Arizona Water Protection Fund
FY 2011 Grant Application Review

Application # WPF0395 **Applicant:** ABOR for Northern Arizona University

Title of Project: Comparative Analysis of Landscape Disturbance Impacts on Springs and Wet Meadow Wetlands at Griffiths Spring and Pumphouse Wash Natural Area

Additional materials were submitted with this application that could not be reproduced and distributed for review. These materials may be reviewed in person at the Arizona Water Protection Fund offices at (3550 N. Central Avenue, 2nd Floor, Phoenix). The additional materials available are the following:

_____ **Maps**
_____ **Photographs**
_X_ **Disk**
_____ **Other**

NORTHERN ARIZONA UNIVERSITY

Office of Grant and Contract Services

Northern Arizona University
PO Box 4130
Flagstaff, AZ 86011-4130

928-523-4880
928-523-1075 fax
nau.edu/grants

August 31, 2010

Arizona Water Protection Fund Commission
Arizona Department of Water Resources
3550 North Central Avenue
Phoenix, Arizona 85012

Dear Sir/Madame:

I am pleased to submit, on behalf of Abe Springer, Professor and Director, School of Earth Sciences and Environmental Sustainability, a proposal for the AWPF Fiscal Year 2011 funding cycle. My signature below confirms the approval to submit this proposal on behalf of Northern Arizona University.

We have reviewed the Grant Award Contract General Provisions, and request the following changes be to the General Provisions, or inclusion in the Special Provisions:

Paragraph 6. Indemnification. Since both AWPF and Northern Arizona Universities are entities of the State of Arizona, and unable to indemnify, we request that the agreement exclude state entities from being subject to this provision.

Paragraph 9(b). Termination of Contract pursuant to A.R.S. § 38-511. NAU also is subject to this provision.

I would be pleased to discuss any of these concerns and provide whatever additional information may be helpful. If I can provide additional assistance, please call me at (928) 523-8319 or contact me via e-mail at winnie.ennenga@nau.edu. Your consideration of our proposal is appreciated.

Sincerely,

Wilma G. Ennenga

Wilma G. Ennenga
Director

Enc.
cc:

RECEIVED

SEP 01 2010

Water Protection Fund

WPF0395

Arizona Water Protection Fund
Application Cover Page
FY 2011

Title of Project: Comparative Analysis of Landscape Disturbance Impacts on Springs and Wet-Meadow Wetlands at Griffiths Spring and Pumphouse Wash Natural Area

Type of Project:
- ☐ Capital or Other
- ☐ Water Conservation
- ☒ Research

Stream Type:
- ☐ Perennial
- ☒ Intermittent
- ☐ Ephemeral

Your level of commitment to maintenance of project benefits and capital improvements:
☒ < 5 years ☐ 5-10 years ☐ 11-15 years ☐ 16-20 years

Applicant Information:

Name/Organization:	ABOR for Northern Arizona University
Address 1:	1298 S. Knoles Dr.
Address 2:	ARD Building #56, Suite 240
City:	Flagstaff
State:	AZ
ZIP Code:	86011-4130
Phone:	928-523-7198
Fax:	928-5239220
Tax ID No.:	[redacted]

Inside an AMA: Yes ☐ No ☒

If yes, which AMA:
- ☐ Phoenix
- ☐ Tucson
- ☐ Prescott
- ☐ Pinal
- ☐ Santa Cruz

Type of Application:
- ☒ New
- ☐ Continuation

Contact Person:

Name:	Abe Springer
Title:	Director, School of Earth Sciences and Env. Sustainability
Phone:	928-523-7198
Fax:	928-5239220
e-mail:	abe.springer@nau.edu

Any Previous AWPF Grants:
☒ Yes ☐ No

If yes, please provide Grant #(s):
04-120, 96-003, 98-059, 95-006

Arizona Water Protection Fund Grant Amount Requested:

$112,564.00

If the application is funded, will the Grantee intend to request an advance:
☐ **Yes** ☒ **No**

Matching Funds Obtained and Secured:

Applicant/Agency/Organization:	Amount ($):
1. Applicant	
2.	
3.	
Total:	

Has your legal counsel or contracting authority reviewed and accepted the Grant Award Contract General Provisions?
☒Yes ☐No ☐N/A

Signature of the undersigned certifies understanding and compliance with all terms, conditions and specifications in the attached application. Additionally, signature certifies that all information provided by the applicant is true and accurate. The undersigned acknowledges that intentional presentation of any false or fraudulent information, or knowingly concealing a material fact regarding this application is subject to criminal penalties as provided in A.R.S. Title 13. The Arizona Water Protection Fund Commission may approve Grant Awards with modifications to scope items, methodology, schedule, final products and/or budget.

Wilma G. Ennenga	Director Grant and Contract Services (928) 523-8319
Typed Name of Applicant or Applicant's Authorized Representative	**Title and Telephone Number**
Wilma G. Ennenga	31 August 2010
Signature	**Date Signed**

2) Executive Summary

We propose to develop a tool for evaluating the health of high elevation springs and wetlands in Northern Arizona, which may be used to correlate vegetation and macroinvertebrate community attributes with natural and human disturbances to pinpoint priority areas for restoration. We will conduct a comprehensive assessment of the Pumphouse Wash Natural Area (PWNA) springs and wetlands at the request of the landowner, Coconino County Parks and Recreation, and compare and contrast it with the relatively undisturbed Griffith's Spring wetlands on nearby Coconino National Forest land. Among the rare high-elevation wet-meadow ecosystems in Northern Arizona, these two are special. Located 5 miles south of Flagstaff and surrounded by the Kachina Village community and Interstate 17, the PWNA springs and wet-meadow wetlands serve the function of slowing runoff and filtering potential pollutants at the headwaters of Oak Creek, a major tributary of the Verde River that provides water to the Verde Valley and Phoenix. Meanwhile the adjacent Griffith Springs wetlands are relatively pristine. These water sources fall along a major wildlife corridor and are used seasonally by migrating waterfowl and other birds. PWNA has very high visibility and recreation use, including wildlife watching. Because of its unique values, Coconino County has invested a large proportion of its tax-generated "open space" dollars toward acquiring and safeguarding this land, to protect the riparian areas and to provide at the same time for public recreation and education. Coconino County is highly motivated to implement riparian restoration work at PWNA and our work will aide them in that process.

In this project we will use the scientific method, conduct place-based data collection, analyze data to evaluate ecological condition in relation to disturbance, and elucidate a method by which researchers and natural resource managers may identify priority sites for spring and wetland restoration. A graduate student in the Northern Arizona University School of Forestry (or School of Earth Sciences and Environmental Sustainability) will have primary responsibility for data collection and analysis with guidance from experts in the fields of hydrogeology and springs ecosystems (Abe Springer), wetlands (Jim Allen), and aquatic ecology (Larry Stevens). Watershed Restoration Research Specialist Sharon Masek Lopez will coordinate the project, and the entire team will participate in field work and composing a scientific paper and final report. Publication of project findings in scientific journals is anticipated, although not a specific deliverable. We will make a presentation at least one regional scientific professional meeting. By developing a diagnostic tool measure the health of high elevation spring and wet meadow wetland ecosystems and prioritize restoration efforts, rare wet meadow systems throughout northern Arizona may ultimately benefit.

3) Project Overview

Background

High elevation wet meadows in Northern Arizona are among the rarest and most threatened ecosystems in the state. They are home to diverse plant, animal, insect and bird species that rely on a unique web of interactions. Because they are dependent on spring discharge and snow melt, wet meadows are sensitive to climate variation and human-caused disturbance. Coconino County recognized the ecological value of Pumphouse Wash and the threats to its springs and wetlands, so they used taxpayer-approved conservation dollars to purchase land and establish the Pumphouse Wash Natural Area (PWNA), the first natural area park in the county park system (see website: http://www.coconino.az.gov/parks.aspx?id=415). This public-access conservation area encompasses a large spring-fed wet meadow ecosystem bounded by Interstate 17 on the east and the community of Kachina Village on the south, west, and north. It is a popular attraction for bird and wildlife viewing. Yet, this wet meadow, like most in the region, is compromised by a legacy of channelization, draining, road crossings, grazing and invasive plants.

Springs of the PWNA issue from perched groundwater in bedding plains of Kaibab Limestone, in steep draws with soils of limestone origin, while the wet meadows and other wetland types are located in flat bottom lands with fine-grained clayey soils generated from sediment deposits. The drainage area of the Pumphouse Wash and Griffith's Springs wetlands is about 10 square miles. Average annual precipitation is 23 inches. Depth to perched groundwater is perhaps 20 feet on the mesas surrounding Pumphouse Wash, whereas depth to the local drinking water source in the Coconino Aquifer is about 670 feet. Pumphouse Wash is a losing reach here with probably considerable groundwater recharge occurring during spring snowmelt when water often inundates the wetlands, although this has not been quantified. The ecosystem services provided by the Pumphouse Wash Natural Area include disturbance regulation, water regulation, erosion control and sediment retention, soil formation, refugia, recreation, cultural (education), and waste treatment.

PWNA is comprised of three distinct riparian areas. *Pumphouse Meadow*, is a 66-acre riverine wetland located between Kachina Boulevard and Tovar Trail. This high-elevation wetland is a rare landform in Arizona and an exceptional habitat for wildlife. *Pumphouse Wash*, a 38-acre site immediately downstream of the meadow, has a different morphology entirely characterized by a distinct stream channel with adjacent wetland hydrology. Wooded slopes on each side of the wash are part of the zone, as is a paved county road, Piñon Trail. A mile west and north, *Harrenburg Wash* is a 16-acre site at the confluence of Pumphouse Wash. Flows here are intermittent and confined to a highly disturbed area that includes a pond, breached earthen

dam, and a channelized reach. The County has expressed a need to restore hydrology in the lower reach of Harrenburg Wash. Each of these reaches is supplied with water by natural springs issuing from Kaibab Limestone bedrock. Most of the springs are situated on County-owned land, while the remaining springs are on adjacent private parcels. Our research will focus on the springs on county-owned land.

