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Southwest Ecological Restoration Institutes (SWERI)

Five-Year Evaluation Report 2010-2014

Prepared by

The U.S. Forest Service, Southwestern Region

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Executive Summary

The Southwest Forest Health and Wildfire Prevention Act (P.L. 108-317, 16 U.S.C. 6701(2004)) (the Act) established the Southwest Ecological Restoration Institutes (SWERI), a unique program of applied research and service via three university-based restoration institutes. These are the Ecological Restoration Institute (ERI) at Northern Arizona University, The Colorado Forest Restoration Institute (CFRI) at Colorado State University, and the New Mexico Forest and Watershed Restoration Institute (NMFWRI) at New Mexico Highlands University. The primary purpose of the institutes is to develop, translate, and provide the best available science to affected entities on designing and implementing forest restoration and hazardous fuel reduction treatments. Affected entities are defined in the Act as land managers; stakeholders; concerned citizens; and the States of the interior West, including political subdivisions of the States. This SWERI Five-Year Evaluation Report was prepared pursuant to the Act (SEC. 7, P.L. 108-317, 16 U.S.C. 6701(2004)). It is the second SWERI Five-Year Evaluation Report. Each institute responded satisfactorily to the recommendations found in the first five year evaluation report (Appendix B). This second report follows the same format used in the first report. It is based on self-evaluation reports from each institute, interviews with the affected entities identified in the Act, and a review of the final report by the Forest Service in consultation with the Department of Interior.

The duties of the institutes are to: 1) develop, conduct research on, transfer, promote, and monitor restoration-based hazardous fuel reduction treatments to reduce the risk of severe wildfires and improve the health on dry forest and woodland ecosystems in the interior West; 2) synthesize and adapt scientific findings from conventional research to implement restoration-based hazardous fuel reduction treatments on a landscape scale using an adaptive ecosystem management framework; 3) translate for and transfer to affected entities any scientific and interdisciplinary knowledge about restoration-based hazardous fuel reduction treatments; 4) assist affected entities with the design of adaptive management approaches (including monitoring) for the implementation of restoration-based hazardous fuel reduction treatments; and 5) provide peer-reviewed annual reports.

Over the last five years the SWERIs have made a considerable contribution to the scientific knowledge available to affected entities and the credibility of landscape scale forest restoration in the Southwest. The three institutes are seen as “go to” resources for scientific information on landscape scale restoration and analysis, risk assessment, and restoration and treatment monitoring. Pursuant to this 5 Year Evaluation the institutes have: 1) Ensured to the maximum extent possible that their research, communication tools, and information transfer activities have made significant progress toward achieving the purposes of the Act; and 2) implemented the duties described under Section 5(c) to the best of their ability within provided resources. More specifically, the SWERIs have: improved communication and cooperation among local, state and federal agencies, environmental organizations, and private industry in the planning process; provided resources and expertise that complement state forest restoration efforts; supported legislation on forest and watershed restoration; assisted the development of forest restoration industries in under-served communities through training and technical assistance; increased trust and credibility with stakeholder groups in landscape scale restoration discussions by providing and interpreting the best available science; provided expert scientific advice to affected entities; facilitated stakeholder group and discussions; and provided independent verification of the best available science for stakeholders in support of Forest Service restoration work.

ERI is well known for its ecological research, publications and outreach. CFRI has taken on the dual role of providing science to stakeholders including government agencies, while also serving as facilitator for stakeholder groups, especially the Colorado Front Range Collaborative Landscape Restoration Program. NMFWRI is involved in projects that contribute to the health of the forest and woodland ecosystems through forest land mapping using a Geographical Information System (GIS), tours of ponderosa pine and mixed conifer restoration demonstration sites, and education and outreach.

All three institutes are meeting the duties and achieving the purposes for which they were established. The Act authorizes an appropriation of \$15 million annually. In the last five years annual allocations to the SWERIs were \$150,000 to \$2 million. During that time record breaking high intensity wildfires in the Southwest and widespread tree mortality due to the mountain pine beetle have galvanized state and local governments on the need for forest restoration. This has increased the demand for technical assistance from the SWERIs. The institutes responded by leveraging an additional \$14.2 million from the states (\$9.8 million) and federal land management agencies (\$4.4 million). Of the \$22.5 million the SWERIs received in the last five years 63% came from state governments and federal agencies for specific projects that were not covered by the annual SWERI allocation. The Act does not require any form of matching funds, so this additional funding demonstrates that the SWERIs are successful in obtaining additional support from affected entities.

The stakeholders that were interviewed indicated that the institutes should broaden their scope to include other ecosystems and larger landscapes to further the science and resources available to states. The interviewees also said that funding for the SWERIs should be increased to expand their outreach and education activities and the continual building of partnerships with other agencies and research entities.

In conclusion, each of the institutes warrants continued provision of federal assistance because they have been successful at working with various stakeholders in the states to establish the credibility of forest restoration and treatment to prevent wildfires; As a result of the work that has been completed with scarce resources, the institutes have generated a high degree of demand and relevance in their states.

Introduction

Background

The Southwest Forest Health and Wildfire Prevention Act (P.L. 108-317, 16 U.S.C. 6701(2004)) (the Act) establishes a unique program of applied research and service via three university-based restoration institutes located in Arizona, Colorado, and New Mexico.¹ The primary purpose of the institutes is to develop, translate, and provide the best available science to land managers, practitioners and stakeholders designing and implementing forest restoration and hazardous fuel reduction treatments.

The responsibility for implementation of the Act was assigned to the Secretary of Agriculture, acting through the Chief of the U.S. Forest Service. The Chief of the U.S. Forest Service delegated the implementation of the Act to the Southwestern Region of the U.S. Forest Service. In 2005, the Forest Service established a Development Team to work with the institutes to identify projects for annual work plans and an Executive Team to approve those work plans. The Development and Executive teams are chaired by the U.S. Forest Service and include representatives from the Bureau of Land Management (BLM), U.S. Fish and Wildlife Service (FWS), The Bureau of Indian Affairs (BIA), State Foresters from each state, and the three institutes. The annual work plans are reviewed, revised and reconciled with federal appropriations by the Development Team and approved by the Executive Team.

On June 13, 2005 the governors of Arizona, Colorado and New Mexico signed a charter to clarify the duties and operating procedures for the SWERI, and their respective states, as envisioned in PL 108-317 (Appendix E).

The annual work plans are the basis for requesting federal and state annual appropriations. Each institute's performance of their duties is tied to the development and successful completion of annual work plans that achieve the purposes of the Act. For this reason, they are a major source of information for the Five-Year Evaluation.

The activities proposed in the work plans (referred to as "projects") address information and service needs identified by land managers and the diverse stakeholders (referred to as "affected entities" in the Act). Needs are identified in reports from workshops, conferences, surveys, collaborative meetings, governmental task forces and councils, field trips, one-on-one communications, by phone, or through correspondence. The institutes then work collaboratively throughout the year with stakeholders to plan projects that may be included in the annual work plan.

Five-Year Evaluation Requirement

Section 7 of the Act requires the Secretary of Agriculture, acting through the Chief of the U.S. Forest Service, and in consultation with the Secretary of the Interior, to complete a detailed evaluation of the programs and activities of each institute five years after the date of enactment of the Act, and every five years thereafter. The evaluation is submitted to the Committee on Resources (now the Committee on Natural Resources), to the Committee on Agriculture of the House of Representatives, and to the Committee on Energy and Natural Resources of the Senate. The purpose of this report is

¹ The Southwest Forest Health and Wildfire Prevention Act passed by Congress on October 4, 2004.

to satisfy this requirement for 2010 through 2014, the second Five-Year Evaluation. The intentions of the evaluation, as defined in the Act, are:

- 1) To ensure, to the maximum extent practicable, that the research, communication tools, and information transfer activities of each institute are sufficient to achieve the purposes of the Act, including:
 - a. Implementing active adaptive ecosystem management practices at the landscape level;
 - b. Reducing unnecessary planning costs;
 - c. Avoiding duplicative and conflicting efforts;
 - d. Increasing public acceptance of active adaptive ecosystem management practices; and
 - e. Achieving general satisfaction on the part of the affected entities.
- 2) To determine the extent to which each institute has implemented its duties under Section 5(c) of the Act, which are to:
 - a. Develop, conduct research on, transfer, promote, and monitor restoration-based hazardous fuel reduction treatments to reduce the risk of severe wildfires and improve the health on dry forest and woodland ecosystems in the interior West;
 - b. Synthesize and adapt scientific findings from conventional research to implement restoration-based hazardous fuel reduction treatments on landscape scale using an adaptive ecosystem management framework;
 - c. Translate for and transfer to affected entities any scientific and interdisciplinary knowledge about restoration-based hazardous fuel reduction treatments;
 - d. Assist affected entities with the design of adaptive management approaches (including monitoring) for the implementation of restoration-based hazardous fuel reduction treatments; and
 - e. Provide peer-reviewed annual reports.
- 3) To determine whether continued provision of federal assistance to each institute is warranted.

Evaluation Methodology

As a first step in the evaluation process, the Southwestern Region requested an evaluation report from each institute describing how it had performed the duties specified in the Act. Key accomplishments for each duty are summarized at the beginning of each institute chapter that follows. The institute evaluation reports are included in full in Appendix A.

The Southwestern Region contracted Lauren Poole to conduct interviews with affected entities (defined in the Act as land managers; stakeholders; concerned citizens; and the states of the interior West, including political subdivisions of the states) for the purpose of assessing their satisfaction with the institutes and their views about how well the institutes had achieved the purposes of the Act. Ms. Poole was also tasked with compiling the SWERI Five-Year Evaluation Report. For consistency with the previous five year review and to show progress the institutes have made over the five year review period, the contractor used the same interview questions when contacting the affected entities. In addition, a new section was added to the report that addresses the institutes' responses to recommendations from the last SWERI Five-Year Evaluation Report (See Appendix B.) In

preparation for the interviews, each institute provided Ms. Poole a list of about 20 people to interview that represented the various affected entities defined above. Out of approximately 60 potential interviewees, a total of 34 responded. A “Range of Perspectives” is provided in Table 1 below. Most of the interviewees were very familiar with the work of each institute in their state. However, a few interviewees were new to the position and could only speak about their experience over the last year or two.

