Effective, useful example for other projects: **Low**

Lessons learned: **High**

Public education/awareness and value: **Low**



Seep willow plantings are well established a short distance from the stream. Cherry Creek is just to left of photo behind willows.



Cottonwoods are established just uphill of seep willow plantings.

Project Purpose:

To develop a site-specific concept plan and construct a river restoration demonstration project on a reach of the Upper Little Colorado River. The project will incorporate a natural channel approach that will demonstrate an effective means for restoring a destabilized stream channel.

Overall Benefits
Realized: **High**

Award Amount: \$348,627.94

Amount Spent*: \$348,014.71

Planning Cost*: \$36,084.43

Implementation Cost*: \$152,576.94

Monitoring Cost*: \$77,166.44

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

- 1) To increase the stability of the stream channel while maintaining their natural dynamic stream processes.
- 2) To enhance the native riparian vegetation along this reach of the Little Colorado River as measured by improvement in the amount of native riparian and wetland vegetative cover along stream banks and within the floodplain over time.
- 3) To assist in educating other landowners and natural resource managers (both public and private) about these techniques for stream and riparian restoration and to use this area as an outdoor classroom to supplement the Apache NRCD's Education Center existing curriculum on biology, aquatic and riparian systems, domestic livestock, and wildlife interactions.



Toe rock and willow plantings used to stabilize banks on the Little Colorado River Demonstration Project.

Project Highlights and Lessons Learned:

- Multiple bank protection measures implemented and monitored.
- Practices which worked well were implemented to replace failing practices over the course of the project
- Project is located on public land which is heavily visited by general public. Project has multiple interpretive signs for various practices.
- Project has been used for several landowner workshops
- Workshops and demonstrations have encouraged and initiated several local stream enhancement projects.



Typical eroded bank along Little Colorado River in 2002.



Same bank in 2006 after bank sloping, rock toe protection and re-vegetation.

Evaluation Summary:

This is a successful demonstration project with a high public profile that has generated interest and education in stream conservation techniques. The site is well visited with lots of interpretive signs. Current practices are performing well, banks are stable and well vegetated. Monitoring of specific practices will help inform future projects. Continued management of nonnative vegetation will be required since weeds from adjacent, abandoned fields are beginning to show in riparian zone.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **High**

Effective, useful example for other projects: **High**

Lessons learned: **High**

Public education/awareness and value: **High**



Slope bank with newly planted vegetation and Christmas tree revetments. Note erosion control fabric and stakes. 2007.



Rock weir installed for grade control and water diversion demonstration.

Case Study: Little Colorado River Enhancement Demonstration Project

Grant No.: 99-092WPF



Bank re-sloping with re-vegetation. 2007



Willows sprouting from pole bundles. 2007.



Interpretive signage is located at many points along visitor trail.



Wooden post vanes slow near shore velocities and capture sediment.

Project Purpose:

To enhance one of the last perennial reaches of streams not managed for recreational fisheries on the Lakeside Ranger District. This will be accomplished by excluding livestock grazing and managing for native riparian and aquatic communities. Baseline inventory and annual monitoring to determine success of a larger livestock management project and vehicular river crossing-reduction. Prepare a riparian management plan for a 2.5 mile stream reach.

Overall Benefits
Realized: **Medium**

Award Amount: \$34,037.00

Amount Spent*: \$20,118.02

Planning Cost*: \$3,825.00

Implementation Cost*: \$8,606.66

Monitoring Cost*: \$7,686.36

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

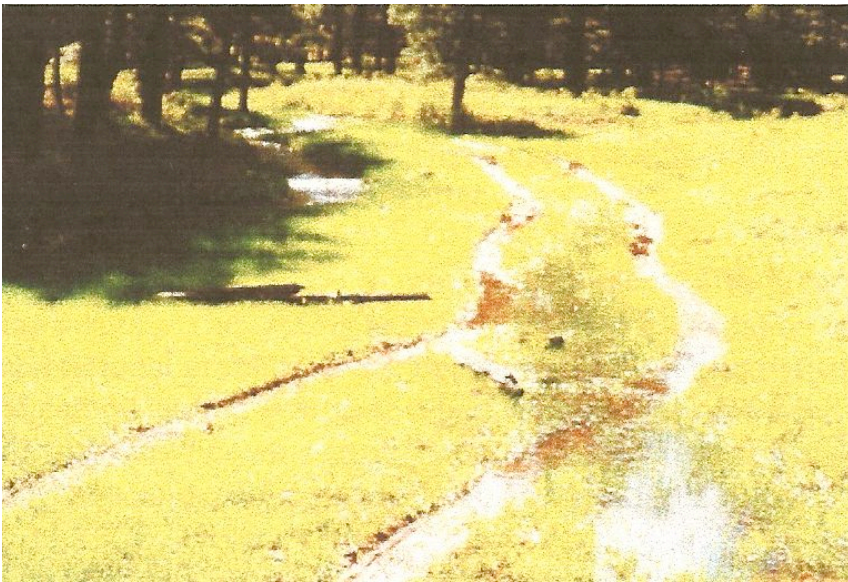
- 1) Improve riparian and aquatic habitat at Brown Spring and along Brown Creek by excluding livestock grazing in the area.
- 2) Implement a monitoring program to measure the improvements of vegetative cover and stream bank stabilization along Brown Creek riparian corridor.