This spring and wet meadow system is situated in Pumphouse Wash, headwaters to Oak Creek which is a major tributary to the Verde River. The wetlands serve an important function in regulating stream flow and filtering pollutants. Animal species we expect to find include northern leopard frog (endangered), native tiger salamander, several species of bat (many are threatened), several species of vole, elk and more than 20 species of seasonal waterfowl. The wetlands are also part of a major wildlife corridor for animals moving between lower and upper elevations. Encroachment by human activity has impinged on some of the wetland's natural functions. However, by developing an understanding or the vital role the wetland serves in the surrounding landscape and by educating the public about what they can do to preserve and protect the wetlands, this natural area can serve as an important regional riparian restoration area that benefits aquatic invertebrates, amphibians, birds and many other wildlife species.

Griffith's Spring is a part of a very popular recreation area in the Coconino National Forest. The Coconino National Forest has constructed a parking area with restrooms and picnic area and one-mile loop trail adjacent to the uplands of the spring and adjacent wet meadow to manage access and use of the site. The spring and the adjacent runoff channel joins Pumphouse Wash in the Forest Highlands neighborhood and then flows through Pumphouse Wash to Oak Creek. To the best of our knowledge, there have not been intensive inventories of the vegetation and invertebrates of Griffith's Spring and it's wet meadow, as we propose to do in this study. Basic reconnaissance has indicated that the wet meadow at Griffith's Spring has a greater percentage of native than non-native species, making it a viable reference site to compare to the Pumphouse Wash Natural area.

Goals

Goal #1 – Document the current condition of the springs and wetlands

Goal #2 – Determine whether correlations exist between landscape disturbance and the biological integrity of Pumphouse Wash Natural Area and Griffith Springs wetlands

Goal #3 – Develop a technique for evaluating gaging wetland health and prioritizing restoration sites

Objectives

Objective #1 – Inventory plants and insects and characterize hydrology of springs and wetlands.

Objective #2 – Analyze field data

Objective #3 – Characterize relationship between disturbance and wetland ecosystem health metrics for high elevation wetlands in Northern Arizona.

Statement of Problem/Causes

Ecological health of the Pumphouse Wash Natural Area springs and wet meadow wetlands appears to have been compromised by a legacy of grazing, invasive plants, draining, channelization, and road crossings. These wetlands are important regionally, but in their degraded condition they fall short of their potential. Coconino County Parks and Recreation has invested considerable resources to acquire 113 acres of land for protection through natural area designation. Local residents enthusiastically participate in actions to enhance and protect the Pumphouse Wash riparian community. What is lacking is an in-depth analysis of the ecosystem condition and a science-based approach to identifying priority sites for restoring the natural hydrology and native vegetation to benefit wildlife while meeting the recreational needs of county residents. The nearby Griffith's Spring and associate wet meadow has been protected and managed differently and more naturally than the Pumphouse Wash Natural Area and will serve as a reference site for this study.

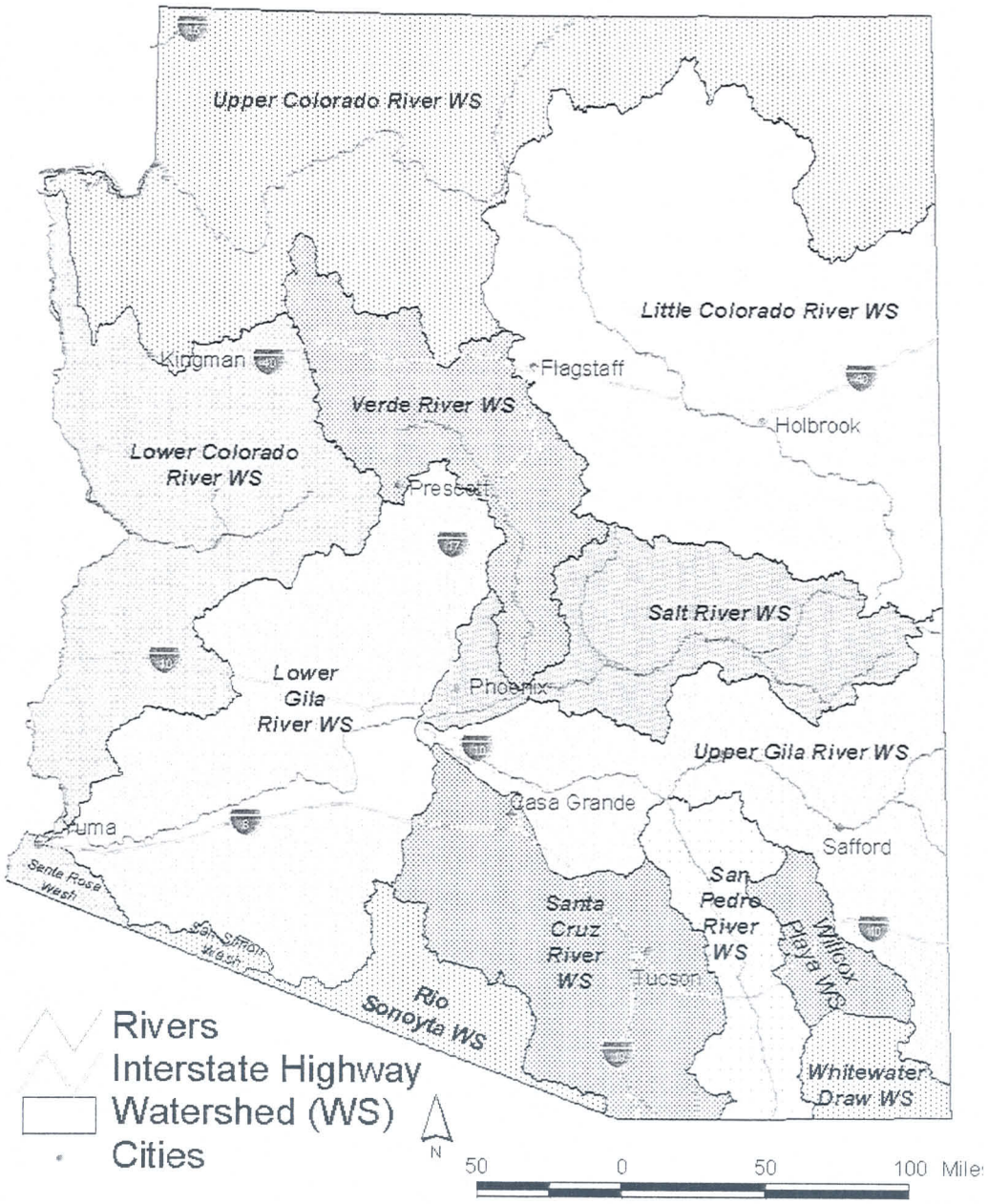
Statement of Solutions/Hypotheses

Through quantitative methods, we propose to conduct a research project based on the hypothesis that the health of high elevation wetlands in Northern Arizona is correlated with specific attributes of natural and human disturbance in proximity to wetlands. These disturbance attributes may include channel cutting, sedimentation, roadway cut and fill, berms, structures, etc. By making a comprehensive inventory of plants and insects, evaluating the geomorphology and hydrology of the springs and associate wet meadows, generating an index of biological integrity (IBI), characterizing disturbance, and conducting statistical analyses, we will ascertain the specific relationships between disturbance factors on ecological health. We will develop a technique that may be used by natural resource managers to evaluate and select potential wetland restoration sites in Arizona and the arid to semi-arid Southwestern U.S.

Statement of Project Years of Benefit

Because the products of this research project will be utilized in future restoration projects, the projected years of benefit could span 10 years of restoration activities, while the benefits to the ecosystem from implementation of restoration at sites selected by using the evaluation tool would extend to probably 30 years or more.

Arizona Watershed Map
FY 2011



Title of Project: **Comparative Analysis of Landscape Disturbance Impacts on Springs and Wet-Meadow Wetlands at Griffiths Spring and Pumphouse Wash Natural Area**

Project Location & Environmental Contaminant Information
FY 2011

Project Location Information

1. County: Coconino	2. Section: 19,30	3. Township: 20N	4. Range: 7E

5. Watershed: Verde River

6. 8 or 10 Digit Hydrologic Unit Code (HUC): 15060202

7. Name of USGS Topographic Map where project area is located: Mountainaire

8. State Legislative District: 1

(Information available at: http://159.87.126.6/mapping/default2.asp?tname=Original.2009.Legislative.Map&org2009leg=on&service=ircmaps&init=true)

9. Land ownership of project area: Coconino County 70%, US Forest Service 30%

10. Current land use of project area: natural area

11. Size of project area (in acres): 113

12. Stream Name: Pumphouse Wash

13. Length of stream through project area: 1.1 miles

14. Miles of stream benefited: 1.1 miles

15. Acres of riparian habitat: 113 acres will be:

- ☒ Enhanced
- ☐ Maintained
- ☒ Restored
- ☐ Created

16. Provide directions to the project site from the nearest city or town. List any special access requirements:

Environmental Contaminant Location Information

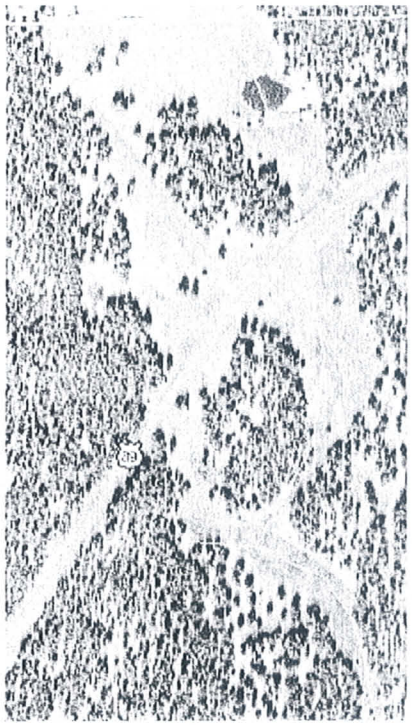
1. Does your project site contain known environmental contaminants? ☐ **YES** ☒ **NO** If yes, please identify the contaminant(s) and enclose data about the location and levels of contaminants:

2. Are there known environmental contaminants in the project vicinity? ☐ **YES** ☒ **NO** If yes, please identify the contaminant(s) and enclose data about the location and levels of contaminants:

3. Are you asking for Arizona Water Protection Fund monies to identify whether or not environmental contaminants are present? ☐ **YES** ☒ **NO**