The interviews were conducted with the understanding that interviewee comments and recommendations would not be attributed to individuals, but rather captured in an overall summary of interview results. A list of interviewees is provided in Appendix C. The interview results are reflected in the chapters that follow and summarized in Appendix D.

The determination whether the institutes accomplished the purposes and duties of the Act is based on the sum of information available through the institutes’ evaluation reports and the interview results.

Table 1: Range of Perspectives

Survey Participants	ERI	CFRI	NMFWRI	TOTAL
Conservation NGO	1	1	1	3
Academic			2	2
Local Government	1		1	2
State Government	3	2	2	7
Federal Government	6	4	3	13
Tribal			2	2
Private Industry	2	1	1	4
Private Land Owner			1	1
TOTAL	13	8	13	34

Note: The range of perspectives is not all inclusive of survey respondents. A total of some 60 people were contacted to complete a written survey and/or phone interview. Out of 60 people, 34 people responded as shown in Table 1.

Funding History

The Act authorized an annual appropriation of \$15, but. The total annual federal appropriation allocation for SWERIs has declined from \$2 million in 2010 to \$ 1.5 million in 2014 (Table 2).

The Forest Service annual budget direction includes a SWERI allocation. The SWERIs develop annual work plans that reflect that allocation. The Forest Service, in consultation with the Department of Interior and the State Foresters from Arizona, Colorado and New Mexico each review the work plans to assure that the work proposed serves the informational needs of the affected entities named in the Act. In addition, the Forest Service, BLM, and states have funded individual projects under separate agreements to address specific needs. The states have provided matching appropriations and funded specific projects. The three universities have contributed the difference between their negotiated indirect cost rate of over 40% and the 10% they agreed to charge the Forest Service under the SWERI agreements.

SWERI Five-Year Evaluation Report

Table 2: Total SWERI Funding (2010-2014)

Source	Funding
Annual Forest Service Allocations	\$8,328
Additional Federal Project Funding	\$4,359
State Funding	\$9,821
TOTAL (2010-2014)	\$22,508

Dollars in thousands

Table 3: Annual Institute Funding by Source

Institute	2010			2011			2012			2013			2014		
	Fed. Work Plan	Add'l Federal Projects	State	Fed. Work Plan	Add'l Federal Projects	State	Fed. Work Plan	Add'l Federal Projects	State	Fed. Work Plan	Add'l Federal Projects	State	Fed. Work Plan	Add'l Federal Projects	State
CFRI	250	23	231	500	223	490	150	573	273	150	281	704	150	665	425
ERI	1,500	0	1,318	1,200	1,101	1,183	1,200	192	1,325	1,200	179	1,225	1,125	764	965
NMFWRI	250	0	342	203	300	427	150	0	263	150	0	263	150	57	387
TOTAL	\$2,000	\$23	\$1,891	\$1,903	\$1,624	\$2,100	\$1,500	\$765	\$1,861	\$1,500	\$460	\$2,192	\$1,425	\$1,486	\$1,777

Dollars in thousands

Table 4: University Indirect Cost Contributions by Year

Institute	2010	2011	2012	2013	2014	Total
CFRI	\$188	\$447	\$229	\$223	\$374	\$1,461
ERI	\$786	\$758	\$900	\$800	\$562	\$3,805
NMFWRI	\$90	\$181	\$54	\$54	\$75	\$454
Total	\$1,064	\$1,386	\$1,183	\$1,077	\$1,011	\$5,720

Dollars in thousands

SWERI Assessment and Recommendations

Assessment of Overall Institute Performance

It is apparent from the institute reports and the interviews with affected entities that, over the last five years, all three institutes are meeting the duties and achieving the purposes for which they were established under the Act. The productivity of each institute was limited by their funding levels, which were significantly less than the annual funding authorized under the Act, with ERI having received more funding than the other two. Their work over the last five years has made a considerable contribution to the amount of scientific knowledge available to affected entities and the credibility of landscape scale forest restoration in the Southwest. The three institutes are often seen as “go to” resources for scientific information on landscape scale restoration and analysis, risk assessment, and restoration and treatment monitoring.

The contributions by the institutes vary, not only because of the difference in funding levels, but also because some specialization has occurred. All of the institutes provide a suite of services. ERI has become well known for its ecological research, publications and outreach. CFRI has taken on the dual role of providing science to stakeholders including government agencies, while also serving as facilitator for stakeholder groups, especially the Colorado Front Range Collaborative Landscape Restoration Program. NMFWRI is involved in projects that contribute to the health of the forest and woodland ecosystems through forest land mapping using a Geographical Information System (GIS), tours of ponderosa pine and mixed conifer restoration demonstration sites, and education and outreach. NMFWRI developed and delivered training courses in the design and safe implementation of forest restoration treatments. NMFWRI is also working with the New Mexico National Forests and watershed health organization (WHO) of the New Mexico State Forestry Division to create a web-based forest and watershed restoration health information clearinghouse for the state of New Mexico.

“I strongly believe that without the institutes’ leadership and organizational skills, we would not be where we are today relative to commencing landscape scale restoration.”

Survey respondent, Appendix-D

The unique value-added niche of the institutes, as reflected in the comments made during the interviews with affected entities, is that they provide the latest science to stakeholder groups on landscape-scale restoration. They are extremely credible with both the public and government agencies, which makes it easier to implement wildfire mitigation treatments on national forest lands.

Given limited resources, especially for the CFRI and NMFWRI, the institutes have strategically invested in specialization while continuing to meet the diverse ecological restoration needs in each state. The Colorado institute has taken on the dual role of research institute and stakeholder facilitator. In the future the CFRI will need to decide if it has the capacity to do both or focus on one area.

Since the last evaluation report, small organizations and local governments have benefited a great deal from the assistance provided by the institutes in designing, implementing, and monitoring on-the-ground treatments. During the last five years, their contribution to landscape-scale restoration has expanded from local to the state and federal level, with many federal and state government

agencies indicating that they relied on the institutes for scientific data, monitoring, and communicating information to conservation groups and other nongovernmental organizations.

The effect of climate change on national forests and its potential to increase wildfires that impact water supplies makes landscape level planning crucial if forest restoration projects are to be successful and cost-effective. The institutes can continue to address scientific questions and assist collaborative efforts of government agencies and nongovernmental organizations as they work together to prevent and reduce the impact of wildfires in the Southwest. Their capacity to provide those services will be function of future funding levels for each institute.

Affected Entity Recommendations

The affected entities that were interviewed for the evaluation offered a number of recommendations that apply to all the institutes. Increased funding to the institutes was their primary recommendation on how to improve future service, especially for the New Mexico and Colorado institutes. Interviewees stated that staffing issues due to funding shortfalls have caused delays in workshops and other educational outreach activities, including the implementation of new college programs in restoration.

The New Mexico institute would benefit from revisiting a proposed college program that did not come to fruition because one staff member left. Another suggestion was to have the institute in New Mexico explore how forest landscape restoration would affect urban and rural communities, private industry, local governments, and economic development. See also Appendix B, NMFWR Question 1.

“The institute’s involvement with the New Mexico Legislature earlier this year was highly significant and important in the forging ahead of New Mexico’s policy on forest and watershed restoration.”

Survey respondent, Appendix-D

“There is a tremendous amount of discipline and institutional based pushback on ecology, restoration, and a science based framework. If the CFRI was not here, I would not be able to have the support to push the science and implementation of both the scale and magnitude of ecology based treatments.”

Survey respondent, Appendix-D

Interviewees also stated that with additional funding, CFRI’s work could expanded beyond the Colorado Front Range Program to benefit wildfire-prone areas throughout the state. An increase in funding would also eliminate the potential for “mission creep,” in which the institute expends valuable resources trying to secure general operating funds, according to interviewees. One suggestion to increase support for CFRI was to hold annual or biennial meetings of stakeholders to report on accomplishments, solicit feedback, and plan for the future. The event would help build a community of stakeholders around CFRI that had a stake in its success.

Increased funding would also allow the institute to deliver more workshops for different stakeholder groups, according to interviewees. That would allow CFRI to increase communication among stakeholder groups and identify new research ideas that apply statewide.

In Arizona, one interviewee wrote that ERI could improve services by increasing coordination and integration with the Rocky Mountain Research Station (RMRS). The institute should also ensure it

aligns its work with Forest Service databases for consistency. Respondents indicated the workshops organized by ERI were valuable and felt that they should do more of them.

The survey results provided the following overall assessment of the three institutes:

Value-Added Contributions

The three institutes have:

- Improved communication and cooperation among local agencies, state agencies, environmental organizations, private industry and federal agencies in the planning process;
- Provided resources and expertise that complement state forest restoration efforts;
- Supported legislation on forest and watershed restoration;
- Assisted the development of forest restoration industries in under-served communities through training and technical assistance;
- Increased trust and credibility with stakeholder groups in landscape scale restoration discussions by providing and interpreting the best available science;
- Provided expert scientific advice to affected entities;
- Facilitated stakeholder group and discussions; and
- Provided independent verification of the best available science for stakeholders in support of Forest Service restoration work.

“ERI’s contributions have made a difference because they are accessible, responsive, proactive, and respected in Arizona. The pace and scale of restoration in Arizona would not be where it is today without the contributions of ERI

Survey respondent, Appendix-D

Recommendations From the Affected Entities to Improve Future SWERI Work

- Increase staffing and programs
- Increase scientific expertise and college programs in landscape scale restoration
- Remain flexible to new research areas
- Share information with other groups

General Recommendations

- Increase staffing to provide stability and expand services
- Improve communication on services offered
- Expand educational workshops and programs

New Mexico Forest and Watershed Restoration Institute Assessment (2015)

Achievement of the Duties of the Act

The information provided in NMFWRI's Five-Year Evaluation Report (Appendix A), cites numerous examples of significant contributions for each duty. Highlights are summarized and presented below.

Duty 1: Develop, conduct research on, transfer, promote, and monitor restoration-based hazardous-fuel reduction treatments to reduce the risk of severe wildfires and improve the health of dry forest and woodland ecosystems in the interior West.

