Final Report

AWPF Grant Projects Evaluation

Phase II: Case Studies

Arizona Water Protection Fund

Phoenix, AZ

Natural Channel Design, Inc.

October 2007
Revised January 2008

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Submitted to:
Rodney Held
Arizona Water Protection Fund
Arizona Department of Water Resources
3550 N Central Ave., Ste 500
Phoenix, AZ 85012

Prepared by:
Natural Channel Design, Inc.
206 E. Elden St.
Flagstaff, AZ 86001

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ACKNOWLEDGEMENTS

A special thanks to all of the wonderful people that took the time to guide us through the project sites and share their lives, personal stories, project successes, and project failures with us. It is because of your willingness to share that the grant program can continue to grow and continue to work for the riparian resources that are so vital to all of our livelihoods in the state of Arizona.

The Arizona Water Protection Fund Commission has funded all or a portion of this report or Project.

The views or findings presented are the Authors and do not necessarily represent those of the Commission, the State, or the Arizona Department of Water Resources.

PROJECT BACKGROUND

The Arizona Water Protection Fund (AWPF) was established under the Arizona Department of Water Resources in 1994. The following description of the fund is provided in its website:

> "The Fund, which is administered by the director of ADWR and the State Land Commissioner, is earmarked for supporting projects that will enhance riparian areas. The authorizing legislation calls for "a coordinated effort for the restoration and conservation of the water resources of this state. This policy is designed to allow the people of this state to prosper while protecting and restoring this state's rivers and streams and associated riparian habitats, including fish and wildlife resources that are dependent on these important habitats."

The AWPF has funded 177 projects since its establishment. These projects have developed and implemented restoration practices to prevent or correct erosion issues, benefit water quality, create habitat, and/or generally enhance Arizona's riparian ecosystems. Many project practices have served the stated purpose of AWPF well; others have not. This assessment aims to evaluate the success of projects funded by the Arizona Water Protection Fund over the past 12 years, provide recommendations, and suggest tools to improve future projects. The goal of this assessment is to evaluate whether grant monies have been well spent through evaluating project success and how well they met AWPF purposes. Therefore, two over-arching objectives present themselves:

1) To evaluate the success of completed AWPF grant projects
2) To assess how effective the AWPF program has been in support of projects.

From these two over-arching objectives, a third objective arises:

3) Compile successful restoration and enhancement techniques to further improve project successes into the future and meet AWPF goals.

This project focuses on the first two objectives, with the understanding that the third objective may be addressed at a later date.

IN THIS REPORT

This report presents the findings of the second phase of this project as well as formal recommendations. Phase I included a general evaluation of all completed AWPF projects using information provided by staff and grantees in project documents. A set of "Case Studies" was selected for Phase II and included site visits and interviews with grantees. The recommendations in this document are the integration of Phase I file analysis and Phase II site visits.

The Phase II Final Report discusses the results of the project evaluations. Project benefits to riparian systems, both direct and indirect, are assessed and rated. Finally, the report includes recommendations for refining the grant process and increasing the effectiveness of project implementation. Fact sheets for each case study are included in Appendix B at the end of this report.

An Access™ database accompanies this final report. In it, are forms from both Phase I and Phase II. Phase I forms include the Summary Sheet form and the Score Sheet form and the appropriate data tables. Phase II forms include the Overall Evaluation form and three Practice forms used in the field during visits: Management, Vegetation, and Mechanical/Structural. Each practice used in a grant can be accessed directly from the Overall Evaluation form by clicking the buttons to the right of the list of practices entered at the top of the form.

THE ASSESSMENT PROCESS

The project was divided into two phases. The first phase included a general evaluation of all 128 completed projects using a standard set of criteria created by Natural Channel Design, Inc. (NCD) in collaboration with AWPF staff. The evaluation was based solely on project records in AWPF archives. If an in-depth description and analysis of the projects evaluated during Phase I is desired, please see the Phase I report. The second phase of the project included a subset of 42 projects that were chosen to serve as case studies by NCD and AWPF with Commission approval. Of these 42 projects, 5 sets of projects were considered continuations of the same project and were paired leaving a total of 37 projects for evaluation. Case studies were evaluated more intensively, including visits to the project sites and interviews with grantees and project implementers to measure the enduring benefits. NCD has been involved in the design and implementation of several AWPF projects. AWPF staff assisted in all field visits to NCD-related projects to confirm the evaluation staff findings.

ASSESSMENT GUIDELINES

During this assessment, several established protocol/goals by AWPF were used as a basis for evaluating projects and their success.

The primary goal of the AWPF projects is to directly improve conditions of riparian ecosystems in Arizona. The Water Protection Fund has created evaluation criteria to define direct resource benefits. These evaluation criteria are used by AWPF staff to rate new grant applications. In the same way, the evaluation criteria were used in this assessment to determine direct project benefits. These criteria are:

Primary issues of concern:

1) Protects/restores native riparian vegetation and habitat
2) Restores proper hydrologic conditions/functions
3) Restores proper stream geomorphology/channel characteristics
4) Restores floodplains
5) Restores wetlands/backwater areas

Secondary issues of concern:

1) Protects/restores habitat needs
2) Decreases negative impacts of non-native species
3) Protects/restores river, stream and riparian resources that will benefit state listed species of special concern
4) Protects/restores river, stream, and riparian resources that will benefit federally listed threatened and endangered (T&E) species, or species of special concern.

Additionally, the AWPF grant program is particularly unique because it provides project planning funding and funds for monitoring in addition to granting funds for project implementation. Thus, the assessment evaluated planning and monitoring efforts in order to assess how well grant funds were being spent in these vital components of the funded project.

Finally, public outreach and the transfer of information are important to the goals of AWPF and a component in many projects. Therefore, the assessment looked at how well information has been shared, used, and built upon over the life of the program and what can be done to improve this technology transfer.

SELECTION OF CASE STUDIES

From the 128 AWPF projects evaluated in Phase I, 42 projects were selected as case studies. Several criteria were used to select the case study candidates during Phase I of this assessment.

First, each case study had to be a capital project or have an 'on the ground' component to evaluate. Implemented "on-the-ground" practices provided the only opportunity to objectively measure effectiveness and/or benefit to the resource. Thus, case study selection was limited to capital projects.

Second, the project had to be completed. Projects that were terminated early with partial on the ground completion are, unfortunately, unsuccessful projects. The purpose of this assessment is not to add up failures, but to find out what practices are most successful from projects that met their contract obligations.

Third, each project selected as a case study candidate had to have an adequate baseline-monitoring component by which to measure success and/or effectiveness. Thus, each project on the candidate list has permanent photo points recorded with accompanying photos, at the very minimum. Many projects also have permanent transects or study plots recorded for repeated measurements.

Finally, case studies were intended to represent a range of counties, watersheds, project sizes, and project types similar to the larger pool of projects. They also needed to represent all years AWPF awarded grants.

Given the selection criteria, the chosen projects do not represent a random sample, but do represent an appropriate cross-section of AWPF projects.

Of 47candidates, 42 case studies were selected for site visits. Of the original candidates, four were de-selected by the AWPF Commission and one case study had to be dropped because the grantee would not return repeated phone calls from the evaluation staff or AWPF staff. Five grants were paired with their partner grant, thus 37 site visits and overall evaluations were completed. The average project cost of 42 case studies equals $202,318.00. This amount is much less than the average cost for all 87 capital projects evaluated in Phase I, which equals $231,119.00, but nearer the amount for 71 capital projects analyzed after terminated and withdrawn projects were excluded, which equals $204,709.00. The complete list of case studies that were evaluated in the field after Commission approval is listed in Table 1.

Table 1. List of case studies, the date they were visited, and project site guide.

Each grant is listed with the amount awarded and the date the site was visited by evaluation staff. Guides whom accompanied staff to the site are also listed. Grant #00-100 was dropped because the grantee did not respond to numerous calls by staff or AWPF and the project is located on private property.

Grant #:	Project Title:	Amount Awarded:	Date Visited:	Site Guide:
95-006	Critical Riparian Habitat Restoration along a Perennial Reach of a Verde River tributary	$102,535.00	8/14/07	Ed Smith
95-015	San Pedro Riparian National Conservation Area Watershed Rehabilitation Restoration Project	$286,000.00	7/26/07	Heather Swanson
95-020	Teran Watershed Enhancement	$151,753.00	9/7/07	Barbara Clark
95-021	Lofer Cienega Restoration	$161,204.00	7/18/07	Danial Parker
95-022	Gooseberry Watershed Restoration Project	$126,406.00	7/18/07	Danial Parker
96-0001	San Pedro Riparian National Conservation Area Watershed Protection and Improvement Project	$89,250.00	7/26/07	Heather Swanson
96-0003	Hoxworth Springs Riparian Restoration	$31,545.00	9/10/07	Dick Fleishman
96-0012	Eagle Creek Watershed and Riparian Stabilization	$80,626.00	9/13/07	Jim & Clarice Holder
96-0016	The 'Ahakhav Tribal Preserve	$1,131,477.00	8/22/07	Jennifer Cleland
96-0017	Big Sandy River Riparian Project	$92,000.00	8/21/07	N/A
96-0020	Cienega Creek Stream Restoration	$210,700.00	9/7/07	Jeff Simms
96-0025	Tsaile Creek Watershed Restoration Demonstration	$152,775.00	10/4/07	Michael Benson, Tom Morris, Irving Brady, Roman Pawluk
96-0026	Riparian Restoration on the San Xavier Reservation Community	$591,319.00	9/7/07	Lorinda Harvey
97-027	Lyle Canyon Allotment Area Restoration Project	$60,359.57	7/26/07	Steve Lindsey
97-029	Demonstration Enhancement of Pueblo Colorado Wash at Hubbell Trading Post	$91,110.00	10/3/07	Anne Worthington, Tom Morris, Michael Benson
97-032	Ahakhav Tribal Preserve - Deer Island Revegetation	$228,800.00	8/22/07	Jennifer Cleland
97-034	Oak Tree Gully Stabilization	$42,491.00	9/5/07	Shane Lyman
97-035	Watershed Improvement to Restore Riparian and Aquatic Habitat on the Muleshoe Ranch CMA	$128,315.00	8/28/07	Bob Rogers
97-037	Talastima (Blue Canyon) Watershed Restoration Project	$310,192.00	8/1/07	Sharon Lopez, Jon Mason, Bruce Keuwemptewa, others
98-050	Watershed Restoration of a High-Elevation Riparian Community	$304,775.00	7/11/2007 & 8/14/07	Ed Smith
98-059	Verde River Headwaters Riparian Restoration Demonstration Project	$204,629.00	9/10/07	Dick Fleishman
98-062	Partnership for Riparian Conservation in Northeastern Pima County II	$54,734.55	8/27/07	Annie Wallace & Chip Llewellyn
98-066	Hay Mountain Watershed Rehabilitation	$116,525.00	8/27/07	Ruth Cowan
99-069	Riparian and Watershed Enhancements on the A7 Ranch Lower San Pedro River	$521,197.45	8/28/07	Charles Kent
99-070	Lyle Canyon allotment Riparian Area Restoration Project Phase 2	$214,211.00	7/26/07	Steve Lindsey
99-075	Glen and Grand Canyon Riparian Restoration Project	$371,285.00	9/5/07	Larry Stevens
99-083	Cherry Creek Enhancement Demonstration Project	$263,255.00	8/28/07	Grant Loomis
99-092	Little Colorado River Enhancement Demonstration Project	$348,627.94	7/17/07	Daric Knight
99-095	Brown Creek Restoration Project	$34,037.00	7/19/07	N/A
99-098	Rio Salado Habitat Restoration Project	$320,540.00	10/3/07	Heather Watson
00-100	Willow Creek Riparian Restoration Project	DROPPED		
00-101	Murray Basin and Saffel Canyon Watershed Restoration	$260,727.83	10/4/07	Kathy McMillan
00-102	Upper Eagle Creek Restoration on East Eagle Allotment of Four Drag Ranch	$66,330.00	9/12/07	Darcy Ely
00-103	Riparian Restoration on the Santa Cruz River - Santa Fe Ranch	$49,008.00	9/5/07	Ron Fish
00-104	Continued Enhancement of Pueblo Colorado Wash at Hubbell Trading Post National Historic Site	$69,349.00	10/3/07	Anne Worthington, Tom Morris, Michael Benson
00-105	Hubbell Trading Post Riparian Restoration with Treated Effluent	$81,951.00	10/3/07	Anne Worthington, Tom Morris, Michael Benson
00-108	Lake Mary Watershed Streams Restoration Project	$253,118.00	8/2/07	N/A
00-110	Upper Fairchild Draw Riparian Restoration	$35,515.00	8/10/07	N/A
00-111	Cooperative grazing management for riparian improvement on the San Pedro	$228,701.00	10/5/07	Jean Schwennesen
00-115	Tucson Audubon Society North Simpson Farm Riparian Recovery	$127,409.30	7/25/07	Kendall Kroesen
03-116	Cottonwood Creek Restoration	$185,772.50	9/6/07	Jeff Hoff
03-117	Lynx Creek Restoration at Sediment Trap #2	$179,771.50	9/20/07	N/A
03-119	Wet Meadows for Water Quality and Wildlife- A Riparian Restoration Project	$137,027.30	9/27/07	Scott Lerich

SITE VISITS

The more intensive evaluation process in Phase II included visits to each project site. To be as consistent as possible, a set of field forms and protocol was developed for staff to complete and follow before visiting and during each site visit. Field forms associated with site visits can be viewed with the Supplemental Information provided with this report.

Before each site visit, evaluation staff attempted to contact each grantee and set up a meeting time to visit the site together or to interview them over the phone. If the grantee was not available, others involved with the implementation of the grant, or the landowner, were contacted for interviewing and a site tour. Many grantees and others associated with the projects took the time to meet with staff, which was extremely helpful and resulted in many insights. Only five projects were unaccompanied by the grantee or others associated with the project largely due to schedule conflicts (see Table 1). One case study was dropped from the list because the grantee did not return calls or allow access to the project site (#00-100WPF).

A project background form was completed by staff before each site visit to help staff become more familiar with the project and to have important information at hand during the site visit. Information recorded on the project background form included the project contact and the objectives of the project, what was monitored, and the details of the practices used. Site elevation and the size of the watershed at the project site were also recorded if available. On the project background form, each specific practice was given a unique number in order to keep track of which types of practices were used in each project.

Practice forms were created to evaluate management, vegetative, and mechanical/structural practices while at the site. One form for each category of practices was created. Information about the practice, whether it was functioning, if it needed repair or attention, whether it was built to specifications, or if it could be improved, and what kind of vegetation was located in the immediate area was recorded. The unique number given to the practice on the project background form was transferred to the appropriate practices form to give consistency between forms and also to make sure each practice recorded on the project background form was evaluated in the field.

During the site visit, staff walked the site with the guide, recorded coordinates of specific practices or the site in general if the practice was not point-specific, and asked a pre-determined set of interview questions, as well as any other questions that came to mind. A stream background form was completed on site, if applicable, and a checklist of site observations/characteristics was completed to make sure staff noted any important physical qualities of the site. Representative photos were taken of the practices used and of the site overall.

After the site visit, staff completed an overall project evaluation sheet to share details of their assessment of the project, the grantee's perspective and opinions, and to rate the project low, medium, or high based on how many benefits they felt the project realized. Additionally, four types of benefits were given ratings by staff, which informed the overall rating. The rationales for the categories are explained in the next section.

Finally, after all of the sites were visited, the entire evaluation staff met and discussed each project, the justification for the ratings it received, as well as the highlights and lessons learned from each project. Benefit ratings were assigned to each project as described below.

BENEFITS REALIZED

The goals of the AWPF program include directly maintaining, enhancing, or restoring Arizona's riparian resources, supporting innovative river and riparian research, and educating or affecting the general public about Arizona riparian areas. The primary goal of this evaluation process was to determine how well AWPF projects advanced these goals. If the AWPF program is to be considered a success, its funded projects should address the goals of the organization and benefit Arizona's riparian resources. Direct benefits are not the only way projects can effectively address AWPF goals. A project also has the ability to influence on other projects, influence local landowners, increase the general understanding of arid riparian systems, and increase the awareness of the general public. All of these outcomes of the project's implementation are also benefits, albeit indirectly. Project benefits, both direct and indirect, were evaluated using four specific categories. These categories include: Direct Benefits, Positive Examples, Lessons Learned, and Public Education/ Intrinsic Value. Finally, an overall 'Benefits Realized' rating was given to each project that allowed for any unique quality of the project to be taken into consideration that was not captured by any of the other four categories.

The five categories of benefits are:

1. **Direct benefits to riparian system.**
   Did the project provide "on the ground" protection, enhancement, restoration, and/or creation of benefits as described in the AWPF primary & secondary issues of concern?

2. **Provide a positive, effective example for other similar projects.**
   Has the project already been built upon by newer projects? Has it 'jumpstarted' or aided other projects? Has the project provided a good example for replication or does it have the potential to do so? Does the project have the potential to encourage or "jumpstart" other similar projects that could benefit the resources of concern to AWPF?

3. **Lessons learned.**
   Did the project learn lessons that extend, refine, or eliminate methods, practices, or theories in the field of stream restoration? Does the project have the potential to advance the field of stream restoration in Arizona and/or provide information that could make other projects more successful?

4. **Public education, awareness, and intrinsic value.**
   Did the project educate the community or surrounding landowners, bring awareness or value to the general public or community? Does the project have the potential to educate and influence the general public in such a way as to protect native riparian systems and support efforts to enhance, restore, or create them?

5. **Benefits Realized**
   Did the project meet the goals and mission of the AWPF and benefit the riparian resources of Arizona?

Direct benefits from project tasks were measured against the evaluation criteria (primary and secondary issues of concern) defined by AWPF and used to evaluate projects in the grant application process. These criteria generally focus on direct benefits to native riparian habitats, stream function, backwater habitats, and benefits to species of concern. These AWPF criteria are described in the Assessment section of this document. It is important to note that how each project scored in categories two through four (Effective Example, Lessons Learned, Public Education) was not only based on how the project actually did, but also its potential to realize those benefits with AWPF program improvement. In many cases these indirect benefits were not included in project tasks and not addressed by the grantee. Evaluating the potential to achieve these benefits, if the grantee had addressed them (such as Lessons Learned) allowed the project itself to be rated rather than the grantee. The 'benefits realized' rating given to each project was not simply a summation of the other categories but also included any unique quality of the project

not captured by any of the four categories. Benefit ratings for each project are presented in Table 2.

Table 2. Project benefits ratings.

Four categories of benefits were recognized and each project evaluated according to how well that benefit was met. Each project also received an overall 'benefits realized' rating. The first category, 'Direct Benefits', is based on AWPF's evaluation criteria (primary and secondary issues of concern) used in the application process.