Stream inside the fencing enclosure 2007.

Project Highlights and Lessons Learned:

- Buck and pole fencing is aesthetically pleasing, but is not very effective to restrict livestock, cattle, and recreation use because it does not hold up well.
- Signage is not enough to inhibit OHV use. Fencing or some other obstruction is need to block vehicle access.
- Exclosure was very effective in inhibiting use, which prevented further degradation and has allowed the riparian corridor to begin to heal.
- Planting native riparian vegetation would have helped the healing and function of the riparian area.
- Seeding in the uplands, while continuing grazing does not work.
- Relocating unofficial campsite might discourage OHV use in the stream channel.



Riparian area before fencing and vehicle access restrictions.
1999.



The riparian area today with the construction of exclusion fencing.
2007.

Evaluation Summary:

The benefits of this project could have been higher if the grazing experiment had not gone wrong and the informal campground issue had been dealt with in a more aggressive manner. Otherwise fencing, drinker installation and reduction of grazing in the uplands and excluding them from a section of the riparian area appear to be working quite well.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Medium**

Effective, useful example for other projects: **Medium-High**

Lessons learned: **Low**

Public education/awareness and value: **Low**



Rain catching storage tank just after completion of construction, before seeding. 2000.



Similar rain catch storage tank in 2007. Area surrounding tank was seeded in 2000.



View from outside fencing enclosure gate. 2007



View of the stream directly inside fencing enclosure. 2007.

Case Study: Rio Salado Habitat Restoration Project

Grant No.: 99-098WPF

Project Purpose:

To install a demonstration project area for the full-scale Rio Salado Habitat Restoration Project (RSHRP) in order to test planting, irrigation, and re-vegetation techniques and to monitor mosquito populations, storm water quality and plant response. To propagate plant materials for the open water marsh, cottonwood/willow and mesquite riparian habitats for both the demonstration project and a portion of the full-scale RSHRP.

Overall Benefits
Realized: **High**

Stated Objectives:

- 1) Test planting and establishment methods for riparian vegetation; wetland marsh, cottonwood/willow gallery forest, and mesquite bosque to determine vegetative health of plants dug with an auger to the water table vs. plant pits that are dug by standard horticultural industry methods.
- 2) Determine an efficient water distribution system that will optimize specific habitat needs while minimizing long-term maintenance and replacement cost. Identify an irrigation regime that will optimize plant establishment and can be modified to replicate the natural watering regimes of wetland marsh, cottonwood/willow gallery forest, and mesquite bosque.
- 3) Evaluate the impact of overhead spray on the selected plant communities for the three primary habitat types; wetland marsh, cottonwood/willow gallery forest and mesquite bosque.
- 4) Contract with a grower to provide the required number of Sonoran Desert riparian trees, shrubs, ground covers, and aquatic plants for the Rio Salado Habitat Restoration Project's wetland marsh, cottonwood/willow gallery forest, and mesquite bosque habitats.
- 5) Assess the ancillary benefits of running storm water discharges that currently enter the Salt River, within the Rio Salado Habitat Restoration Project. Construct wetland marsh habitats to improve water quality.
- 6) To minimize to the extent possible, mosquito breeding and nuisance conditions.

Award Amount: \$950,408.00

Amount Spent: \$949,908.00

Planning Cost*: \$53,010.50

Implementation Cost*: \$862,340.89

Monitoring Cost*: \$24,556.61

*Best estimate derived from project files and total may not equal amount spent or awarded.



The Rio Salado Project established native riparian plantings in a park setting along the dry Salt River in Central Phoenix.

Project Highlights and Lessons Learned:

- Drip and open channel irrigation were both effective in establishing plantings.
- “Wet” riparian species (cottonwood, willow) will continue to require supplemental irrigation for maintenance due to the deep groundwater table.
- The open channel irrigation provided tremendous natural recruitment of cottonwood, willow, and baccharis which reduced the need to plant these species.
- Cattails are a great nuisance in the open channels and backwater/wetlands and impossible to eradicate, requiring constant maintenance to control.
- The riparian plantings including open channels and backwater/wetlands produced fewer mosquitos than the abandoned tires and other pre-project trash.



Trash was removed and project area was recontoured and backwater wetland created. Supplemental irrigation was used to establish native plantings. January 2003.



Cottonwood, willow, and ash surround backwater/wetland. Quailbush, mesquite, acacia, wolfberry and other more xeric species are planted on the adjacent terrace. October 2007.