NMFWRI was involved in projects that contributed to the health of the forest and woodland ecosystems through forest land mapping, introductory tours of ponderosa pine and mixed conifers, and education and outreach. Prominent examples include:

- **Desired Conditions Workshops**—Guidelines were created and applied to the ponderosa pine and mixed conifer ecosystems on New Mexico national forest lands. In May of 2012 an introductory tour was held in the Bluewater area west of Grants and the Jemez Mountains.
- **New Partnerships**— In the fall of 2014 the NMFWRI assisted the Otero County Working Group and the Grant County Eco-Watershed Planning Group to be more strategic in addressing forest and grassland issues by looking at a watershed scale and developing communication tools to improve education and outreach. Initial steps have been taken to create a partnership with Western New Mexico University (WNMU) to establish a Geographic Information Systems (GIS) storehouse for maps under the *AllAboutWatersheds* portal.
- **Socioeconomic Monitoring**—NMFWRI established standardized protocols for collecting and evaluating socioeconomic monitoring data as it relates to the effectiveness of restoration projects.
- **Coleman Ranch Water Budget Study**—NMFRI worked with the Lower Pecos Watershed Alliance and New Mexico Institute of Technology to examine how thinning in a mixed conifer stand would impact the surface and subsurface water budget.
- **BLM Contract Work**—NMFWRI used digital ortho-imagery and Trimble eCognition software to develop a vegetation and land cover classification map of the Rosa and Carrizo Largo Landscape Areas in Rio Arriba and San Juan Counties of New Mexico.
- **Teacher's Camp**—NMFWRI hosted the Forestry and Fire Ecology Academy in partnership with the New Mexico Highlands University's (NMHU) Natural Resources Department and the Environmental Education Association of New Mexico. The three-day teacher's camp presented a condensed overview of issues and research on forest restoration and fire management in New Mexico.

Duty 2: Synthesize and adapt scientific findings from conventional research to implement restoration-based hazardous fuels reduction treatments on a landscape scale using an adaptive ecosystem management framework.

- **AllAboutWatersheds.org**—NMFRI worked with the Forest and WHO of New Mexico State Forestry Division to create a web-based forest and watershed restoration health information clearinghouse from across the state.
- **Ojo Peak**—NMFWRI monitored the response of the ponderosa pines within the perimeter of the Ojo Peak Wildfire (November 2007) to determine if the trees would live or die after being burned late in the season.
- **Estancia**—NMFWRI served on the Estancia Basin Monitoring Steering Committee, which comprises the three Soil and Water Conservation Districts in the basin. The institute worked with SWCA environmental consulting to monitor thinning projects throughout the basin.
- **Gallinas**—The Gallinas watershed, the source of municipal drinking-water for the city of Las Vegas, is a high priority for restoration. To NMFRI helped develop and implement a watershed plan and hazardous fuel reduction strategy to mitigate the potential for catastrophic wildfire, and to secure a sustainable water supply for the City and the region.
- **Zuni Mountain Collaborative Forest Landscape Restoration program (CFLRP)**—NMFWRI attended collaborative meetings with other stakeholders.
- **Long-Term Collaborative Forest Restoration Program (CFRP) Monitoring**—NMFWRI identified 20 CFRP projects that represent multiple jurisdictions and forest types that will be measured at five, ten, and fifteen years post-treatment. NMFWRI has completed the first round of post-treatment monitoring of these projects.

Duty 3: Translate for, and transfer to, the affected entities any scientific and interdisciplinary knowledge about restoration-based hazardous fuels reduction treatments.

- **Demonstration Areas**—Pritzalff Ranch, a private ranch about 20 miles from Las Vegas, NM, is used by NMFRI for training and outreach. The forest on the Ranch was thinned in the fall of 2008 followed by a prescribed fire burn in November of 2010.
- **Habitat Characterization of the Jemez Mountain Salamander**— During the summers of 2011 and 2012 NMFWRI trained students and Jemez Pueblo crews to conduct a vegetation survey using modified monitoring protocols to measure vegetation and down logs.
- **Little Bear Fire**—NMFWRI evaluated the effectiveness of various hazardous fuel reduction treatments that had been implemented prior to the fire.
- **Mastication**—NMFWR selected three sites in which to evaluate fire behavior in masticated material: one in pinyon-juniper stands on the Lincoln National Forest; one in ponderosa pine on the Tonto National Forest, and one in chaparral on the Prescott National Forest.

- **Guide to Bosque Monitoring**— NMFWRI developed guidelines and protocols for monitoring fuel and fire dynamics in response to riparian restoration projects.
- **Santa Fe Community College**—NMFRI presented a three-week course at the Santa Fe Community College on forest restoration principles, timber marking, basic GIS and monitoring.

Duty 4: Assist affected entities with the design of adaptive management approaches (including monitoring) for the implementation of restoration-based hazardous fuels reduction treatments.

- **HB 38, the Forest and Watershed Restoration Act**—NMFWRI provided technical assistance to state legislators, the State Forester and stakeholders to establish the Forest and Watershed Restoration Fund.
- **Statewide Vegetation Treatment Database**—NMFWRI collected data on planned and completed restoration projects on private, state, tribal, and federal forest land to develop a statewide geospatial database of watershed treatments in New Mexico.

Duty 5: Provide peer-reviewed annual reports.

NMFWRI prepared annual reports that were sent to stakeholders for comment prior to being submitted to the Forest Service. They are available at the following website:
<http://www.nmNMFWRI.org/annual-reports>.

Achievement of the Purposes of the Act

The NMFWRI self-assessment demonstrates progress toward achieving the purposes of the Act through many activities and outcomes, including:

Purpose 1: Implement active adaptive ecosystem management practices at the landscape level.

In working on the images for the Estancia Basin project, the GIS group noticed the relationships among that project and other projects in the Manzano Mountains. The projects funded by the CFRP, the Water Trust Board, the Natural Resource Conservation Service (NRCS) under Environmental Quality Incentives Program (EQIP), and the Cibola National Forest, and included at least six different ownership groups.

These projects constituted landscape-level restoration of forest structure but require the reintroduction of fire for full restoration. The NMFWRI gave presentations across the region on the significant accomplishment and cumulative effect these projects represent.

Purpose 2: Reduce unnecessary planning costs.

NMFWRI has been involved in collaborative planning efforts across the state. The legal structure of the federal planning process left little room for cost cutting. With the possible exception of maps and other GIS support, NMFWRI's involvement did not reduce planning costs.

Purpose 3: Avoiding duplicative and conflicting efforts.

NMFWRI avoided duplication by working with other organizations doing similar work. The Institute brought different groups together to implement restoration which prevented duplication and increased awareness in the community of restoration work going on in the area.

NMFWRI's tasks potentially overlap with the New Mexico State Division of Forestry's WHO. NMFWRI participates in quarterly meetings with state and federal land management agencies in New Mexico to share and coordinate efforts in order to avoid duplication.

Purpose 4: Increasing public acceptance of active adaptive ecosystem management practices.

NMFWRI has lacked a monitoring specialist to provide feedback on adaptive management efforts, which has hindered its ability to increase public acceptance in this area. NMFWRI recently hired a monitoring specialist to develop strategies to close this adaptive management feedback loop.

Purpose 5: Achieving general satisfaction on the part of affected entities.

The majority of the stakeholders interviewed were satisfied with the institute's work. NMFWRI's former director worked with NMHU to create a Certificate in Forest and Watershed Restoration that would be available to high school students and high school graduates, but the project fell through after the director left the position.

Colorado Forest Restoration Institute Assessment (2015)

Achievement of the Duties of the Act

Based on the information provided in CFRI's Five -Year Evaluation Report (Appendix A), the institute performed a significant amount of work toward achieving each of the duties specified in the Act. Examples of the contributions for each duty are presented below.

Duty 1: Develop, conduct research on, transfer, promote, and monitor restoration-based hazardous fuel reduction treatments to reduce the risk of severe wildfires and improve the health of dry forest and woodland ecosystems in the interior West.

CFRI was involved in multiple collaborative wildfire mitigation, forest restoration and fuel reduction projects in Colorado. Prominent examples include:

- **Colorado Bark Beetle Cooperative (CBBC)**—CFRI developed a state of the science report on the effects of mountain beetles on forest ecology, fuels and fire, wildlife, watershed, and recreation; convened symposia to translate and transfer current available science from research (especially the RMRS); developed a hazard assessment framework for CBBC partners to identify treatment goals and priorities; and assisted the RMRS in a 5-year monitoring project to assess the impact of the Church Park Fire on tree and plant regeneration.
- **Uncompahgre Plateau and Front Range Collaborative Forest Landscape Restoration (CFLR) Projects**—CFRI developed and implemented multi-party monitoring plans for these projects and provided scientific expertise to improve collaborative learning and consensus-building during project design and adaptive management.
- **Colorado Wildfire Risk Reduction Grant Program**—CFRI served on an advisory committee to create the grant program and review and select grant applications for treatment. The Institute developed and implemented treatment effectiveness monitoring for the grant program and promoted the program by giving presentations to the Colorado General Assembly.
- **Denver Water-US Forest Service Forest-to-Faucets Program**—CFRI developed and implemented a treatment effectiveness monitoring strategy for the program 2015 renewal and developed a framework for linking treatment effectiveness to return-on-investment metrics for the project for Denver Water.
- **San Juan Headwaters Forest Health Partnership**—CFRO developed a status of knowledge report pertaining to dry mixed-conifer ecology and management to inform managers and stakeholders about restoration needs and opportunities. The Institute also organized and led stakeholder workshops to deliver current knowledge about dry mixed-conifer ecology and management and to identify priority areas for forest restoration.

CFRI gave multiple public presentations, media interviews, and media editorials about forest restoration and fuel reduction activities.

Duty 2: Synthesize and adapt scientific findings from conventional research to implement restoration-based hazardous fuels reduction treatments on a landscape scale using an adaptive ecosystem management framework.

CFRI collaborates with researchers at area universities, the RMRS, and other federal research institutions to compile, synthesize, and apply current scientific information for managers, collaborative groups, and stakeholders. Over the last five years, CFRI published reports on desired conditions for Colorado Front Range Collaborative Forest Restoration, a status of knowledge report on dry mixed-conifer forest ecology and management in southwestern Colorado, and a general technical report on principles and guidelines for restoring Ponderosa pine and dry mixed conifer forests in Colorado's Front Range.

Duty 3: Translate for, and transfer to, the affected entities any scientific and interdisciplinary knowledge about restoration-based hazardous fuels reduction treatments.

CFRI continuously assesses affected entities to identify needs and opportunities for knowledge transfer. The institute organizes events involving a wide range of participants, and collaborates with other entities, including the RMRS, to apply and integrate the best available science into forest restoration and wildfire risk reduction.