Project Name	Grant #	Direct Benefits to the Riparian Area	Positive/ Effective Example for Others	Useful Lessons Learned	Public Education/ Awareness Value	Overall Benefits Realized
Critical Riparian Habitat Restoration along a Perennial Reach of a Verde River tributary	95-006 & 98-050	MEDIUM	MEDIUM-LOW	HIGH	HIGH	**MEDIUM**
San Pedro Riparian National Conservation Area Watershed Rehabilitation Restoration Project	95-015 & 96-0001	LOW	LOW	HIGH	LOW	**LOW**
Teran Watershed Enhancement	95-020	LOW	LOW	MEDIUM	LOW	**LOW**
Lofer Cienega Restoration	95-021	MEDIUM	HIGH	HIGH	LOW	**MEDIUM**
Gooseberry Watershed Restoration Project	95-022	LOW	LOW	LOW	LOW	**LOW**
Hoxworth Springs Riparian Restoration	96-0003	MEDIUM-HIGH	HIGH	HIGH	HIGH	**HIGH**
Eagle Creek Watershed and Riparian Stabilization	96-0012	MEDIUM-LOW	MEDIUM-LOW	MEDIUM-LOW	LOW	**MEDIUM**
The 'Ahakhav Tribal Preserve	96-0016 & 97-032	HIGH	HIGH	HIGH	HIGH	**HIGH**
Big Sandy River Riparian Project	96-0017	LOW	LOW	LOW	LOW	**LOW**
Cienega Creek Stream Restoration	96-0020	HIGH	MEDIUM	HIGH	MEDIUM-LOW	**HIGH**
Tsaile Creek Watershed Restoration Demonstration	96-0025	MEDIUM-HIGH	HIGH	HIGH	MEDIUM-HIGH	**HIGH**
Riparian Restoration on the San Xavier Reservation Community	96-0026	MEDIUM-HIGH	HIGH	HIGH	HIGH	**HIGH**
Lyle Canyon Allotment Area Restoration Project	97-027 & 99-070	MEDIUM-LOW	MEDIUM-LOW	LOW	LOW	**LOW**
Demonstration Enhancement of Pueblo Colorado Wash at Hubbell Trading Post	97-029 & 00-104	HIGH	HIGH	HIGH	MEDIUM-HIGH	**HIGH**
Oak Tree Gully Stabilization	97-034	HIGH	HIGH	HIGH	LOW	**HIGH**
Watershed Improvement to Restore Riparian and Aquatic Habitat on the Muleshoe Ranch CMA	97-035	MEDIUM	HIGH	HIGH	HIGH	**HIGH**
Talastima (Blue Canyon) Watershed Restoration Project	97-037	LOW	LOW	MEDIUM	LOW	**LOW**
Verde River Headwaters Riparian Restoration Demonstration Project	98-059	HIGH	HIGH	HIGH	MEDIUM	**HIGH**
Partnership for Riparian Conservation in Northeastern Pima County II	98-062	HIGH	HIGH	MEDIUM	LOW	**HIGH**
Hay Mountain Watershed Rehabilitation	98-066	MEDIUM	LOW	MEDIUM	LOW	**MEDIUM**

Project Name	Grant #	Direct Benefits to the Riparian Area	Positive/ Effective Example for Others	Useful Lessons Learned	Public Education/ Awareness Value	Overall Benefits Realized
Riparian and Watershed Enhancements on the A7 Ranch Lower San Pedro River	99-069	LOW	LOW	LOW	LOW	**LOW**
Glen and Grand Canyon Riparian Restoration Project	99-075	HIGH	HIGH	HIGH	HIGH	**HIGH**
Cherry Creek Enhancement Demonstration Project	99-083	HIGH	LOW	HIGH	LOW	**HIGH**
Little Colorado River Enhancement Demonstration Project	99-092	HIGH	HIGH	HIGH	HIGH	**HIGH**
Brown Creek Restoration Project	99-095	MEDIUM	MEDIUM-HIGH	LOW	LOW	**MEDIUM**
Rio Salado Habitat Restoration Project	99-098	MEDIUM-HIGH	HIGH	HIGH	HIGH	**HIGH**
Murray Basin and Saffel Canyon Watershed Restoration	00-101	MEDIUM	MEDIUM	LOW	MEDIUM-LOW	**MEDIUM**
Upper Eagle Creek Restoration on East Eagle Allotment of Four Drag Ranch	00-102	HIGH	HIGH	LOW	LOW	**HIGH**
Riparian Restoration on the Santa Cruz River - Santa Fe Ranch	00-103	LOW	LOW	LOW	LOW	**LOW**
Hubbell Trading Post Riparian Restoration with Treated Effluent	00-105	LOW	LOW	MEDIUM	LOW	**LOW**
Lake Mary Watershed Streams Restoration Project	00-108	MEDIUM	MEDIUM	MEDIUM	LOW	**MEDIUM**
Upper Fairchild Draw Riparian Restoration	00-110	HIGH	HIGH	LOW	LOW	**HIGH**
Cooperative grazing management for riparian improvement on the San Pedro	00-111	MEDIUM-LOW	LOW	LOW	MEDIUM-HIGH	**LOW**
Tucson Audubon Society North Simpson Farm Riparian Recovery	00-115	MEDIUM	MEDIUM-HIGH	HIGH	MEDIUM-HIGH	**MEDIUM**
Cottonwood Creek Restoration	03-116	HIGH	HIGH	HIGH	LOW	**HIGH**
Lynx Creek Restoration at Sediment Trap #2	03-117	HIGH	HIGH	MEDIUM-HIGH	MEDIUM-LOW	**HIGH**
Wet Meadows for Water Quality and Wildlife- A Riparian Restoration Project	03-119	HIGH	HIGH	LOW	MEDIUM-HIGH	**HIGH**

Direct Benefits

Direct benefits to the riparian area was rated based on observed and documented changes that occurred to the project area that increased the value of riparian ecosystem properties; including ecosystem function, wildlife habitat, and water quantity and quality. Projects that scored high in this category successfully accomplished enhancing and creating one, two, or all three of these properties. A number of projects, mostly involving active ranches, implemented upland practices such as fencing and water development. This is primarily due to the projects focus on upland changes to relieve stress to the riparian area. The direct benefits to the riparian system from these projects were dependent on the effectiveness of livestock management. Those projects that scored high had effectively managed livestock in the riparian areas. Livestock management scored lower

if it was less effective or failed to create any direct benefit. However, the indirect benefits from these projects can often be moderate to high. It is worth noting that few of these projects included vegetative or structural tasks to directly benefit the riparian system and would have scored higher had these practices been included.

Positive/Effective Example
Many projects have informed or have the ability to influence other projects by demonstrating practices that either work well or do not work well. Some projects provided a positive example that other projects have been built upon while others have the potential to 'jumpstart' other projects and/or ideas. Some projects that received a 'low' rating in this category are too unique, complex, or site specific. For example, project #99-083WPF (Cherry Creek) scored 'high' in direct benefits to the riparian system and scored a low rating in the positive example category because of the complexity of the project and project tasks. Successful fencing exclosure projects scored 'high' in this category, as did projects that implemented new restoration techniques and new structural designs. Projects that scored low in this category generally scored low in direct benefits category as well. Some projects received this rating simply because they were not effective and did not provide a positive example for other projects.

Lessons Learned
The 'Useful Lessons Learned' category was used to evaluate the practices used during the project that could provide useful lessons to aid future similar projects. If a project implemented a new technique that resulted in valuable information for the riparian restoration community, the project received a high rating, regardless of whether or not the practice(s) failed. Projects that utilized well-known practices may be rated slightly lower in this category. For example, projects that utilized exclusion fencing generally scored low not because the practice was not effective, indeed it was, but because the technique has already been tried and proven to be a valuable practice as well as refined by many practitioners. Older projects, that were implemented before certain practices were generally accepted as an effective method, usually received a high rating.

Education/Outreach
Public outreach, awareness, and value were rated based on the potential for a project to inform the general public. Outreach potential varied greatly between all projects. This variation was sometimes due to the location of the project (remote location vs. high visibility), the lack of information available to the public (via signs, pamphlets, or other methods that relay what actions took place at the site and how they benefit the ecosystem and/or the public), or whether the project was on public or private land. A project did not warrant a low rating simply based on remote location or lack of signage, but rather on its ability for the public to visually see a change. For example, projects #96-0016WPF and #97-032WPF (both 'Ahakhav Tribal Preserve) received a high rating in this category based on the fact that changes can be easily observed from the contrast between the project area and the untreated control areas. The control plots remain infested with tamarisk; while project areas are dominated by native vegetation. These projects demonstrate to the general public that riverbanks do not have to be monotypic stands of invasive vegetation and that there are effective techniques that can lessen the negative impacts of non-native, invasive vegetation.

Overall Benefits
Nineteen projects (51%) received a high overall 'benefits realized' rating, while eight (22%) received a medium rating, and ten (27%) projects realized 'low' overall benefits from the project grant. Projects that scored in the low category experienced high structural failure, low plant survival, or had very little impact directly on the riparian area. Projects that received a high rating restored, enhanced, or created riparian areas effectively, provided valuable examples for other

projects, and have experienced high structural integrity and plant survival. The overall rating is not directly correlated to ratings in the other four categories; but in general, if a project scored high in all or many of the categories the overall rating was also high.

FINDINGS AND RECOMMENDATIONS

In the following sections, data and observations gathered during the assessment have been used to evaluate several components of the AWPF program including both the grant administration process and project implementation. Project implementation is in turn divided into separate components including planning/design, implementation practices, monitoring, and public outreach. The findings were used to generate recommendations to AWPF to improve the grant process and make projects more effective in meeting AWPF goals.

Overall, the AWPF grants program has been a success as attested by the fact that over 50% of the Phase II case studies received a "high" overall benefits rating. Over 75% had a high or medium rating. These projects provided direct benefits to the riparian systems of Arizona, set good examples for future projects, advanced the field of stream restoration in our arid climate, and positively increased public awareness of the value and need of riparian systems. However, not all were successful.

Almost a quarter of the case studies received a low overall benefits rating but many still provided valuable lessons learned for future projects. Significantly, only four of the 37 case studies scored low in all 5 benefits categories. Many times failures can be as valuable as successes. However, at present there is little mechanism to effectively disseminate these successes or failures.

GRANT ADMINISTRATION AND PROCESS

During Phase I and Phase II, a number of observations were made regarding the administration aspect of grant projects. These observations included comments by grantees regarding the grant process and methods for improving the process identified during the evaluation.

Most commonly reported by grantees was the time and resources associated with large amounts of paperwork. While a few felt that the time spent on paperwork took away from implementation of the project, most grantees seemed to respect the need for the AWPF reporting requirements. Grantees also widely reported their appreciation for grant manager input and assistance and highly valued the flexibility of the grant manager. However, many also reported that the high turnover of grant managers was difficult and frustrating. Lastly, grantees commented that site visits by the grant manager were worthwhile and built a level of understanding about the project, making it easier to accomplish tasks. Perhaps most telling, the majority of grantees reported that they would recommend the grant program to others and/or apply again themselves.

Program Goals and Objectives

Clear, consistent direction is essential to the success of the AWPF program. In most programs this involves a set of integrated guidelines including a mission or goal statement that defines the overarching goal of the program, a set of more specific objectives that define program emphasis, and a set of criteria to evaluate efforts to achieve those objectives. While the AWPF program describes some of these programmatic elements in various documents (e.g. website, grant application manual), they lack the clarity to provide direction to the program. The following purpose statement is located on the "Common Questions" page of the AWPF website.

"The purpose of the Fund is to provide monies for the development and implementation of measures to protect water of sufficient quality and quantity to maintain, enhance and restore

rivers and streams and associated riparian habitats. This also includes fish and wildlife resources that are dependent on these important habitats."

The grant application manual describes the fund in the following way. "The AWPF is a state grant program that provides money to interested parties for maintaining, enhancing, and restoring river and riparian resources throughout Arizona, including projects that benefit fish and wildlife that are dependent on these important resources." The application goes on to describe the types of supported projects.
"The AWPF supports projects that:

- Develop or implement on the ground measures that directly maintain, enhance, and restore Arizona's river and riparian resources.
- Acquire Central Arizona Project water or effluent to restore and maintain river and riparian resources,
- Conduct innovative river and riparian research.
- Implement water conservation measures/programs outside of the 5 Active Management Areas."

During the evaluation of case studies it became apparent that because these programmatic guiding elements were inconsistent, vague, or missing, project implementation and benefits suffered. During the evaluation process a number of recommendations were developed to increase the effectiveness of the AWPF program. The program has been very effective at funding projects that directly benefit riparian resources in Arizona. However, additional opportunities were identified that would greatly increase the program's impact. The opportunities that await are the use of successful 'on the ground' projects to more effectively encourage other similar projects, increase the science of riparian restoration, and educate the general public.

To take advantage of these opportunities, it is suggested that the goals, objectives, and evaluation criteria be examined and potentially modified. There is no formal AWPF mission or goal statement. However, the purpose statement located on the program website appears to provide an adequate mission statement.

> "The purpose of the Fund is to provide monies for the development and implementation of measures to protect water of sufficient quality and quantity to maintain, enhance and restore rivers and streams and associated riparian habitats. This also includes fish and wildlife resources that are dependent on these important habitats."

The types of projects funded are described in the grant application manual, but program objectives are not defined. Four categories were identified during efforts to evaluate project benefits for this assessment (see Benefits Realized section). They include direct benefits to riparian areas, effectiveness or good example potential of projects, advancing the field of stream restoration, and educating the general public. Since they describe the range of potential benefits from AWPF projects, these four categories are also appropriate to serve as the objectives to guide the program. The proposed objectives are:

1. **AWPF projects provide direct benefits to riparian systems.**
   Projects provide "on the ground" protection, enhancement, restoration, and/or creation of benefits as described in the AWPF primary & secondary issues of concern.

2. **AWPF projects provide positive, effective examples for other similar projects.**
   Projects can build upon the successes of past projects, provide a positive example for replication, and encourage or "jumpstart" other similar projects that benefit the resources of concern to AWPF.

3. **AWPF projects should advance the field of riparian restoration in arid regions.**
   Projects advance the field of riparian restoration by providing lessons that extend, refine, or eliminate methods, practices, or theories and/or could make other projects more successful.

4. **AWPF projects increase public awareness of the function and intrinsic value of riparian systems.**
   Projects educate the community and/or surrounding landowners and bring awareness of the value of riparian resources to the general public or community.

These objectives can provide a structure through which AWPF staff and Commission can evaluate individual projects as well as programmatic changes. It is not to say that all future projects must meet each objective. By their nature some projects will target one or more objectives more than others. For example, projects that result in high quality direct benefits (#1) to the riparian system are certainly worthwhile regardless of their public education value. Research projects, on the other hand, provide little direct benefit but can advance the science of restoration (#3) and could result in other successful projects (#2) and educate the public (#4). These objectives are consistent with the recommendations for specific components of the program and/or projects contained in this report.

Just as a project's monitoring plan requires criteria to judge success, criteria to define and judge efforts to meet program objectives are important. The evaluation criteria described in the grant application manual are appropriate for Objective #1. However, additional evaluation criteria should be established to define efforts to meet the remaining objectives.

Project Objectives
Evaluation staff also noted that although heavy emphasis is put on the objectives during the grant application review process, objectives were rarely referenced after the grant was awarded. As reported in Phase I, some objectives were more appropriate as project goals, tasks, or monitoring benchmarks. There also appears to be considerable confusion between goals, objectives, tasks, and monitoring benchmarks. Clear goals and objectives are critical to determining appropriate tasks and to setting monitoring benchmarks. More consistency and clarity regarding the meaning of each of these items would provide greater guidance throughout the project. Definitions and examples of each are presented below.

Project goals describe the broad intent of the project: "The goal of the project is enhancing existing riparian habitats." Or "The goal is to improve water quality."

Objectives provide additional specificity to the goals: "The objective is to increase the number and variety of native woody species." Or "The objective is to stabilize eroding banks."

Tasks are the actual practices implemented to achieve the objective: "Task 4 is the planting of 150 native willow poles along the stream bank." Or "Task 5 is the re-sloping and replanting of 450 feet of eroding stream bank."

Monitoring benchmarks establish a metric by which to measure success of a task in meeting the objective: "Live and dead willow plantings will be counted each fall with the expectation of 80% survival rate." Or "The slope and vegetative cover of treated stream banks will be measured each fall with the expectation that slope will not increase and vegetative cover will."

It is important that the grant manager and grantee meet and clarify the goals, objectives, tasks, and monitoring benchmarks early in the project to increase project accuracy and to serve as a guide for the project throughout its duration. Several project's success was increased when tasks were modified in response to monitoring data. Clear objectives should be included in the contract between AWPF and the grantee and referred to often. Figure 1 displays the hierarchy of these project components. As displayed, the figure illustrates that all project components should fit

under AWPF's mission and work from a broad to specific scale. A worksheet could be provided to help guide the process. At the minimum, an explanation of each item in the grant application manual could provide guidance.

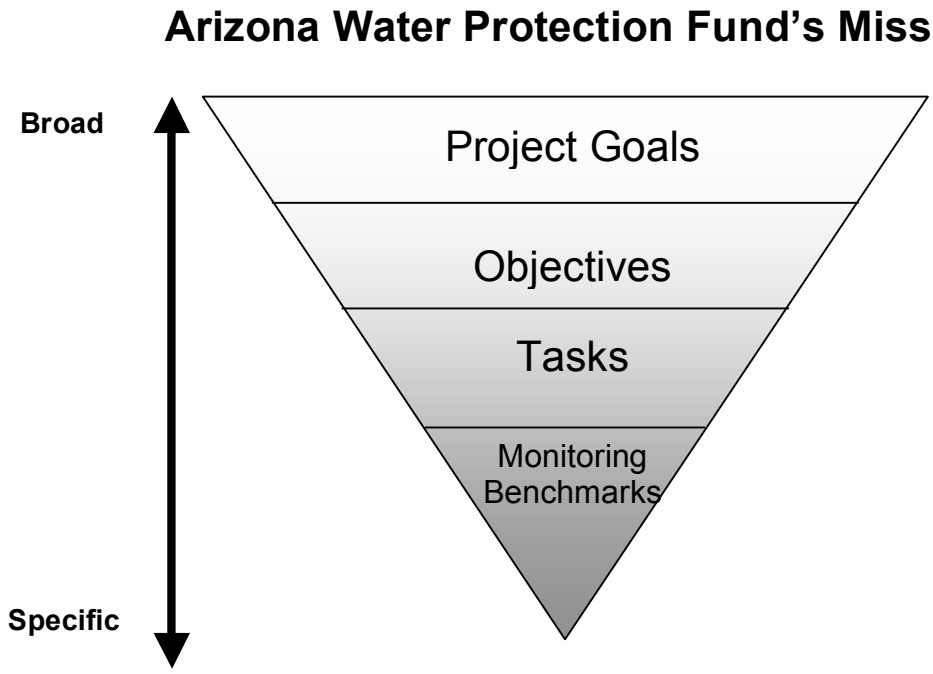

Figure 1. The hierarchy of project goals, objectives, and tasks from broad to specific, all of which fall under AWPF's mission statement.

The grantee is asked to describe project goals, objectives, and tasks in the application. This can be confusing for many and is reflected in the wide array of objectives recorded during this assessment. The above diagram can help clarify at what level of specificity and how much is expected to be achieved by the grantee if all categories are taken into consideration at the time of contract writing.

The results of previous AWPF research projects could provide a sound foundation for good projects. For example, grant #99-074WPF rated springs and seeps for restoration potential and #99-086WPF rated wells for well abandonment potential. These projects produced very useful information that could lead to implementation. Likewise, projects that are implemented on adjacent lands can provide added wildlife habitat benefits. Encouraging projects to "piggy back" each other, either through extra evaluation points or other incentives, could increase the benefits associated with both the new and old project. A method for broader dissemination of research project results would be critical to implementing this suggestion.

Application

Inconsistency in project information provided by the grantee was sometimes misleading or inaccurate. Project size and stream length varied widely and appeared rather arbitrary. Some grantees estimated the project area; others included the entire watershed or allotment as a project site, while others only included the area directly associated with modifications. This was especially prevalent in the grant applications, possibly in an effort to show the project in a good light. AWPF may want to set guidelines or protocols regarding the determination of project site size so more accurate comparisons can be made between projects by AWPF staff and the Commission. Project location information was also often vague and difficult to follow. It is recommended that GPS coordinates be required for the application, in addition to range, township, and section, perhaps at the upstream and downstream end of the project site. Driving

directions may be more useful if they originate from a central location. Perhaps AWPF offices in Phoenix would suffice.

It is strongly recommended that as part of the application process, grantees be required to delineate the watershed from the downstream end of the project site and include the delineation on the project site map with watershed size in square miles or acres. Watershed size provides crucial information about which practices are appropriate for the given channel and can help avert major pitfalls. Watershed delineation will also further educate the grantee about the properties of the watershed in which they will be working. The procedure and an example of a delineated watershed is in Appendix C. Finally, it may be useful to address the scale that the project will be working within, such as: reach level, watershed level, or landscape level. This information will provide AWPF staff additional insight about the project and will allow for comparisons between projects of similar scales. During this evaluation, it was difficult to compare watershed restoration approaches with reach level restoration approaches.

Report Writing and Documentation

A major concern of evaluation staff during the Phase I assessment was the variability in thoroughness and quality of the reporting for each project. This concern was also evident in much of the correspondence between AWPF and grantees as well as Phase II interviews with grantees. Many grantees looked upon the final report as a daunting and formidable task. Evaluation staff also found that final reports lacked background information and justification for the project so that the entire AWPF file needed to be reviewed in order to understand the objectives, justification and tasks associated with the project. Final reports need to be molded into a communication tool that can be disseminated widely to pass on lessons learned, techniques used, costs, timelines and other information to prospective AWPF grantees and other interested parties. All of this information should be available in a single document, accessible via the AWPF website or written request to AWPF staff.