Case Study: Rio Salado Habitat Restoration Project

Grant No.: 99-098WPF

Evaluation Summary:

The project is located along the dry terraces of the Salt River in Central Phoenix. The Salt River is now ephemeral due to upstream regulation and the current groundwater elevation is well below riparian species rooting depths. The City plans to create riparian habitats along this reach of the river. The objectives of the project were to test various planting methods, species, and irrigation strategies to be used in the larger project. A second objective was to create a diverse native riparian plant community. The project was successful in meeting its objectives. The 6 acre site now contains a robust, diverse native habitat that is attracting muskrats, peregrine falcons, coyotes, and other native wildlife species dependent on these ecosystems. Lessons learned during the project were noted and are being incorporated into ongoing projects. The area is now a formal park and is used by thousands of urban visitors. On the other hand, the cost for the 6 acres of habitat was almost \$1 million and the system is entirely dependent on pumped groundwater for survival. Overall, the creation of habitat, lessons extended to other projects, and public education components are worth the cost and therefore the project benefits are High.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Medium-High**

Effective, useful example for other projects: **High**

Lessons learned: **High**

Public education/awareness and value: **High**



Due to the deep groundwater, plantings had to be supplemented by irrigation. Here drip irrigation supplies water to a Desert willow (*Chilopsis linearis*). Irrigation was removed from the more xeric desert species once established but riparian species require continued irrigation.



Riparian species with high soil moisture requirements were supported with open channel irrigation. This irrigation system is less efficient than drip but encouraged natural recruitment of the riparian species.



The project is located in the center of Phoenix and is visited by thousands of people each year. The project trails and signs provide the opportunity to educate the general public on the importance of Arizona riparian systems.

Rio Salado project includes creation of a backwater/wetland, streamside riparian plantings, and desert riparian species.



Case Study: Murray Basin and Saffel Canyon Watershed Restoration **Grant No.:** 00-101WPF

Project Purpose:

To restore two severely degraded upper watersheds to satisfactory conditions, reduce erosion processes currently in force, and restore channels to their natural form and function.

Stated Objectives:

- 1) Stabilization of gully banks to reduce erosion.
- 2) Narrow the stream channel and widen the riparian zone.
- 3) Establish herbaceous vegetation and riparian shrubs in Picnic Creek.
- 4) Reduce density of pinyon-juniper stands in uplands to increase herbaceous growth and reduce runoff volumes.
- 5) Obliterate and rehabilitate undesignated roads and trails from 10 mi/mi² to an average of 2 mi/mi².
- 6) Eliminate OHV use in project area.
- 7) Improve soil water retention in uplands and valley bottoms.

Overall Benefits
Realized: **Medium**

Award Amount: \$260,727.83

Amount Spent*: \$260,727.83

Planning Cost*: \$0.00

Implementation Cost*: \$260,727.83

Monitoring Cost*: \$0.00

*Best estimate derived from project files and total may not equal amount spent or awarded.



Restored gully. 2007.

Project Highlights and Lessons Learned:

- Gullies removed and more natural channel shapes restored.
- Rock placement and spacing is critical to structural success.
- Multiple re-seeding efforts are needed for successful vegetation establishment.
- Multiple years of construction are needed to repair and install additional structures.



Pre-construction gully. Spring 1999.



Post-construction – gully removed. September 2007.

Case Study: Murray Basin and Saffel Canyon Watershed Restoration **Grant No.:** 00-101WPF

Evaluation Summary:

The majority of the project eliminated the gullies which were dominant in the uplands of this system. Erosion has been significantly reduced and aggradation has occurred in the bottom of the channels. Seeding has not been as successful as they would have liked, but vegetation is slowly filling in. The elimination of OHV use and road closures has vastly improved the range conditions. Riparian vegetation has not improved as much as was expected.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Medium**

Effective, useful example for other projects: **Medium**

Lessons learned: **Low**

Public education/awareness and value: **Medium-Low**



Pre-construction headcut. Summer 2000.



Repaired headcut becoming revegetated. September 2007.

Case Study: Upper Eagle Creek Restoration On
East Eagle Allotment of Four Drag Ranch

Grant No.: 00-102WPF

Project Purpose:

Construct range improvements that will protect and improve watershed and riparian conditions. Improvements are aimed at improving watersheds and habitat that support Spikedace and Loach minnow habitat.

Overall Benefits
Realized: **High**

Award Amount: \$66,330

Amount Spent*: \$64,793.36

Planning Cost*: \$938.84

Implementation Cost*: \$60954.52

Monitoring Cost*: \$0.00

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

- 1) To implement all range improvements on the East Eagle Allotment as delineated by the U. S. Fish and Wildlife Services' Biological Opinion on Ongoing Grazing Activities on Allotments, which was issued to the U.S. Forest Service in response to impacts on threatened Spikedace and Loach minnow from livestock grazing on the East Eagle Allotment.
- 2) To develop and implement a monitoring strategy that documents the current condition and project related improvements of upland and riparian habitat on the East Eagle Allotment.
- 3) To prepare a public presentation that provides for information transfer of project need, goals and objectives
- 4) Maintain improvements for 20 years.



Existing riparian corridor on Eagle Creek. September 2007.

Project Highlights and Lessons Learned:

- The riparian zone is functioning well, hydrologic conditions and native fish habitat have improved.
- Upland range conditions have improved due to improved pasture water developments and improved grazing plan.
- Fiberglass tanks and troughs are not strong enough to withstand curious bears.



Pre-project upland range conditions. pre 2000.



Post project upland range conditions. September 2007.