Examples of their work during the last five-years include:

- Hosting a symposium on post-mountain pine beetle effects and management priorities involving 100+ managers, stakeholders, community leaders, and elected officials;
- Arranging scientific presentations on post-mountain pine beetle research pertaining to forest recovery and watershed effects for the Colorado Bark Beetle Cooperative;
- Co-sponsoring a webinar with the RMRS on mountain pine beetle outbreak impacts and management effects; and
- Co-sponsoring multiple field trips involving scientists, managers, and stakeholders for the Front Range and Uncompahgre Plateau CFLR projects.

CFRI published multiple research briefs, including a report on the sudden decline of Aspen trees in Southwestern Colorado and the use of physics-based fire behavior modeling to assess treatment effectiveness to inform researchers and managers on the use and application of new fire behavior models. Another brief examined signs of recovery for Colorado forests in the wake of the mountain pine beetle. The paper was based on research conducted by the RMRS and co-sponsored by CFRI.

Duty 4: Assist affected entities with the design of adaptive management approaches (including monitoring) for the implementation of restoration-based hazardous fuels reduction treatments.

CFRI is an active participant in collaborative forest landscape restoration and fuel reduction projects. It has developed and implemented monitoring and adaptive management strategies linked to several large-scale forest restoration and fuel reduction projects. Examples include:

- Developing and implementing a multi-party monitoring plan for the Front Range and Uncompahgre CFLR projects. This included working closely with managers on collecting data on treatments and providing information back to managers to inform future treatment prescriptions. Took a leadership role in developing a collaborative adaptive management strategy document to guide the Front Range CFLR project.
- Organizing and leading a multi-party monitoring and adaptive management reviews for the Uncompahgre Plateau CFLR project and engaging stakeholders in “citizen science” field experiences.
- Assisting in the development and implementation of a monitoring and adaptive management strategy for the Denver Water–U.S. Forest Service Forest-to-Faucets program (2015 renewal).
- Participating on the Spruce Beetle Epidemic-Aspen Decline Management Response (SBEADMR) project Science Team of the Grand Mesa-Uncompahgre-Gunnison (GMUG) National Forest to develop and implement a collaborative adaptive implementation strategy.

Duty 5: Provide peer-reviewed annual reports.

The CFRI prepared annual reports as required under the Act. They were circulated among stakeholder groups for comment before being submitted.

Achievement of the Purposes of the Act

CFRI has demonstrated progress toward achieving the purposes of the Act through many of its activities and outcomes, including, for example:

Purpose 1: Implement active adaptive ecosystem management practices at the landscape level.

CFRI is actively involved in the Front Range and Uncompahgre Plateau Collaborative Forest Landscape Restoration projects. The institute is integrated into the project planning, goal setting, design, monitoring and adaptive management of these large-landscape projects. CFRI has convened numerous meetings among scientists, managers, and stakeholders to identify current scientific knowledge about reference conditions, silvicultural treatments, and monitoring metrics and methods. CFRI produced written reports and oral presentations of results.

CFRI has also increased its portfolio to non-federal lands and is utilizing spatial analysis techniques to assist in treatment planning and design to complement work on federal lands. CFRI is also leading the development and implementation of effectiveness monitoring to inform non-federal managers on treatment effects and the design of future treatments.

Purpose 2: Reduce unnecessary planning costs.

CFRI regularly receives requests from federal land managers to assist, lead, and participate in various phases of project planning to address social conflict over treatments, address uncertainties in

scientific knowledge, assist in project design, and provide guidance on monitoring metrics and adaptive management strategies.

Examples include the following:

- CFRI collaborated with the US Forest Service and The Nature Conservancy (TNC) to develop design criteria for various forest types on the Upper Monument Creek project.
- In 2012, CFRI co-sponsored field-based rapid assessments of historic forest structure to inform the planning and design of the Escalante Forest Restoration and Stewardship Project on the Grand Mesa-Uncompahgre-Gunnison (GMUG) National Forest.
- In 2015, CFRI, along with the RMRS, provided a status of knowledge report on spruce ecology and management to inform its Spruce Beetle Epidemic & Aspen Decline Management Response (SBEADMR) project. The report addressed stakeholder concerns by developing and implementing a robust monitoring strategy that ties in with the proposed adaptive implementation action.
- Collaborative, multi-stakeholder planning helped build agreement prior to and during the National Environmental Policy Act (NEPA) process, and reduced the costs to federal agencies in addressing objections and appeals.

Purpose 3: Avoiding duplicative and conflicting efforts.

CFRI seeks efficiencies in its efforts by:

- Engaging in pilot/demonstration projects, such as the Uncompahgre Mesas Forest Restoration Projects that serve as a launching point for larger-scale work;
- Conducting assessments of historic versus current forest conditions across large areas to inform management in setting priorities and developing prescriptions;
- Collecting, analyzing, and disseminating monitoring data for treatment prescriptions that have been commonly implemented across a large area to inform the development of future prescriptions;
- Participating in a variety of collaborative forest health partnerships to identify needs and common issues across partnerships;
- Developing, compiling, and applying science-based information that is locally relevant to managers; and
- Producing reports and sponsoring knowledge transfer activities and that target managers facing similar issues in similar forest conditions.

Purpose 4: Increasing public acceptance of active adaptive ecosystem management practices.

CFRI regularly receives requests to participate in the planning, design, and monitoring and adaptive management of forest restoration and fuel reduction projects on federal and non-federal lands, primarily in the state of Colorado. These requests are due in large part to the credibility CFRI has with a variety of stakeholders, managers, and elected officials in providing unbiased, objective science-based information. For example, the GMUG national forest reached out to CFRI in spring 2015 to participate in a Science Team (along with the RMRS) to develop and implement monitoring strategies for the SPEADMR project. CFRI's involvement has helped assuage concerns among many stakeholders about the U.S. Forest Service's proposed "adaptive implementation" strategy.

In the last five years CFRI has received an increasing number of requests to give presentations to state and federal elected officials on the scientific basis for forest landscape restoration, fuel reduction, monitoring results and lessons learned. Core concepts and ideas presented by CFRI have been incorporated into the Colorado Wildfire Risk Reduction Grant program and proposals for federal legislation. This is evidence of CFRI's impact on increasing the acceptance of active adaptive ecosystem management practices.

Purpose 5: Achieving general satisfaction on the part of affected entities.

CFRI strives to maintain regular, active communication with affected entities, including federal and state forest land management agencies, water providers, non-governmental stakeholder groups, and other research institutions, such as the RMRS, other federal research institutions (e.g., U.S. Geological Survey), and other universities.

Ecological Restoration Institute in Arizona Assessment (2015)

Achievement of the Duties of the Act

Based on the information provided in ERI's Five -Year Evaluation Report (Appendix A), the institute has performed a significant amount of work toward achieving each of the duties specified in the Act. Examples of significant contributions for each duty are presented below.

Duty 1: Develop, conduct research on, transfer, promote, and monitor restoration-based hazardous fuel reduction treatments to reduce the risk of severe wildfires and improve the health of dry forest and woodland ecosystems in the interior West.

ERI assessed unnatural and potentially catastrophic changes in frequent-fire areas and tested treatments designed to restore more benign fire conditions in these areas. ERI studied sites throughout Arizona, New Mexico, and southern Colorado. Each site was set up to be a stand-alone experimental study test site and is part of ERI's Long-term Ecological Assessment and Restoration Network (LEARN).

During this time period ERI compiled current scientific information on forest restoration for land managers and forged new partnerships with federal agencies to increase adaptive management through treatment monitoring.

Duty 2: Synthesize and adapt scientific findings from conventional research to implement restoration-based hazardous fuels reduction treatments on a landscape scale using an adaptive ecosystem management framework.

To scale up small-scale landscape restoration efforts to large-scale restoration, ERI has been collaborating with stakeholders in the largest forest landscape restoration project to date that spans four national forests and covers 2.4 million acres of ponderosa pine forests in Arizona. ERI has a leadership role in supporting the various working groups associated with this project, including the landscape restoration strategy group and the scientific and monitoring group.

ERI has also collaborated with the National Forest Foundation (NFF) to develop a set of national indicators for Collaborative Forest Landscape Restoration (CFLR) projects.

Other work in this area includes hosting workshops on how to use best available science for monitoring and producing two publications to assist groups with restoration implementation.

Duty 3: Translate for, and transfer to, the affected entities any scientific and interdisciplinary knowledge about restoration-based hazardous fuels reduction treatments.

Since 2010, ERI has translated and communicated scientific information to affected entities through working papers designed to assist managers in making restoration decisions; white papers designed to assist stakeholders and policy makers in making restoration decisions; fact sheets that translate peer reviewed scientific papers for land managers, stakeholders and nontechnical audiences; technical reports; a website and an online library of publications; and newsletters.

Duty 4: Assist affected entities with the design of adaptive management approaches (including monitoring) for the implementation of restoration-based hazardous fuels reduction treatments.

In addition to providing monitoring support for the CFLR pilots described in Duty 3 above, ERI assisted the White Mountain Stewardship Multi-Party Monitoring Board with measuring the outcomes of its 10-year forest restoration project of 70,000 acres in eastern Arizona. The forest treatments provided under this project were credited with preventing the 2011 Wallow Fire from burning into surrounding towns such as Alpine.

Duty 5: Provide peer-reviewed annual reports.

ERI provides online copies of its annual reports and presents a summary of its annual deliverables to Congress and the U.S. Forest Service in Washington, D.C. Reports are available online at: <http://nau.edu/ERI/Resources/Annual-Reports-Work-Plans/>

Achievement of the Purposes of the Act

Below is a summary of ERI's achievement of the purposes of the Act. More details on report titles, stakeholders, and events are found in the institute's evaluation in Appendix A.

Purpose 1: Implementing adaptive ecosystem management practices at the landscape level.

ERI manages LEARN, which monitors the outcomes of different landscape restoration treatments across the Southwest. The monitoring data from these sites provides defensible scientific results to inform restoration treatments.

In addition, ERI provides leadership, scientific data, and administrative support to the Four Forest Restoration Initiative (4FRI). The 4FRI is the largest restoration pilot authorized under the CFLRP. The 4FRI Stakeholder Group and the four national forests that make up the initiative are collaborating to restore 2.4 million acres of ponderosa pine forest across northern Arizona.