Evaluation staff suggests that a standardized outline for the final report be developed by AWPF staff and explained to grantees at the beginning of each project. The outline could also contain some standardized tables for project budgets (allocated and spent), project timelines, practices used and extent, etc. AWPF may also wish to include space holders for specific figures and maps. The final report outline should be organized along the basic deliverables due for each project. The deliverable for each project task may even require its own outline so that grantees know exactly what kind of information needs to be included. Every deliverable report should contain the costs, time and manpower used, accomplishments and lessons learned. If the deliverable reports are properly structured, the final report will likely be a 'cut & paste' exercise with editing to improve the flow between sections. The final report should reflect all aspects of the grant from objectives and goals, types of permits required, and type of practices, to time and materials required to accomplish implementation, monitoring results and analysis, and public outreach. Lessons learned should be described in each section of the final report including any overall lessons learned. Grantees should be as forthright as possible and reminded by AWPF that they need not justify the grant monies spent, just report the basic facts of the grant. Lessons learned are also important benefits to riparian systems. An example of what the outline, or checklist, might look like is included in Appendix D.

This process is likely to increase the amount of 'coaching' required by AWPF staff. Most grantees do not have extensive experience in technical writing, however most have access to home computers and all have valuable experience that should be shared with the AWPF program. AWPF should be prepared to explain where photos can be scanned to electronic format, how to search for electronic maps on the Internet, and work with grantees on editing problems. While

this requires a considerable amount of effort for already overtaxed AWPF grant managers, it will provide several important benefits to the AWPF program. Some of these benefits are:

- A complete deliverable report outline will define the information needs for each phase of the project and ease frustration between AWPF grant managers and grantees during the review process. Grantees will immediately be informed of which records to keep and the expectations of the documentation process.
- The outline process will facilitate greater communication between grant managers and grantees creating a partnership and timely exchange of information, which will improve the chances of success for each project.
- A well conceived formal outline for each project will foster a less daunting final report task. Grantees who have little experience in managing a large scale project will be essentially 'walked' though the process with the outline as a guide and encouraged to document the information needed for the final report as it becomes available rather than trying to remember the initial steps of the project which may have occurred several years previously.
- A thorough, high quality final report will improve information transfer and expand the AWPF from a program which has been very successful at installing 'on-the-ground' projects to a program which also provides valuable information to the general public concerned with riparian and aquatic resource conservation. This model is essential to the mission of the AWPF since it builds upon knowledge gained by practical experience during enhancement and restoration projects to improve future conservation attempts.

Funding Window

Understanding that limitations exist for lengthening funding windows, grantees suggested that if the funding could be placed within a larger window for these types of projects, success would greatly increase. For example, five years of funding placed within a 10 to 15 year window, could provide the time necessary to wait for proper climate conditions needed to implement prescribed fire. This would increase the success of the fire and help increase the safety of the burn, while utilizing a very effective watershed restoration tool. Similar arguments were made for vegetation practices. An alternative to this suggestion may be to award additional monitoring funding to selected projects that have effective monitoring plans and/or would provide valuable lessons learned from additional monitoring. The AWPF Commission could grant extensions on a case-by-case basis. The Commission would determine the length of the extension as well.

PROJECT COMPONENTS

In AWPF project implementation, there are three major components. The first is planning and design of the project, the second is implementation, and the third is monitoring the results of implementation. In the following sections, observations and resulting recommendations are presented. The 'Implementation Practices' section is further divided into the three categories of practices that were recorded during the assessment: Management, Vegetation, and Mechanical/Structural.

PLANNING AND DESIGN

A valuable and unique component of the AWPF grant program is the allocation of funds for planning of capital projects, not just implementation. Clear, thorough planning is essential to a successful project. However, planning and design documents examined for the Phase II case studies were often incomplete or superficial. The incomplete planning and design documents limited the scope of project evaluations. It was hoped that the evaluation team would be able to use project planning documents to determine: 1) whether the project had been implemented as planned, 2) whether successes and/or failures were due to planning or implementation, and 3) the

reasons or mechanisms responsible for successes and/or failures. Unfortunately, this was often not possible because planning documents lacked the specifics necessary to answer these questions.

The reason for the lack of specificity in design is not clear. There was not a clear correlation between grant year and the amount of design information in the project file. However, one reason may be that grantees are not utilizing the available funding for sufficient planning documents. Of the 71 capital projects evaluated in Phase I, 90 percent dedicated 30 percent or less of project funding to planning, nearly half of the projects (48%) dedicated less than 10 percent of their funding and almost 20 percent had no planning task funding. In some projects, planning was completed prior to the AWPF grant or supported by another funding source. However, most projects appeared to depend on AWPF funding for planning efforts.

Quantitative criteria for implementation commonly called “specifications” were most often missing from the design documents. Examples of specifications for management practices might address fencing requirements such as number of strands, wire gauge, post spacing. In vegetative practices specifications might include seed mix composition and rates, protocols for harvesting and planting, spacing of plantings, and depth of plantings. Clear, concise specifications are especially critical in structural practices. Examples for grade control structures might include materials size and strength, design geometry, site restrictions, maximum drop, maximum watershed size, and other information critical to the success of the practice. Lack of specific criteria for these practices increase the risk that they will be implemented incorrectly and fail. The third objective stated for this evaluation addresses the need for assessment and compilation of a ‘best practices’ manual. The lack of specifications throughout many project files supports the implementation of this objective.

No direct correlation was found between the quality of design documents and the success of implementation practices. Several very successful projects lacked good design documents. In these cases, it appears the grantee had the technical expertise to successfully implement the project but simply failed to document the design. Clearly, other projects suffered from a lack of design criteria that led to inconsistent implementation and greater failure. Regardless of the grantee’s technical experience, complete planning documents with specific design criteria increases the chances of project success and also increases the ability of AWPF to disseminate project information and lessons learned from implementation.

Thorough planning and design documents aid in other phases of the project as well. They often form the basis for monitoring protocols and provide valuable information to understand why practices fail or succeed. More often the specifications can help determine where and when practices are successful providing the invaluable “lessons learned” for future projects. With experience, specifications are revised so that the practice is more successful. These documents help AWPF grant managers as well. Thorough planning documents including a design plan, construction sheets, construction specifications, and post implementation as-built sheets will help grant managers immensely in evaluating whether or not the grantee completed their implementation task. It was observed that some projects, even well executed with outstanding results, did not have construction sheets or as-built designs, or if they had one, the other was absent. In order to evaluate the success of a construction project in any detail, the ability to compare pre- and post- construction sheets is critical. Experience with more current AWPF projects suggest that project managers are requiring greater detail in planning and design documents. Even when planning and design is funded by another source, a design task should be identified and a deliverable required for review prior to implementation.

A number of grantees utilized outside professional services to complete their projects noting that they felt that they did not have the technical knowledge to implement practices that would have the desired results, nor did they know where to go for help. Evaluation staff made no attempt to correlate outside services with project benefits, but in general the deliverables were of high quality. As the field of riparian restoration and habitat enhancement grows in Arizona, the number of experienced technical providers will grow as well. It may be worthwhile to inform grantees in the grant application manual that technical assistance during any part of project implementation is acceptable and often beneficial and that resource information is available from grant managers.

IMPLEMENTATION PRACTICES

A wide variety of practices have been used in AWPF projects to restore or enhance riparian areas. In order to assess and compare similar practices to one another, practices were divided into three categories: management, vegetation, and mechanical/structural. These categories were separated even further into sub-categories depending on the type and purpose of the practice. In light of the wide array of practices, the sections below do not attempt to list every practice used in every project. It is expected that the third objective of this evaluation will clarify and list 'best practices'. Instead, general observations derived from observing many practices in the field are presented, as well as practices that stood out from the rest by working extremely well. In addition, specific projects are named if the evaluation staff felt that the project should be noted for its achievement. Lastly, it should be noted that all case study project sites have experienced floods at bankfull stage or higher, and thus structures and other practices used in the channel have been tested against at least moderate flows at the time of the site visit.

Management Practices

A management practice was considered to be a change in the way the landowner used the land and/or its resources. These practices were generally intended to remove stressors from riparian areas and included grazing management plans, the construction of fencing, changes in water use, irrigation, and restrictions to vehicle/OHV use and access. The exception is interpretive infrastructure that addressed public outreach but was included in this section due to its benign nature.

Grazing management

Seventeen case studies contained grazing plans. The goal of these plans aimed to relieve stressors on riparian resources. Some of these case studies were on working ranches. In these cases, the goal of the project was to improve riparian resources within the allotment while maintaining a productive ranch. Many times, this was accomplished by relocating livestock to the uplands and excluding them from the riparian area at some point during the year, if not completely. Most often these projects implemented rest-rotation grazing practices. All projects that included a grazing plan also had a fencing component. Generally, the fencing created additional pastures to rotate livestock in order to decrease utilization in each pasture and/or to exclude livestock from the riparian area. If livestock are to be excluded, four elements that riparian areas provide must be supplied in the uplands: shade, windbreaks, food, and water. Ranchers implemented a variety of grazing plans. Staff observed a 45-day or one-third utilization grazing plan, winter season grazing for longer (30-60 days) or shorter (5-10 days) periods, and utilization of the riparian corridor for livestock movement between pastures. Only two projects with grazing plans did not have water development and distribution as part of project improvements. In some projects, there were noticeable benefits to the riparian system from changes in management but often improvements were difficult to identify due to a lack of baseline information.

Fencing

The most common management practice observed in the case studies was fencing; more than half (33) of the projects had tasks that involved this practice. Livestock and elk exclosures were the most frequent reason for fencing, but this practice was also used in restricting OHV access. Based on observations made during site visits, fencing exclosures are very beneficial to the riparian area if the fence is maintained, because it effectively removes the stressor(s) that degrade the system. The direct benefits to the enclosed area were very visible at each site whether the aim was to exclude livestock or elk (Figure 2).

Figure 2. Elk exclosure at project site (#03-119WPF) with aspen saplings within exclosure.

The elk exclosure at Little Valley Springs clearly shows how directly fencing can benefit the riparian area. Aspen regeneration is absent outside the fencing, while many aspen saplings are present within the exclosure (right-hand side of photo).

However, in some cases fencing was not maintained and/or gates were left open resulting in no benefit to the riparian area. Most grantees agreed that fencing was a necessary and effective method to protect riparian plantings. Fencing is a well-developed practice and effective when implemented correctly. Elk fencing design showed much more variability. It appears designs are still actively evolving. A number of innovative designs were evident in the case study projects and grantees have further built upon ideas tested in grant projects to make other project designs even stronger (Figure 3).

Figure 3. Low maintenance and innovative elk fence on Coconino National Forest installed by grantee Dick Fleishman using Arizona Game and Fish Habitat Partnership dollars at General Springs.

Elk fence, made of metal posts and sucker rod welded together, installed by Dick Fleishman of the Coconino National Forest. Although materials may be more expensive, this fence follows the contour of the land well, needs much less maintenance, and does not deteriorate as quickly as some other fencing materials resulting in complete exclusion of elk for a long period of time.

Restricting OHV Access

Damage to riparian areas from OHV and other recreational use was not uncommon and these impacts are expected to increase as populations grow in the southwest. A number of projects attempted to restrict OHV access through signage, fencing, road obliteration, or a combination of fence and signage. The restriction of vehicles and OHVs was observed at seven project sites; two used road obliteration, two used just fencing, one used fencing and signage, and one used just signage. Most found restricting recreational access was more difficult than restricting livestock or wildlife. From the observations made during the site visit and conversations with grantees, signage alone is not an effective way to accomplish vehicle access restrictions. Effective access restriction requires constant maintenance and vigilance. Figure 4 illustrates a successful attempt at restricting vehicles and OHVs.

Figure 4. Fencing and signage used to exclude vehicle access at the Lake Mary Watershed Restoration project site (#00-108WPF).

One of the objectives for the Lake Mary Watershed Restoration (#00-108WPF) was to restrict vehicle access at Priest and Howard Draw. AWPF funds were spent to build this buck-n-pole fence, construct the sign, obliterate the road (just beyond the sign), and seed the abandoned road.

Irrigation and Water Management

Irrigation was an important component in thirteen case study projects. Most of these projects relied on temporary irrigation in the establishment of plantings that could be maintained by natural rainfall and soil moisture. However, there were a few projects such as Grant #99-098WPF (Rio Salado) and #96-0026WPF (San Xavier) where project plantings will require long-term water. These projects were generally limited to areas with large urban populations that could afford to dedicate long-term water supplies. Based on observations and interviews with grantees, it was evident that flood-terrace or upper riparian zone plantings were rarely, if ever, successful without supplemental irrigation. Generally, temporary drip irrigation to plantings for two to three years displayed the highest rates for planting success. Three types of irrigation systems were observed; drip, surface, and sprinkler.

Drip irrigation was most common and highly successful. This method is effective, relatively inexpensive, easy to construct, and conservative in the use of water. Although it is widely used, several grantees made important observations regarding what kind of pipe works best in the presence of small rodents and other animals. Many reported hard or PVC pipe works well because small animals cannot chew through it, compared to the sponge drip line, and they are relatively inexpensive. Grant #00-115WPF (Tucson Audubon Society North Simpson Farm Riparian Recovery Project) and #98-062WPF (Partnership for Riparian Conservation in NE Pima County II) are great examples of successful drip irrigation systems. In addition, #00-115WPF (North Simpson Farm) augmented irrigation by contouring the earth around the plantings to maximize rainfall and infiltration potential. This technique appeared to increase planting success in the grantees perspective.

Projects that utilized surface irrigation were also successful. Although not the most efficient use of water, ditch irrigation increases riparian planting survival rates and encourages natural recruitment. Grant #99-098WPF (Rio Salado) and #96-0026WPF (San Xavier) are good examples of how this type of irrigation can be very successful and beneficial.

Finally, one grant used a sprinkler system to provide water to plantings. However, the plantings were unsuccessful at this site. It was unclear whether this was due to ineffective irrigation or irrigation management. One drawback to this irrigation system is the fact that the broad application of water encouraged the establishment and infestation of invasive species.

Evaluation staff noted temporary irrigation line was left littering the ground at many project sites. It may be useful for managers to encourage grantees to leave funding for labor to remove the irrigation system once it is no longer being used. This also allows the system to be re-used elsewhere instead of decaying on site.

Lastly, very little documentation was present in the project files regarding how to manage the water that would be used by the different irrigation systems. Little information was supplied that addressed the process of determining and controlling water volume, frequency, or application in an efficient manner. Some grantees created their own watering schedule, however many times it was not documented. Thus, very little can be discussed about water management. It is recommended that more attention be paid to water management in future projects.

Interpretive Infrastructure

Interpretive signs placed at a project site can impact visitors and inform the public of the changes that occurred and how these changes benefit the riparian area. Without signs, opportunities for awareness are missed and the project site may be 'just another nice place to sit' instead of 'a place that is nice to sit because of the hard work done to an impaired system'. Signs varied in the type of information presented, size, and number. At least one interpretive sign could accompany each project that describes project funding, objectives, tasks, and results. The history of the site and how it has changed provides the public with some reference. Project #98-059WPF, Verde River Headwaters Riparian Restoration, used durable board and provided excellent information to visitors (Figure 5). Many projects also included trail systems that were greatly appreciated by grantees and allowed public access and education. These appear to be a useful outreach tool.

Figure 5. Interpretive sign at the Verde River Headwaters Riparian Restoration Project (#98-059WPF).

Large kiosks were installed at the upstream and downstream end of the project site with information about riparian areas and the restoration process.

Vegetation Practices

Vegetation practices involve all techniques intended to establish, enhance, or restore obligate or facultative riparian species. Categories include: flood-terrace plantings, riparian plantings along channel or floodplain, seeding, vegetative bank stabilization, natural recruitment and use of fabric, bio-logs, or mulch.

Riparian plant species have specific zones along the riparian buffer that they should be planted in to achieve greatest success. These zones are dependent upon a ratio of disturbance and soil moisture. The plantings in the case studies were generally in the appropriate riparian planting zone. It is not clear whether this was planned or coincidental as very few projects included planting specifications as part of the design plans.

The success of vegetative plantings may be inhibited by the observation that very few projects had planting specifications within the design plans. Planting specifications are important for plant spacing and orientation. Additional consideration to these components can increase channel stabilization by helping to add roughness and slow flows on flood terraces. Often the potential of vegetation to increase stream stability by adding roughness and slowing flows on banks, floodplains, and flood terraces was well understood. An additional consideration often overlooked was the potential for plantings to *decrease* channel stabilization. For example, one project planted trees parallel to the stream channel. The orientation of these plantings encourages high velocity flows behind plantings and increases risk of erosion. Lastly, some projects had plantings too closely spaced, resulting in a decrease in survival rates due to competition of limited resources.

Riparian Plantings

Re-establishing native vegetation is an important component of riparian restoration and protection. Vegetation provides habitat, reduces erosion, increases stability, and increases water infiltration. Re-vegetation after non-native invasive species removal is also important to reduce the re-establishment of the removed species. The techniques grantees used to encourage native vegetation included: container plantings, pole/post plantings, plug transplants, seeding, and natural recruitment.

A common practice for re-establishing willows and cottonwoods was bare pole planting (Figure 6). This practice includes harvesting cuttings of these species from local sources and installing them as bare poles to the depth of the saturated soil. At most project sites these plantings were successful. Failures were most commonly attributed to a failure to dig the hole into the groundwater table. Willows generally had a higher rate of success than cottonwoods especially in higher elevation systems. Staff noted that if general specifications had been followed, perhaps success would have increased. For instance, cottonwood plantings are generally more successful if planted in moist soils above the saturated zone. Minimum cutting diameter is important for both willow (>1/2 inch) and cottonwood (2-3 inches) poles. Finally, burying more than half of the post beneath the ground is generally more successful because more of the plant energy will go to root establishment. Although these planting practices are well established, they may be under utilized. Grant managers may consider asking for planting specifications from grantees to help increase plant survival.

Figure 6. Successful cottonwood post plantings at the 'Ahakhav Tribal Preserve project site (#96-0016WPF).

With supplemental irrigation, cottonwood post plantings were highly successful. Natural recruitment was observed during the site visit.

Container plantings

Container plantings were used on a number of projects. These were generally successful, though supplemental irrigation was often required since plantings were on drier terraces. Plug transplants

of sedges and rushes were less common and less successful. This may be the result of placing plugs in the wrong zone, or high flows that carried transplants downstream before they could establish sufficient root systems. Containerized plantings of deer grass (*Muhlenbergia rigens*) were fairly successful.

Natural recruitment

Increased natural recruitment was a component of most of projects either because stream function was restored or stressors removed. However, those projects that depended mostly or entirely on natural recruitment showed much slower success in enhancing or restoring habitat. Not surprisingly, natural recruitment was most successful in higher elevation where precipitation is greater and where perennial stream flow more common. It appeared that natural recruitment is an unreliable technique to promote native vegetation establishment in the drier parts of the state. Active seeding and planting is a much more effective method for successful plantings. This is especially true for willows and other clonal species.

Seeding

Seeding has proven to be a challenging practice. Of the fifteen projects that attempted to revegetate a portion of the project area through seeding, five had no success with seeding efforts, and eight had limited success. Projects that simply broadcast seed had little or no success. Those projects that covered seeded areas with erosion fabric were more successful. Observations of seeding techniques and success led to the conclusion that multiple seeding efforts, seeding during the proper season, and increasing the seeding rate, are important factors that contribute to success. Project #98-059WPF (Verde River Headwaters) is a good example of fabric and seeding resulting in higher germination of grasses (Figure 7).

Figure 7. Fabric was used after seeding at the Verde River Headwaters Riparian Restoration Project (#98-059WPF).

Fabric used to cover grass seeds after construction appears to have increased germination success. Notice many bunches of Arizona fescue.

Upland Plantings

Upland plantings refer to vegetation commonly found on the flood-terrace within a riparian area. In this region, drought tolerant species are most appropriate for these areas. A variety of native xeric species were utilized including mesquite, Palo Verde, acacia, yucca, saltbush, quail bush, and others. All successful upland plantings required irrigation to become established; after irrigation ceased, plantings were generally successful and maintained by precipitation. Project #00-115WPF, Tucson Audubon Society North Simpson Farm Riparian Recovery Project, experienced high success using drip irrigation for the upland plantings (Figure 8).

Figure 8. Upland (flood terrace) plantings at the Tucson Audubon Society North Simpson Farm Riparian Recovery Project (#00-115WPF).