Case Study: Upper Eagle Creek Restoration on
East Eagle Allotment of Four Drag Ranch

Grant No.: 00-102WPF

Evaluation Summary:

This project was initiated and implemented because of the Biological Opinion on Ongoing Grazing Activities on Allotments developed by the U.S. Forest Service regarding livestock grazing around critical habitat for Loach minnow and Spikedace. Monitoring reports indicated positive changes in riparian and upland vegetation. Overall, the project has benefited the riparian and upland areas. This is the type of ranch improvement project that might be an appropriate candidate for funding based on the stated purpose and objectives of AWPF. The project did benefit the riparian area. Since the completion of the AWPF project, the grantee has utilized other grants to continue improvements to the land (ADEQ & ADA). Management and maintenance continues.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **High**

Effective, useful example for other projects: **High**

Lessons learned: **Low**

Public education/awareness and value: **Low**



Eagle Creek riparian corridor at beginning of project implementation. September 2001.



Eagle Creek riparian corridor. September 2007.

Case Study: Riparian Restoration on the Santa Cruz River - Santa Fe Ranch

Grant No.: 00-103WPF

Project Purpose:

The purpose of this project is to reestablish a riparian corridor along a 1,200-foot reach of the Santa Cruz River at the Santa Fe Ranch, in Santa Cruz County. The riparian corridor will protect the site from further bank erosion and serve as an outdoor educational experience for local schools and the public.

Overall
Benefits
Realized: **Low**

Award Amount: \$49,008.00

Amount Spent*: \$48,320.00

Planning Cost*: \$3,979.00

Implementation Cost*: \$10,097.00

Monitoring Cost*: \$7,752.00

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

- 1) Erosion control
- 2) Revegetation of the area
- 3) Increase public awareness of riparian systems and values



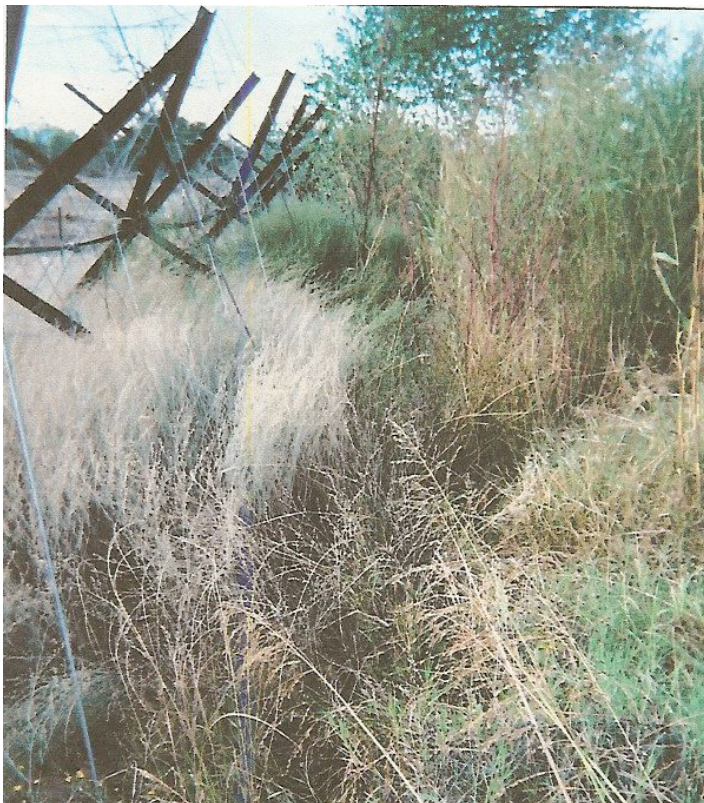
Native riparian species were planted along the stream bank behind the Kellner Jacks for erosion protection and habitat. 2007.

Case Study: Riparian Restoration on the Santa Cruz River -
Santa Fe Ranch

Grant No.: 00-103WPF

Project Highlights and Lessons Learned:

- Sprinkler system encouraged invasive species colonization
- Drip or other irrigation method may be more effective for riparian plantings
- More attention needs to be paid to effective riparian plantings



Pre-project vegetation dominated by grasses. 2003.



Despite plantings, invasive Johnson grass dominates project site. There is very little native riparian vegetation is present at the project site. 2007.

Case Study: Riparian Restoration on the Santa Cruz River - Santa Fe Ranch

Grant No.: 00-103WPF

Evaluation Summary:

The grantee appears to have entered the grant process with the best intentions. However, the project resulted in only a handful of riparian trees. The lack of project success is underscored by the natural recruitment of many riparian plants along the active stream channel only a few hundred yards away. It appears that an ineffective irrigation system was to blame but was not recognized. No additional plantings are planned. Plantings by volunteers provided some positive public education but the lack of success may actually reduce enthusiasm for future projects. The ranch is now being operated as an educational center and has the potential for positive outreach but the lessons will not be positive until the project practices are more successful. The project provided few benefits consistent with AWPf goals.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Low**

Effective, useful example for other projects: **Low**

Lessons learned: **Low**

Public education/awareness and value: **Low**



A variety of native riparian species were planted by volunteers along the project streambank. 2004.



The failure of project plantings is contrasted by vigorous natural recruitment along the adjacent Santa Cruz River. 2007.