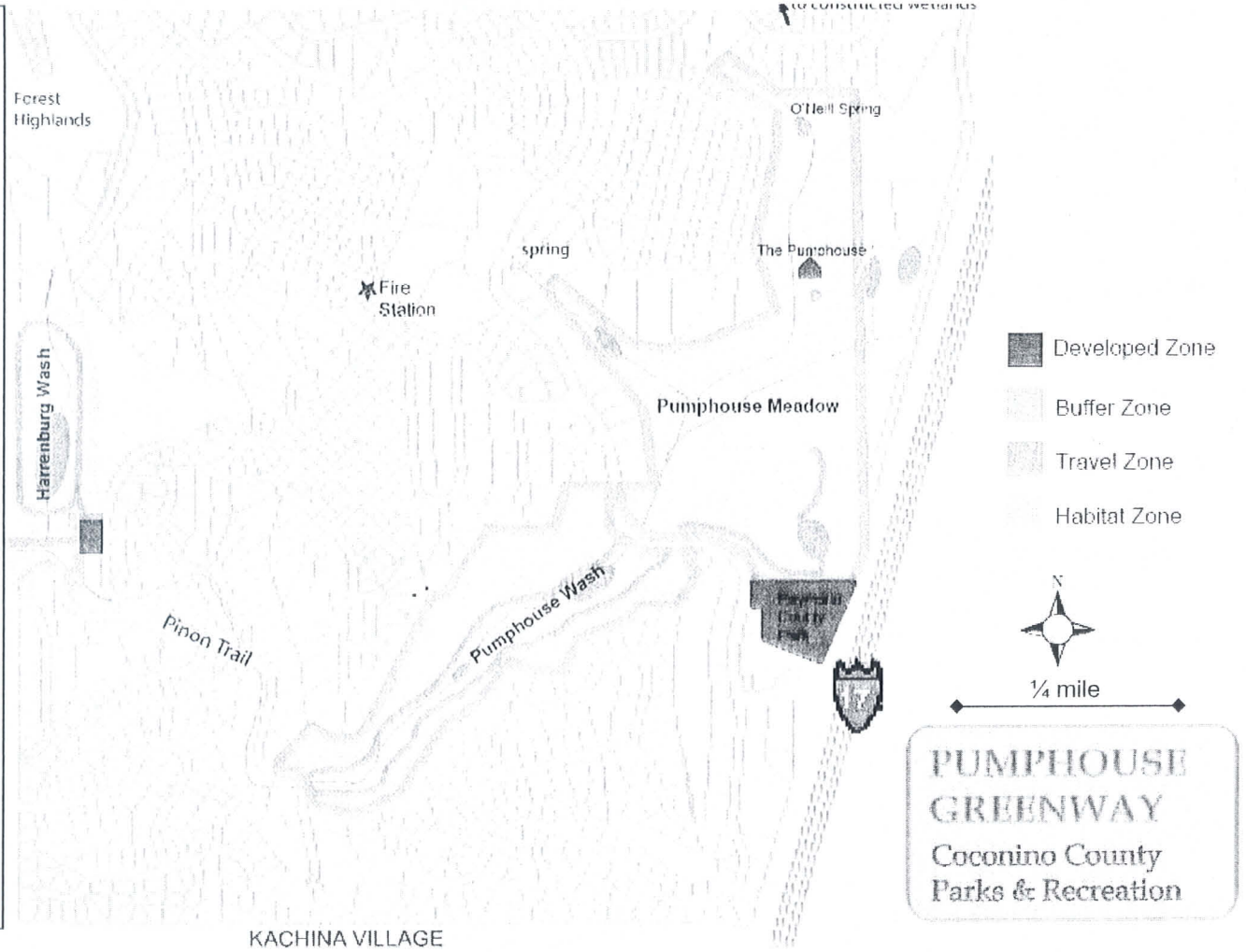
Northern Arizona University: Comparative Analysis of Landscape Disturbance Impacts on Springs and Wet-Meadow Wetlands at Griffiths Spring and Pumphouse Wash Natural Area

Project Location/Ownership Map – All land within the project is owned by Coconino County or the U.S. Forest Service. Surrounding ownership is private parcels in the Kachina Village and Forest Highlands communities and ADOT I-17 right-of-way.



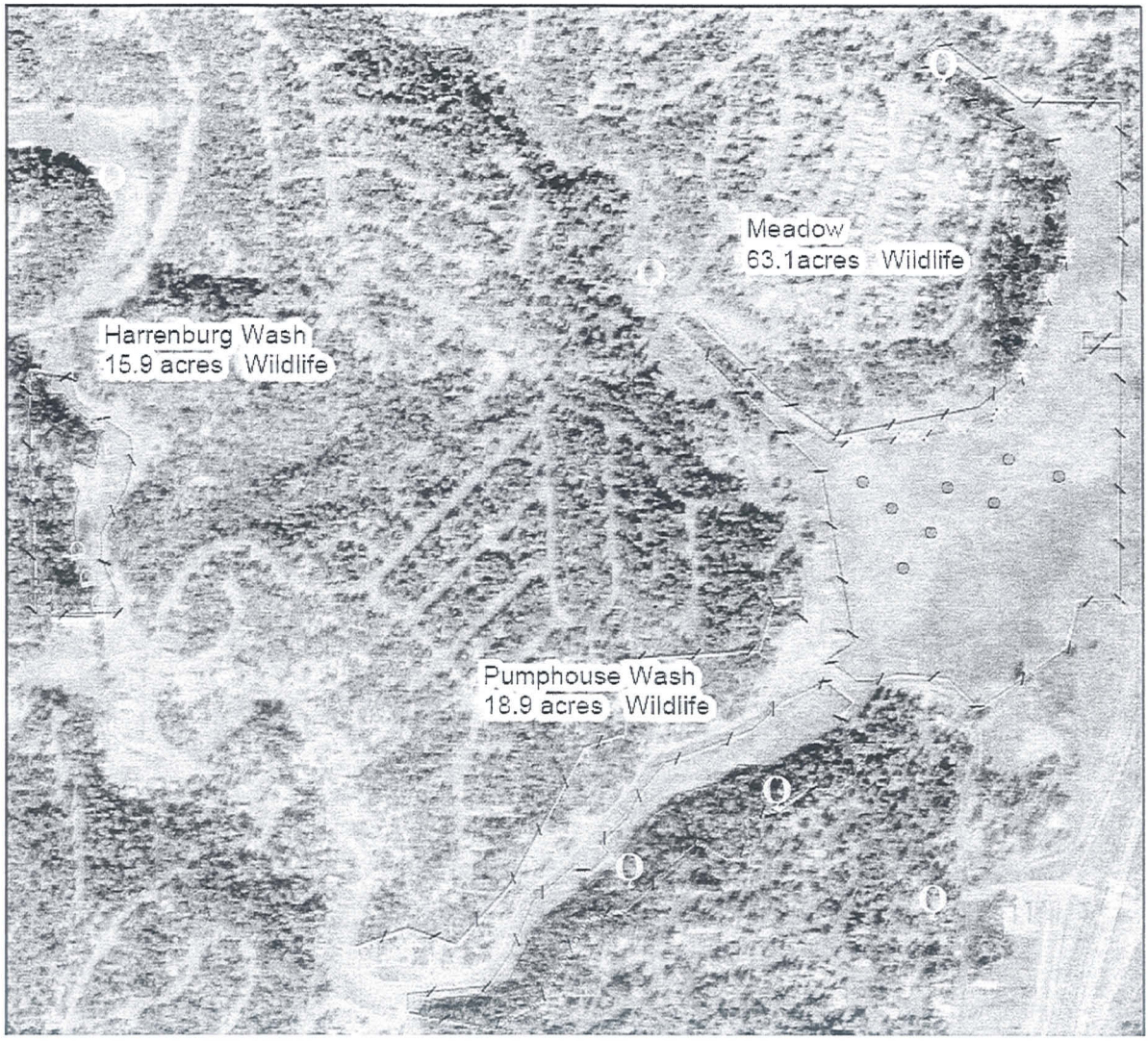
Griffiths Spring is one mile north west of the Pumphouse Wash Natural Area. The land is owned entirely by Coconino National Forest.

¼ mile



Northern Arizona University: Comparative Analysis of Landscape Disturbance Impacts on Springs and Wet-Meadow Wetlands at Griffiths Spring and Pumphouse Wash Natural Area

Project Schematic



or ♀ = approximate location of springs that will be surveyed

Pumphouse Meadow, Pumphouse Wash, and Harrenburg Wash areas are outlined where wetlands including wet meadows will be inventoried.

This map was adapted from "Pumphouse Wash WRP (Wetland Reserve Program)" map on page 11 of the Pumphouse Natural Area Management Plan (Draft May 21, 2009). See online report for explanation of outline colors:
http://www.coconino.az.gov/uploadedFiles/Parks_and_Recreation/DRAFT_2009%20Pumphouse%20Management%20Plan_Web.pdf

6) Scope of Work

Task 1: Permits, Authorizations, Clearances and Agreements

Task Description: We will enter into land access agreements with the landowners, Coconino County and the U.S. Forest Service, for the conduct of all research activities. Any other clearances that may be necessary, such as SHPO, will also be addressed
Purpose/objective: To confirm permission to conduct research on subject lands
Deliverable Description: land access agreements
Deliverable Due Date: August 30, 2011
AWPF Reimbursable Cost: $9,609

Task 2: Field reconnaissance and mapping

Task Description: Field reconnaissance and mapping will be conducted to describe the geomorphic settings of the Pumphouse Wash and Griffith Spring wetlands. Topographic and geomorphic features, such as stream channels, terraces, valley floors and hillslopes will be surveyed at both sites. Areas of native and non-native invasive plants will be delineated. During this task, sampling methodology will be finalized and survey plot locations will be located and staked.
Purpose/objective: To prepare for data sampling activities
Deliverable Description: Field reconnaissance report (including map), finalized sampling design, all necessary supplies and equipment will be purchased as part of this task
Deliverable Due Date: August 30, 2011
AWPF Reimbursable Cost: $17,484

Task 3: Inventory existing wetland/wet meadow ecosystem

Task Description: Wetland vegetation and macroinvertebrates will be inventoried in the Pumphouse Meadow, Pumphouse Wash, Harrenburg Wash and the Griffith Springs areas using protocols based on Miller and Waldrop (2006) and Barbour et al. (1999). Disturbance will be quantified for each site using information on surrounding land use, buffer characteristics, and an assessment of potential site stressors. Plant assemblages that indicate wetland health will be noted. Insects will be surveyed. Soils and hydrology will be evaluated with particular attention on the impacts of past hydrologic modifications.
Purpose/objective: To provide a comprehensive accounting of ecosystem parameters to evaluate wetland ecosystem health.