ERI led the successful development of a Monitoring and Adaptive Management Plan for the first Environmental Impact Statement (EIS) analysis for 900,000 acres. ERI assisted in the identification of almost 600,000 acres for active ecological restoration and continues to play a major role in the ongoing Multi-Party Monitoring Board that has already begun pre-treatment monitoring for the first EIS.

ERI also provides monitoring and adaptive management technical support for 23 CFLR projects via webinars, workshops, and one-on-one consultations. ERI provided leadership to a CFLR stakeholder and Forest Service team to help develop the biophysical monitoring metrics for a five year CFLR progress report to Congress.

Purpose 2: Reducing unnecessary planning costs.

The ERI provides a variety of services that improve the efficiency and effectiveness of planning, thereby reducing planning costs through: 1) Rapid Assessments to develop science-based documents and treatment prescriptions; 2) One-on-one science support in response to

information requests from agency personnel and stakeholders; 3) Publication of evidence-based reviews, working papers, white papers and fact sheets that synthesize the best available science for planners, specialists, and stakeholders; 4) Assistance to stakeholders throughout the CFLR network to help them advance restoration projects that will make it through the NEPA process (without litigation) and into implementation; and 5) Workshops designed to assist land managers apply best available science.

Purpose 3: Avoiding duplicative and conflicting efforts.

ERI first assesses whether or not the answer is known in the research community before pursuing the expensive task of research. In addition, ERI participates in numerous networks and communicates with other research entities, such as the Southwest Fire Science Consortium (SWFSC) and the RMRS in order to avoid duplication. Finally, collaboration occurs annually between the institutes to avoid unnecessary duplication and to coordinate projects where resources can be leveraged.

Purpose 4: Increasing public acceptance of active adaptive ecosystem management practices.

During the last five years, ERI's outreach activities for the public include presentations, publications, their website, and active and passive engagement with print, television, and radio media. The ERI also uses social media including Twitter, LinkedIn, and Facebook to connect, inform, and engage with a broad audience. In 2013, ERI helped coordinate a public forum at the Museum of Northern Arizona about the Four Forest Restoration Initiative (4FRI). The public response was overwhelming and led to the conclusion that future 4FRI public meetings should be jointly sponsored by the Stakeholder Group (of which ERI is an integral member) and the Forest Service.

Purpose 5: Achieving general satisfaction on the part of affected entities.

“Affected Entities” is defined in PL108-317 as land managers, stakeholders, concerned citizens, and states of the Interior West, including political subdivisions of the states. Some examples of general satisfaction with ERI from the affected entities include the following: several land managers found their research papers and fact sheets to be very helpful and cited the work in their reports; a city official stated that an ERI white paper had been widely shared and valued by decision makers in the City of Flagstaff, and the ERI is routinely asked to testify in Congress by both Republicans and Democrats due to the objectivity, quality and accessibility of ERI science. (See ERI evaluation for report titles and details).

Appendix A — Institute Reports

Each of the institutes prepared an evaluation report to comply with the Five-Year Evaluation Report requirement of the Southwest Forest Health and Wildfire Prevention Act. Each institute's evaluation focused on the institute's performance for each of the following program duties specified in the Act:

1. Develop, conduct research on, transfer, promote, and monitor restoration-based hazardous fuel reduction treatments to reduce the risk of severe wildfires and improve the health on dry forest and woodland ecosystems in the interior West;
2. Synthesize and adapt scientific findings from conventional research to implement restoration-based hazardous fuel reduction treatments on a landscape scale using an adaptive ecosystem management framework;
3. Translate for and transfer to affected entities any scientific and interdisciplinary knowledge about restoration-based hazardous fuel reduction treatments;
4. Assist affected entities with the design of adaptive management approaches (including monitoring) for the implementation of restoration-based hazardous fuel reduction treatments; and
5. Provide peer-reviewed annual reports.

An institute's successful implementation of its duties demonstrates that its programs and activities have sufficiently met the purposes of the Act. Continued federal assistance to an institute is warranted if it has programs and activities that have resulted in the achievement of the purposes of the Act.

New Mexico Forest and Watershed Restoration Institute Report

Work Plans by year, listing projects and federal funds available.

FY 2010

- Technical assistance for communities and restoration collaborative
- Ecological restoration monitoring, restoration-based prescriptions, and water budget after forest restoration
- Outreach, continuing education, and forest worker safety trainings
- \$250,000 in federal budget

FY 2011

- Technical assistance for communities and restoration collaborative
- Ecological restoration monitoring
- Outreach, continuing education, and training
- \$203,500 in federal budget

FY 2012

- Technical assistance and monitoring
- Restoration-based economic development
- Facilitating watershed restoration partnerships
- \$150,000 in federal budget

FY 2013

- Technical assistance and monitoring
- Restoration-based economic development
- Facilitating watershed restoration partnerships
- \$150,000 in federal budget

FY 2014

- Technical assistance
- Monitoring
- Facilitating watershed restoration partnerships
- \$150,000 in federal budget

Table 5: NMFWR I Funding

Funding Source	2010	2011	2012	2013	2014	Total
Federal Work Plan	250.0	203.5	150.0	150.0	150.0	903.5
Additional Federal Projects	0	299.6	0	0	57.2	356.8
State	342.0	427.3	263.3	263.3	387.0	1,682.9
Total	\$592.0	\$930.4	\$413.3	\$413.3	\$594.2	\$2,943.2

The NMFWRI work plans have reflected the views and needs of our statewide stakeholders from the beginning. Each year the institute develops a work plan based on the duties and purposes of the Act, recommendations from the New Mexico Forest and Watershed Health Plan, and conversations with natural resource professionals and other stakeholders. NMFWRI draws heavily on the needs identified at the 2010 joint meeting of the SWERIs and the RMRS. The Institute also relies on core funding by the NM Legislature, which has been twice the Forest Service funding for the last five years. NMFWRI works closely with New Mexico State Forestry Division Office of Forest and Watershed Health to efficiently utilize resources and avoid redundancy.

The NMFWRI has endeavored to work with our two sister Institutes during the period covered by this report. One example is the SWERI-wide collaboration on Desired Condition tours that were sponsored by the Forest Service Southwestern Region. ERI took the lead, CFRI participated in the tours, and NMFWRI helped with site selection and logistics in New Mexico. NMFWRI has also overlapped with CFRI in southern Colorado on work with the Chama Peaks Land Alliance, the Rio Grande Water Fund, and the upcoming project database for the Rio Grande basin. These projects are described below in greater detail.

About The New Mexico Forest and Watershed Restoration Institute

NMFWRI exists to promote practices that reduce the risk of catastrophic wildfire and enhance ecosystem function. The Institute has pursued this through four program areas: ecological of restoration treatments, or which tree to cut and which to leave, with an emphasis on the need to burn treated areas; the mechanics of treatments, or how to operate safely and efficiently, a program area that was most active 2008-2010 but currently is dormant; support from GIS to field work by NMFWRI and our partners, which usually involves maps; monitoring, or how to determine if treatments are effective; and collaboration, which is an umbrella covering all four of the other program areas.

NMFWRI is a stand-alone office attached to NMHU in Las Vegas. At full staffing, NMFWRI employs 6.8 Full-Time Equivalent (FTE). In addition to the full-time staff, we employ NMHU' undergraduates as work-students, a small group of undergraduates to assist with summer fieldwork, and contractors as needed. Since the first SWERI Five-Year Evaluation Report, NMFWRI has had two Directors, and other staff turnover that has affected capacity and performance. Two recent hires, the program directors for monitoring and for collaboration, put the Institute in a good position for the future.

To What Extent Did The Institute Meet The Duties Under The Act?

Duty 1: Develop, conduct research on, transfer, promote, and monitor restoration-based hazardous fuel reduction treatments to reduce the risk of severe wildfires and improve the health of dry forest and woodland ecosystems in the interior West.

Desired Conditions Workshops

For several years, the Southwestern Region of the Forest Service worked on the science underlying forest restoration. The resulting combination of research, observations, and prescriptions came to be called Desired Conditions for ponderosa pine and mixed conifer on national forests in New Mexico and Arizona. In 2011 and 2012 the SWERIs assisted the Forest Service Southwestern Region in organizing and conducting field tours with stakeholders to discuss desired conditions for pine in Arizona and New Mexico and for mixed conifer in in Arizona.

NMFWRI played a key role in the 2012 ponderosa pine tour. That tour began at the Bluewater demonstration area west of Grants, and then moved to the Jemez Mountains. NMFWRI worked with the Santa Fe National Forest to select tour sites in the Jemez Mountains. The desired condition guidelines were used to mark a demonstration area. The Institute identified key partners to invite who coordinated ground transportation and helped with logistics.

New Partnerships

In the fall of 2014 the Washington Office of the Forest Service provided funding for NMFWRI to assist the Otero County Working Group and the Grant County Eco-Watershed Planning Group. These groups include representatives from New Mexico State Forestry Division, USDA Forest Service, tribes (in Otero County), the State Land Office, conservation and environmental organizations, forest industry, contractors, citizens, and city and county representatives.

NMFWRI assisted these groups to be more strategic in addressing forest and grassland issues at a watershed scale. They identified and prioritized future implementation areas and funding, identified stakeholders and partners including economic development organizations and wood products industries, and developed tools to improve education and outreach.

Past, planned and current watershed projects were identified by land ownership and maps were drawn to identify future project areas. A current Community Wildfire Protection Plan was used to identify areas of greatest fire risk. This was compared to focal areas identified by New Mexico State Forestry Division and TNC based on fire risk, water quality and supply, economic opportunity, forest health, and fish and wildlife. Individuals also shared criteria they used to identify areas of importance. From these multiple areas, one priority project area was established for each group.

Potential partners and stakeholders for each of these areas were identified. The Otero group selected one focal area based on greatest fire risk and partnership potential to initiate the next phase. They are working with potential partners and stakeholders to identify projects and discuss options for communicating with the public on planning, implementing and funding these activities. This approach will then be duplicated in other focal areas.

As part of the work with the Grant County group, a partnership developed between Western New Mexico University (WNMU) and NMFWRI in the area of GIS. A storehouse for maps was created under the AllAboutWatersheds portal so group members could have access to

maps created by the working group. Maps of past, present, and future projects, by landowner, are now in these two private folders, as well as maps that outline the priority project areas.

Socioeconomic Monitoring

While some core ecological indicators have been developed and widely used to evaluate the effectiveness of restoration projects, efforts to systematically develop and apply indicators related to the social and economic outcomes of projects historically have been limited. Beginning soon after he arrived in 2010, NMFWRI's former director recognized this shortcoming and worked to standardize protocols for collecting and evaluating socioeconomic monitoring data. While the work was targeted at CFRP projects, it could be applicable to all restoration projects.