Case Study: Hubbell Trading Post Riparian Restoration With Treated Effluent

Grant No.: 00-105WPF

Project Purpose:

To continue restoration of the habitat at the Hubbell Trading Post National Historic Site using treated effluent from the Navajo Tribal Utility Authority facility. Restoration shall occur on the upper terrace of the Pueblo Colorado River.

Overall Benefits
Realized: **Low**

Award Amount: \$81,951.00

Amount Spent*: \$81,951.00

Planning Cost*: \$7,345.81

Implementation Cost*: \$65,990.00

Monitoring Cost*: \$4,972.00

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

- 1) Deliver treated effluent to the proposed habitat restoration area.
- 2) Reestablish the cottonwood/willow grove on the bank of the river.
- 3) Monitor the plants and soils to demonstrate the value of effluent as a renewable resource in the region.



Limited cottonwood plantings growing on the Pueblo Colorado River Terrace. October 2007.

Case Study: Hubbell Trading Post Riparian Restoration with Treated Effluent

Grant No.: 00-105WPF

Project Highlights and Lessons Learned:

- Great opportunity to demonstrate developing an irrigation system using treated effluent.
- National Park Service is pleased with the conveyance system and success of the demonstration garden (garden not part of the AWPf grant) and has requested help to renovate the irrigation system to the riparian terrace as well as expand the application downstream. There appears to be adequate water available, no information in files as to quantity and application rates documented.
- No irrigation water is being delivered to the five drain fields except manual watering. This may be a result of system design deficiencies, however the garden area irrigation system appears to be functioning well.
- An above ground drip irrigation system may be a more appropriate application in very fine silty sand soils. The drain fields appear to be clogged possibly as a result of the use of a woven geotextile instead on a non-woven fabric. In addition, the fabric may need to be installed between the gravel and fine soil layers instead of around just the pipe.
- Diameter of woody materials was small (~1 inch), cottonwood plantings tend to be more successful using 3 to 4 inch posts. In addition, a great amount of energy must go to the 5 ft length sticking out of the ground instead of focusing on root development; after planting cuttings should be trimmed 6 to 12 inches from the ground. Unknown if planting occurred during dormant season.



Habitat restoration area along terrace. September 2004.



Habitat restoration area along terrace. October 2007.

Case Study: Hubbell Trading Post Riparian Restoration with Treated Effluent

Grant No.: 00-105WPF

Evaluation Summary:

The objectives of the project were to provide water to support interpretive gardens and establish native riparian vegetation (cottonwood/willow) on the flood terraces along Rio Pueblo Colorado, to monitor the project, and demonstrate effectiveness of using effluent in the local area. The project irrigation system was plagued with problems that limited the direct "on the ground" benefits to the riparian system. Monitoring was effective but did not provide information to repair irrigation system. As a consequence, the project did not provide a positive example of effective use of effluent. The lessons learned are not well understood and have not been transferred to other projects and there is little or no potential to educate the general public. There are few benefits to AWP resources of concern.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Low**

Effective, useful example for other projects: **Low**

Lessons learned: **Medium**

Public education/awareness and value: **Low**



Cottonwood plantings just after installation. August 2005.



Cottonwood planting success and failure. October 2007.

Case Study: Hubbell Trading Post Riparian Restoration with Treated Effluent

Grant No.: 00-105WPF



Conveyance pipe (black) crossing Pueblo Colorado Wash from sewage lagoons towards NPS. October 2007.



Collection reservoir at Hubbell Trading Post. From here water is delivered to gardens or riparian terrace. October 2007.

Project Purpose:

The project purpose is to restore two degraded reaches of the Howard and Priest Draws in the Lake Mary Watershed, perform short and long-term monitoring activities on the reaches, and complete survey of Upper and Lower Lake Mary.

Overall Benefits
Realized: **Medium**

Award Amount: \$253,118.00

Amount Spent*: \$221,415.59

Planning Cost*: \$88,170.84

Implementation Cost*: \$104,154.57

Monitoring Cost*: \$6,147.18

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

- 1) To restore two degraded reaches of stream, both of which have watershed scale impacts.
- 2) To protect and possibly improve the water quality of Lake Mary.
- 3) To protect and possibly improve the water quality of Lake Mary.
- 4) Disseminate information related to project and overall watershed to public.



Priest Draw within the Lake Mary Watershed. August 2007.

Project Highlights and Lessons Learned:

- High benefits gained from road removal.
- Trail impacts are important consideration as a riparian stressor.
- Low water trail crossing was need to mitigate high pedestrian traffic.
- Removal of additional failing rock weir structures is needed to prevent local scour and erosion.



Old road crossing in Priest Draw. 2000.



Road crossing in Priest Draw seven years after removal. August 2007.

Evaluation Summary:

The objectives of this project were to restore two degraded reaches, protect and improve water quality, establish long term monitoring points, educate the public. One reach was partially restored, while the other saw little to no benefits from implementation of the project. The removal and relocation of the roads has helped to protect and improve water quality; to what extent is not clear. Although long term monitoring points were established, they are no longer used and are beginning to deteriorate. It is unclear how much information was provided to the public regarding this project. Priest Draw is seeing improvements and vegetation is returning to the system and the banks. There are still a few old weirs that continue to degrade the stream channel because flows have started to cut around the structures into the banks. Howard Draw benefitted only slightly to not at all from this project.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Medium**

Effective, useful example for other projects: **Medium**

Lessons learned: **Medium**

Public education/awareness and value: **Low**



Cut banks in Howard Draw near the Priest Draw confluence. August 2007.