Deliverable Description: summary report of vegetation, insect, soil and hydrology survey data
Deliverable Due Date: October 31, 2011
AWPF Reimbursable Cost: $21,498

Task 4: Comprehensive ecosystems inventory of springs

Task Description: Springs ecosystems that provide water to the Griffith Springs and Pumphouse Wash wetlands will be inventoried with techniques developed by Stevens and Springer for the U.S. Forest Service and the National Park Service. The geology, geomorphology, and extent of development of each spring will be characterized. Discharge will be measured (if possible). Water quality will be tested at labs at NAU. A rapid bioassessment of aquatic macroinvertebrates will be conducted. Percent cover of riparian vegetation will be inventoried by geomorphic surface type. Geomorphic surface diversity will be correlated with vegetative cover and invertebrate distribution cover following a method recently developed by Hallam (2010).

Purpose/objective: To provide a comprehensive accounting of ecosystem parameters to evaluate spring ecosystem health and assess contributions to downstream wetlands.

Deliverable Description: summary report of geologic, vegetation, insect, and hydrology survey data

Deliverable Due Date: May 15, 2012
AWPF Reimbursable Cost: $21,663

Task 5: Analyze data to ascertain specific correlations between disturbance and spring and wetland ecological health

Task Description: We will develop an index of biological integrity (IBI) for high elevation wetlands and springs in Northern Arizona, based on a floristic quality assessment index (FQAI) (Miller and Wardrop 2006) and an invertebrate index (Barbour et al. 1999). Ecological dose–response curves will be plotted to evaluate the relationship between each ecological attribute and the disturbance score. All correlations with P values smaller than 0.01 will be considered significant. Inventory data will be used to characterize the native and non-native species composition in the wetlands and springs, the distribution of species by geomorphic surfaces, and to assess the current condition of the wetlands and springs. The current conditions of the PWNA will be compared to the condition of Griffith's Spring and any other reference sites with existing inventory information in the region. Multiple attributes of the spring and wetland plant community will be evaluated including species richness, diversity, and evenness.

Purpose/objective: To determine how and to what extent landscape disturbances impact spring and wetland health to inform future restoration prescriptions.

Deliverable Description: summary report of analysis findings
Deliverable Due Date: August 31, 2012
AWPF Reimbursable Cost: $15,253

Task 6: Presentation of results

Task Description: A scientific paper will be prepared detailing research objectives, methods, results and conclusions. We will present the findings at least one regional scientific professional meeting.

Purpose/objective: To make the diagnostic tool that we have developed available to other researchers and natural resource managers in the Southwest

Deliverable Description: Scientific paper, presentation materials, documentation of participation in professional meerting

Deliverable Due Date: December 31, 2012
AWPF Reimbursable Cost: $21,350

Task 7: Final Report

Task Description: We will prepare and submit a comprehensive final report consistent with the Final Report Guidelines in AWPF Policies and Application Guidelines Manual, including a summary of all methodologies used, outcome of all tasks, analysis of all project data, suggestions for any further changes needed in the project, and an evaluation of the project's success measured against the objectives.

Purpose/objective: To provide a concise accounting of project accomplishments

Deliverable description: A report summarizing all project activities and deliverables, including an evaluation of the project's success measured against the objectives.

Deliverable due date: May 15, 2013
AWPF Fixed Cost: $5,707

Arizona Water Protection Fund

Comparative Analysis of Landscape Disturbance Impacts on Springs and Wet-Meadow Wetlands at Griffiths Spring and Pumphouse Wash Natural Area

Northern Arizona University

Personnel:

				Requested	Match	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7
Salary and Wages												
Sharon Masek Lopez - Research Specialist	$20	/ hour	x 480	$9,600		$1,436	$1,436	$1,436	$1,436	$1,436	$1,920	$500
Abe Springer - Hydrogeologist	$50	/ hour	x 160	$8,000		$700	$700	$700	$700	$700	$4,000	$500
Jim Allen - Wetlands Ecologist	$50	/ hour	x 80	$4,000		$360	$360	$360	$360	$360	$2,000	$200
Larry Stevens - Aquatic Ecologist	$50	/ hour	x 200	$10,000				$4,000	$4,000		$1,000	$1,000
Kimberly Everidge - project financial manager	$18	/ hour	x 175	$3,150		$450	$450	$450	$450	$450	$450	$450
Graduate Research Assistantship												
academic year	$13,000	/ year	x 2	$26,000		$2,600	$2,600	$5,200	$5,200	$5,200	$5,200	
summer	$1,444	/ month	x 6	$8,664		$866	$866	$1,733	$1,733	$1,733	$1,733	
Subtotal Salary & Wages				*$69,414*								
Fringe Benefits												
Research Specialist		16.00%	salary	$1,536		$230	$230	$230	$230	$230	$307	$80
Hydrogeologist		16.00%	salary	$1,280		$112	$112	$112	$112	$112	$640	$80
Wetland Ecologist		16.00%	salary	$640		$58	$58	$58	$58	$58	$320	$32
Aquatic Ecologist		8.21%	salary	$821				$328	$328		$82	$82
Financial manager		62.00%	salary	$1,953		$279	$279	$279	$279	$279	$279	$279
Graduate Research Asst. (AY)		0.55%	salary	$143		$14	$14	$29	$29	$29	$29	
Graduate Research Asst. (Summer)		8.21%	salary	$711		$71	$71	$142	$142	$142	$142	
Student tuition remission (2 years)												
2011-2012				$5,549		$1,387	$1,387	$2,775				
2012-2013				$5,714					$2,857	$2,857		
Student health insurance (2 years)												
2011-2012				$1,734		$434	$434	$867				
2012-2013				$1,884					$942	$942		
Subtotal Fringe Benefits				*$21,965*								
Total Salary plus Fringe				**$91,379**								

Other Direct Costs:

Supplies												
investigation equipment -stream flow and water quality measurements				$4,500			$4,500					
weirs, stage gages, Solar Pathfinder, water quality meters												
investigation materials - invertebrate and plant collection, water sampling				$3,000			$3,000					
plant presses, kick nets, frame nets, sample bottles, calibration solutions												
statistical software, database support												
printing/publication				$1,000							$500	$500
soil & water quality analyses				$3,000				$1,500	$1,500			
Subtotal Supplies				*$11,500*								
Transportation												
Flagstaff to Phoenix	8	trips										
4 trips/year	280	miles/trip	$0.345 per mile	$773		$155	$155				$232	$232
Flagstaff to field site	80	trips										
40 trips/year	20	miles/trip	$0.345 per mile	$552				$276	$276			
two trips for two people to meetings to present results from the project				$3,000							$1,500	$1,500
Subtotal Transportation				*$4,325*								
Total Other Direct Costs				**$15,825**								
Total Direct Costs				**$107,204**		*$9,152*	*$16,652*	*$20,474*	*$20,631*	*$14,527*	*$20,334*	*$5,435*
Indirect Costs	5.00%			**$5,360**		$458	$833	$1,024	$1,032	$726	$1,017	$272
Forgone Indirect Costs	49.00%				**$47,170**							
Total Project Costs				**$112,564**	**$47,170**	**$9,609**	**$17,484**	**$21,498**	**$21,663**	**$15,253**	**$21,350**	**$5,707**

8) Detailed Matching Funds Breakdown

Matching funds for this project are in the form of waived indirect cost. Northern Arizona University has an indirect cost rate of 49%. Because AWPF offers 5% for administrative cost, there is a difference of 44% of project cost that we consider as match in the form of waived indirect cost.

STATE HISTORIC PRESERVATION OFFICE
Review Form

In accordance with the State Historic Preservation Act (SHPO), A.R.S. 41-861 *et seq*, effective July 24, 1982, each State agency must consider the potential of activities or projects to impact significant cultural resources. Also, each State agency is required to consult with the State Historic Preservation Officer with regard to those activities or projects that may impact cultural resources. Therefore, it is understood that **recipients of state funds are required to comply with this law** throughout the project period. All projects that affect the ground-surface that are funded by AWPF require SHPO clearance, **including those on private and federal lands.**

The State Historic Preservation Office (SHPO) must review each grant application recommended for funding in order to determine the effect, if any, a proposed project may have on archaeological or cultural resources. To assist the SHPO in this review, the following information MUST be submitted with each application for funding assistance:

- A completed copy of this form, and
- A United States Geological Survey (USGS) 7.5 minute map
- A copy of the cultural resources survey report if a survey of the property has been conducted, and
- A copy of any comments of the land managing agency/landowner (i.e., state, federal, county, municipal) on potential impacts of the project on historic properties.
  NOTE: If a federal agency is involved, the agency must consult with SHPO pursuant to the National Historic Preservation Act (NHPA); a state agency must consult with SHPO pursuant to the State Historic Preservation Act (SHPA),
  OR
- A copy of SHPO comments if the survey report has already been reviewed by SHPO.

Please answer the following questions:

1. Grant Program: Arizona Water Protection Fund

2. Project Title: Comparative Analysis of Landscape Disturbance Impacts on Springs and Wet-Meadow Wetlands at Griffiths Spring and Pumphouse Wash Natural Area

3. Applicant Name and Address: Northern Arizona University, ARD Building #56, Suite 240, Flagstaff, AZ 86011-4130

4. Current Land Owner/Manager(s): Coconino County Parks and Recreation

5. Project Location, including Township, Range, Section: T20N, R7E Sections 19 and 30

6. Total Project Area in Acres (or total miles if trail): 113

7. Does the proposed project have the potential to disturb the surface and/or subsurface of the ground? ☐ YES ☒ NO

8. Please provide a brief description of the proposed project and specifically identify any surface or subsurface impacts that are expected: We propose to develop a tool for evaluating the health of high elevation springs and wetlands in Northern Arizona, which may be used to correlate vegetation and macroinvertebrate community attributes with natural and human disturbances to

pinpoint priority areas for restoration. We will conduct a comprehensive assessment of the Pumphouse Wash Natural Area (PWNA) springs and wetlands at the request of the landowner, Coconino County Parks and Recreation, and compare and contrast it with the relatively undisturbed Griffith Spring wetlands on nearby Coconino National Forest land. In this project we will use the scientific method, conduct place-based data collection, analyze data to evaluate ecological condition in relation to disturbance, and elucidate a method by which researchers and natural resource managers may identify priority sites for spring and wetland restoration. The only surface disturbance would be very minimal to collect small soil samples.