This work incorporated a Delphi process, an iterative method of questioning a group of opinion leaders, controlled feedback, response modification based on the feedback, and eventual consensus, without the opinion leaders knowing one another before consensus is reached. Using this process, a set of indicators was developed. The indicators were grouped into three levels of detail and five thematic areas: collaborative participation; community sustainability; economic impacts and outcomes; public support for restoration; and outreach and training. As would be suspected, job creation ranked highest of all the indicators. The full report and a user's guide are available on our website at <http://www.nmfwri.org/for-land-managers>.

Coleman Ranch Water Budget Study

NMFWRI teamed with the Lower Pecos Watershed Alliance and New Mexico Tech in the development of a project designed to examine how thinning in a mixed conifer stand would impact the surface and subsurface water budget. NMFWRI conducted the pre-treatment monitoring in 2008, and the post-treatment monitoring in 2013. NM Tech continues to collect and analyze water data. This project was partially supported with funding from New Mexico Institute of Mining and Technology (NM Tech).

NMFWRI also developed an object-based image classification for the Colman Ranch area using eCognition software to develop canopy cover maps for pre and post-treatment areas. Canopy classifications were developed at 1- meter scale for each year using ortho-imagery from 2003 and 2014. Percent canopy coverage was calculated at 10-meter grid cells based on the 1-meter canopy classification. Knowing the percent canopy before treatment and after indicates the amount of canopy reduction and the spatial distribution of the change. These canopy cover datasets were used as inputs in computer modeling performed at NM Tech. NM Tech continues to collect and analyze water data. This project was also partially supported with funding from NM Tech.

BLM Contract Work

NMFWRI works with project managers across the state to provide them with maps to assist them in project planning. Between 2011 and 2015, the BLM funded NMFWRI to develop a vegetation and land cover classification map of their Rosa and Carrizo Largo Landscape Areas in Rio Arriba and San Juan Counties of New Mexico. For both areas a detailed 30cm (1 foot) vegetation classification was created using digital ortho-imagery and Trimble

eCognition software. Percent cover for each land cover type was derived using 30x30 meter grid cells.

The Rosa landscape area comprises over 111,000 acres and borders Navajo Lake on the San Juan River. The Carrizo Largo study area covers over 259,000 acres and is located 40 miles northeast of Cuba, NM. Extensive road and well-pad networks to support oil and natural gas production dominate the landscape in both study areas. Because of the fragmented landscape, habitat for wildlife is a concern. Working with the BLM Farmington Field Office and our own field crew, field plots and vegetation transects were used to validate the accuracy of the classification. The Rosa Landscape land cover classification included 21 land cover classes and had an overall accuracy of 80.14%. The Carrizo Largo Landscape land cover classification included 20 land cover classes and had an overall accuracy of 85.63%.

Creating a vegetation and land cover classification is important for habitat assessment and land management activities. Having a baseline assessment of vegetation cover and diversity is critical to support long-term land management activities. More information about these projects can be found on our website: <http://www.nmfwri.org/projects>.

Teacher's Camp

In the summer of 2014, NMFWRI partnered with NMHU's Natural Resources Department and the Environmental Education Association of New Mexico to host a three-day teacher's camp on NMHU's campus. Called the Forestry and Fire Ecology Academy, it presented a condensed overview of issues and research surrounding forest restoration and fire management in New Mexico. Classes included fire laboratory activities, a Simtable demonstration, an orientation to dendrochronology and Project Learning Tree, a sawmill tour and a tour of the Pritzlaff Ranch demonstration area. Twenty educators participated, including an equal mix of high school teachers and nature center operators. Participants were funded by a grant from New Mexico State Forestry Division.

Duty 2: Synthesize and adapt scientific findings from conventional research to implement restoration-based hazardous fuels reduction treatments on a landscape scale using an adaptive ecosystem management framework.

AllAboutWatersheds.org

The AllAboutWatersheds portal is a forest and watershed restoration health information clearinghouse. It is a joint effort with the Forest and WHO of New Mexico State Forestry Division. The web-based portal contains links, postings, and videos related to prescriptions, groups, funding sources, and monitoring protocols from across the state and is used by groups (e.g., the Zuni Mountain Landscape CFLR) and agencies (e.g., the NM Environment Department). Planning was supported by Federal funds, and start-up funding for the portal was from New Mexico State Forestry Division. NMFWRI currently is supporting the portal with core state funding, and additional funding is actively being sought. AllAboutWatersheds has become a valuable tool for exchanging information about restoration.

Ojo Peak

This project was funded under a Participating Agreement between the Cibola National Forest and NMFWRI. The objective was to monitor the response of ponderosa pine that were within the perimeter of the Ojo Peak Wildfire (November 2007) to determine if the trees would survive after being burned late in the season. A November wildfire is uncharacteristic in the Southwest, and little was known about the effects on tree mortality or survival rates. NMFWRI and the Forest Service established plots in 2008, and NMFWRI re-measured those same plots during the summers of 2009 and 2011. Thirty-one plots were established. Fourteen plots had good survival. Most of these plots were in areas mapped as having low severity fire.

On the 17 moderate-to-high mortality ponderosa pine plots survival improved as diameter increased and as the percentage of post-fire green crown increased. Having green in the crown after fire is an indicator of survival. Diameter was a weaker indicator than expected. Minimum bark char height also shows some potential as an indicator of survival. (Two measures are made on each tree: the maximum bark char height will typically be found on what was the leeward side during the fire, and the minimum height on the windward side.) The ponderosa pines with the highest minimum bark char heights died, and those with the lowest minimums tended to live. Some relationships, like crown position, scorch, and consumption, were weak. Survival was better for trees higher in the canopy, but many trees lower in the canopy survived. Complete post-fire crown scorch is not an indicator of death, and less post-fire crown consumption is better, but there was little relationship with mortality. Bark thickness is generally accepted as positively related to survival, but these data show no relationship.

Southwest Jemez Mountains (SWJM) Collaborative Forest Landscape Restoration (CFLR)

This project, funded by the Washington Office of the Forest Service, originally included 210,000 acres on the Santa Fe National Forest and the Valles Caldera National Preserve (VCNP). NMFWRI participates with the collaborative and partners in regular planning and informational meetings.

Estancia

Since 2007, NMFWRI has been a member of the Estancia Basin Monitoring Steering Committee, which comprises the three Soil and Water Conservation Districts in the basin and representatives from cooperating agencies. NMFWRI works with the SWCA consulting group to monitor thinning projects in the basin.

Gallinas

The 52,000 acre Gallinas watershed provides municipal drinking-water for the city of Las Vegas, NM and has been prioritized for restoration. Two-thirds of the area is on National Forest land, with the remainder divided between municipal and private ownership. NMFWRI organized the Gallinas Partnership in 2010 to bring the land management organizations together to improve the health and safety of the Gallinas and neighboring watersheds by mitigating the potential for catastrophic wildfire, and to secure a

sustainable water supply for the City of Las Vegas and the region. The Partnership developed and implemented a comprehensive watershed plan and hazardous fuel reduction strategy.

Zuni Mountain CFLRP

NMFWRI attends collaborative meetings along with other stakeholders for the Zuni Mountain CFLRP.

Long-Term CFRP Monitoring

The first SWERI Five-Year Evaluation Report described NMFWRI's involvement in long-term monitoring of projects funded by the CFRP. In late 2008, a five-person team identified twenty projects across multiple jurisdictions and forest types to be measured at five, ten, and fifteen years post-treatment. This long-term monitoring closes the feedback loop essential for adaptive management. NMFWRI has completed the first round of post-treatment monitoring of those projects, and is on schedule for the ten-year post-treatment monitoring. Using the same criteria as the first selection, we have selected additional projects for five year monitoring.

Duty 3: Translate for, and transfer to, the affected entities any scientific and interdisciplinary knowledge about restoration-based hazardous fuels reduction treatments.

Pritzlaff Ranch Demonstration Area

NMFWRI established a 10-acre demonstration area in a ponderosa pine stand on the Pritzlaff Ranch outside of Las Vegas in 2007. Areas of equal size were marked according to evidence-based guidelines developed by ERI, Northern Goshawk guidelines developed by the U.S. Forest Service, and genetic (phenotypic) guidelines developed by NMFWRI. Areas are large enough for visitors to see what a residual stand would look like. The ERI and Northern Goshawk plots exhibit the group-and-opening structure characteristic of historic ponderosa pine stands. Thinning of this stand was completed in the fall of 2008, and the area was burned in a prescribed fire in November 2010. The area has been used several times a year for training and outreach. The area is being continually monitored to determine lessons learned.

Habitat Characterization of the Jemez Mountain Salamander

In 2010, TNC asked NMFWRI to characterize the habitat of the Jemez Mountain salamander (JMS). A team of biologists assembled by TNC identified areas where the JMS had been found, and prioritized those areas for vegetation measurement. NMFWRI's role was to conduct a vegetation survey using the Institute's modified monitoring protocols. NMFWRI used a combination of student and Jemez Pueblo crews to measure the vegetation and down logs in these areas in summers of 2011 and 2012.

Very little is known about the JMS. It is associated with closed-canopy mixed conifer forest. Salamander biologists used to find JMS in places they no longer occur. Ladder fuels have increased and the canopy has filled in and become more continuous. Places where salamanders had been known to occur and that were selected for us to measure varied from

sparse ponderosa pine with a New Mexico locust understory, to very dense wet mixed conifer. Vegetation cover seemed to have little to do with past JMS occurrence.

Due to the declining numbers of salamanders found during the NMFWR surveys the US FWS listed the Jemez Mountain Salamander as Endangered in the spring of 2013.

Little Bear Fire

The Little Bear Fire ignited from a lightning strike in June 2012 in the Lincoln National Forest outside of Ruidoso, NM and grew to become the most financially destructive fire in New Mexico history. Prior to the fire, various hazardous fuel reduction treatments were implemented on private, municipal, and federal land. In 2012 the Forest Service Washington Office provided funding for NMFWR to evaluate the effectiveness of these treatments based on various ecological metrics.