Reshaped and seeded banks in Priest Draw. August 2007.

Project Purpose:

To protect approximately 15 acres of wet meadow and 0.5 mile of an intermittent stream channel in the headwaters of the Willow Creek Watershed from detrimental ungulate impacts. Promote restoration of the native riparian plant community and facilitate recovery of the drainage morphology.

Stated Objectives:

- 1) Increase the vigor and abundance of existing native species of riparian vegetation.
- 2) Restore a Bebb's willow community that once dominated this cienega.
- 3) Prevent the onset of new degradation to the drainage channel morphology while reducing the size of existing headcuts in the stream.

Overall Benefits
Realized: **High**

Award Amount: \$35,515.00

Amount Spent*: \$32,084.00

Planning Cost*: \$1,005.00

Implementation Cost*: \$28,579.00

Monitoring Cost*: \$1,500.00

*Best estimate derived from project files and total may not equal amount spent or awarded.



Fence line contrast: right side of fence is inside enclosure. 2007.

Project Highlights and Lessons Learned:

- Successfully halted active headcuts and prevented further channel incision from occurring in the meadow upstream.
- Allowed for a much more diverse wet meadow plant community to recover
- Bebb's willow restoration efforts are difficult and need more attention than was provided



Advancing headcut prior to enclosure. Spring 2000.



Headcut hidden by tall grasses, no longer advancing. August 2007.

Evaluation Summary:

The objective of the project was to increase the vigor and abundance of existing native vegetation, restore Bebb's willow community, and to prevent further onset of headcuts and down cutting to the channel. The project successfully completed these objectives, except to restore Bebb's willow. The Bebb's willow present is stressed and struggling. Sedges, rushes, grasses and other forbs have become well established on the banks. Headcuts and downcutting of the channel has halted and the system is healing inside the enclosure. Directly outside the enclosure on the downstream end, the channel continues to degrade and headcuts are advancing up to the enclosure. Ponderosa pine are encroaching into the valley and there is a lot of dead ponderosa pine in the area. Overall this was a successful project that highly benefited the riparian system.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **High**

Effective, useful example for other projects: **High**

Lessons learned: **Low**

Public education/awareness and value: **Low**



Headcut advancing into wet meadow system. Summer 1999.



Existing decadent Bebb's willows prior to fencing.
Summer 1999.



Same Bebb's willow with new sprouts at base.
August 2007.

Case Study: Cooperative Grazing Management For Riparian Improvement On The San Pedro

Grant No.: 00-111WPF

Project Purpose:

To improve a major Arizona riparian area by providing the physical and social infrastructure to better manage a sub-watershed that directly feeds a perennial portion of the San Pedro River.

Overall Benefits
Realized: **Low**

Award Amount: \$228,701.00

Amount Spent*: \$208,188.28

Planning Cost*: \$683.00

Implementation Cost*: \$19,8521.18

Monitoring Cost*: \$3,192.93

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

- 1) To develop a cooperative grazing management plan.
- 2) To improve water holding capacity of the soil.
- 3) To engender a sense of responsibility and stewardship in local community.



Installation of drinkers and corrals allowed better management of Double Check Ranch along the San Pedro River.

Case Study: Cooperative Grazing Management for Riparian Improvement on the San Pedro

Grant No.: 00-111WPF

Project Highlights and Lessons Learned:

- Water improvements and fencing to enhance herd management
- Cooperative grazing plan with neighboring ranch (The Nature Conservancy)
- Riparian litter cleanups with local volunteers
- Sponsored herding work shop
- Used cattle to successfully obliterate ORV trails
- Wildlife friendly, smooth-wire fencing worked well for managing cattle



Grant sponsored community cleanup of riparian area.



ORV trails were closed in this area.

Case Study: Cooperative Grazing Management for Riparian Improvement on the San Pedro

Grant No.: 00-111WPF

Evaluation Summary:

The main thrust of this grant was to improve the ability of the landowners to graze in an environmentally sensitive manner. To this end they succeeded and used the funding wisely. The grantees are obviously sensitive to the needs of the stream and riparian area and are attempting to make a living from the land in ways that will eventually improve the function of the San Pedro River. However, except for the direct fencing and cleanup activities, there is likely to be little improvement to the riparian zone or the stream for quite a while due to the practices in this grant. Despite this shortcoming, the grantees learned a lot from the project tasks and the grant process as a whole. The grantee will be able to apply many of the lessons learned from this grant to the management of their new ranch; as well as being able to educate the new owners of the Double Check Ranch on some of these lessons. While their attempts at community education may have been frustrating, the outcome has been positive even though improvements are slow to be realized.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Medium Low**

Effective, useful example for other projects: **Low**

Lessons learned: **Low**

Public education/awareness and value: **Medium High**



Pipeline and reservoir tanks were installed to distribute water from existing wells.