9. Describe the condition of the current ground surface within the entire project boundary area (for example, is the ground in a natural undisturbed condition, or has it been bladed, paved, graded, etc.). Estimate horizontal and vertical extent of existing disturbance. Also, attach photographs of project area to document condition: Most of the project area is in a natural condition. There are at least two road crossings that have been existence for at least 40 years. There is an old pumphouse (hence Pumphouse Wash) located in the project area that is more than 50 years old. It was historically used to pump water to Flagstaff to operate saw mills. SHPO may have previously assessed this structure for Coconino County.

10. Are there any known prehistoric and/or historic archaeological sites in or near the project area?
☒ YES ☐ NO

11. Has the project area been previously surveyed for cultural resources by a qualified archaeologist?
☐ YES ☐ NO ☒ UNKOWN

If YES, submit a copy of the survey report. Please attach any comments on the survey report made by the managing agency and/or SHPO

12. Are there any buildings or structures (including mines, bridges, dams, canals, etc.), which are 50-years or older in or adjacent to the project area? ☒ YES ☐ NO

If YES, complete an Arizona Historic Property Inventory Form for each building or structure, attach it to this form and submit it with your application.

13. Is your project area within or near a historic district? ☐ YES ☒ NO

If YES, name of the district:

Please sign on the line below certifying all information provided for this application is accurate to the best of your knowledge.

Wilma G. Ennenga / 31 Aug 2010 Wilma G. Ennenga, Director

Applicant Signature /Date Applicant Printed Name

FOR SHPO USE ONLY

SHPO Finding:

☐ Funding this project will not affect historic properties.

☐ Survey necessary – further GRANTS/SHPO consultation required (*grant funds will not be released until consultation has been completed*)

☐ Cultural resources present – further GRANTS/SHPO consultation required (*grant funds will not be released until consultation has been completed*)

SHPO Comments

For State Historic Preservation Office: Date:

Northern Arizona University: Comparative Analysis of Landscape Disturbance Impacts on Springs and Wet-Meadow Wetlands at Griffiths Spring and Pumphouse Wash Natural Area

Key Personnel – *please see resumes attached below*

Abe Springer, Professor of Hydrogeology and Director of the School of Earth Science and Environmental Sustainability at NAU will serve as project manager and as the supervisor of the graduate student in Environmental Sciences and Policy at NAU who will conduct much of the work.

James Allen, Professor of Forestry and Executive Director of the School of Forestry will provide expertise on wetland ecology and advise the graduate student conducting the wetland surveys and analysis.

Sharon Masek Lopez, Watershed Restoration Research Specialist, will serve as project coordinator and prepare reports for all deliverables.

Larry Stevens, curator of ecology and conservation at the Museum of Northern Arizona, will conduct aquatic macroinvertebrate surveys and assist with spring characterizations.

To be selected, NAU graduate student, will have primary responsibility for literature review, data collection, data analysis, and interpretations, and will lead all publications related to the project.

All team members will participate in field work and composing the scientific paper and final report.

Northern Arizona University: Comparative Analysis of Landscape Disturbance Impacts on Springs and Wet-Meadow Wetlands at Griffiths Spring and Pumphouse Wash Natural Area

ABRAHAM E. SPRINGER
School of Earth Sciences and Environmental Sustainability
Northern Arizona University
P.O. Box 4099, Flagstaff, AZ 86011
(928) 523-7198; e-mail abe.springer@nau.edu

PROFESSIONAL PREPARATION

The College of Wooster, Wooster, Ohio, Geology, B.A. with Departmental Honors, 1987.
The Ohio State University, Columbus, Ohio, Hydrogeology, M.S. 1990.
The Ohio State University, Columbus, Ohio, Hydrogeology, Ph.D. 1994.

APPOINTMENTS

NAU, School of Earth Sciences and Environmental Sustainability, 2009-present, **Director**
Northern Arizona University, Department of Geology, 2008-present, **Professor**
University of Lethbridge, Alberta, Canada, 2007.
Fulbright Visiting Chair in Water and the Environment
Alberta Ingenuity Centre for Water Resources
Northern Arizona University, Arizona Water Institute, 2005-2009
Water Coordinator: Led NAU water coordination activities
Northern Arizona University - Department of Geology, 1999-2008
Associate Professor: Taught new University Colloquium, Applied Geology
University of Wisconsin - Madison, Spring 2001
Visiting Associate Professor - sabbatical research
Northern Arizona University - Department of Geology, 1994-1999
Assistant Professor: Taught classes in Hydrogeology, Ground-Water Flow Modeling, Contaminant Hydrogeology, Environmental Geology, Introductory Geology
The Ohio State University, Department of Geological Sciences, 1989-1994
Graduate Research Associate: Conducted research on wellhead protection, agricultural water quality, and tracer tests.

PUBLICATIONS (selected relevant manuscripts)

Springer, A.E. and L.E. Stevens. 2009. Spheres of Discharge of Springs, *Hydrogeology Journal*, doi: 10.1007/s10040-008-0341-y.

Griffiths, R.E., D.E. Anderson, and **A.E. Springer**. 2008. The morphology and hydrology of small spring-dominated channels, *Geomorphology*, doi:10/1016/j.geomorph.2008.05.038.

Springer, A.E., L.E. Stevens, D.E. Anderson, R.A. Parnell, D.K. Kreamer, S.P. Flora, 2008. A comprehensive springs classification system: Integrating geomorphic, hydrogeochemical, and ecological criteria. in Aridland Springs in North America: Ecology Ecology and Conservation, Univ. Arizona Press, Tucson, eds. Stevens, L.E. and V.J. Meretsky..

Mullen, R.M. **A.E. Springer**, T.E. Kolb. 2006. Complex effects of prescribed fire on restoring the soil-water content in a high-elevation riparian meadow, Arizona, *Restoration Ecology* 14(2):242-250.

Northern Arizona University: Comparative Analysis of Landscape Disturbance Impacts on Springs and Wet-Meadow Wetlands at Griffiths Spring and Pumphouse Wash Natural Area

Springer, A.E, M.A. Amentt, T.E. Kolb, R.M. Mullen. 2006. Evapotranspiration of two vegetation communities in a high-elevation riparian meadow at Hart Prairie, Arizona. *Water Resources Research,* 42, W03412, doi:10.1029/2004WR003863.

OTHER SIGNIFICANT PUBLICATIONS

Crossey, L.J., K.E. Karlstrom, **A.E. Springer**, D. Newell, D.R. Hilton, T. Fischer. 2009. Degassing of mantle-derived CO2 and He from springs in the southern Colorado Plateau region– neotectonic connections and implications for groundwater system, Geological Society of America Bulletin., 121:1034-1053, doi: 10.1130/B26394.1

Adams, E.A, S.A. Monroe, **A.E. Springer**, K.W. Blasch, D.J. Bills. 2006. Flow Timing of South Rim Springs of Grand Canyon, Arizona, Using Electrical Resistance Sensors, *Ground Water*, 44(4), doi.10.1111/j.1745-6584.2006.00223.x.

James Andrew Allen
Northern Arizona University, School of Forestry
P.O. Box 15018, Flagstaff, AZ 86011-5018
928-523-5894; James.Allen@nau.edu

Education:

1994	Ph.D., Forest Ecology, Louisiana State University, Baton Rouge, LA
1986	M.S., Natural Resource Policy and Planning, Cornell University, Ithaca, NY
1980	B.S., Forestry and Wildlife, Virginia Polytechnic Institute, Blacksburg, VA
1978	A.A.S., Pre-Professional Forestry, Paul Smith's College, Paul Smiths, NY

Professional Experience:

2/07– present	Interim Executive Director, Northern Arizona University, School of Forestry
7/06 – 2/07	Associate Director/Associate Professor, Northern Arizona University, School of Forestry
7/00-6/06	Dean, Paul Smith's College, Forestry, Natural Resources and Recreation Division
4/96 -7/00	Research Ecologist/Forester, U.S.D.A. Forest Service, Institute of Pacific Islands Forestry, Honolulu, HI
9/86 - 4/96	Research Ecologist, U.S. Fish and Wildlife Service, National Wetlands Research Center, Lafayette, LA
3/81 -7/84	Peace Corps Volunteer, Swaziland

Peer-Reviewed Journal Articles:

Krauss, K.W., D.R. Cahoon, **J.A. Allen**, J.C. Lynch, N.C. Cormier and K.C. Ewel. 2010. Surface elevation change and susceptibility of different mangrove zones to sea-level rise on Pacific high islands of Micronesia. Ecosystems 13: 129-143.

Woodcock, T, C. Evans, C. Laxson, R. Tucker, **J. Allen**, J. Mihuc, E. Allen and T. Mihuc. 2008. Land use designation and vegetation community structure in the Adirondack uplands (New York, USA). Applied Vegetation Science 11: 509-520.

K.W. Krauss, B.D. Keeland, **J.A. Allen**, K.C. Ewel and D.J. Johnson. 2007. Effects of season, rainfall, and hydrogeomorphic setting on mangrove tree growth in Micronesia. Biotropica 39: 161-170.

Allen, J.A. and K.W. Krauss. 2006. The influence of propagule flotation longevity and light availability on the establishment of introduced mangrove species in Hawaii. Pacific Science 60: 367-376.

Allen, J.A., K.W. Krauss, K.C. Ewel, B.D. Keeland and E.E. Waguk. 2005. A tropical freshwater wetland: I. Structure, growth, and regeneration patterns. Wetland Ecology and Management 13: 657-669.

Allen, J.A., K.W. Krauss, and R.D. Hauff. 2003. Factors limiting the intertidal distribution of the mangrove species Xylocarpus granatum. Oecologia 135: 110-121.

Krauss, K.W. and **J.A. Allen**. 2003. Factors influencing the regeneration of the mangrove, Bruguiera gymnorrhiza (L.) Lamk., on a tropical Pacific island. Forest Ecology and Management 176: 49-60.

Krauss, K.W. and **J.A. Allen**. 2003. Influences of salinity and shade on seedling photosynthesis and growth of two mangrove species, Rhizophora mangle and Bruguiera sexangula, introduced in Hawaii. Aquatic Botany 77: 311-324.

Krauss, K.W., **J.A. Allen** and D.R. Cahoon. 2003. Differential rates of vertical accretion and elevation change among aerial root types in Micronesian mangrove forests. Estuarine, Coastal and Shelf Science 56: 251-259.