Drought tolerant species were planted on the flood terrace and existing berm. Micro-basins were created around each plant to catch rainwater; drip irrigation was used for two years to establish plants.

A few projects focused on restoring mesquite bosque habitat found in upland riparian terraces. Those projects also utilized supplemental irrigation to establish the plants. Project #98-062WPF, Partnership for Riparian Conservation in Northeast Pima County II, is a successful example of restoring mesquite bosque habitat (Figure 9).

Figure 9. Mesquite plantings in background at the Partnership for Riparian Conservation in Northeast Pima County II Project (#98-062WPF).

At this project site, Partnership for Riparian Conservation in Northeast Pima County II, supplemental irrigation was used to start obligate riparian species and facultative upland species. Mesquite plantings in the background of this photo taken August 2007 shows established mesquite trees that no longer require supplemental irrigation.

Vegetative Bank Stabilization

Vegetation was not frequently utilized as a bank stabilization strategy. In projects that did, shrubby willows were the most common species used. Those projects that did use this practice saw at least some success. Project #92-092WPF (LCR Demo) utilized this practice and had high success with willow vertical bundles and clusters (Figure 10). Horizontal willow fascines were less successful due to fluctuating water levels that either drowned or desiccated the cuttings.

Figure 10. Vertical willow bundles used for bank stabilization at the Little Colorado River Enhancement Demonstration Project (#99-092WPF).

Willow stems bundled together, trenched into the bank, and laid vertically sprout roots and provide an effective method to stabilize stream banks.

The projects at the Hubbell Trading Post (#97-029WPF and #00-104WPF) had very high success with willow poles and plantings at or near bankfull and at floodplain elevation. Project #99-083WPF (Cherry Creek) experienced high success with baccharis fascines. Brush revetments constructed of conifers laid horizontally along the stream channel to provide temporary bank protection was used successfully on three projects (Figure 11). Table 3 displays each practice used and the associated project.

Table 3. Vegetation bank stabilization practices used in case study projects.

Practices used for vegetation bank stabilization are listed below with the appropriate grant number and project title.

Project Title:	Grant #:	Practice:
Cherry Creek Enhancement Demonstration Project	99-083	Baccharis fascines, willow trench, deer grass plugs
Little Colorado River Demonstration Project	99-092	Willow fascines, willow vertical bundles & clusters
Lynx Creek Restoration at Sediment Trap #2	03-117	Vertical bundles
Enhancement of Pueblo Colorado Wash at Hubbell Trading Post	00-104	Willow poles -clustered
Demonstration Enhancementof Pueblo Colorado Wash at Hubbell Trading Post	97-029	Willow poles -clustered

Figure 11. Brush revetments on the Little Colorado River (#99-092WPF).

Christmas trees were used as brush revetments and were placed at the base of the willow plantings to provide temporary bank protection at the Little Colorado River Enhancement Demonstration Project (#99-092WPF). The trees were installed during the fall of 2006 and will eventually become buried by gravel and fine sediments.

Fabric/bio-logs/mulch

Biodegradable products were used in a variety of projects. Fabrics provide temporary bank stabilization and protect new plantings. Fabric was successfully used as mulch over newly seeded areas. Bio-logs produced from coconut fibers provided temporary toe protection on the LCR Demonstration project (#99-092WPF) (Figure 12). The use of these materials can increase the effectiveness of project treatments but is not yet widely used in AWPF projects.

Figure 12. Bio-logs provide temporary bank protection along the Little Colorado River (#99-092WPF).

Bio-logs constructed from biodegradable coconut fibers were installed along the toe of this treated bank at the LCR Demonstration project (#99-092WPF) along the Little Colorado River. The treatment provides temporary protection until native vegetation can become established. In this photo the bio-logs are no longer visible because native sedges have become well established on the bio-log from natural recruitment.

Mechanical/Structural Practices

Mechanical and structural practices were used in 24 (65%) of the case studies. These types of practices include bank and grade stabilization techniques, upland mechanical treatments, non-native invasive species removal, channel modifications, aquatic habitat structures, and backwater/pond/wetland habitat creation. Structural practices are complex and generally require more rigorous design analysis and construction specifications than management or vegetative practices for effective installation and operation. Successful operation depends on many variables including watershed size, hydraulic pressures, structural materials, placement, height, and others. Because of their complex, structural nature, they are generally more costly than other practices, have greater risk of failure, and have greater potential to cause unintentional negative impacts.

Bank Stabilization

Bank stabilization was a component in only eight projects, but included a variety of innovative practices. Projects generally included more than one practice. For instance, the LCR Demo (#99-092WPF) included bank sloping, toe rock, brush revetments, and bio-logs to directly address stabilizing stream banks. The project also incorporated structures that redirect flows away from the bank (rock barbs, rock and post vanes) and a variety of bioengineering practices. Post vanes were also successfully used at Hubbell Trading Post (#97-029 & #00-104WPF) to re-direct water flows and to stabilize banks (Figure 13).

Figure 13. Post vane used for bank stabilization at the Demonstration Enhancement of Pueblo Colorado Wash at Hubbell Trading Post and Continued Enhancement projects (#97-029WPF and #00-104WPF) (left-hand side of picture).

Post vanes are installed in the channel to re-direct flow and capture sediment. They are installed at an angle, pointing upstream, and dipping down toward the channel bed. Post vanes were very successful in the project.

The majority of practices used have proved effective, however not all are functioning or did not have desired results. An innovative log revetment was tried unsuccessfully at Hoxworth Springs (#96-0003WPF) apparently because of the smooth nature of the wood, the structure actually increased flow velocities. Post vanes installed in a very tight meander at the LCR Demo site (#99-092WPF) also resulted in less success than anticipated. The practices used and associated project is in Table 4.

Table 4. Bank stabilization practices used in case study projects.

Practices used for bank stabilization are listed below with the appropriate grant number and project name.

Project Title:	Grant #:	Practice:
Enhancement of Pueblo Colorado Wash at Hubbell Trading Post	00-104	Post vanes; a number of logs installed end first at an angle pointing upstream, dipping toward the center of the channel. Installed on outside bend of meander
Lake Mary Watershed Streams Restoration Project	00-108	Lowering of banks, widening and sloping banks to 2:1.
Hoxworth Springs Riparian Restoration	96-0003	Logs crib stacked on outside of meander
Tsaile Creek Watershed Restoration Demonstration	96-0025	Rock stream barb at Demo #6: Large rock installed in stream bank, structure dips from bankfull height to channel floor and points upstream. Structure centers flows and redirects flows away from bank.
Demonstration Enhancement of Pueblo Colorado Wash at Hubbell Trading Post	97-029	Deflectors installed using vanes and baffles to induce meanders. Stabilizing one side of the bank and eroding the other side to speed up the channel evolution
Verde River Headwaters Riparian Restoration Demonstration Project	98-059	Bank Reshaping on right bank (5:1) and left bank (3:1)
Cherry Creek Enhancement Demonstration Project	99-083	Two rock vanes w/vegetation planted
Little Colorado River Demonstration Project	99-092	Post vanes set at angle pointing upstream and dipping down into stream. In some cases willows planted behind.
Little Colorado River Demonstration Project	99-092	Along outside meanders up to bankfull height toe rock placed along bank
Little Colorado River Demonstration Project	99-092	Fabric used on all sloped banks. Heavier mat used on floodplains. Brush revetments or bio-log used at toe of bank on outside of meanders and on newly sculpted floodplain.
Little Colorado River Demonstration Project	99-092	Rock vanes

Grade Stabilization

Structural grade stabilization techniques were used by grantees in fourteen case studies. Practices used included rock wire/fabric sausages, cross-vane weirs, log and sandbag structure, rock riffle weirs, water and sediment control basins, a combination of grading then seeding, V-mesh spreaders, net wire and rails sediment traps, and small check dams. These practices have been historically intended to maintain (or at times raise) the streambed elevation in incising channels. Rock structures at the Oak Tree Gully Stabilization Project in the Coronado National Forest (#97-034WPF) were successful at stabilizing many active headcuts in a small watershed (Figure 14). At Tsaile Creek (#96-0025WPF) a variety of small, hand-built structures high in the watershed successfully stabilized perennial and ephemeral channels (Figure 15).

Figure 14. Rock structures stabilize headcuts at Oak Tree project (#97-034WPF).

Low hand-placed rock structures successfully stabilized active headcutting in Oak Tree Wash watershed in the Coronado National Forest.

Figure 15. Log and sand bag structure at the Tsaile Creek Watershed Restoration Demonstration project (#96-0025WPF).

The log and sand bag structures installed at Tsaile Creek slowed flows and effectively stopped active headcuts from advancing further up the wet meadow.

There were less successful examples as well. Grade control structures with a variety of designs failed at a few projects. There were a variety of causes for these failures but they highlight the need for caution in the use of structures across an active watercourse and the importance in the use of specific design criteria. For example, Teran Watershed Enhancement (#95-020WPF) used many small rock check dams to catch sediment and retain water within the system. However, the design was inappropriate for the stream type and high sediment load. The grantee estimated that approximately 75 percent of the small rock dams installed have failed.

Other AWPF projects utilized these practices in a variety of new and innovative ways. At the LCR Demo project site (#99-092WPF), an innovative cross-vane weir demonstrated a more effective diversion structure (Figure 16). At Cottonwood Creek (#03-116WPF) hundreds of small, hand-placed rock structures were installed in small ephemeral channels to slow velocities, dissipate energy, store sediment, and increase infiltration to benefit riparian vegetation downstream (Figure 17). This application was less successful in a more arid region of the state (#95-020WPF).

Figure 16. Cross-vane weir structure demonstrates improved diversion at the LCR Demo project site (#99-092WPF).

A low weir structure allows water diversion while maintaining sediment transport and allowing fish passage on the Little Colorado River.

Figure 17. Rock structures at Cottonwood Creek (#03-116WPF).

Hundreds of low rock structures were hand-placed in ephemeral channels of the Cottonwood Creek watershed to slow flows and increase infiltration. The increased soil moisture benefits downstream riparian areas. Sediment and moistures stored behind structures greatly increased vegetation in the channels as well.

The grade stabilization practices used, their functioning condition, and associated projects are in Table 5.

Table 5. Grade stabilization practices used in case study projects.

Practices used for grade stabilization are listed below with the appropriate grant number and project name.

Project Title:	Grant #:	Practice:
Critical Riparian Habitat Restoration along a perennial reach of a Verde River tributary	95-006	3 rock weirs installed where dam was removed: 1 directly where the old dam stood, 1 upstream ~10 yards, 1 downstream ~10 yards
Teran Watershed Enhancement	95-020	~5,200 small check dams throughout watershed
San Pedro RNCA WS Protection and Improvement Project/ San Pedro RNCA WS Rehabilitation and Restoration Project	96-0001/ 95-015	A structure built to the width of the channel with railroad tie posts, hogwire placed across the channel and tied to the posts with hay bales and rocks at the bottom.
San Pedro RNCA WS Protection and Improvement Project/ San Pedro RNCA WS Rehabilitation and Restoration Project	96-0001/ 95-015	V-mesh spreaders; spaced 25 feet apart in upper reaches; small straw bales placed around base
Hoxworth Springs Riparian Restoration	96-0003	Small drop structure made with local rock and concrete
Cienega Creek Stream Restoration	96-0020	Cross-vane weir; 3 layers of rocks in center of channel and 2 layers of rock on the wings. Partially buried. Some very large boulders used (D100=size of VW)
Tsaile Creek Watershed Restoration Demonstration	96-0025	Log headcut structures; Slash piles; Log and sandbag structures; Erosion Fences; One-Rock dam; Rock and Brush; Rock
Demonstration Enhancement of Pueblo Colorado Wash at Hubbell Trading Post	97-029	Rock riffle weirs installed between baffles to hold position of newly created riffle in channel
Oak Tree Gully Stabilization	97-034	Check dams, step pool structures, chevrons
Verde River Headwaters Riparian Restoration Demonstration Project	98-059	Large rock drop structure (cross-vane weir) Total drop is about 5 feet
Cherry Creek Enhancement Demonstration Project	99-083	Two cross vane weirs. Two rock sills.
Little Colorado River Demonstration Project	99-092	Cross-vane weir; Rock structure in v-shape pointing upstream and dipping down toward center of channel.
Murray Basin and Saffell Canyon Watershed Restoration Project	00-101	Rock Sausage, Rock Apron, Rock apron with sausage, check dams; Rock wedge drop down
Cottonwood Creek Restoration	03-116	Hundreds of low head check-dams with ramps on downstream side and v-shaped top.
Lynx Creek Restoration at Sediment Trap #2	03-117	Rock Weirs

Channel Modifications

Channel modifications covered a broad range of practices including channel re-alignment, induced meander structures, low water crossings, tank/dam removals, or diversion structure installation/removal. Eleven projects implemented these practices. In the majority of these projects, the objective was to improve stream function either by removing man-made structures (tanks, dikes, dams, road crossings, and berms) or by restoring a more natural channel alignment (Figure 18). Several projects above the Mogollon Rim successfully removed existing livestock tanks to restore channel profile. The Cienega Creek (#96-0020WPF) and Lynx Creek (#03-117WPF) projects attempted to restore stream function following diversions and damming to store sediments that altered channel alignments (Figure 19). At Cherry Creek (#99-083WPF) a post-flood channel was modified to enhance native riparian plant establishment. An innovative project at Hubbell Trading Post (#97-029WPF) installed brush baffles to induce natural channel modification processes to restore meander and floodplain access (Figure 20).

Figure 18. Area where an old dirt tank was removed and gradient was reconnected to the historic channel (#98-050WPF).

At Hart Prairie Preserve, The Nature Conservancy used specific engineer-approved design plans to fill in an old dirt tank. The Nature Conservancy collected data in order to re-contour the land area to reconnect flows to the historic channel and to mimic the historic micro-topography.

Figure 19. Restored channel at Cienega Creek (#96-0020WPF).

The Cienega Creek channel had been diverted to protect and irrigate adjacent agricultural fields. The project removed the diversion dike and restored the historic channel. The enhanced riparian vegetation is evident in this photo.

Figure 20. Induced meander structure, or baffle, at the Hubbell Trading Post project site (#00-104WPF).

Logs driven into the ground with rock pointing into the stream help create point bars and increase meander.

These practices are complex and require a relatively high level of technical expertise; as a result, most projects included outside consultants in the design process. Despite the complexity of these practices, none of the project practices were considered a failure. However, rarely were the results precisely what were originally expected leading to a considerable body of "Lessons Learned." In some cases these lessons were incorporated into project documents, in others they were described by the grantees. Compilation and additional analyses of these practices could greatly benefit future projects. Table 6 displays the channel modifications used and associated projects.

Table 6. Channel modification practices used in case study projects.

Practices used for channel modification are listed below with the appropriate grant number and project name.

Project Title:	Grant #:	Practice:
Critical Riparian Habitat Restoration along a Perennial Reach of a Verde River Tributary	95-006	Removal of an old diversion dam and some modification to the diversion ditch to prevent water from flow through.
Watershed Restoration on a High Elevation Riparian Community	95-006	Removal of tank in meadow
Critical Riparian Habitat Restoration along a Perennial Reach of a Verde River Tributary	95-006	Tank removed; ground contoured to mimic historic microtopography as best as possible. Area reconnected to the natural channel.
Critical Riparian Habitat Restoration along a Perennial Reach of a Verde River Tributary	95-006	Lowering of berm around Snowbowl Tank
GooseberryWatershed Restoration Project	95-022	Redirect flows to old channel; removal of a beaver dam; install culverts
Hoxworth Springs Riparian Restoration	96-0003	Re-alignment; removal of berms
Cienega Creek Stream Restoration	96-0020	Earthen Dam Removall; Cement Dike Removal
Cienega Creek Stream Restoration	96-0020	Low water concrete crossing; 6 foot deep headers and footers reinforced with rebar; Old road removed
Tsaile Creek Watershed Restoration Demonstration	96-0025	Channel Baffles; Worm channel through wet meadow
Tsaile Creek Watershed Restoration Demonstration	96-0025	Rock at inlet to culvert; Streambarb creates riffle section for road crossing downstream
Demonstration Enhancement of Pueblo Colorado Wash at Hubbell Trading Post	97-029	Rock riffle weirs & deflector vanes and baffles
Verde River Headwaters Riparian Restoration Demonstration Project	98-059	Existing channel filled and meander increased where possible. Road closure.
Cherry Creek Enhancement Demonstration Project	99-083	Widened floodplain; re-routed channel
Little Colorado River Demonstration Project	99-092	New channel created to cut through floodplain of meander to create ox-bow pond/backwater.
Enhancement of Pueblo Colorado Wash at Hubbell Trading Post	00-104	Baffles in stream at points where an increased meander was desired. Baffles are branchs or logs that are driven into the ground (can be tamarisk) and other branches are woven in between post or branches.
Lake Mary Watershed Streams Restoration Project	00-108	PRIEST DRAW: Removal of weirs, Removal of ponderosa pine in channel, reduction in stream gradient; increasing flow length; HOWARD DRAW: used material cut from bank sloping to flatten existing channel; construct new trapiziodal channel design
Lake Mary Watershed Streams Restoration Project	00-108	PRIEST DRAW: Low water crossing & the road on the west side of channel abandoned and seeded. HOWARD DRAW: Road on the East side of the channel abandoned and seeded
Lynx Creek Restoration at Sediment Trap #2	03-117	Constructed alignment

Backwater/Pond/Wetland Habitat

These practices included the creation of backwater or off-channel pond habitat. Habitats of this kind are considered rare in the arid southwest and are valuable resources. The six projects that created these habitats can be divided into two categories. The first is the creation of natural backwater habitats associated with and supported by functioning riparian systems. Cienega Creek (#96-0020WPF) and the LCR Demonstration (#99-092WPF) projects provide successful examples of this (Figure 21). The second category includes the creation of functioning backwater habitats adjacent to a riparian system but dependent on supplemental water due to deep groundwater levels. Although these backwaters could not exist without maintenance, they are especially valuable because they function within areas that are essentially devoid of these habitats (Figure 22). The backwater area enhanced at the ‘Ahakhav Tribal Preserve (#96-0016WPF) created a unique habitat that is now utilized by several aquatic species. The extensive backwater system was created through water control structures, but functions in connection with the Colorado River (Figure 23).

Figure 21. Backwater habitat created by plugging an old diversion ditch the Cienega Creek Stream Restoration project (#96-0020WPF).

Using existing conditions, such as diversion ditches or channelized stream segments to create backwater during restoration implementation is innovative and benefits the riparian area greatly.

Figure 22. Off channel backwater at San Xavier Indian Reservation (#96-0026WPF).

Backwater pond habitat created at San Xavier Indian Reservation. Two ponds were created. Both ponds are fed through open channel irrigation. The project successfully created riparian habitat, increased public awareness, and the intrinsic value of the area to local residents.

Figure 23. 'Ahakhav backwater created through the 'Ahakhav Tribal Preserve project (#96-0016WPF).

To enhance the backwater pond habitat at the 'Ahakhav Tribal Preserve, the project excavated 227,000 cubic yards of sediment. Riparian and upland terrace plants were reestablished through irrigated plantings and natural recruitment.

Table 7 displays the type of backwater/pond habitat created and associated projects.

Table 7. Backwater/pond/wetland habitat created/restored in case study projects.

Types of backwater habitat created are listed below with the appropriate grant number and project name.

Project Title:	Grant #:	Practice:
The 'Ahakhav Tribal Preserve Habitat Restoration Project	96-0016	Removal of sediment from the back water area; insert several culverts
Cienega Creek Stream Restoration	96-0020	Canal Plug using woody debris and dirt
Tsaile Creek Watershed Restoration Demonstration	96-0025	Earthen Berms; Filling of incised channel; Worm Channel
Riparian Restoration on the San Xavier Indian Reservation Community	96-0026	Excavated dirt; Banks lined with wire fencing as support; Line wetlands/pond with clay rich soils; cover with logs
Little Colorado River Demonstration Project	99-092	Oxbow pond creation
Rio Salado Habitat Restoration Project	99-098	Backwater pond created in center of project on ~10 year flood terrace.

Upland Mechanical Treatment

Five case studies utilized upland treatments to benefit riparian areas. These practices fell into three general areas: road removal, water infiltration or redirecting water flow, and brush management. Prescribed burns of uplands can be beneficial for watershed oriented restoration projects by increasing under story vegetation and decreasing woody vegetation, thereby decreasing runoff and sediment transport, and increasing upland infiltration. Brush reduction of pine trees or mesquite to manage for encroachment appeared to be beneficial and effective for restoring riparian meadows and grasslands. The upland mechanical practices used and associated projects are in Table 8.