Case Study: Tucson Audubon Society North Simpson Farm Riparian Recovery Project.

Grant No.: 00-115WPF

Project Purpose:

The purpose is to extend a riparian enhancement project initially funded by the ACOE. Previous work involved the preparation of a comprehensive site assessment on the 350 acre Tucson Audubon Society Santa Cruz River North Simpson Farm Project, with 6 acres of riparian habitat recovery work. The AWPf funding will enhance 20 acres through a variety of techniques and will engage the local community in the restoration activities.

Overall Benefits
Realized: **Medium**

Award Amount: \$127,409.30

Amount Spent*: \$124,111.78

Planning Cost*: \$9,206.69

Implementation Cost*: \$71,461.97

Monitoring Cost*: \$22,215.20

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

- 1) Assess the site to identify favorable areas for AWPf habitat recovery efforts and develop a restoration and rainwater harvesting plan for the AWPf area.
- 2) Increase plant diversity, decrease erosion, and improve the sustainability of the riparian corridor at this site, link the riparian corridor with adjacent abandoned agricultural land to expand habitat available to birds, animals and plants using the site.
- 3) Monitor the results of the restoration efforts with varying rainwater harvesting, mulching and seeding and planting regimes to determine rates of survival of plantings.
- 4) Engage local and regional members of the public and governmental bodies in learning and recovery activities at the site to promote a sense of stewardship, educate and act as a model for other habitat recovery efforts.



Created perches to attract predator birds. July 2007.

Project Highlights and Lessons Learned:

- Project utilized dead woody debris as perches to attract predator birds to control rodent populations.
- Rodents, specifically gophers, frequently chewed through irrigation piping.
- Project used a large variety of species for plantings, which can increase survival rates for various species in this ecosystem type. Species diversity is high.
- Bird species diversity and density has increased since project completion.
- Basins were created around plantings to collect rain water. This practice decreased runoff, increase infiltration, and aided in watering plantings.
- Cottonwoods were planted parallel to the channel which caused water to channelize behind each row of plantings. To help mitigate this problem plantings should be placed perpendicular to the stream channel.



Flood terrace plantings along constructed old berm. October 2002.



Flood terrace plantings along old constructed berm. July 2007.

Case Study: Tucson Audubon Society North Simpson Farm Riparian Recovery Project

Grant No.: 00-115WPF

Evaluation Summary:

Overall, this project received a medium rating for benefits realized. Many issues are still present with channel function and shape. However, this project focused primarily on increasing vegetation abundance and diversity to promote bird habitat and utilization. Although the area had previously been moderately covered with vegetation, the added diversity was important and successful in creating a multiple layered vertical structure and the addition of desirable species which appear to attract more birds and may attract new bird species. Berms and channel constriction, some of which are outside grantee's control, pose additional obstacle to complete rehabilitation of the site; some of these obstacles threaten planted vegetation. The techniques used to plant vegetation may compromise revegetation efforts if stream flows reach bankfull levels or greater. Vegetation planted in rows perpendicular to the channel may have been more effective in protecting stream stability; rather than the applied technique which planted vegetation parallel to the stream channel. This project is a good start to complete riparian rehabilitation.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **Medium**

Effective, useful example for other projects: **Medium-High**

Lessons learned: **High**

Public education/awareness and value: **Medium-High**



Flood terrace plantings. October 2004.



Flood terrace plantings. July 2007.

Project Purpose:

The grantee and its cooperators intended to increase the duration of annual stream flow in Cottonwood Creek and enhance the riparian corridor along the creek and upland communities. The project included the installation of 750-800 rock structures throughout the Cottonwood Creek Watershed in the uplands, and the development and implementation of a grazing management and fencing plan along the creek.

Overall Benefits
Realized: **High**

Award Amount: \$185,772

Amount Spent*: \$180,440

Planning Cost*: \$30,200

Implementation Cost*: \$107,386

Monitoring Cost*: \$25,200

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

- 1) Increase the annual duration of base water flow in Cottonwood Creek and in the 13 miles of tributary channel network. This will benefit riparian vegetation and wildlife along the riparian corridor of Cottonwood Creek and extend it up into the tributaries.
- 2) Reduce direct impacts to Cottonwood Creek banks and riparian vegetation.
- 3) Monitor project results to ensure we are achieving our restoration objectives and refine the usefulness of project practices.



Hundreds of low rock structures were installed to capture sediment, dissipate energy, and increase infiltration. 2004.

Project Highlights and Lessons Learned:

- Structure designs were refined (ramp added) during project to reduce failures
- Treatments most effective when implemented in all channels throughout watershed
- Structures should have small drops with downstream aprons and center stream flow



Structures were placed in series in even the smallest channels. 2004.



Treatments were in place and covered with grasses. 2007.

Evaluation Summary:

The project channel structures have successfully weathered a number of flooding cycles and are effectively collecting sediment. Grass and forb density is vastly improved over pre-project conditions. Direct measurement of increases in groundwater and surface flow were difficult with the variability of precipitation and runoff. However, observation of the duration of flows in Cottonwood Creek suggest some improvement in surface flow duration. The project and lessons learned provide positive examples for other areas. The remoteness of the site reduces the potential for broad public education. The project has provided benefits for the resources targeted by AWPf.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **High**

Effective, useful example for other projects: **High**

Lessons learned: **High**

Public education/awareness and value: **Low**



Wildlife drinkers were also part of the project. 2007.