Allen, J.A., K.C. Ewel, and J. Jack. 2001. Patterns of natural and anthropogenic disturbance of the mangroves on the Pacific Island of Kosrae. Wetlands Ecology and Management 9: 291-301.

Allen, J.A., K.C. Ewel, B.D. Keeland, T. Tara, and T.J. Smith, III. 2000. Downed wood in Micronesian mangrove forests. Wetlands 20: 169-176.

Allen, J.A., K.W. Krauss, N.C. Duke, O. Bjorkman, D.R. Herbst, and C. Shih. 2000. Bruguiera species in Hawaii: Systematic considerations and ecological implications. Pacific Science 54: 331-343.

Krauss, K.W., J.L. Chambers, **J.A. Allen**, D.M. Soileau, Jr., and A. DeBosier. 2000. Growth and nutrition of baldcypress families planted under varying salinity regimes in Louisiana, USA. Journal of Coastal Research 16: 153-163.

Cox, E.F. and **J.A. Allen**. 1999. Stand structure and productivity of the introduced Rhizophora mangle in Hawaii. Estuaries 22: 276-284.

Krauss, K.W., J.L. Chambers, **J.A. Allen**, B. Luse, and A. DeBosier. 1999. Root and shoot responses of Taxodium distichum seedlings subjected to saline flooding. Environmental and Experimental Botany 41: 15-23.

Allen, J.A. 1998. Mangroves as alien species: The case of Hawaii. Global Ecology and Biogeography Letters 7: 61-71.

King, S.L., **J.A. Allen**, and J.W. McCoy. 1998. Long-term effects of a lock and dam and greentree reservoir management on a bottomland hardwood forest. Forest Ecology and Management 112: 213-226.

Krauss, K.W., J.L. Chambers, and **J.A. Allen**. 1998. Salinity effects and differential germination of several half-sib families of baldcypress from different seed sources. New Forests 15: 53-68.

Allen, J.A. 1997. Reforestation of bottomland hardwoods and the issue of woody species diversity. Restoration Ecology 5: 125-134.

Allen, J.A., J.L. Chambers, and S.R. Pezeshki. 1997. Effects of salinity on baldcypress seedlings: Physiological responses and their relation to salinity tolerance. Wetlands 17: 310-320.

Allen, J.A., S.R. Pezeshki, and J.L. Chambers. 1996. Interaction of flooding and salinity stresses on baldcypress (Taxodium distichum). Tree Physiology 16: 307-313.

King, S.L. and **J.A. Allen**. 1996. Plant succession and greentree reservoir management: Implications for management and restoration of bottomland hardwood wetlands. Wetlands 16: 503-511.

Allen, J.A., J.L. Chambers, and D. McKinney. 1994. Intraspecific variation in the response of Taxodium distichum seedlings to salinity. Forest Ecology and Management 70: 203-214.

Allen, J.A., J.L. Chambers, and M. Stine. 1994. Prospects for increasing the salt tolerance of forest trees: A review. Tree Physiology 14: 843-853.

Allen, J.A. 1990. Establishment of bottomland oak plantations on the Yazoo National Wildlife Complex. Southern Journal of Applied Forestry 14(4): 206-210.

Allen, J.A. 1990. Homestead tree planting practices in two rural Swazi communities. Agroforestry Systems 11: 11-22.

Allen, J.A., D.P. Pimentel, and J.A. Lassoie. 1988. Fuelwood production and use in Swaziland: A case study of two rural communities. Forest Ecology and Management 25(3/4): 239-254.

Pimentel, D., **J. Allen**, A. Beers, L. Guinand, R. Linder, P. McLaughlin, B. Meer, D. Musonda, D. Perdue, S. Poisson, S. Siebert, K. Stoner, R. Salazar, and A. Hawkins. 1987. World agriculture and soil erosion. Bioscience 37(4): 277-283.

Bleys, J.A., W.K.M. Mazibuko, and **J.A. Allen**. 1982. The silviculture of indigenous and exotic trees other than pines and eucalypts in Swaziland. South African Forestry Journal 121: 24-28.

Book Chapters:

Schoenholtz, S.H., J.A. Stanturf, **J.A. Allen**, and C.J. Schweitzer. 2005. Afforestation of agricultural lands in the Lower Mississippi Alluvial Valley: The state of our understanding. Pages 413-432. In L.H. Fredrickson, S.L. King, and R. M. Kaminski (eds.), Ecology and Management of Bottomland Hardwood Systems: The State of our Understanding. University of Missouri-Columbia. Gaylord Memorial Laboratory Special Publication No. 10. Puxico, MO.

Pimentel, D., **J. Allen**, A. Beers, L. Guinand, A. Hawkins, R. Linder, P. McLaughlin, B. Meer, D. Musonda, D. Perdue, S. Poisson, R. Salazar, S. Siebert, and K. Stoner. 1993. Soil erosion and agricultural productivity. Pages 277-292 in D. Pimentel (ed.), World Soil Erosion and Conservation. Cambridge University Press, Cambridge.

Guntenspergen, G.R., J.R. Keough, and **J. Allen**. 1993. Wetland systems and their response to management. Pages 383-390 in G.A. Moshiri (ed.), Constructed Wetlands for Water Quality Improvement. Lewis Publishers, Boca Raton, FL.

LAWRENCE EDWARD STEVENS, PhD

Stevens Ecological Consulting
P.O. Box 1315
Flagstaff, Arizona 86002
(520) 774-4923 TEL
(520) 773-4939 FAX
e-mail: farvana@aol.com

EDUCATION: PhD Zoology, Northern Arizona University, Flagstaff, 1989.
MS Biology, Northern Arizona University, Flagstaff, 1985.
Selected coursework in biology and fine arts, University of Arizona, 1977-1978.
BA Biology and fine arts, with honors, Prescott College, Prescott, Arizona, 1974.

PERTINENT EXPERIENCE, EMPLOYMENT:

2000-present Grand Canyon Wildlands Council Arizona Strip Springs Inventory Project Coordinator
2001-present Welton-Mohawk Irrigation and Drainage District Title Transfer EIS Biological Assessment preparer
2001-present Yuma East Wetlands Project, vegetation and avifaunal analyses and monitoring
2001-present President, Grand Canyon Wildlands Council, Flagstaff, AZ
2000-present Grand Canyon tamarisk control/native vegetation restoration avian monitoring
1999-present Consulting Ecologist, Stevens Ecological Consulting
1999-present. Associate editor, Western North American Naturalist
1998-present. Science Advisor Ecologist, Grand Canyon Wildlands Council, Flagstaff, AZ
1998-2000. Benthic aquatic biological analysis of 'Ahakhav restoration project, Colorado River Indian Tribes
1998-1999. Ecologist, Department of the Interior, Grand Canyon Monitoring and Research Center, Flagstaff, AZ.
1995-1997. Ecological Analyst, Applied Technology Associates, Inc.
1993-present. Adjunct Faculty, Prescott College, Prescott, AZ.
1990-present. Adjunct Faculty Member, Department of Biological Sciences, Northern Arizona University.
1988-1994. Ecologist, Grand Canyon National Park Resource Management and Planning Division.
1986-present. Research Associate, Museum of Northern Arizona, Flagstaff, Arizona.
1989-1991. Summer faculty member, Northern Arizona University Department of Biological Sciences.
1986-1989. Doctoral research, Northern Arizona University. PhD completed in May, 1989.
1983-1989, 1995-present. Whitewater guide in Grand Canyon for Arizona Raft Adventures and Outdoors Unlimited, Flagstaff, Arizona.

PEER-REVIEWED PUBLICATIONS:

In press Kreamer, D.K. and A.E. Springer, in Every Last Drop: Springs Ecology and Conservation, Univ. Arizona Press, Tucson, eds. Stevens, L.E. and V.J. Meretsky.
In press Springer, A.E., L.E. Stevens, D.E. Anderson, R.A. Parnell, D.K. Kreamer, S.P. Flora. A comprehensive springs classification system: Integrating geomorphic, hydrogeochemical, and

ecological criteria. in Every Last Drop: Springs Ecology and Conservation, Univ. Arizona Press, Tucson, eds. Stevens, L.E. and V.J. Meretsky.

In press Stevens, L.E. and A.E. Springer. A conceptual ecosystem model of terrestrial springs, with emphasis on the Colorado Plateau, in Every Last Drop: Springs Ecology and Conservation, Univ. Arizona Press, Tucson, eds. Stevens, L.E. and V.J. Meretsky, 74 p.

2002 Stevens, L.E. and T.J. Ayers. The biodiversity and distribution of alien vascular plant and animals in the Grand Canyon region. Pp. 241-265 *in* Tellman, B., editor. Invasive exotic species in the Sonoran Region. University of Arizona Press, Tucson.

2002 Stevens, L.E. and B.D. Gold. A long-term monitoring program for adaptive management of the Colorado River ecosystem in Glen and Grand canyons. Busch, D. and J. Trexler, editors. Ecological monitoring of ecoregional initiatives: interdisciplinary approaches for determining status and trends of ecosystems. Island Press, submitted.

2001 Hueftle, S.J. and L.E. Stevens. Experimental flood effects on the limnology of Lake Powell Reservoir, southwestern U.S.A. Ecological Applications 11:635-643.

2001 LaRue, C.T., L.L. Dickson, N.L. Brown, J.R. Spence, and L.E. Stevens. Recent bird records from the Grand Canyon region, 1974-2000.

2001 Patten, D.T. and L.E. Stevens. Restoration of the Colorado River ecosystem using planned flooding. Ecological Applications 11:633-634.

2001 Schmidt, J.C., R. Parnell, P.E. Grams, J.E. Hazel, M.A. Kaplinski, L.E. Stevens, and T.L. Hoffnagle The 1996 controlled flood in Grand Canyon: flow, sediment transport, and geomorphic change. Ecological Applications 11:657-672.

2001 Meretsky, V.J., E.G. North, and L.E. Stevens. Surveys for succineid snails in South-Central Utah, Western North American Naturalist, *in press.*

2001 Stevens, L.E., T.J. Ayers, J.B. Bennett, K.Christensen, M.J.C. Kearsley, V.J. Meretsky, A.M. Phillips III, R.A. Parnell, J.Spence, M.K. Sogge, A.E. Springer, and D.L. Wegner. Planned flooding and Colorado River riparian trade-offs downstream from Glen Canyon Dam, Arizona. Ecological Applications 11:701-710.