Four fuel reduction treatments were evaluated: thinning the trees; thinning and piling the biomass; thinning and masticating the biomass; and thinning, chipping the biomass, and hauling it away from the site. The primary post-fire metrics used to evaluate the impacts were fire severity, tree mortality, and bare ground. Other post-fire metrics were collected to examine their relationships to tree mortality and bare ground, and provide information for future management. These include fuels, trees per acre, woody basal area per acre, habitat type, slope, aspect, non-woody canopy cover, non-woody basal area, and insect occurrence.

Analysis showed five statistically significant relationships. These were between fire severity and tree basal area, tree mortality, bare ground, and fuel treatments, and between the fuel treatments and bare ground. As basal area increased, fire severity increased. Increased fire severity also was correlated with increased tree mortality and increased bare ground. Bare ground increased with fire severity and the thin-and-pile treatment. Two of the four treatments – thin-and-pile, and thin, -chip, -and-haul – appeared to be the driver of the relationship with fire severity. The thin-and-pile plots showed high fire severity, and thin, -chip, -and-haul showed low fire severity.

Mastication

In 2012 the Forest Service, New Mexico State Forestry Division, and BLM requested a study on fire behavior in masticated materials. Three sites were chosen in 2013: for pinyon-juniper, the Lincoln National Forest near Ruidoso, NM; for ponderosa pine, the Tonto National Forest near Payson, AZ; and for chaparral, the Prescott National Forest near Prescott, AZ.

Three general methodological approaches were used: fuel bed and soil temperatures and heat residence time on masticated and burned plots; observations of flame length, heat output, rate of spread, and the post-fire masticated fueled conditions; and short-term monitoring of vegetation changes in and proximate to treated plots – both masticated only and masticated and burned.

Site selection, fieldwork, and planned burns were coordinated with the local District Offices. At each treatment site, data was collected on mastication depth, species, and cover of understory plants. NMHU faculty leveraged other funding to examine soil factors. More than

ten students have been involved in this project, and a strong link has been established between the NMHU and NM State University fire programs.

Guide to Bosque Monitoring

Well-designed monitoring of riparian projects is critical to improving current treatments and modifying future techniques. Riparian sites frequently are identified in community wildfire protection plans as priority areas for fuels reductions. Because riparian areas have been poorly studied with regard to fuel and fire dynamics, little science is available to guide the fuel management process.

NMFWRI developed guidelines for monitoring in riparian areas including: cover plot layout; measurement of ecological indicators; Hink and Ohmart structural determinations; and groundwater monitoring. The protocols and a handbook for field use are available on the NMFWRI website at <http://www.nmfwri.org/collaborative-forest-restoration-program>.

Santa Fe Community College

In 2012 the Santa Fe Community College (SFCC) asked NMFWRI to develop and deliver a course for woods workers. SFCC's Workforce Development Program offered a course in February 2013 for environmental science technicians, and NMFWRI presented the three-week program on restoration monitoring and principles, timber marking, and basic GIS. A member of the Alamo Navajo field crew assisted in the instruction, and two of the twenty students were members of pueblos. Funding was provided by Santa Fe Community College.

Duty 4: Assist affected entities with the design of adaptive management approaches (including monitoring) for the implementation of restoration-based hazardous fuels reduction treatments.

HB 38, the Forest and Watershed Restoration Act

During its 2014 Session, the New Mexico Legislature passed two Memorials that recognized the urgent need for watershed restoration, and requested "the appropriate interim committee of the Legislature to develop a long-term funding plan for federal, state, local and tribal agencies and diverse stakeholders to cooperate on forest and watershed restoration work in New Mexico". The Interim Water and Natural Resources Committee assigned this task to the NMFWRI.

Developing a long-term funding plan requires the agencies involved in watershed restoration to work together. In early August NMFWRI called a meeting in Santa Fe attended by 19 organizations including state and federal agencies, universities, tribes, soil and water conservation districts, and other stakeholders. This group discussed what was being done in watershed restoration, what needed to be done, and what was needed to cover that gap.

The full group appointed a smaller group who determined that the two key issues were promoting forest and watershed function, and protecting water sources by reducing the risk of catastrophic fire. The smaller group determined the funding needed and what the funds should be used for. The group agreed that \$15 million would cover about one-fourth of the total annual treatment needed in New Mexico. They then developed a list of criteria to use in prioritizing projects that emphasizes on-the-ground work but allows for planning, especially

when there is an opportunity for collaboration and leveraging other sources of funding. This process led the Interim Water and Natural Resources Committee to establish a Forest and Watershed Restoration Fund.

A bill was drafted and presented to the Interim Committee at a meeting in December. The draft was voted on and endorsed as a committee-sponsored bill for the 2015 Session. House Bill (HB) 38, the Forest and Watershed Restoration Act, would have established a Fund and a Board to manage the money, given guidance on projects and proposals, and raised \$15 million annually by diverting tax revenues from the homeowner's insurance premium tax that currently goes to the General Fund. It was co-sponsored in the House by a Republican rancher from Aztec, and in the Senate by a Democratic lawyer from Santa Fe.

HB 38 passed through the House and Senate, but was vetoed by the Governor. The final version and other documentation can be found on the Legislature's website <http://www.nmlegis.gov/lcs/legislation.aspx?Chamber=H&LegType=B&LegNo=38&year=15>.

Statewide Vegetation Treatment Database

NMFWRI is developing a statewide geospatial database of planned watershed treatments on private, state, tribal, and federal forest land for all of New Mexico.

Development of this database involves working collaboratively with and receiving data from NM State Forestry, USDA-Forest Service, BLM, the State Land Office, NRCS, and a host of other agencies. The collected data populates an integrated database. Pulling together this information from different State and Federal agencies is aided by NMFWRI's GIS capabilities and by its unique position as an active but neutral participant in statewide projects.

The geospatial database will allow users to overlay project-level information with other data such as fire history, imagery, and vegetation. Project-specific pages can be assembled into customized map books with a project map, a location map, and information related to the project listed in a summary table.

In the past two years, TNC has established the Rio Grande Water Fund to identify funding for vegetation treatments in the Rio Grande basin in New Mexico and southern Colorado. The statewide geospatial database will be a valuable tool in identifying priority treatment areas for the Water Fund

Duty 5: Provide peer-reviewed annual reports.

Annual reports have been prepared every year. They have been circulated among our stakeholder group for comment before being submitted. They are available on our website: <http://www.nmNMFWRIOrg.org/annual-reports>.

Colorado Forest Restoration Institute Report

CFRI’s work plans are based on semi-annual statewide needs assessments. The assessments are performed by the director and include focus group discussions with affected entities such as the U.S. Forest Service, the U.S. BLM, and the Colorado State Forest Service (CSFS). Formal needs assessments were conducted in 2005, 2007, and 2009. CFRI assumed the directorship in May of 2008 and conducted the 2009 assessment. Since this time, assessment of needs occurs through ongoing conversations and collaborations with resource specialists and line officers at the ranger district, forest supervisor, and regional office levels in Colorado, as well as with individuals from non-federal and non-governmental organizations (NGO) working on forest landscape restoration and wildfire mitigation.

Table 6: CFRI Funding

Funding Source	2010	2011	2012	2013	2014	Total
Federal Work Plan	250	500	150	150	150	1,200
Additional Federal Projects	23	223	573	281	665	1,765
State	231	490	273	704	425	2,123
Total	\$ 504	\$ 1,213	\$ 996	\$ 1,135	\$ 1,240	\$ 5,088

Dollars in thousands

** Includes salary support for Cheng, unrecovered indirect cost/overhead at CSU’s research rate, and financial agreements with State of Colorado government for projects.*

About The Colorado Forest Restoration Institute

The CFRI is housed in the Department of Forest and Rangeland Stewardship, Warner College of Natural Resources at Colorado State University. As such, it is well positioned to leverage the science and outreach capacity within the College by drawing on the expertise of faculty, staff, and students, and the CSFS. Located in Fort Collins, Colorado, CFRI is fortunate to be located in close proximity to the U.S. Forest Service RMRS, affording opportunities for collaboration with RMRS scientists to synthesize current research pertaining to restoration-based hazardous fuels reduction and insect infestation impacts on Colorado’s forests, as well as drawing on RMRS research expertise in conducting forest condition assessments and monitoring.

The mission of the CFRI is to build the capacity of land managers, communities, and policy makers to address forest health and restoration issues through collaborative science-based approaches to assessing, designing, and adaptively managing restoration projects. CFRI staff brings ecological and social science expertise to bear on forest restoration issues, and are constantly called upon to work with agencies, collaborative partnerships, and policy makers. Currently CFRI is staffed by a director, eight full-time research associates, three graduate students, and between nine and fifteen temporary Colorado State University student employees working on field projects. CFRI also draws on multiple faculty and research scientists in the Department of Forest and Rangeland Stewardship, in other departments within the Warner College of Natural Resources, and across the university to collaborate on developing, synthesizing, and applying science-based knowledge to place-specific forest restoration and wildfire mitigation management situations.

To What Extent Did The Institute Meet The Duties Under The Act?

Duty 1: Develop, conduct research on, transfer, promote, and monitor restoration-based hazardous fuel reduction treatments to reduce the risk of severe wildfires and improve the health of dry forest and woodland ecosystems in the interior West.

CFRI meets this duty through its involvement in multiple collaborative wildfire mitigation-based forest restoration and fuel reduction projects in Colorado. Prominent examples include: the Colorado Bark Beetle Cooperative, the Colorado Front Range CFLRP, the Colorado Wildfire Risk Reduction Grant Program, Denver Water-U.S. Forest Service Forest-To-Faucets Program, the San Juan Headwaters Forest Health Partnership, and the Uncompahgre Plateau CFLRP. Highlights include:

Colorado Bark Beetle Cooperative

- Developed a status of knowledge report on effects of the mountain beetle outbreak on forest ecology, fuels and fire, wildlife, watershed, and recreation.
- Convened two symposia to identify treatment goals and priorities for post-mountain pine beetle hazard reduction.
- Developed a hazard assessment framework to assist local managers to identify goals, objectives, and priorities for reducing fire and other hazards to communities and critical infrastructure.
- Collaborated with the RMRS on a five-year monitoring project to assess the impact of the Church Park Fire (burned in October 2010 in beetle-killed forests) on tree and plant regeneration, comparing impact in previously cut and uncut stands.