Table 8. Upland mechanical treatments used in case study projects.

Practices used for upland mechanical treatments are listed below with the appropriate grant number and project name.

Project Title:	Grant #:	Practice:
San Pedro RNCAWS Protection and Improvement Project/San Pedro RNCA WS Rehabilitation and Restoration Project	96-0001/ 95-015	Piled soil in larger drainage about 8-10 feet high with culverts spilling into drainage or off to side to handle large flows.
Tsaile Creek Watershed Restoration Demonstration	96-0025	Abandoned and turned up road, re-routed to stable area
Watershed Improvement to Restore Riparian & Aquatic Habitat on the Muleshoe Ranch CMA	97-035	Prescribed fire in the uplands of Hot springs Watershed, Hooker, Double R, and Bass creeks.
Watershed Restoration on a High Elevation Riparian Community	98-050	Thinning of Ponderosa pine trees and prescribed burning
Hay Mountain Watershed Rehabilitation	98-066	Small berms approximately 12" high; contour furrows
Hay Mountain Watershed Rehabilitation	98-066	V-mesh keyed into ground on both sides and filled with rock. T-posts placed on either end; about 3-4 feet wide placed in small gullies about 25 feet apart.
Hay Mountain Watershed Rehabilitation	98-066	Removal of native mesquite encroaching into riparian zones; cut and grub roots

Two projects included the removal of encroaching woody upland species by mechanical means or prescribed fire. Watershed Improvements to Restore Riparian and Aquatic Habitat on the Muleshoe Ranch (#97-035WPF) used funding for a large scale prescribed burn in the upland grasslands of their ranch (Figure 24). Other projects used a variety of manipulations to reduce concentrated flows and the resulting scour. These practices had varying success. In some cases the treatments failed and were completely removed by flows. In others, the treatments remained but the benefits were difficult to accurately assess. In all cases the direct benefits to the riparian systems were difficult to evaluate and quantify.

Figure 24. Prescribed burn to control woody encroachment and increase grasses at the Watershed Improvements to Restore Riparian and Aquatic Habitat on the Muleshoe Ranch project (#97-035WPF).

The Nature Conservancy used prescribed fire in the uplands at Muleshoe Ranch to reduce mesquite and juniper encroachment into the grasslands.

Non-native Invasive Species Removal

Invasion of non-native species has become a threat to riparian areas; nine case studies utilized practices to address this threat. Tamarisk and Russian olive were the two most common non-native species addressed in past funded projects. Projects utilized a number and combination of treatments including fire, mechanical removal, hand removal, and herbicide with varying success. Tamarisk removal at Lees Ferry (#99-075WPF) and Hubbell Trading Post (#97-029WPF) appeared to be successful (Figure 25). Others were less successful. It appeared that the use of herbicides and/or aggressive follow-up maintenance was essential to success. Eradication at Talastima project (#97-037WPF) was largely unsuccessful due to the lack of follow-up treatments and a revegetation component to the project.

Figure 25. Post tamarisk treatment at the Hubbell Trading Post project site (#97-029WPF).

Tamarisk was removed at the Hubbell Trading Post project site by first cutting down the trees and then applying herbicide to the stump. Slash piles were burned. Some slash was used in stream structures.

Several other species pose a large problem to riparian areas in the southwest including Johnson grass, knapweed, tumbleweed, Bermuda grass, and many species of thistles. However, removal of these invasive species was seldom the focus of any project. Invasive species continue to be a problem in Arizona's riparian areas and effective treatments are still evolving. The lessons from these and future AWPF projects can be valuable in meeting this threat. Table 9 displays projects that implemented non-native invasive species removal practices and the target species of that plan.

Table 9. Non-native invasive species removal practices used in case study projects.

Practices used for non-native invasive species removal are listed below with the appropriate grant number and project name.

Project Title:	Grant #:	Practice:
Enhancement of Pueblo Colorado Wash at Hubbell Trading Post	00-104	Tamarisk and Russian Olive removed using cut/stump treat with Garlon IV; burn slash piles
Tucson Audubon Society North Simpson Farm Riparian Recovery	00-115	Cut stumps of arundo/tamarisk. Flattened tumbleweed w/ wire mesh. Hand pulled Johnsonweed.
The 'Ahakhav Tribal Preserve Habitat Restoration Project	96-0016	Clear all tamarisk; One pass with dozer and debris pushed to edges and piled.
Tsaile Creek Watershed Restoration Demonstration	96-0025	Removed Russian Olive from project area
Riparian Restoration on the San Xavier Indian Reservation Community	96-0026	Mechanical removal of tamarisk and Russian thistle
Demonstration Enhancement of Pueblo Colorado Wash at Hubbell Trading Post	97-029	Tamarisk and Russian Olive removed; cut/stump treating with Garlon IV; burn/slash piles, some slash was used in structures.
'Ahakhav Tribal Preserve-Deer Island Revegetation	97-032	Clear all tamarisk from area by ripping and tearing roots from soil. Pile slash; treat stumps with herbicide
Talastima (Blue Canyon) Watershed Restoration Project	97-037	Test of tamarisk removal methods-primarily burning and cutting; No herbicide applied; No revegetation
Glen and Grand Canyon Riparian Restoration Project	99-075	Tamarisk removal: Mechanical removal (bulldozer)

Aquatic Habitat Structures

Aquatic habitat structures are important to native fish habitat in Arizona but were not common in AWPF projects. The 'Ahakhav Preserve project (#96-0016) was the only case study that utilized aquatic habitat structures. The purpose of the installed structure was to attract non-native fish in order to indirectly reduce competition for native fish habitat. It was difficult to assess the effectiveness of this structure. As more projects begin to use aquatic habitat structures, it will be easier to evaluate their effectiveness.

MONITORING

The purpose of monitoring is to assess project success. A properly implemented monitoring program can also provide mid-project information on the success of specific practices and be carried into the future to address long-term success of the project. Additionally, monitoring methods must be robust enough to capture changes in the project site yet simple enough for busy landowners to complete and analyze. Of the 64 projects assessed in Phase I of this study, it appears that, in general, the monitoring methods were clearly defined, that they were appropriate for the objectives of the project, that they targeted the appropriate resources, and that monitoring was completed. Overall, between 69 and 77 percent of the projects received a 'good' rating for each of these four categories.

However, despite these high ratings, conclusions from monitoring efforts were weak or absent from reports. As a result, it was difficult to assess whether the monitoring programs had detected trends at the project site. In many cases data was collected and presented, but never analyzed. The lack of analysis limited the potential for the grantee or evaluation staff to draw conclusions or to identify "lessons learned". It is not clear whether the lack of conclusions stems from a limited ability of the grantee, programmatic ambiguity, or physical site conditions like climate. However, it appears that even though considerable effort is expended on monitoring, analysis is often not complete and conclusions unclear.

Originally, a few monitoring methods from each of the projects' monitoring plans were to be re-measured by evaluation staff for this assessment. The intent was to replicate some of the monitoring methods, thus not only testing the method, but also gathering an additional data set to help determine project success quantitatively. However, it was quickly realized that the wide variety of methods, lack of detail regarding the monitoring plans, associated maps, and locations of monitoring points precluded this approach. Additionally, the wide variety of monitoring

methods and goals made this approach unworkable for the purpose of this report. Instead, we relied on the previously noted guidelines for comparing projects and interviewed grantees on the usefulness and effectiveness of the monitoring methods they had utilized. Photo point monitoring was commonly used and understood by grantees. At least one grantee commented that the photo monitoring protocol disseminated by AWPF was very helpful and they had used it on several other projects. AWPF may want to consider re-instating the photo point monitoring protocol to gain consistency throughout projects and increase the ability to re-visit photo points for project assessment.

It was remarked by several grantees that the project period was too short to measure results. Nearly any project with a vegetation component requires more than the 2-3 years of monitoring provided in the current 5-year projects. The short period limits the value of monitoring data and makes success or failure difficult to assess. A few grantees with the means have continued monitoring at the site, usually as task within another funded project outside of AWPF. However, most discontinued monitoring once the project had ended. It is important to note that AWPF recognizes the value in longer grant periods and has lengthened the grant period to the maximum extent currently allowed by state statutes.

Several successful monitoring programs provided information necessary to make positive 'mid-course' corrections in the project. This is especially true for management and vegetative practices that tend to be more site specific. For example, the LCR Demonstration (#99-092WPF) and Hubbell Trading Post (#97-029WPF) projects identified weaknesses in planting methods during the grant period and were able to adjust future plantings to make them more successful. Lofer Cienega Restoration (#95-021WPF) found that vegetation outside of the experimental elk exclosures was not responding to livestock fencing treatments and the fencing design was altered.

Vegetative and structural practices require more sophisticated monitoring methods in an attempt to identify specific causes of failure or lack of function. Ideally, monitoring methods should not only identify success or failure, but also be able to identify the cause. For this to be successful, practice implementation should be based on specific design criteria. Planting willows during the dormant period to the depth of permanent groundwater is an example of specific design criteria. In this manner monitoring can identify the reasons for failure of a practice. Once identified, this information can be used to revise the design specifications in order to improve effectiveness in future applications. Unfortunately, due to limited time and simple monitoring protocols, most projects simply measured structural integrity and few described the valuable 'lessons learned' in project documents. It is recommended that a more in-depth examination of the effectiveness of the variety of vegetative and structural practices used in AWPF projects be completed to provide invaluable information in order to improve the effectiveness of future riparian restoration projects.

A variety of strategies could be employed to address these shortcomings. At a project level, additional funding from AWPF or other sources could be used to lengthen monitoring periods. Another option is to extend the monitoring period for selected projects beyond five years to allow biennial monitoring using the same funds. A final option might be to allow grantees to apply for additional AWPF funding at the end of the grant period, or in the final year, specifically for additional monitoring. These applications could be judged by the commission on the quality of existing monitoring efforts, importance of the monitoring, and grantees ability to effectively complete additional monitoring. Any of these strategies could allow grantees to conduct monitoring specific to individual project goals and objectives that may only be met long after the project and the grant life has ended.

Additionally, monitoring benchmarks are essential to evaluating success and to communicating monitoring results in a helpful way to managers and others. Benchmarks are specific targets set by the grantee and grant manager to provide goals for practices and provide the grantee the ability to compare results to a stated goal. Benchmarks should be reasonable given the extent and duration of the project. An example of an effective monitoring benchmark is 80% success in willow plantings. Another might be the structural integrity and channel stability through a certain design flood event (i.e., 10-year) associated with a structural practice. The absence of monitoring benchmarks combined with lack of design specifications made it especially difficult for evaluation staff, and sometimes the grantee, to determine reasons for success or failure, or extract specific 'lessons learned'. Commonly, grantees reported whether vegetation survived or structures were intact, but few identified lessons learned. Grant managers may want to emphasize that grantees purposefully develop and communicate 'lessons learned' in a dedicated section of the final report. Finally, clearly defined monitoring benchmarks will also aid in clarifying project goals and objectives during the course of project planning. Without specific, objective, monitoring benchmarks, it is difficult to provide conclusive results from monitoring, which could be a reason why few conclusive determinations were made.

On a program level, AWPF may want to recommend additional specific monitoring tools that are more appropriate for wider applicability. Given the diversity of projects and associated practices, it does not appear that there is a single assessment method that could provide this information. Therefore, a specific monitoring plan must be designed for each project. However, many projects share similar goals, objectives, and practices that provide the opportunity for greater consistency between projects. Some monitoring methods could be commonly used if not universally adopted. The AWPF photo monitoring protocol was widely used in the evaluated projects and several grantees commented on its usefulness. This monitoring protocol should be recommended, or perhaps required, to increase consistency across projects and ensure useful photo documentation. AWPF may want to consider updating the protocol for digital cameras and re-instating its use. Land ownership and priorities change over time and a more standardized set of protocols that can be applied over a wide variety of projects for an extensive period of time (decades) could be very valuable. The identification and recommendation of specific monitoring methods or protocols for use in future AWPF projects is beyond the scope of this project. However, more consistency is recommended in monitoring procedures so that AWPF has the information it needs to judge the success of specific practices and its program over the long run. AWPF may consider compiling a separate monitoring manual to hand to grantees at the beginning of the funded project at the time the contract is signed.

For long-term monitoring goals, far beyond the life of the grant contracts, AWPF should consider using photo point monitoring points established by the grantee to continue to assess the project site over time. This procedure would allow long-term evaluation of specific vegetative or structural practices that are easily affected by climatic and biological events occurring on a long-term scale and could be used to judge the effectiveness of projects and the AWPF program. The long-term evaluation should not only include a site visit and repeat photo documentation of the project, but should also include conversations with the grantee/landowner and review of pertinent project documents. The evaluation should subjectively answer the following questions, which are derived from the AWPF program objectives suggested in this report.

1. Has the project created an overall improvement in riparian/aquatic resources since implementation?
2. Has the project incubated interest in other similar enhancement/restoration activities?
3. Have the lessons learned from the project furthered the science and practice of stream restoration/enhancement?

4. Has the project increased the general publics understanding/awareness of riparian functions and values?

For the shorter term monitoring goals of the grant projects, AWPF may need to revisit efforts made by grantees. Currently, the responsibility for monitoring falls on the grantee with some oversight and review from AWPF staff. There are other models that may be more effective. AWPF should devote some thought to the range of options for the role of and methods for monitoring, from fully individualized monitoring plans conducted by the grantee and individually tailored to the specific project, to a more standardized monitoring protocol conducted by either the grantee or AWPF for all projects. Figure 26 graphically displays a spectrum of possible options that illustrate this concept. Except for the far left circle, which is currently status quo, options A through F located on the bar bring increasing degrees of monitoring consistency as the reader moves from left to right. The circle on the far right represents complete responsibility by AWPF to conduct monitoring for all granted projects. Since, this is not desirable for a number of reasons, it will not be considered here as a viable option.

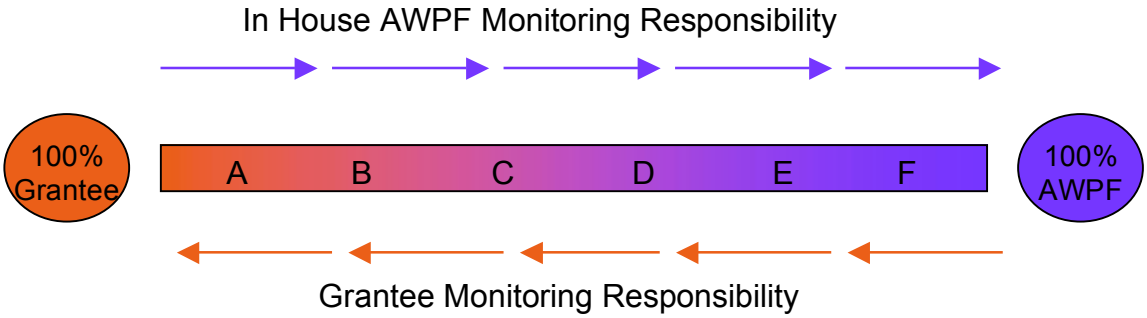

Figure 26. A visual explanation of varying combinations of grantee and AWPF monitoring responsibility to increase consistency between projects over the long term.

The letters A-F depict different options which may be suitable for the AWPF depending upon their goals, financial abilities, desired level of responsibility for monitoring, and desire for consistency in monitoring between projects.

Option A: Grantees create monitoring plan, with more overview and guidance from grant managers especially during construction of monitoring benchmarks.

Option B: AWPF mandates several monitoring methods that all projects use and leave the remaining methods to grantee for their own monitoring desires.

Option C: AWPF creates booklet of monitoring techniques already approved and grantee chooses from the list.

Option D: AWPF hires a Project Monitoring Specialist that can supply intensive support to grantees during projects and allows freedom in monitoring while mandating several set monitoring methods.

Option E: AWPF hires one staff member that conducts pre-project monitoring and post-project monitoring and re-visits the project every 5 years for 20 years. All monitoring relevant to project is still accomplished by grantee.

Option F: AWPF mandates a pre-project site visit and post-project site visit with grant manager (and/or hired monitoring staff) to exit contract. Simple assessment conducted by AWPF at that time. AWPF creates booklet of monitoring techniques already approved and grantee chooses from the list.

In summary, evaluation staff felt that monitoring was a critical aspect of each project and continuation of funding for monitoring activities is extremely important in meeting project and AWPF goals. However, well-defined benchmarks, more extensive analysis, and identification of 'lessons learned' would make the task even more valuable. This would require a closer interaction between AWPF staff and grantees, especially when it comes to setting specific monitoring goals and communicating monitoring results. AWPF could be served well in the long run if at least some aspects of individual monitoring plans were focused on providing standardized information that is useful for comparison between projects and across the AWPF program.

PUBLIC OUTREACH AND INFORMATION

Public outreach and information dissemination has been identified by AWPF as an important component of grant projects. The benefits to Arizona riparian systems can be multiplied by effective dissemination of information from grants that raise awareness of conservation issues in the community or present methods and effects for specific practices. During the application process, the presence or absence of public outreach is factored into the final staff recommendation. Historically, public outreach has not been considered an important component of most AWPF projects. Only 44 of 71 capital projects analyzed in Phase I used AWPF funds for public outreach. This does not necessarily mean that public outreach was not a project component as it was often a way for the grantee to contribute in-kind or matching funds. However, funding for this important project component from another source reduces the leverage grant managers have to ensure that effective outreach takes place. This lack of attention toward this component is underscored by the fact that in five projects, public outreach funds were transferred to cover other tasks.

Public outreach efforts can be divided into two categories. The first includes approaches that directly reach the public such as on-site workshops, interpretive signs/trails, and project tours. The second category includes knowledge-based approaches such as articles in newspapers, magazines, newsletters, and technical journals. Public workshops were the most common outreach method followed by interpretive signs and published articles. All of these approaches can be effective, but it was impossible to evaluate the success on a project-by-project basis in this study.

As discussed in the 'Benefits Realized' section of this report, the effect of the project and its 'lessons learned' can be an important added benefit from any project. There are two different avenues for information dissemination and technology transfer from grant projects. The first is the grantee's efforts to actively share information learned from the project. More effective public outreach by the grantee including interpretive signage, trails, or other visitor access, and public education should be encouraged. The second is the potential for AWPF, as the funding organization, to make project information more accessible. The greatest potential for increasing information transfer lies with AWPF.

In previous years, grantees participated in information dissemination meetings. It may be worthwhile to re-instate this meeting annually or semi-annually. To increase attendance and gain a wider audience, AWPF may consider linking the session with Arizona Riparian Council or another riparian focused organization at their yearly meeting. Regardless of these efforts, the final

reports and 'lessons learned' from all projects should be made accessible on the AWPF website. AWPF may consider uploading each final report so the interested public would be able to visit the AWPF site and have volumes of information available to them as well as have the ability to build on past projects, increasing the benefits received from funding of those projects.

For greater information transfer to occur, information from each project must be compiled into a comprehensive, standard format. Final reports should be standardized to provide a summary of all the activities throughout the project as is discussed in the 'Report Writing and Documentation' section of this report. Briefly, these include project goals, objectives, and tasks; a project timeline; a description of the issues of concern and implementation tasks; monitoring protocols and benchmarks; final monitoring results; and public outreach efforts. Each final report should include a section addressing 'lessons learned'; what worked and didn't, and how it could be done in the future. This recommendation has already been addressed by AWPF and will continue to strengthen the final deliverable of the project.

RESEARCH AND FEASIBILITY PROJECTS

AWPF also funds research and feasibility projects. AWPF research projects are intended to answer questions in order to advance knowledge of riparian systems and their functions. AWPF also considers projects that collect baseline data or take inventory in this category. Currently, AWPF describes feasibility projects as projects that investigate the implementation potential of a proposed capital project and are considered a capital project during the application process. Evaluation staff differentiated feasibility studies from capital projects for this assessment because of the planning nature of the studies and lack of "on the ground" implementation.

Twenty-six research projects and 15 feasibility projects were included in this assessment. Of 24 research projects evaluated (two were not completed), the average award was $80,406.00, while the average cost for feasibility projects was $164,914.00. Funding for research projects is restricted by statute to five percent of the total amount of money available to be awarded by AWPF each year. This cap may account for the lower research project average. It should be noted that one feasibility project was awarded $1,000,000, which may skew the average feasibility award amount. It should also be noted that several grant cycles were limited to capital projects only because full funding was not available from the state in certain years.