2000 Merényi, E., W.H. Farrand, L.E. Stevens, T.S. Melis, and K. Chhibber. Mapping Colorado River ecosystem resources in Glen Canyon: analysis of hyperspectral low altitude AVRIS imagery. 14th Congress on Applied Geologic Remote Sensing, Las Vegas, NV.

2000 Meretsky, V.J. and L.E. Stevens. Kanab ambersnail, an endangered succineid snail in southwestern USA. Tentacle 8:8-9.

2000 Miller, M.P., L.E. Stevens, J. D. Busch, J.A. Sorensen, and P. Keim. Amplified fragment length polymorphism and mitochondrial sequence data detect genetic differentiation and relationships in endangered southwestern U.S.A. ambersnails (*Oxyloma* spp.). Canadian Journal of Zoology 78:1845-1854.

2000 Meretsky, V.J., D.L. Wegner, and L.E. Stevens. Balancing endangered species and ecosystems: a case study of adaptive management in Grand Canyon. Environmental Management 25:579-586.

2000 Walters, C., J. Korman, L.E. Stevens, and B.D. Gold. Ecosystem modeling for evaluation of adaptive management policies in the Grand Canyon. Conservation Ecology 4:1[online] URL: http://www.consecol.org/vol4/iss2/art1.

Northern Arizona University: Comparative Analysis of Landscape Disturbance Impacts on Springs and Wet-Meadow Wetlands at Griffiths Spring and Pumphouse Wash Natural Area

SHARON MASEK LOPEZ

School of Earth Sciences and Environmental Sustainability
Northern Arizona University
P.O. Box 4099
Flagstaff, AZ 86011

Telephone: (928) 523-8902 e-mail: sharon.masek_lopez@nau.edu

EDUCATION

Master of Science	Environmental Science and Policy *Northern Arizona University, Flagstaff, AZ* May 2009
Thesis Title:	"Geomorphic Response to Land Use Change, Middle Verde River, Arizona"
Major Fields:	Hydrology, Geomorphology, Geographical Information Systems.
Research Interests:	Ecological restoration, high elevation wetlands, watershed management, fire management and watershed processes.
Bachelor of Science	Fresh Water Studies *Western Washington University, Bellingham, WA* June 1988

PROFESSIONAL EXPERIENCE

1/2010 – Present	Watershed Restoration Research Specialist, Northern Arizona University Flagstaff, AZ,
2008 – 2009	Acting Director, Water Resources Program, The Hopi Tribe, Kykotsmovi,
2006 – 2009	GIS Administrator, Water Resources Program, The Hopi Tribe, Kykotsmovi,
2004 – 2006	Nonpoint Source Coordinator, Water Resources Program, The Hopi Tribe, Kykotsmovi, AZ,
2003 – 2004	Merriam Powell Fellow, Northern Arizona University, Flagstaff, AZ,
2002 – 2004	Graduate Student, Environmental Science and Policy, NAU, Flagstaff, AZ,
1999 – 2000	Research Assistant, Geology Department, NAU, Flagstaff, AZ,
1996 – 1998	Self-employed consultant, Clients included Arizona Department of Water Resources, USDA Forest Service Rocky Mountain Research Station, and ETD Environmental, Flagstaff, AZ,
1994 – 1996	Hydrologist II / Water Resources Specialist, Arizona Department of Water Resources, Phoenix, AZ,
1992 – 1994	Biological Sciences Technician, Rocky Mtn. Research Station, Flagstaff,

Northern Arizona University: Comparative Analysis of Landscape Disturbance Impacts on Springs and Wet-Meadow Wetlands at Griffiths Spring and Pumphouse Wash Natural Area

1980 – 1990 Wildlife Technician, Firefighter, Hydrological Technician, Engineering Technician, Conservation Corp Worker, Mt. Baker-Snoqualmie and Gifford Pinchot National Forests, WA, Seasonal work.

SELECTED PUBLICATIONS

Masek Lopez, Sharon. 2009. Geomorphic Response to Land Use Change, Middle Verde River, Arizona. Masters Thesis, NAU. 84 pp.

Masek Lopez, Sharon and Abraham E.Springer. 2000. Assessment of Human Influence on Riparian Change in the Verde Valley, Arizona, published to Watershed Research and Education Program website, Northern Arizona University, http://www.watershed.nau.edu/Research/RiparianAssessment/index.htm

Masek, Sharon. 1994. Wintering Bald Eagles in Northern Arizona. Wild Earth magazine.

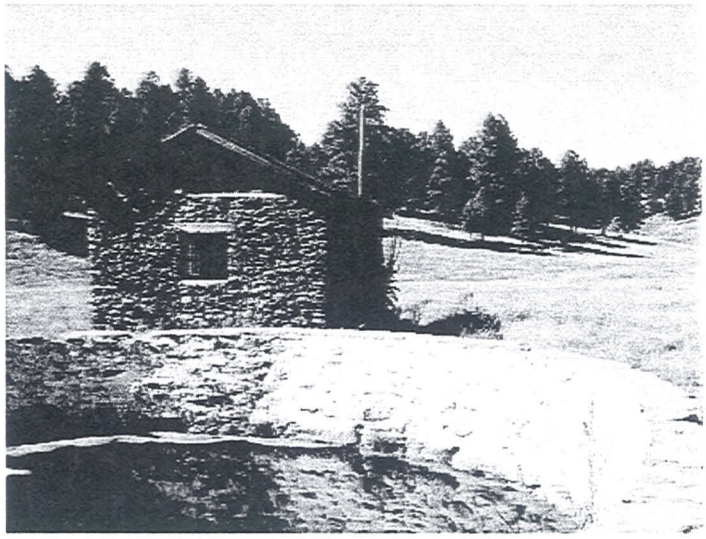
SELECTED PRESENTATIONS

"Geomorphic Response to Land Use Change, Middle Verde River, Arizona" Twenty-Third Annual Meeting, Arizona Riparian Council, Camp Verde, Arizona, April 2009

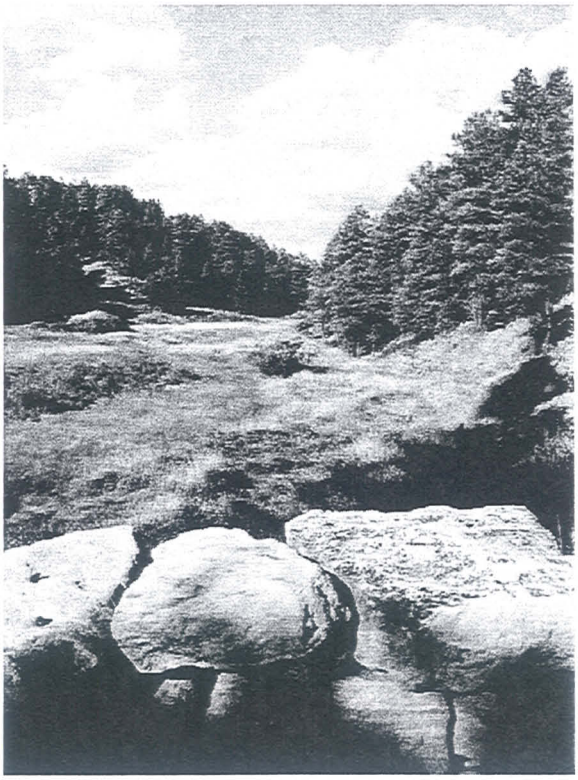
"Oraibi Wash Arroyo Cutting – The Role of Climate Variability and Effects on Culture" Ninth Biennial Conference of Research on the Colorado Plateau, Northern Arizona University, Flagstaff, Arizona, October 2007

"Riparian and Hydrogeomorphologic Changes in Response to Land Use and Climate Change in the Verde Valley Arizona." 47th Annual Meeting of the Arizona-Nevada Academy of Science, Northern Arizona University, Flagstaff, Arizona, April 2003.

Project Site Photographs



The old pumphouse, Pumphouse Wash's namesake

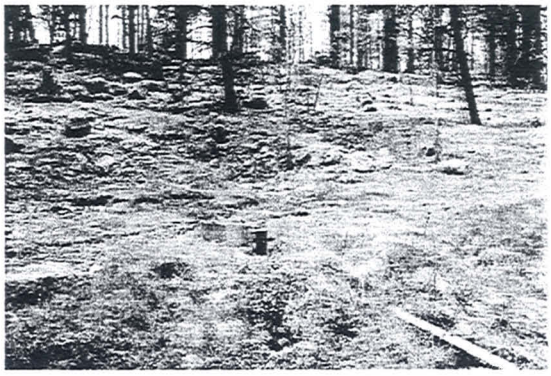


Pumphouse meadow

Pumphouse Wash downstream of the large meadow

Heron in Pumphouse Pond

Wildlife viewers line up to watch elk.



Point of emergence of Griffiths Springs.

Griffiths Spring riparian area

Wet meadow fed by water discharging from Griffiths Springs.

Description of Monitoring/Sampling Plans

We will conduct field reconnaissance to determine the exact number and location of springs and extent of wetland vegetation. Based on this reconnaissance we will finalize a sampling plan using protocols that draw on previous studies, such as those that are listed in the reference section. We will then inventory spring and wetland hydrology, water quality, soils, vegetation, and aquatic invertebrates and adjacent natural and human disturbances at approximately 8 springs and 4 distinct wetland areas during the growing season. A complete sampling plan will be delivered as part of task 2.

Description of Research Design

Our research design is as follows:

1. survey physical and biological parameters of springs and wetland ecosystems and the natural and human disturbances that may affect them,
2. perform statistical analyses such as regression analysis and the Mantel Test to determine any significant correlations between attributes of disturbance and measures of ecosystem health (such as species richness, diversity, and evenness)
3. select the most highly correlated ecosystem health attributes as indicators of biological integrity (IBI), and
4. produce and publish a scientific paper of our findings.

Existing Plans, Reports, Information Relevant to the Project

Coconino County in collaboration with the Natural Resources Conservation Service has drafted the Pumphouse Natural Area Management Plan (2009) with the goal "to protect, preserve, and enhance the wetland and wildlife habitat values of the Pumphouse Greenway system and provide for compatible recreation and educational uses". (Plan can be viewed at http://www.coconino.az.gov/uploadedFiles/Parks_and_Recreation/DRAFT_2009%20Pumphouse%20Management%20Plan_Web.pdf) This plan includes some ecological survey data and will be used a reference document in selecting survey locations in the PWNA. Springs ecosystems inventory protocols developed by aquatic ecologist Larry Stevens and hydrogeologist Abe Springer will be used in conducting field inventories of springs. Jim Allen's graduate student Karissa Ramstead has conducted a systematic review (in prep for publication) about wet meadow restoration in the Southwest, and how effective restoration projects have been, which will be used to develop a recommendations section in the final report.