Structures are stable and ephemeral channels well vegetated. 2007

Overall Benefits
Realized: High

Project Purpose:

To restore a 0.3-mile stretch of Lynx Creek and at least two adjacent springs and seeps that have been drastically altered over the past 25 years due to the presence of a large manmade sediment trap.

Award Amount: \$179,771.50

Amount Spent*: \$176,985.79

Planning Cost*: \$2,065.44

Implementation Cost*: \$157,955.11

Monitoring Cost*: \$6,146.74

*Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

- 1) Reshape approximately 0.3 mile of stream channel based on a design that will allow the channel to be self-maintaining, to transport sediment efficiently through the system, and to naturally sustain a viable riparian/wetland vegetation community.
- 2) Reconnect seeps/springs to the stream channel to work in concert with the fluvial processes of the stream channel.
- 3) Revegetate approximately 3 acres of stream banks and seeps with native riparian and wetland vegetation appropriate to the site.
- 4) Educate the public about the importance of riparian and wetland areas in the region.



Riparian vegetation established on site. September 2007.

Project Highlights and Lessons Learned:

- The project successfully removed 20 years of accumulated sediment.
- Re-establishment of riparian vegetation was successful.
- Proper channel geometry was restored.
- More geotechnical investigations are needed to determine the original grade of the channel prior to any construction. More material should have been excavated to restore the original grade especially in the upper reach. The failure to remove this material resulted in downcutting of the channel and tributaries as well as failure of rock weirs.



Gabion structure and accumulated sediment upstream. September 2003.



Restored channel looking downstream towards gabion location. September 2007.

Evaluation Summary:

The objectives of the project were to restore the natural channel, reconnect tributaries/seeps, reestablish native riparian vegetation, and educate the public. The removal of accumulated sediments and channel excavation appear to have resulted in a stable, functioning channel despite subsequent adjustments. The riparian plant community is well established and should continue to spread over time. The area has easy public access and the potential to provide educational benefits. Lessons learned in the project are valuable but not being transferred to other projects or practitioners. Overall, the project greatly improved pre-project conditions and provide benefits to the AWPf resources of concern.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **High**

Effective, useful example for other projects: **High**

Lessons learned: **Medium-High**

Public education/awareness and value: **Medium- Low**



Sediment accumulation upstream of gabion dam.
September 2003.



Restored stream channel upstream of removed gabion structure.
September 2007.



Looking downstream at upper end of project area.
September 2003.



Looking downstream at same location as above photo.
September 2007.

Case Study: Wet Meadows for Water Quality and Wildlife –
A Riparian Restoration Project

Grant No.: 03-119WPF

Project Purpose:

The purpose of this project is to preserve, protect, and enhance five wet meadow sites (27 acres total) in the Apache Sitgreaves National Forest, Springerville Ranger District, through the use of elk proof enclosures.

Overall Benefits
Realized: **High**

Award Amount: \$137,027.30

Amount Spent*: \$133,726.35

Planning Cost*: \$10,517.85

Implementation Cost*: \$83,736.07

Monitoring Cost*: \$24,274.47

* Best estimate derived from project files and total may not equal amount spent or awarded.

Stated Objectives:

- 1) Improve wildlife habitat, including wild turkey nesting and brooding habitat.
- 2) Provide protection for populations of native riparian plant species, especially Bebb's willows.
- 3) Improve water quality by reducing soil compaction and increased infiltration.



Little Valley elk enclosure. September 2007.

Case Study: Wet Meadows for Water Quality and Wildlife – A Riparian Restoration Project

Grant No.: 03-119WPF

Project Highlights and Lessons Learned:

- Aspen regeneration and wet meadow restoration is occurring.
- Designed with wildlife access gaps that are being used by wildlife.
- Elk successfully excluded and shown on video monitoring.
- Volunteer base maintains fencing.
- Willow regeneration slower than expected.



Signage on each elk enclosure at point of public access. September 2007.



Wildlife access at bottom of elk enclosure fence placed around perimeter. September 2007.

Case Study: Wet Meadows for Water Quality and Wildlife –
A Riparian Restoration Project

Grant No.: 03-119WPF

Evaluation Summary:

Overall, there have been multiple benefits realized at the fencing sites. The area inside the exclosures are returning to a functioning wet meadow system, which includes hydrology, vegetation, soil conditions, and associated habitat. The grantee is maintaining the sites, through volunteer efforts, which guarantees that benefits will continue into the future. Lessons learned were considered low since elk exclosures are a tested way to help return meadows to functioning condition and design of elk exclosures is pretty well established. Through volunteer efforts and relative proximity of some exclosures to well traveled areas, public education and awareness was considered medium to high.

Sub-Categories of Benefits and Ratings

Direct benefits to riparian system: **High**

Effective, useful example for other projects: **High**

Lessons learned: **Low**

Public education/awareness and value: **Medium-High**



Aspen regeneration within exclosure at Duke Springs. September 2007.