Research

Research projects were difficult to evaluate. Research projects addressed a variety of subjects at different levels: species, community, or landscape. Data collection and analyses included both fine and/or coarse scales. An evaluation of the thoroughness or appropriateness of the scientific method was beyond the scope of this project. It was also difficult to evaluate these projects against the current AWPF evaluation criteria presented earlier in this report. Due to their scientific nature, these projects had no "on the ground" component and therefore did not *directly* benefit riparian communities, which is the focus of the AWPF evaluation criteria. Some addressed questions that were directly useful to future projects and the immediate goals of AWPF. The project titled Evaluation of *Carex* species for use in Riparian Restoration (#98-051WPF) is a good example. Others are Regeneration and Survivorship of Arizona Sycamore (#95-009WPF), and Assessment of the Role of Effluent Dominated Rivers in Supporting Riparian Functions (#95-010WPF). AWPF may want to consider creating separate evaluation criteria for research projects in order to clarify what research projects should accomplish. Finally, it appeared that many research projects provided preliminary analyses or included very few conclusions. AWPF should require research projects to deliver a final technical paper with as much rigor and detail as this evaluation suggests for capital project final reports.

Some projects either did not have well-developed methods, or did not have the resources to answer the research questions they proposed. For example, the groundwater tracer studies appeared weak in design and in all cases results were inconclusive. Some projects provided information that would be difficult to directly include in a project design or collected data that could only be used to build a larger research program or concept. Others generated valuable information that had the potential to lead to "on the ground" projects. The seeps and springs inventory (#99-074WPF) is a good example. However, while producing worthwhile information, most research projects did not produce results that were directly applicable to restoration projects. A subset of research projects simply collected data to create an inventory or identify baseline conditions. The nature of inventory or baseline data collection is very site specific and 'needs' oriented. Generalizing information from one study site with this type of data is often not valid, reducing the usefulness of the information in the greater region. Evaluation staff felt that inventory or baseline studies that were *not tied to specific projects* might have been a poor use of AWPF research funds.

Research projects have the potential to provide valuable information that will increase the understanding of riparian systems and advance the field of stream restoration in Arizona, which indirectly advances the goals of AWPF. There are still many unanswered questions concerning stream and riparian enhancement. AWPF has the potential to take a leadership role in defining which questions are most pertinent to its mission and targeting the limited research funding toward those specific questions. There are many approaches that might be taken by AWPF to guide research questions. One approach the evaluation staff suggests may be that research funding be awarded through a 'request for proposals' (RFP) venue. Specific research questions could be proposed and ranked by AWPF staff (perhaps with the aid of a scientific/technical steering committee). Once specific questions or topics have been identified, an RFP can be vetted to private, agency and academic research institutions that can demonstrate the expertise to accomplish the study required. The RFP responses should be reviewed by AWPF staff and the scientific/technical committee (if formed) and funding recommendations passed on to the Commission. Priority should be given to those proposals that are most likely to supply information that directly applies to the design and implementation of practices that could be employed by AWPF grantees, practitioners, or managers of Arizona's waterways and riparian systems. Priority should also be given to research topics that are specific to this region and stand a low chance of funding from national science funding sources.

Examples of the types of research topics that would be applicable to the mission of AWPF are:

- Inventory and identification guide to small diameter, obligate riparian trees in Arizona.
- Classification and identification of flood terrace plant communities across elevation and latitudinal gradients in the southwest.
- Evaluation of effectiveness and identification of design criteria for structural practices for bank stabilization and grade control in southwestern streams.
- Evaluation of seed-mix composition and seeding techniques for flood terrace restoration across elevation and latitude gradients in the southwest.
- Evaluation of the effects of invasive crayfish on substrate composition and sediment transport of southwestern streams.
- Evaluation of effectiveness and identification of design criteria for structural practices to enhance aquatic wildlife the southwest.

Once completed, results of these studies should be disseminated to users of the AWPF program and the wider community. Reports could be available online through the AWPF website and abstracts or links to published material should be made available as well; though in many cases,

publication of manuscripts will occur months or years after the end of the AWPF project. All research contracts should include a stipulation, if possible, that any manuscripts produced with data collected with AWPF funding must be made available to AWPF in electronic format, or at least an announcement of publication with the associated internet link, as soon as practical after publication.

Feasibility Studies

Over the years of the program, the definition and categorization of feasibility studies has changed and continues to change. Most recently, AWPF has adjusted this category to Feasibility of Design under the broader Capital Projects category, which is more in line with evaluation staff observations and recommendations. Some recommendations still stand as explained in the following paragraphs. However, the program has already addressed some of the observations and credit should be given to the flexible and responsive staff and Commission of AWPF.

Feasibility projects differed from research projects in their focus to determine the potential for future implementation of an 'on-the-ground' project. However, evaluation staff noted that of the fifteen studies completed, only two were feasibility studies by this definition. Nine studies were planning documents to assist groups or managers in deciding what action to take next, to gather more community support, to find the appropriate project location, or to collect inventory or baseline data. Others were inventory alone and one study tested the feasibility of a research tool.

It appears that feasibility studies by the original definition are rare and perhaps not that useful to AWPF. In the opinion of the evaluation staff, there is a wealth of viable, worthwhile projects waiting for funding without expending limited funds to establish the feasibility of possible projects. As stated above in the discussion concerning research projects, inventory and baseline data collection as a stand-alone project is not very beneficial to the overall mission of AWPF, but data collection in conjunction with the evaluated planning documents appears very beneficial. In some cases, the inventory or baseline data collection component was essential in preparing a comprehensive assessment and a valuable set of information to planners. Likewise, the funds expended on planning tasks within individual projects are extremely valuable. However, planning money and effort is best expended when it is directly connected to a specific project. Recognizing that planning may be a large portion of specific projects, planning tasks and costs may need to be expanded for some projects that require specific extensive planning activities. These tasks may have fallen into feasibility or inventory funding categories in the past. In this manner, planning monies would be tied to specific projects that AWPF had evaluated as valuable to their mission. Evaluation staff recommends phasing out funding of feasibility studies by the current definition, dropping the term 'feasibility' altogether and moving toward funding comprehensive planning documents that will benefit the mission and program objectives of AWPF. If planning is not connected to specific on-the-ground projects, it may be worthwhile to list separate evaluation criteria for this category of projects, so that during application review, staff can address each criterion in a similar manner as capital projects.

Within the feasibility projects reviewed, there were a few that used the monies to fund organizational or momentum-gathering activities. A worthwhile example of this type of project is 95-002WPF, Partnership for Riparian Conservation Northeastern Pima County. This project used funds to initiate dialogue with landowners, hold meetings for interested parties, and brainstorm about ideas and possibilities. In some cases, this kind of project can lead to on-the ground projects or community awareness that furthers the goals of the AWPF. While evaluation staff did see merit in these activities, they did not feel that this was a well-defined portion of the AWPF mission, especially when considered as a feasibility project. AWPF should consider how this

type of project fits into the mission and goals of the program and evaluate how best to plan for funding these types of projects in the future.

If AWPF would like to keep feasibility studies as a category of projects that are eligible for funding, the program staff may want to consider requiring design documents as part of the contract, which would increase the potential that the project had been thoroughly thought through and was ready for implementation funding. As it stands, of the nine planning documents evaluated, four were related to future projects or had funding already secured for implementation. Two of those four had design or construction documents as a deliverable.

SUMMARY OF RECOMMENDATIONS

This evaluation suggests that the Arizona Water Protection Fund has been successful in its overall goal to support and protect riparian resources in the state. Many effective restoration projects have been implemented and direct benefits to the riparian resources of Arizona have been realized. Moreover, this program has helped further the field of stream and river restoration by providing the opportunity for new and innovative restoration techniques to be implemented and refined. In addition, educational opportunities and 'moments of impact' have been created, which can only help support the program and increase the general knowledge of riparian areas in Arizona. It is important to note that this evaluation was based on completed projects from the start of the program to the most recently completed. File reviews and case study site visits included projects from 1996 through 2002, a few from 2003, and one from 2005. Thus, AWPF staff has already addressed some of the recommendations made in this report.

The program's strengths include the ability to fund a variety of on-the-ground projects across a diverse region, AWPF staff's ability to guide and help many non-technical grantees achieve stream enhancement and restoration goals, and the progressive mindset needed to support a diverse array of grantees and projects in a grassroots approach to protecting riparian resources. The program has also recognized the importance of permitting, planning and monitoring, which is a unique component when compared to other grant programs and has undoubtedly led to the high rate of successful projects.

While the ability of the AWPF to fund effective on-the-ground projects is a success and a major strength of the program, 'lessons learned' from both successful and unsuccessful projects provides an opportunity to build upon this strength and nurture an even more valuable program. Stream and riparian habitat conservation is a developing science. There are many ideas, theories, and an ever-growing body of knowledge concerning rehabilitation, enhancement, and restoration of aquatic and riparian habitats. AWPF is uniquely poised to provide guidance and leadership to this field. Lessons learned from practical, hands-on application of conservation concepts is a key component of conservation science. Careful assessment and analysis of each project's successes and failures as well as the active dissemination of this knowledge is needed to create the most value from the funded projects. AWPF has already taken many steps in this direction, as monitoring and information transfer are already key aspects of every project. However, AWPF should take further action to improve the quality of report materials as well as the information dissemination process. Many of the observations and recommendations made in this report are to this aim.

Other observations and recommendations summarized below are intended to assist the program to more concisely target projects that meet the AWPF goals and objectives. AWPF may want to revise the types of projects that it funds. This is especially true of research and feasibility projects that have demonstrated mixed success towards achieving the program's objectives. AWPF should redefine and reconsider the criteria by which it judges the merits of these types of projects. The feasibility category may be more effectively defined as 'essential planning'. In addition, AWPF may want to take a proactive role in determining where money for research projects is spent by forming research topics or questions that are most important to the program's mission and posing them to the research community rather than evaluating all proposed projects.

The following is a summary of the recommendations included in this report. For a detailed discussion, please refer to the appropriate report section.

Program Objectives

- **Program objectives should be better defined to guide the program into the future. (Pp. 10-12).** The types of projects funded are described in the grant application manual, but program objectives are not defined. Four objectives were identified during efforts to evaluate projects for this assessment. They include 1) direct benefits to riparian areas, 2) effectiveness or good example potential of projects, 3) advancing the field of stream restoration, and 4) educating the general public. These objectives were created from the benefits ratings staff gave to case studies, which were derived from the program goals and other statements made by AWPF staff. The program objectives outlined in this assessment are:

    1. **AWPF projects provide direct benefits to riparian systems.**
    Projects provide "on the ground" protection, enhancement, restoration, and/or creation of benefits as described in the AWPF's current primary & secondary issues of concern evaluation criteria.

    2. **AWPF projects provide positive, effective examples for other similar projects.**
    Projects can build upon the successes of past projects, provide a positive example for replication, encourage or "jumpstart" other similar projects that benefit the resources of concern to AWPF.

    3. **AWPF projects should advance the field of riparian restoration in arid regions.**
    Projects advance the field of riparian restoration by providing lessons that extend, refine, or eliminate methods, practices, or theories and/or that could make other projects more successful.

    4. **AWPF projects increase public awareness of the function and intrinsic value of riparian systems.**
    Projects educate the community and/or surrounding landowners and bring awareness of the value of riparian resources to the general public or community

- **Evaluation criteria should be created for each programmatic objective.** Just as a project's monitoring plan requires criteria to judge success, criteria to define and judge efforts to meet program objectives are important. The evaluation criteria (primary and secondary issues of concern) described in the grant application manual are appropriate for evaluating the first objective identified by evaluation staff (see above bullet). However, additional evaluation criteria should be established to define efforts to meet the remaining objectives. For example, evaluation criteria that AWPF staff may use to review incoming applications for the second objective may state, " The project has the ability 'jumpstart' similar projects", or, "The project has the ability to be replicated". Evaluation criteria that AWPF staff may use for the third objective may state, "The project has the ability to refine, extend, or eliminate restoration methods".

Grant Administration and Process

- **Clear, concise project goals, objectives, tasks, and monitoring benchmarks should be agreed upon by the grantee and grant manager. (Pp. 12-13).** Clear and concise goals, objectives, tasks, and monitoring benchmarks will help provide focus for the project and those involved, as well as a clear path to for grantees to plan the implementation of the project. When a grant is awarded funding, AWPF staff and the grantee should discuss and revise objectives as needed to ensure that contracted objectives are appropriate, achievable, and realistic. Placing a greater emphasis on project goals and objectives throughout the life of the grant would help grantees keep on task, accomplish stated goals and objectives, and have a better chance of overall success. Examples of clearly defined statements at each 'level' of a project are listed below:

Project goals describe the broad intent of the project: "The goal of the project is enhancing existing riparian habitats." Or "The goal is to improve water quality."

Objectives provide additional specificity to the goals: "The objective is to increase the number and variety of native woody species." Or "The objective is to stabilize eroding banks."

Tasks are the actual practices implemented to achieve the objective: "Task 4 is the planting of 150 native willow poles along the stream bank." Or "Task 5 is the re-sloping and replanting of 450 feet of eroding stream bank."

Monitoring benchmarks establish a metric by which to measure success of a task in meeting the objective: "Live and dead willow plantings will be counted each fall with the expectation of 80% survival rate." Or "The slope and vegetative cover of treated stream banks will be measured each fall with the expectation that slope will not increase and vegetative cover will."

- **Project scale should be considered on grant applications. (Pg.14).** It was difficult to compare projects that were implemented at different scales. AWPF may want to consider asking for project scale information (reach, watershed, etc.) in order to be able to evaluate similar projects and know at what scale the project should be effective. For instance, if grantees are working at watershed scale instead of reach scale, certain information becomes arbitrary while other information becomes more relevant. For example, stream length through the project area, which is important information for a reach-scale project, becomes unimportant for a watershed-scale project. On the other hand, the number of streams that will be affected in a watershed-scale project is important information, while completely inapplicable for a reach-scale project. AWPF may even consider including two different Project Location information forms in the application. The scale the grantee is working at would dictate which form they completed.

- **Watershed size and delineation should be requested on grant applications. (Pg. 14).** Watershed size should be included on the grant application and delineated by the grant applicant. This basic information is essential in project planning and would provide AWPF staff and grantee with accurate information regarding appropriate actions for the given area and help determine if implementation of tasks is appropriate for a given project. A worksheet on how to delineate a watershed for a specific project site could be included in the grant manual. An example of the worksheet that may be included is in Appendix C.

- **Final reports should be standardized to increase utility. (Pp. 14-15).** Final reports need to be molded into a communication tool which can be disseminated widely to pass on lessons learned, techniques used, costs, timelines and other information to prospective AWPF grantees and other interested parties. All of this information should be available in a single document, accessible via the AWPF website or written request to AWPF staff. Evaluation staff suggests that a standardized outline or checklist for the final report be developed by AWPF staff and explained to grantees at the beginning of each project. This information could also be included in an updated, web-accessible database (see Public Outreach recommendations). An example outline has been created by evaluation staff and is included in Appendix D.

- **A formal procedure for extending grant contracts should be implemented. (Pg. 15 and 44).** In many cases, valuable information could be gained by extending the

monitoring programs of well-administered projects. For certain restoration practices (e.g. prescribed fire), climate related extensions to increase success of the project might be warranted. Evaluation staff also realizes there are certain statutory limitations to grant cycles in the state, however perhaps worthwhile projects could receive extensions on a case by case basis as the Commission deems appropriate. Extensions are periodically awarded by the Commission but usually as a result of unanticipated delays or other problems. AWPF may want to consider formal policy that encourages grantees with worthwhile projects to apply for an extension during the final year of the grant to continue monitoring or certain restoration techniques, with or without addition funding. The extensions would be approved by the Commission on a case-by-case basis as part of the annual grant cycle.

- **The evaluation identified the importance of adequate AWPF staffing.** Active AWPF staff involvement was identified as a critical factor in the success of many projects. Staff site visits and active participation in planning, design, and implementation are as important as document review and accounting. It appears from the evaluation that site visits are less frequent than at times in the past indicating the need for additional staff. Whether it is administrative assistance, monitoring personnel, or more grant managers, sufficient AWPF support staff will aid the grant program and its ambitious and worthwhile goals.

Upland Projects

- **Upland focused projects are more successful when direct riparian restoration components are associated with them. (Pp. 8-9).** Though many upland projects received low ratings from this assessment it does not mean they weren't worthwhile. These projects could have been much stronger if, in addition, direct restoration work was completed in the riparian area to help spring the system into recovery.

Planning and Design

- **Construction sheets, both pre- and post construction are essential to monitor success. (Pp. 15-16).** Clear, thorough planning is essential to a successful project. AWPF recognizes the importance of helping grantees develop thorough project planning and design. This emphasis is important to maintain in high quality grant projects. However, more consistent and specific construction sheets, specifications, and design plans should be developed and provided to grant managers for approval. These items would increase the ability of the grant manager to assess whether the design was designed and implemented correctly, as well as improve the program's ability to help future grantee's to avoid past failures and replicate past successes.

Implementation Practices

- **The implementation of all practices, especially vegetative and structural, should guided by specific design specifications to assure proper installation, pinpoint failures, and pass on success to others (Pp. 22-23)** Each project practice should have a set of specific design criteria or specifications that guide its effective placement and construction. Fencing criteria might include fence type, materials, location, and water gaps if needed. Planting specification could include species, type (seed, container, bare pole), time of harvest, time of planting, locations, age of plants, depth to groundwater, etc. Specifications for structural measures might include size of rock, gradation, orientation, specific gravity, or other physical characteristics as well as placement depth, thickness, etc. The lack of these criteria or specifications in project design documents limited the ability to evaluate what was successful and the reason for failure. Likewise,

the lack of "as-built" drawings or documents increased the difficulty in determining whether failure was a function of poor design, faulty installation, or incorrect placement. Specific design criteria will help insure proper implementation and help to identify causes of failure. This information is critical to inform future applications and improve effectiveness.

Monitoring

- **Vegetative and structural practices need more detailed monitoring protocols and analysis. (Pg. 44).** Vegetative and structural practices require more sophisticated monitoring methods in an attempt to identify specific causes of failure or lack of function. It is recommended that a more in-depth examination of the effectiveness of the variety of vegetative and structural practices used in AWPF projects take place, which would provide invaluable information and improve the effectiveness of future riparian restoration projects. For example, monitoring protocols should be specific enough to identify why plantings failed. Was it poor implementation, inadequate planting depth, lack of precipitation, or other factors that led to the failure of project plantings? Did the grade control fail due to flooding beyond the design standard, insufficient size, too shallow scour depth, improper installation, or other reason? The answers to these questions are important to improving the science of stream restoration in Arizona.

- **Develop separate monitoring manual for grantees. (Pg. 45).** Monitoring is mandatory element in all AWPF projects. Yet monitoring results in past projects has been variable and too often incomplete. It may be useful for AWPF to compile a separate monitoring manual that is given to grantees at the time the grant contract is signed for their information and to assist greater consistency in methods used and data collected. The existing, but currently retired AWPF photo monitoring protocol could serve as the basis with other protocols added as needed, approved, and available.

- **Monitoring benchmarks will lead to greater monitoring conclusions and help clarify lessons learned by the grantee. (Pp. 44-45).** Monitoring benchmarks are an essential part of evaluating project success and help communicate monitoring results in a helpful way to managers and future readers. It was observed during the evaluation that often grantees presented no formal conclusions from their monitoring data. Evaluation staff surmises that a lack of clear benchmarks, which help define what was successful and what was not, may be the reason. It is recommended that grant managers and grantees work together to formulate attainable benchmarks for monitoring project success. For example, an attainable benchmark may state, 'Seventy-five percent of plantings should survive and become established without irrigation by the project's end', or, 'Stream channel width should decrease because of established vegetation over time'. These statements allow the grantee to report on what actually occurred in comparison to the declared benchmark. Why the benchmark was met or why it was not will help the grantee complete the Lessons Learned section in the final report. Monitoring benchmarks will also aid in clarifying project goals and objectives during the course of project planning.