Letters of Community Support

Attached letter:

Coconino County Parks and Recreation

Anticipated letters

Northern Arizona Audubon Society
Willow Bend Environmental Education Center
Friends of Coconino County Parks

Evidence of Control and Tenure of Land

Please, see attached letter from Coconino County Parks and Recreation
Letter from Coconino National Forest with explanation about control and tenure of land will follow at a later date.

Evidence of Physical and Legal Availability of Water

Please, see attached letter of support from Coconino County Parks and Recreation with discussion of their application for instream flow rights. Note, this is included on the Evidence of Control and Tenure of Land letter from Coconino County Parks and Recreation.

References

Barbour, MT, J Gerritsen, BD Snyder, and JB Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic macroinvertebrates and Fish. U.S. Environmental Protection Agency, Office of Water, Washington, DC. EP 841-B-99-002

DeKeyser, Edward S., Donald R. Kirby and Michael J. Ell. 2003. An index of plant community integrity: development of the methodology for assessing prairie wetland plant communities. Ecological Indicators, 3(2)119-133.

Dwire, K.A., Kauffman J.B., Baham J.E. 2006. Plant species distribution in relation to water-table depth and soil redox potential in mountain riparian meadows. Wetlands: Vol. 26, No. 1 pp. 131-146.

Hallam, V. 2010. Detailed statistical analyses of fundamental properties of springs ecosystems in relation to their geomorphological and ecological diversity. M.S. thesis, Northern Arizona University, Flagstaff, AZ.

Hammersmark, C.T., M.C. Rains, and J.F. Mount. 2008. Quantifying the hydrological effects of stream restoration in a montane meadow, Northern California, USA. River. Res. Applic. 24: 735-753.

Mack, John J. 2007. Developing a wetland IBI with statewide application after multiple testing iterations. Ecological Indicators, 7(4)864-881.

Sarah J. Miller and Denice H. Wardrop. 2006. Adapting the floristic quality assessment index to indicate anthropogenic disturbance in central Pennsylvania wetlands. Ecological Indicators, 6(2)313-326.

Miller, Sarah J., Denice H. Wardrop, Wendy M. Mahaney and Robert P. Brooks. 2006. A plant-based index of biological integrity (IBI) for headwater wetlands in central Pennsylvania. Ecological Indicators, 6(2)290-312.

Mitch, W.J. and Gosselink, J.G. 2000. Wetlands (3rd edition). John Wiley and Sons, New York, NY.

Pollack, Michael M., Robert J. Naiman, and Thomas A. Hanley. 1998. Plant species richness in riparian wetlands – A test of biodiversity theory. Ecology, 79(1) 94–105.

Purdy, Sabra E. and Peter B. Moyle. 2008? Mountain Meadows of the Sierra Nevada: An integrated means of determining ecological condition in mountain meadows – Protocols and Results from 2006. UC Davis Center for Watershed Sciences report to Nevada Department of Water Resources, Contract No. 4600004497.

Purdy, Sabra E., Peter B. Moyle, and Patrick Crain. Mountain Meadows: Connecting aquatic and terrestrial health indicators. UC Davis Center for Watershed Sciences presentation.

Resh, V.H., R.H. Norris, and M.T. Barbour. 1995. Design and implementation of rapid assessment approaches for water resource monitoring using benthic macroinvertebrates. Australian Journal of Ecology. 20:108-121.

STATE OF ARIZONA
HISTORIC PROPERTY INVENTORY FORM

Please type or print clearly. Fill out each applicable space accurately and with as much information as is known about the property.

PROPERTY IDENTIFICATION

For properties identified through survey: Site No. _____ Survey Area: _____

Historic Names (*enter the name(s), if any that best reflect the property's historic importance*): _____

Address: _____

City or Town: _____ ☐ Vicinity County: _____ Tax Parcel No.: _____

Township: _____ Range: _____ Section: _____ Quarters: _____ Acreage: _____

Block: _____ Lot(s): _____ Plat (Addition): _____ Year of plat (addition): _____

UTM Reference – Zone: _____ Easting: _____ Northing: _____

USGS 7.5' quadrangle map: _____

ARCHITECT: _____ ☐ not determined ☐ known Source: _____

BUILDER: _____ ☐ not determined ☐ known Source: _____

CONSTRUCTION DATE: _____ ☐ known ☐ estimated Source: _____

STRUCTURAL CONDITION

☐ Good (*well maintained; no serious problems apparent*)
☐ Fair (*some problems apparent*) Describe: _____
☐ Poor (*major problems; imminent threat*) Describe: _____
☐ Ruin/Uninhabitable

USES/FUNCTIONS

Describe how the property has been used over time, beginning with the original use: _____

Sources: _____

PHOTO INFORMATION

Date of photo: _____
View Direction (looking towards): _____

Attach a recent photograph of property in this space. Additional photographs may be appended.

SIGNIFICANCE

To be eligible for the National Register, a property must represent an important part of the history or architecture of an area. The significance of a property is evaluated within its historic context, which are those patterns, themes, or trends in history by which a property occurred or gained importance. Describe the historic and architectural contexts of the property that may make it worthy of preservation.

A. HISTORIC EVENTS/TRENDS – *Describe any historic events/trends associated with the property:* _____

B. PERSONS – *List and describe persons with an important association with the building:* _____

C. ARCHITECTURE – Style: _____ ☐ no style

Stories: _____ ☐ Basement Roof Form: _____

Describe other character-defining features of its massing, size and scale: _____

INTEGRITY

To be eligible for the National Register, a property must have integrity (i.e. it must be able to visually convey its importance). The outline below lists some important aspects of integrity. Fill in the blanks with as detailed a description of the property as possible.

Location - ☐ Original Site ☐ Moved: Date: _____ Original Site: _____

DESIGN

Describe alterations from the original design, including dates: _____

MATERIALS

Describe the materials used in the following elements of the property:

Walls (structure): _____

Walls (sheathing): _____

Windows: _____

Roof: _____

Foundation: _____

SETTING

Describe the natural and/or built environment around the property: _____

How has the environment changed since the property was constructed? _____

WORKMANSHIP

Describe the distinctive elements, if any, of craftsmanship or method of construction: _____

NATIONAL REGISTER STATUS (*if listed, check the appropriate box*)

☐ Individually Listed; ☐ Contributor; ☐ Non-contributor to _____ Historic District

Date Listed: _____ ☐ Determined eligible by Keeper of National Register (date: _____)

RECOMMENDATIONS ON NATIONAL REGISTER ELIGIBILITY (opinion of SHPO staff or survey consultant)

Property ☐ is ☐ is not eligible individually.

Property ☐ is ☐ is not eligible as a contributor to a listed or potential historic district.

☐ More information needed to evaluate.

If not considered eligible, state reason: _____

COCONINO COUNTY ARIZONA
PARKS & RECREATION

August 30, 2010

Todd Graeff
Director

Arizona Water Protection Fund Commissioners
c/o Rodney Held, Executive Director
Arizona Water Protection Fund
3550 North Central Avenue
Phoenix, Arizona 85012

Dear Commissioners,

Coconino County's efforts to protect and restore the wetland ecosystem complex at Pumphouse Natural Area will be enhanced by Northern Arizona University's proposal titled "*Comparative Analysis of Landscape Disturbance Impacts on Springs and Wet-Meadow Wetlands at Griffiths Spring and Pumphouse Wash Natural Area.*"

With respect to ownership and access to the wetlands, the County currently holds fee title to 133 acres within Kachina Village including those areas known as Pumphouse Wash, Kachina Wetland Meadow and Harrenburg Wash.

The County has legal access all of these areas either by easement or directly from a paved public road. The most sensitive areas are only accessible by single-track pedestrian trails. Access to areas outside of the County-owned lands would have to be arranged with each affected landowner. The County has had a good working relationship with the adjacent private landowners and may be able to facilitate access to areas outside of the public domain.

Regarding water rights, ADWR recently accepted an application from the County for Instream Flow Maintenance that encompasses Pumphouse Wash and the Kachina Wetland Meadow. This proposal would directly benefit the application by providing valuable baseline data to further enhance our ability to protect the springs and associated wetlands.

Should this proposal win approval, Coconino County is willing to enter into an agreement that would allow for NAU to have physical access to carry out the tasks contained in this proposal.

Thank you for your consideration of NAU's proposal. Please call Jeanne Trupiano, Planning and Acquisition Manager at (928) 679-8025 with any questions you may have regarding the County's support for this proposal.

Best regards,

Todd Graeff

FORT TUTHILL COUNTY PARK
HC 39 Box 3A • Flagstaff, AZ 86001-8701
(928) 679-8000 • Fax (928) 774-1572

COCONINO COUNTY ARIZONA
PARKS & RECREATION

August 30, 2010

Todd Graeff
Director

Arizona Water Protection Fund Commissioners
c/o Rodney Held, Executive Director
Arizona Water Protection Fund
3550 North Central Avenue
Phoenix, Arizona 85012

Dear Commissioners,

Coconino County Parks and Recreation Department whole heartedly supports Northern Arizona University's proposal for the "*Comparative Analysis of Landscape Disturbance Impacts on Springs and Wet-Meadow Wetlands at Griffiths Spring and Pumphouse Wash Natural Area.*" The County has worked diligently to use the dedicated Coconino Parks and Open Space funds, approved by the voters in 2002 based on a 1/8 of 1 cent sales tax, to acquire those acres containing the most significant natural and cultural resources that now make up the Pumphouse Wash Natural Area. The unique resources found at Pumphouse are highly valued by Coconino County residents as a peaceful place to appreciate nature. We have an obligation to preserve and enhance this rare wetland ecosystem, while keeping it accessible for passive recreation and outdoor environmental education purposes. That is why we approached NAU and asked for their assistance in planning ecological restoration for the natural area, and we are happy with the scope of work they have developed.

Thank you, for your consideration of NAU's proposal. If all goes well, you will see a restoration proposal from us in the coming years based on their work.

Best regards,

Todd Graeff

FORT TUTHILL COUNTY PARK
HC 39 Box 3A • Flagstaff, AZ 86001-8701
(928) 679-8000 • Fax (928) 774-2572