- **Greater short-term monitoring consistency is needed to be able to evaluate project success, which may include revisiting the level of monitoring responsibility of the grantee and the AWPF program. (Pp. 46-47).** More consistency is recommended in monitoring procedures so that AWPF has the information it needs to judge the success of specific practices and its program over the long run. Monitoring consistency can be derived from grantees or AWPF staff. For example, if AWPF would like to keep monitoring the responsibility of the grantee, the program could still increase consistency

by mandating several monitoring methods that all projects use and leave the remaining methods to grantees for their own monitoring desires. Thus, monitoring implementation remains with the grantee, but is somewhat directed by AWPF. In this example, AWPF may mandate all projects to complete photo monitoring and specific vegetation transect methods, while other monitoring methods remained the sole responsibility of the grantee. This approach allows comparison between projects in the future, compiles a very large data set across projects for use by AWPF, and still allows the grantee freedom to gain their own monitoring information. Another alternative, which moves more responsibility toward the AWPF program, may require hiring a staff person to work closely with grantees specifically on monitoring issues and methods. This approach allows grantees great freedom to conduct monitoring methods of their choice, but also gives AWPF great oversight and ensures methods are appropriate and data is collected correctly.

- **Long-term monitoring of projects is needed to track project success after the grant contract ends. (Pp. 45-46).** Long-term monitoring of projects will help AWPF track successes and failures of previous projects through time. This is important in order to gain insight about what to pass on to future grantees, which practices not to repeat, and to record what practices are working really well. Since the life of the grant will have ended, it is the responsibility of the AWPF program to monitor projects long-term. Given the diversity of projects and associated practices, it does not appear that a single assessment tool is appropriate to evaluate project success. Thus, it is recommended that AWPF mandate photo monitoring during the life of the grant and re-visit the same photo monitoring points every few years after the contract ends to document change at the project site. The long-term evaluation should not only include a site visit and re-photo documentation of the project, but also conversations with the grantee/landowner and review of pertinent project documents. The evaluation should subjectively answer the following questions, which are derived from the AWPF program objectives suggested in this report.

    1. Has the project created an overall improvement in riparian/aquatic resources since implementation?
    2. Has the project incubated interest in other similar enhancement/restoration activities?
    3. Have the lessons learned from the project furthered the science and practice of stream restoration/enhancement?
    4. Has the project increased the general publics understanding/awareness of riparian functions and values?

Public Outreach and Information

- **The database developed during this project should be maintained and available to the greater community in order to effectively disseminate information gained by the projects. (Pg. 47).** Many lessons were learned from the assessment of these projects. AWPF will gain even more benefit from each project by making this information more accessible to the interested community. Failures often provide as much value to understanding ecosystems, ecosystem function, and ecosystem response to human management. Therefore, it may be beneficial to AWPF staff, grantees, and the restoration community to create and make available a database that not only explains successes within a project, but details the failures in a project as well. The example checklist in Appendix D provides a possible list of information that could be entered into the database.

- **Re-instate projects seminar day in new format. (Pg. 47).** In previous years, grantees participated in information dissemination meetings. It may be worthwhile to re-instate this meeting annually or semi-annually. To increase attendance and gain a wider audience, AWPF may consider linking the session with Arizona Riparian Council or another riparian focused organization at their yearly meeting.

Research Projects

- **Create separate evaluation criteria for research projects. (Pg. 48)** Unlike capital projects, research projects often had no "on the ground" component, and therefore did not 'directly' benefit riparian communities as the evaluation criteria used by AWPF states in the list of primary and secondary issues of concern. However, some research projects addressed questions that were directly useful to future projects and the immediate goals of AWPF. Thus, AWPF may want to consider creating separate evaluation criteria, or issues of concern, for research projects in order to clarify what they should accomplish and to be able to review research proposals during the application process more effectively.

- **Add contract language that requires research projects to provide information about published materials to AWPF. (Pg. 48).** Research studies should have a contract agreement with AWPF to provide published materials, conference abstracts, or other materials gained from research conducted with grant money to add to the file and contribute to the pool of knowledge created by the grant program. If peer reviewed technical papers cannot be produced within the timeframe of the contract, a grey literature paper or other alternative method of disseminating the information should be substituted. The alternative should be patterned after a technical paper and most importantly include a thorough analysis and conclusion section.

- **Require research projects to provide final technical paper with same rigor as capital project final report requirements. (Pg. 48).** Research projects should contribute to the pool of knowledge created by the grant program to the maximum extent possible. To this end, they should also include detailed methods, conclusions and results, as well as lessons learned. It appeared that several research projects gave preliminary data as the final deliverable, or very few conclusions. Increasing the utility of the data collected increases the usefulness of these projects to the program.

- **Fund inventory or data collection research only in conjunction with a greater question or project. (Pg. 48).** The nature of inventory or baseline data collection is very site specific and 'needs' oriented. Generalizing information from one study site with this type of data is often not valid reducing the usefulness of the information in the greater region. Evaluation staff felt that inventory or baseline studies that were *not tied to specific projects* might have been a poor use of AWPF research funds.

- **Focus research funding by identifying questions to be answered. (Pg. 49).** There are still many unanswered questions concerning stream and riparian enhancement. AWPF has the potential to take a leadership role in defining which questions are most pertinent to its mission and targeting the limited research funding toward those specific questions. There are many approaches that might be taken by AWPF to guide research questions. One approach the evaluation staff suggests may be that research funding is awarded through a 'request for proposals' venue. Specific research questions could be proposed and ranked by AWPF staff (perhaps with the aid of a scientific/technical steering committee).

Feasibility Projects

- **Discontinue funding traditional feasibility studies and move toward comprehensive planning projects. (Pg. 50).** Evaluation staff recommends phasing out funding of feasibility studies by the original definition, dropping the term 'feasibility' altogether and moving toward funding comprehensive planning documents that will benefit the mission and program objectives of AWPF. It may be worthwhile to list separate evaluation criteria for this category of projects, so that during application review, staff can address each criterion similar to what is currently practiced for capital projects. Additionally, AWPF could consider expanding the role of planning within proposed capital projects. This would link planning and inventory efforts to projects that have been evaluated and judged worthy of funding by AWPF staff and the commission.

- **If AWPF continues funding feasibility studies, mandate design documents as a deliverable. (Pg. 50).** If AWPF would like to keep feasibility studies as a category of projects that are eligible for funding, the program staff may want to consider requiring design documents as part of the contract, which would increase the potential that the project had been thoroughly thought through and was ready for implementation funding.

The above recommendations are intended to help make the program even more successful and will help increase the value of an already valuable program. The Arizona Water Protection Fund is an innovative, responsive program that has implemented a wide variety of valuable projects to protect and conserve aquatic and riparian resources in Arizona. Arizona's people and resources are improved by its efforts. The recommendations in this report are aimed at improving the knowledge gained from individual projects will be an invaluable resource for other practitioners, researchers, future grantees, and the restoration community that will have a lasting affect far into the future.

APPENDIX A

LIST OF ALL PROJECTS EVALUATED*

Grant #:	Project Type	Project Title:	Project Status:	Grantee:	County:	Watershed:
00-099	Capital	Gila Reference Riparian Area, Discovery Park	terminated early	Mt. Graham Int. Science & Cult. Foundation	Graham	Upper Gila River
00-100	Capital	Willow Creek Riparian Restoration Project	complete	David Movius	Mohave	Lower Colorado River
00-101	Capital	Murray Basin and Saffel Canyon Watershed Restoration	complete	Apache Sitgreaves NF	Apache	Little Colorado River
00-102	Capital	Upper Eagle Creek Restoration On East Eagle Allotment of Four Drag Ranch	complete	Gary and Darcy Ely	Greenlee	Upper Gila River
00-103	Capital	Riparian Restoration on the Santa Cruz River - Santa Fe Ranch	complete	Coronado Resource Conservation & Development, Inc.	Santa Cruz	Santa Cruz River
00-104	Capital	Continued Enhancement Of Pueblo Colorado Wash At Hubbell Trading Post National Historic Site	complete	National Park Service - Hubbell Trading Post NHS	Apache	Little Colorado River
00-105	Capital	Hubbell Trading Post Riparian Restoration With Treated Effluent	complete	National Park Service Hubbell Trading Post NHS	Apache	Little Colorado River
00-106	Capital	Tres Alamos Ranch Dirt-Tanks-To-Aquatic-Habitat Conversion	complete	Duncan K. Blair - Tres Alamos Ranch	Yavapai	Lower Colorado River
00-108	Capital	Lake Mary Watershed Streams Restoration Project	complete	NAU	Coconino	Little Colorado River
00-110	Capital	Upper Fairchild Draw Riparian Restoration	complete	Apache Sitgreaves NF	Coconino	Little Colorado River
00-111	Capital	Cooperative Grazing Management For Riparian Improvement On The San Pedro	complete	Double Check Ranch	Pinal	San Pedro River
00-112	Research	Town of Eagar/Round Valley Water Users Association-Additional Mapping For Water Quality Improvements in Watershed	complete	Town of Eagar	Apache	Little Colorado River
00-113	Capital	Polacca Wash Grazing Management	terminated early	Hopi Tribe	Navajo	Santa Cruz River
00-115	Capital	Tucson Audubon Society North Simpson Farm Riparian Recovery Project	complete	Tucson Audubon Society	Pima	Santa Cruz River
03-116	Capital	Cottonwood Creek Restoration	complete	Coronado RC&D Area Inc.	Cochise	Wilcox Playa
03-117	Capital	Lynx Creek Restoration at Sediment Trap #2	complete	Prescott NF	Yavapai	Lower Gila River
03-118	Capital	Verde River Riparian Area Partnership Project	terminated early	Mingus Union High School	Yavapai	Verde River
03-119	Capital	Wet Meadows for Water Quality and Wildlife- A Riparian Restoration Project	complete	National Wild Turkey Federation	Apache	Little Colorado River
05-127	Capital	EC Bar Ranch Reach 8 Water Well & Drinker Project	complete	Jim Crosswhite	Apache	Upper Colorado River
95-001	Research	Stable Isotope Assessment of Groundwater and Surface Water Interaction: Application to Verde River Headwaters	complete	Robert Grim (ASU)	Yavapai	Verde River
95-002	Feasibility	Partnership for Riparian Conservation in Northeastern Pima County (PROPINA)	complete	Rincon Institute	Pima	Santa Cruz River
95-003	Capital	Sycamore Creek Riparian Management Area	terminated early	Tonto NF Mesa Ranger District	Maricopa	Verde River

Grant #:	Project Type	Project Title:	Project Status:	Grantee:	County:	Watershed:
95-004	Capital	Road Reclamation to Improve Riparian Habitat along the Hassayampa and Verde Rivers	complete	Prescott NF	Yavapai	Verde River, Lower Gila River
95-005	Capital	Preservation of the San Pedro River Utilizing Effluent Recharge: Phase I & II	complete	City of Sierra Vista	Cochise	San Pedro River
95-006	Capital	Critical Riparian Habitat Restoration along a Perennial Reach of a Verde River Tributary	complete	NAU	Coconino	Verde River
95-007	Capital	High Plains Effluent Recharge Project	complete	Pima County Flood Control District, City of Marana	Pima	Santa Cruz River
95-008	Capital	Picacho Reservoir Riparian Enhancement Project	terminated early	Pinal County Dept of Civil Works	Pinal	Upper Gila River
95-009	Research	Regeneration and survivorship of Arizona sycamore	complete	ASU Office of Research and Creative Activities	Cochise	San Pedro River
95-010	Research	Assessment of the Role of Effluent Dominated Rivers in Supporting Riparian Functions	complete	Arizona State University (Duncan Patton)	Yavapai, Santa Cruz, Maricopa	Lower Gila River
95-012	Feasibility	The Comprehensive Plan for the Watson Woods Riparian Preserve	complete	Prescott Creek Preservation Association	Yavapai	Verde River
95-013	Research	Streambank use by livestock: Effects on native aquatic vegetation, morphology and fish habitat and populations.	terminated early	USFS, John Rinne	Yavapai	Verde River
95-014	Capital	Gila Box Riparian and Water Quality Improvement Project	complete	Bureau of Land Management	Graham, Greenlee	Upper Gila River
95-015	Capital	San Pedro Riparian National Conservation Area Watershed Rehabilitation/Restoration Project	complete	Bureau of Land Management	Cochise	San Pedro River
95-016	Research	Refinement of Geological Model, Lower Cienega Basin, Pima County, Arizona	complete	AZ Geological Survey	Pima	Santa Cruz River
95-017	Research	Restoration of Fossil Creek Riparian Ecosystem	complete	USDA/USFS, NAU	Yavapai, Gila	Verde River
95-018	Research	Autecology and Restoration of Sporobolus wrightii Riparian Grasslands in Southern Arizona	complete	ASU - Julie Stromburg	Pima, Santa Cruz, Cochise	Santa Cruz River
95-019	Research	Quantifying Anti-Erosion Traits of Streambank Graminoids	complete	ASU	Pima	Santa Cruz River
95-020	Capital	Teran Watershed Enhancement	complete	Redington natural Resource Conservation District	Cochise	San Pedro River
95-021	Capital	Lofer Cienega Restoration	complete	White Mtn Apache Tribe	Apache	Salt River
95-022	Capital	Gooseberry Watershed Restoration	complete	White Mountain Apache Tribe	Apache	Little Colorado River
95-023	Research	Sabino Creek Riparian Ecosystem Protection	complete	Hidden Valley Homeowners	Pima	Santa Cruz River
95-024	Feasibility	Potrero Creek Wetland Characterization and Management Plan	complete	Environet, Inc.	Santa Cruz	Santa Cruz River
96-0001	Capital	San Pedro Riparian National Conservation Area Watershed Protection and Improvement Project	complete	Bureau of Land Management	Cochise	San Pedro River
96-0002	Capital	Completion Phase - Hi Point Well Project	complete	Navajo County NRCD	Coconino, Navajo	Little Colorado River

Grant #:	Project Type	Project Title:	Project Status:	Grantee:	County:	Watershed:
96-0003	Capital	Hoxworth Springs Riparian Restoration	complete	NAU - Dept of Geology - Abe Springer	Coconino	Lower Colorado River
96-0004	Research	Hydrologic Investigation and Conservation Planning - Pipe Spring, Arizona	complete	Pipe Springs N.M.	Mohave	Upper Colorado River
96-0005	Feasibility	Tres Rios - River Management & Constructed Wetlands Project	complete	City of Phoenix, Water Services Dept	Maricopa	Lower Gila River
96-0006	Research	Hydrogeologic Investigation of Groundwater Movement and Sources of Base Flow to Sonoita Creek, and Implementation of Long-Term Monitoring Program	complete	The Nature Conservancy	Santa Cruz	Santa Cruz River
96-0007	Capital	Ash Creek Riparian Protection Project	complete	Mingus Springs Camp, Henry Dahlberg, Ed.D.	Yavapai	Verde River
96-0008	Feasibility	Watson Woods Vegetation Inventory	complete	Prescott Creeks Preservation Association	Yavapai	Verde River
96-0009	Capital	Watson Woods Riparian Preserve Visitor Management	complete	Prescott Creeks Preservation Association	Yavapai	Verde River
96-0010	Capital	Rehabilitating the Puertocito Wash on the Buenos Aires National Wildlife Refuge	terminated early	Arizona Conservation Boaters, Habitat Fund	Pima	Santa Cruz River
96-0011	Capital	Lower Colorado River - Imperial Division Restoration	complete	US Bureau of Reclamation	Yuma	Lower Colorado River
96-0012	Capital	Eagle Creek Watershed and Riparian Stabilization	complete	Allotment Lessee (Holder Family)	Greenlee	Upper Gila River
96-0013	Capital	Happy Valley Riparian Area Restoration Project	complete	Coronado NF	Cochise	San Pedro River
96-0014	Feasibility	Klondyke Tailings Response Strategy Analysis	complete	AZ Dept. Environmental Quality	Graham	Upper Gila River
96-0015	Capital	Abandonment of an Artesian Geothermal Well	complete	Smithville Canal Company	Gila	Upper Gila River
96-0016	Capital	The 'Ahakhav Tribal Preserve	complete	Colorado River Indian Tribes	La Paz	Lower Colorado River
96-0017	Capital	Big Sandy River Riparian Project	complete	BLM (Range Management Specialist)	Mohave	Lower Colorado River
96-0018	Capital	San Carlos Spring Protection Project	terminated early	San Carlos Apache Tribe	Gila	Upper Gila River
96-0019	Research	Response of Bebb Willow to Riparian Restoration	complete	NAU-School of Forestry	Coconino	Little Colorado River
96-0020	Capital	Cienega Creek Stream Restoration	complete	Bureau of Land Management	Pima	Santa Cruz River
96-0021	Research	Riparian Vegetation & Stream Channel Changes Associated with Water Management along the Bill Williams River	complete	ASU, Center for Environmental Studies	Mohave, La Paz	Lower Colorado River
96-0022	Feasibility	Saffell Canyon and Murray Basin Watershed Restoration Project	complete	Apache Sitgreaves NF	Apache	Little Colorado River
96-0023	Capital	Watershed Restoration at the Yuma Conservation Garden (YCG)	complete	Yuma Conservation Garden	Yuma	Santa Rosa Wash
96-0025	Capital	Tsaile Creek Watershed Restoration Demonstration	complete	Navajo Nation	Apache	Upper Colorado River
96-0026	Capital	Riparian Restoration on the San Xavier Indian Reservation Community	complete	San Xavier Indian Reservation Community	Pima	Santa Cruz River

Grant #:	Project Type	Project Title:	Project Status:	Grantee:	County:	Watershed:
96-0027	Capital	Nogales International Wastewater Treatment Plant Constructed Wetland Demonstration Project	withdrawn	City of Nogales	Santa Cruz	Santa Cruz River
97-027	Capital	Lyle Canyon Allotment Riparian Area Restoration Project	complete	Byrd Lyndsey	Cochise, Santa Cruz	San Pedro River
97-028	Capital	Creation of a Reference Riparian Area in the Gila Valley	complete	Mt Graham International Science and Culture Found.	Graham	Upper Gila River
97-029	Capital	Demonstration Enhancement of Riparian Zone and Stream Channel along Stretch of Pueblo Colorado Wash at Hubbell Trading Post Historic Site	complete	National Park Service - Hubbell Trading Post	Greenlee	Little Colorado River
97-030	Research	Walnut Creek Center for Education and Research - Biological Inventory	complete	Yavapai College	Yavapai	Verde River
97-031	Capital	Lincoln Park Riparian Habitat Project (a.k.a. Atturbury Wash Project)	complete	City of Tucson Water Dept.	Pima	Santa Cruz River
97-032	Capital	Ahakhav Tribal Preserve - Deer Island Revegetation	complete	Colorado River Indian Tribes	La Paz	Lower Colorado River
97-033	Capital	Proctor Vegetation Modification	complete	Coronado NF	Pima	Santa Cruz River
97-034	Capital	Oak Tree Gully Stabilization	complete	Coronado NF - Nogales Ranger District	Pima	Santa Cruz River
97-035	Capital	Watershed Improvement to Restore Riparian and Aquatic Habitat on the Muleshoe Ranch CMA	complete	The Nature Conservancy	Cochise	San Pedro River
97-036	Research	Stable Isotopes as Tracers of Water Quality Constituents in the Upper Gila River	complete	Arizona Geological Survey	Cochise, Graham, Greenlee	Upper Gila River
97-037	Capital	Talastima (Blue Canyon) Watershed Restoration Project	terminated early	Hopi Tribe	Coconino, Navajo	Little Colorado River
97-038	Research	Tres Rios Wetland Heavy-Metal Bioavailability, and Denitrifications Investigation	complete	City of Phoenix, Wastewater Engineering	Maricopa	Salt River
97-040	Capital	Bingham Cienega Riparian Restoration Project	complete	Pima County Flood Control District	Pima	San Pedro River
97-041	Research	Altar Valley Watershed Resource Assessment	complete	Pima Natural Resource Conservation District	Pima	Santa Cruz River
97-042	Feasibility	Queen Creek Restoration and Management Plan	complete	Town of Superior	Pinal	Upper Gila River
97-044	Capital	San Pedro River Preserve Riparian Habitat Restoration Project	complete	The Nature Conservancy	Pinal	San Pedro River
97-045	Capital	Santa Cruz Headwaters Project	complete	The Nature Conservancy	Santa Cruz	Santa Cruz River
98-046	Capital	EC Bar Ranch Water Well Project	complete	James Crosswhite	Apache	Little Colorado River
98-047	Capital	Upper Verde Adaptive Management Unit	complete	Almida Land and Cattle	Yavapai	Verde River
98-049	Capital	Empire-Cienega & Empirita Fencing Project	complete	MacFarland Donaldson	Pima	Santa Cruz River
98-050	Capital	Watershed Restoration of a High-Elevation Riparian Community	complete	Northern Arizona University	Coconino	Verde River
98-051	Research	Evaluation of Carex Species For Use In Riparian Restoration	complete	NAU-Forestry	Coconino	Little Colorado River
98-052	Feasibility	Tritium As a Tracer of Groundwater Sources and movement In the Upper Gila River Drainage	complete	Arizona Geological Survey	Graham	Upper Gila River

Grant #:	Project Type	Project Title:	Project Status:	Grantee:	County:	Watershed:
98-054	Research	Fluvial Geomorphology Study And Demonstration Projects To Enhance And Restore Riparian Habitat On The Gila River From The New Mexico Border	complete	Graham County	Graham, Greenlee	Upper Gila River
98-055	Capital	Horseshoe Allotment: Verde Riparian Project II	complete	George and Sharon Yard	Yavapai	Verde River
98-057	Research	Upper Verde Valley Riparian Area Historical Analysis	complete	NAU, Dr. Abe Springer	Yavapai	Verde River
98-058	Research	Effects Of Removal Of Livestock Grazing On Riparian Vegetation And Channel Conditions Of Selected Reaches Of The Upper Verde River	terminated early	USFS Rocky Mtn Research St.	Yavapai	Verde River
98-059	Capital	Verde River Headwaters Riparian Restoration Demonstration Project	complete	NAU (AZ Board of Regents for & on behalf of NAU)	Coconino	Verde River
98-061	Capital	Watershed Enhancement On The Antelope Allotment	almost completed	Foremaster Revocable Trust	Mohave	Upper Colorado River
98-062	Capital	Partnership For Riparian Conservation In Northeastern Pima County II	complete	Rincon Institute	Pima	Santa Cruz River
98-066	Capital	Hay Mountain Watershed Rehabilitation	complete	Ruth Evelyn Cowan	Cochise	Whitewater Draw
99-067	Capital	EC Bar Ranch Wildlife Drinker Project	complete	James Crosswhite	Apache	Little Colorado River
99-068	Feasibility	Lower Cienega Creek Restoration Evaluation Project	complete	Arizona Department of Environmental Quality	Pima	Santa Cruz River
99-069	Capital	Riparian And Watershed Enhancements on the A7 Ranch Lower San Pedro River	complete	City of Tucson	Cochise	San Pedro River
99-070	Capital	Lyle Canyon Allotment Riparian Area Restoration Project Phase 2	complete	Byrd B. Lindsey	Cochise	San Pedro River
99-071	Feasibility	Protection Of Spring And Seep Resources Of The South Rim, Grand Canyon National Park, By Measuring Water Quality, Flow And Associated Biota	complete	Grand Canyon NP	Coconino	Upper Colorado River
99-072	Capital	Leopard Frog Habitat And Population Conservation At Buenos Aires National Wildlife Refuge	terminated early	University of Arizona	Pima	Santa Cruz River
99-073	Feasibility	Colorado River Nature Center Backwater-Phase II	complete	AZ Game and Fish	Mohave	Upper Colorado River
99-074	Feasibility	Proposal To Inventory, Assess And Recommend Recovery Priorities For Arizona Strip Springs, Seeps And Natural Ponds	complete	Grand Canyon Wildlands Council	Coconino, Mohave	Upper Colorado River
99-075	Capital	Glen and Grand Canyon Riparian Restoration Project	complete	Grand Canyon Wildlands Council	Coconino	Upper Colorado River
99-076	Capital	Watson Woods Preserve Herpetological Interpretive Guide And Checklist	complete	Prescott Creeks	Yavapai	Verde River
99-077	Capital	Blue Box Crossing	complete	Greenlee County	Greenlee	Upper Gila River
99-078	Research	Aquifer Framework And Groundwater Flow Paths In Big and Little Chino Basins	complete	U.S, Geological Society	Yavapai	Verde River
99-080	Capital	Cortaro Mesquite Bosque	terminated early	Pima County Flood Control	Pima	Santa Cruz River
99-083	Capital	Cherry Creek Enhancement Demonstration Project	complete	Tonto National Forest	Gila	Salt River

Grant #:	Project Type	Project Title:	Project Status:	Grantee:	County:	Watershed:
99-084	Research	Assessments Of Riparian Zones In The Little Colorado River Watershed	complete	LCR Multi Objective Management Program, Colorado River Plateau RC & D	Navajo, Apache, Coconino	Little Colorado River
99-085	Feasibility	Kirkland Creek Watershed Resource Assessment	complete	Triangle Natural Resource Conservation District	Yavapai	Lower Colorado River
99-086	Capital	Abandonment of Gila Oil Syndicate Well #1	complete	Gila Valley NRCD	Graham	Upper Gila River
99-087	Capital	Rillito Creek Habitat Restoration Project	withdrawn	City of Tucson-DOT	Pima	Santa Cruz River
99-088	Capital	Wickenburg High School Stream Habitat Creation	complete	Wickenburg Unified School District	Maricopa	Lower Gila River
99-089	Feasibility	Town of Eagar/Round Valley Water Users Association Pressure Irrigation Feasibility Study and Preliminary Design	complete	Town of Eagar / Round Valley Water Users Assoc.	Apache	Little Colorado River
99-090	Capital	Redrock Riparian Improvement	terminated early	U. S. Forest Service	Santa Cruz	Santa Cruz River
99-091	Research	Effects Of Livestock Use Levels On Riparian Trees On The Verde River	complete	Arizona State University	Yavapai	Verde River
99-092	Capital	Little Colorado River Enhancement Demonstration Project	complete	Apache Natural Resources Conservation District	Apache	Little Colorado River
99-093	Research	Coconino Plateau Regional Water Study	complete	City of Williams	Coconino	Upper Colorado River
99-094	Capital	Santa Cruz River Park Extension	terminated early	City of Tucson Dept of Transportation	Pima	Santa Cruz River
99-095	Capital	Brown Creek Restoration Project	complete	Apache Sitgreaves NF	Navajo	Little Colorado River
99-096	Capital	Upper Santa Cruz Watershed Restoration	withdrawn	Lazy J2 Ranch	Santa Cruz	Santa Cruz River
99-097	Capital	Dakini Valley Riparian Project	terminated early	Dakini Valley LLC	Gila	Salt River
99-098	Capital	Rio Salado Habitat Restoration Project	complete	City of Phoenix: Parks, Rec & Libraries Dept.	Maricopa	Salt River

*Case studies visited during Phase II are shaded peach.

APPENDIX B
CASE STUDY SUMMARIES

APPENDIX C

WATERSHED DELINEATION EXAMPLE

A watershed is defined as the basin or catchment area that contributes storm water to a given point on a stream channel. Therefore, watershed size is relative to a specific point on a stream channel. In practice, this means that a raindrop falling anywhere within the watershed will (assuming it does not infiltrate or evaporate) eventually flow past the specific point on the stream channel.

Watershed area increases in size as one picks points further down the stream channel. Conversely, the watershed area decreases as the chosen point moves closer to the headwaters of a given stream. The size of the watershed or watersheds is critical in planning for riparian projects. There is a variety of important information gained from delineating watershed size that is valuable to riparian restoration. For example, once the watershed size is known, how much water flows through the project area can be determined, as well as how much additional flow the project area will experience during storms. Large watershed areas equal large flows and restoration efforts need to be designed accordingly.

Very small watersheds are sometimes given in acres but most commonly watershed areas are given in square miles. Because watershed area differs with every point on a stream, the only way to arrive at the value is to measure or delineate it on a map from your specific project site. The procedure for delineating and computing watershed area is described below.

Procedure:
Traditionally, watersheds are delineated on a scaled map, commonly the 1:24,000 scale topographic maps produced by the United States Geological Survey (USGS). These maps are available from map stores and a variety of sources on the Internet. The project location is marked on the map and from that point a line is drawn around the contributing watershed. Finally, the area within the watershed is determined by one of several methods.

There are also electronic alternatives to the use of a paper map. Fancy Geographical Information Systems (GIS) can automatically generate a watershed area for chosen point or at least allow an operator to draw the watershed boundary and automatically calculate the area. However, these systems are complex, expensive and beyond the reach of most private landowners. The DeLorme company (www.delorme.com) sells relatively inexpensive PC software (TopoQuads, ~$100) that includes all the 1:24000 scale USGS topographic maps for the entire state of Arizona. The software allows the user to draw a boundary around a watershed while it automatically calculates the area within. This program is readily available at stores and online and can also be used to produce location and other maps for your project.

The steps to compute watershed area by hand are as follows:

Step 1: Outlining the Watershed Area
Identify your project site and mark it on the map. In a large watershed, it is often helpful to roughly outline the stream network first. The network of channels gives a visual idea of the watershed shape like the veins in a leaf. To do this, start at the project site and highlight or color the stream moving upstream. Highlight all of the streams connected to the main stem your on which your project is located.

Next, using the highlighted network of channels as a guide, start to outline the watershed area. The watershed area should include **all** of the highlighted streams. Always begin at the project site and draw either clockwise or counter-clockwise. Sometimes it is useful to draw in both directions

until you meet in the middle. There are a few important guidelines that will help you draw the watershed boundary:

The watershed boundary should:
- Generally follow ridges,
- Cross saddles of mountains from peak to peak,
- Never cross a watercourse or stream channel, and
- Cross topographic lines perpendicularly.

If you get stuck, it may be useful to think of where a water drop would run from the point that is giving you trouble. If you are still having trouble, move on to a spot your feel more confident about and perhaps when you come back, which line to draw will be clearer.

Step 2: Calculating the Watershed Area
Great job! The watershed area has been delineated. Now, the area *within* your watershed boundary must be calculated. There are several ways to accomplish this. A GIS system or mapping program may have the ability to calculate the watershed area automatically. Viola, you're done!

If you are going the old-fashioned paper map route, there are two options. 1) A mechanical or electronic planimeter is a tool used to measure the area of a polygon. You simply run the tool around the perimeter of your watershed and it calculates the area in units, generally square inches. 2) A cheaper alternative is to cover your map with squared engineering paper purchased at an office supply store. This paper is often divided into 1-inch squares with 16 or 25 smaller squares within. Tape several sheets together if need be carefully aligning the squares. Trace your delineated watershed onto the squared paper and count the number of whole or partial 1 square-inch squares. Combine as many partial squares as you can to make whole squares to your best estimate. Write down how many squares were inside your boundary.

Finally, the area in square inches must be converted to square miles. It is relatively easy if you are using the USGS 1:24,000 scale topographic maps. In these maps 1 inch of paper equals 24,000 inches or 2,000 feet on the ground. Therefore, each 1-inch square on your paper equals 4,000,000 sq feet (2,000 ft x 2,000 ft) or 0.1435 square miles. To convert total square inches on the map to watershed area in square miles, multiply your total number of squares (or inches) by 0.1435 to get square miles. You've done it!

Example:
An example using Deadwood Draw along the Mogollon Rim is shown on the next page. Both maps are of the same area, the shading in the lower map is an option with the Delorme software and can make the delineation easier. The watershed is long and narrow with a contributing area of 4.1 square miles. A smaller tributary has a watershed area of 0.3 square miles. Although the tributary is separately delineated on this example, it is not necessary for you to do the same for the tributaries connected to your project site.

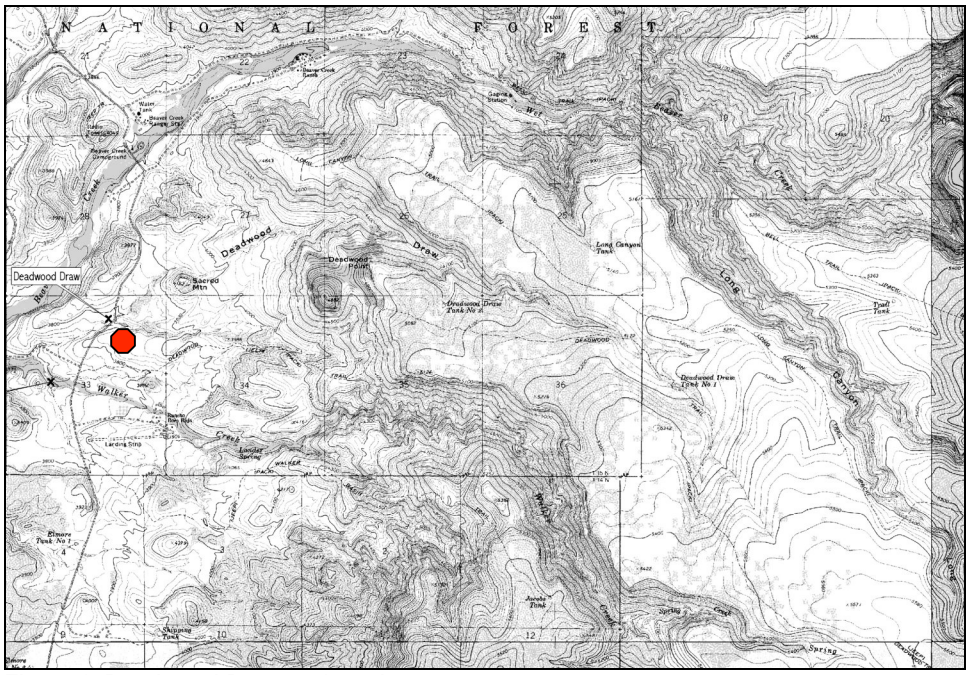

Figure 1. Deadwood Draw project site map.

The example project site is identified by the red dot on the left of the map. The watershed lies to the east or right of the site. The map is a 1:24,000 scale USGS topographic map. The map is not to scale.

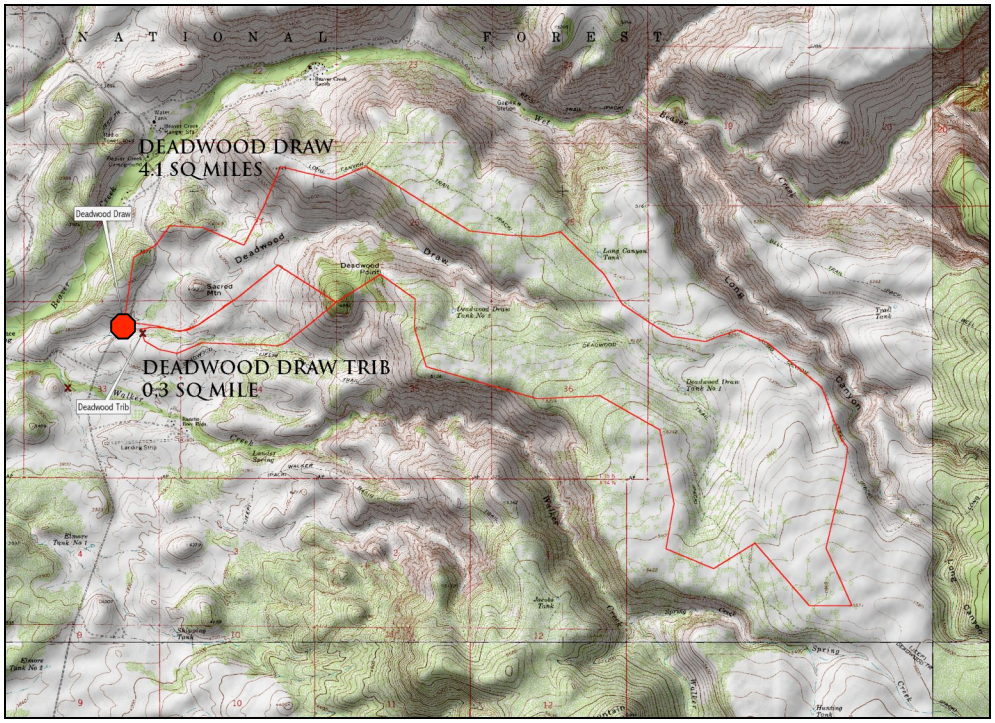

Figure 2 Deadwood Draw watershed.

Two watersheds are delineated on this shaded relief map of watershed. The shading is an option on the Delorme software and can make the delineation easier. The deadwood Draw watershed is 4.1 square miles while the small tributary watershed has an area of 0.3 square miles. The map is not to scale.

APPENDIX D
FINAL REPORT CHECKLIST/OUTLINE EXAMPLE

Final Report Checklist

☐ Executive Summary

Include the executive summary of the project and project area that was included in the original application. This summary should include the following information:

- ☐ Project Area Description
- ☐ Project Goal
- ☐ Land Use/Watershed History
- ☐ Pre-Project Stream Flow and Hydrology
- ☐ Short description of Implementation
- ☐ 'Bottom-line' results

☐ Project Introduction

Basic information regarding the project is provided in this section. Before beginning any stream restoration project, it is important to know the scale of the project (such as does the project aim to work at the watershed level, or just the at the level of a single reach). It is also important to know the size of the entire watershed. This information is important when determining what type and size of structures that may be necessary for stabilizing stream banks and channels. It will also help to determine appropriate placement of riparian vegetation plantings. Finally, this information can be helpful in guiding the management changes necessary. Other important factors that will aid in management activities to be implemented are to know the elevation of the project site. This information is helpful in 1) identifying the stream type, 2) understanding the type of flows these channel may experience, and 3) what plants will grow. The following information should be included in the narrative:

- ☐ Project Title
- ☐ Grant Number
- ☐ Project Location
- ☐ Project Area
- ☐ Project Scale (single reach, entire watershed, other?)
- ☐ Watershed Area
- ☐ Project site elevation & elevation of the highest point in the watershed
- ☐ Project Type/Category (choose one: capital, research, water conservation)

☐ Project Background

The project background describes the problems and/or the need for change within the project area. It defines the purpose of the project and the goals and objectives that are to be accomplished through the implementation of project components. It also provides the timeline in which project tasks and components are to be completed and the monies required in order to accomplish the tasks and components.

- ☐ Statement of Problem
- ☐ Purpose
- ☐ Goals
- ☐ Objectives

- Timeline
- Budget

Project Planning/Assessment

This section summarizes the activities leading up to the construction of the structures. Assessment activities contribute to the overall success of the structural design for the restoration project and will help to guide the implementation component of the project. Assessment activities included 1) interviews with persons with experience in the design, construction, and results of loose rock structure treatments, 2) visual evaluations of existing structures on private and public lands, 3) direct measurements of structure dimension and spacing, and 4) an evaluation of existing conditions against the reference conditions or full potential of the system. The following list of information should be included in this section:

- Tasks
- Site assessment plan
- Design approach
  - Prioritization of treatment areas
  - Design plan
- Identify/describe reference reaches

Project Implementation

This section describes the practices used in the project and how those practices were executed. It also explains the permits necessary to carry out implemented practices, why those permits were necessary, and the outcomes of the permit. Provide the as-built construction drawings/plans with any necessary explanations. The design component of the narrative explains any modifications that had to be made to the original design plans and why these changes came about.

- Permitting
- Practices Used
  - Management Practices
  - Vegetation Practices
  - Mechanical/Structural Practices
- Design Components
  - As Built Construction Plans
  - Design Modifications

Project Monitoring

This section is an evaluation of the changes that have occurred over time relative to the full potential of the stream, or relative to the expected outcomes.

- Monitoring Methods/Protocol
- Monitoring Benchmarks
- Graph/Tables that summarize observed trends, changes, etc.
- Post-Project Stream Flow and Hydrology
- Channel Geomorphology
- Riparian Vegetation Evaluation/Results
- Channel Stability Evaluation/Results
- Bank Stability Evaluation/Results
- Structure Evaluation/Results

- Public Outreach
  - Techniques Used To Reach the Public
  - What was most effective
  - What would be more effective

- Project Summary/Lessons Learned

Summarize the highlights of the project, as well as any important information that other landowners, land managers may be able to use in future projects. This includes things that did not result as expected and things that may have had negative impacts to the system. Include items and lessons that were beneficial, with positive impacts to the system. Include any obstacles that had to be overcome and how they were overcome. Be sure to include the following in the narrative:

- Project area improvements
- Observed changes
- Management treatments effectiveness
- Vegetation treatments effectiveness
- Mechanical/Structural treatments effectiveness
- Monitoring Protocols
- Project Strengths
- Project Weakness
- Overall Trends Observed

- Report Summary

This is the summary of the entire final report. The summary should include a brief summarization of each of the above sections (except for the executive summary).