Front Range CFLRP

- Provided assistance in developing the monitoring component for the Front Range CFLRP.
- Assisted in the formation and ongoing functioning of the Landscape Restoration Team of the Front Range Roundtable to oversee implementation, monitoring, and adaptive management of the project.
- Worked continuously through the Landscape Restoration Team since 2011 to develop, synthesize, and apply currently available scientific knowledge to inform and monitor projects on the Arapaho-Roosevelt and Pike-San Isabel national forests.
- Took the lead in producing three core documents underlying the Front Range CFLRP: desired conditions at stand and landscape scales; the multi-party monitoring plan; and a framework for collaborative adaptive management.
- Helped initiate collaboration between two national forests, the USDA Forest Service's RMRS, and Rocky Mountain Tree Ring Research to implement a large-scale assessment of historic forest structure and fire regimes. Results from the assessment are already being used by federal and non-federal managers as reference conditions for developing restoration prescriptions for Colorado Front Range Ponderosa pine and dry mixed-conifer forests.

- Led efforts to develop and implement methods for monitoring treatment effects on estimated fire potential and behavior, forest structure, and understory plant communities.
- Developed and implemented a socio-economic monitoring strategy to gauge the effect of treatments on local employment, wood utilization, and the regional economy.
- Helped organize and lead annual multi-party monitoring reviews to provide adaptive management guidance to managers.

Colorado Wildfire Risk Reduction Grant Program

- Serve on the advisory committee to formulate the grant program and review and select grant applications.
- Developed and implemented a treatment effectiveness monitoring strategy, and provided information back to the advisory committee and to grantees.
- Provided technical guidance and citizen science opportunities to landowners and managers on monitoring treatment effectiveness.
- Promoted the program through invited presentations to the Colorado General Assembly.

Denver Water-US Forest Service Forest-to-Faucets Program

- Developed and implemented a treatment effectiveness monitoring strategy.
- Developed a framework for linking treatment effectiveness to return-on-investment metrics for Denver Water for the project's 2015 renewal.

San Juan Headwaters Forest Health Partnership

- Developed a status of knowledge report pertaining to dry mixed-conifer ecology and management to inform managers and stakeholders about restoration needs and opportunities.
- Organized and led a multi-stakeholder workshop to deliver current knowledge about dry mixed-conifer ecology and management, and identify priority areas for forest restoration.
- Provided technical guidance on multi-party monitoring of treatment effectiveness for the ten-year stewardship contract.
- Helped organize and lead a community workshop reviewing the effects of the Little Sand Fire (burned June 2012).

Uncompahgre Plateau Collaborative Forest Landscape Restoration Project

- Assisted in developing the monitoring component for the Front Range CFLRP.
- Participated in a core group focused on monitoring and adaptive management, including leading the development and implementation of the multi-party monitoring strategy.

- Provided technical assistance to the high school Forestry Internship Program to collect treatment effectiveness data pertaining to forest structure and fuels.
- Developed and implemented a socio-economic monitoring strategy to gauge the effect of treatments on local employment, wood utilization, and regional economic impacts.
- Developed an assessment of forest structure in roadless old growth stands to provide managers with an understanding the influence of soils on variability of long-term vegetation dynamics and fire history.
- Conducted analysis of stakeholder perspectives on forest restoration projects that harvest and utilize wood.
- Organized and lead annual multi-party monitoring reviews to provide guidance to managers.

Additional activities:

- Gave presentations on forest restoration and fuel reduction projects to congressional members and staff, and the Colorado state legislature.
- Organized and led annual meetings of forest health collaborative groups to identify lessons learned, areas of common need, and best practices for forest restoration and fuel reduction treatments.
- Gave multiple public presentations, media interviews, and media editorials about forest restoration and fuel reduction activities.

Duty 2: Synthesize and adapt scientific findings from conventional research to implement restoration-based hazardous fuels reduction treatments on a landscape scale using an adaptive ecosystem management framework.

CFRI collaborates with researchers at area universities, the RMRS, and other federal research institutions to compile, synthesize, and apply current research for managers, collaborative groups, and stakeholders. Examples include:

- A report defining desired conditions for Colorado Front Range Collaborative Forest Restoration.
- A status of knowledge of dry mixed-conifer forest ecology and management in Southwestern Colorado.
- In collaboration with the RMRS, a general technical report on principles and guidelines for restoring ponderosa pine and dry mixed conifer forests in Colorado's Front Range.

Duty 3: Translate for, and transfer to, the affected entities any scientific and interdisciplinary knowledge about restoration-based hazardous fuels reduction treatments.

CFRI continuously assesses needs and opportunities for knowledge transfer, organizing and convening a range of events involving a wide range of participants, and collaborating with other entities with a mission to apply and integrate best available science into forest restoration and wildfire risk reduction. Examples include:

- Participated in an April 2010 symposium on post-mountain pine beetle effects and management priorities involving 100+ managers, stakeholders, community leaders, and elected officials.
- Arranged scientific presentations in 2010-2014 on post-mountain pine beetle research pertaining to forest recovery and watershed effects for the Colorado Bark Beetle Cooperative.
- Published the research brief, *Signs of recovery for Colorado forests in the wake of the mountain pine beetle*, based on research conducted by the RMRS and co-sponsored by CFRI.
- Co-sponsored a webinar with the RMRS on mountain pine beetle outbreak impacts and management effects.
- Co-sponsored multiple field trips 2011-2015 involving scientists, managers, and stakeholders for the Front Range and Uncompahgre Plateau CFLRPs.
- Published two research briefs synthesizing current research on aspen forest conditions and Sudden Aspen Decline in Southwestern Colorado.
- Published the research brief, *Use of physics-based fire behavior modeling to assess treatment effectiveness*, to inform researchers and managers on the use and application of new fire behavior models.

Duty 4: Assist affected entities with the design of adaptive management approaches (including monitoring) for the implementation of restoration-based hazardous fuels reduction treatments.

CFRI actively participates in collaborative forest landscape restoration and fuel reduction projects. CFRI developed and implemented monitoring and adaptive management strategies linked to several large-scale forest restoration and fuel reduction projects. Examples include:

- Developed and implemented a multi-party monitoring plan for the Front Range and Uncompahgre CFLRP projects and collected data on treatments to inform managers on future treatment prescriptions.
- Led the development of a collaborative adaptive management strategy document to guide the Front Range CFLR project.
- Organized and led multi-party monitoring and adaptive management reviews for the Uncompahgre Plateau CFLR project, which included engaging stakeholders in “citizen

science” field experiences.

- Assisted in the development and implementation of a monitoring and adaptive management strategy for the Denver Water-US Forest Service Forest-to-Faucets program (2015 renewal).
- Ongoing participation on the Science Team associated with the Spruce Beetle Epidemic-Aspen Decline Management Response (SBEADMR) project of the Grand Mesa-Uncompahgre-Gunnison (GMUG) National Forest to develop and implement an adaptive implementation strategy.

Duty 5: Provide peer-reviewed annual reports.

The CFRI has prepared annual reports as required under the Act. They have been circulated among stakeholder groups for comment before being submitted.

CFRI website: <http://warnercnr.colostate.edu/cfri-home/>

Achievement of the Purposes of the Act

Purpose 1: Implementing active adaptive ecosystem management practices at the landscape level.

CFRI is actively involved in the Front Range and Uncompahgre Plateau CFLRPs. The institute is integrated into project planning, goal setting, design, monitoring, and adaptive management of these large-landscape projects. CFRI has convened numerous meetings among scientists, managers, and stakeholders to identify current scientific knowledge about reference conditions, silvicultural treatments, and monitoring metrics and methods. CFRI supervises the gathering of pre- and post-treatment data pertaining to forest structure, fuels, understory plants, and socio-economic impacts, and produced written reports and oral presentations on results to feed back into the adaptive management process. CFRI helps organize and convene annual field reviews of treatments, and leads collaborative discussions about effects and future treatment design.

CFRI has also increased its portfolio to non-federal lands and is utilizing spatial analysis techniques to assist in treatment planning and design to complement work on federal lands. CFRI is the lead entity in developing and implementing effectiveness monitoring to inform non-federal managers on treatment effects and on design of future treatments.

Purpose 2: Reducing unnecessary planning costs.

CFRI regularly receives requests from federal land managers to assist, lead, and participate in various phases of project planning to address social conflict over treatments, address uncertainties in scientific knowledge, assist in project design features, and provide guidance on monitoring metrics and adaptive management strategies. For example, CFRI worked closely with US Forest Service managers and TNC on the Upper Monument Creek project (a project under the Front Range CFLR initiated in 2012) to develop design criteria for various forest types in the project area. By doing so, CFRI helped reduce the time that would have been allocated by the US Forest Service during its internal planning and analysis pursuant to

the National Environmental Policy Act (NEPA). Similarly, in 2012 CFRI co-sponsored a field-based rapid assessment of historic forest structure to inform the planning and design of the Escalante Forest Restoration and Stewardship Project on the GMUG National Forest. Without this information, US Forest Service planners would have either had to collect it themselves or been open to stakeholder objections over the lack of information for the decision. Relatedly, CFRI's collaborative work with the RMRS to establish reference conditions for forest restoration across the Colorado Front Range (and into southern Wyoming and the Black Hills, South Dakota), will greatly reduce the exposure of the US Forest Service and other agencies to objections about the lack of a scientific basis for restoration treatments in ponderosa pine/dry mixed-conifer. This is crucial given recent publications by researchers at the University of Colorado and University of Wyoming who call into question the need for forest restoration.

In 2015, the GMUG asked CFRI and the RMRS to provide a status of knowledge report on spruce ecology and management to inform its SBEADMR project. The report addressed stakeholder concerns by developing and implementing a robust monitoring strategy that ties in with the adaptive implementation proposed action.

This type of multi-stakeholder collaboration surrounding forest restoration and fuel reduction project planning and design can help build agreement prior to and during the NEPA process, and reduce the costs to federal agencies in fighting objections and appeals.

Purpose 3: Avoiding duplicative and conflicting efforts.

CFRI seeks efficiencies in its efforts by: 1) engaging in pilot/demonstration projects, such as the Uncompahgre Mesas Forest Restoration Project, that can serve as a launching point for larger-scale work; 2) Conducting well-sampled assessments of historic vs. current forest conditions across large areas to inform management priorities and prescriptions; 3) collecting, analyzing, and disseminating monitoring data for treatment prescriptions commonly implemented across a larger area to inform future prescriptions; and 4) participating in a variety of collaborative forest health partnerships in order to identify needs and issues common across partnerships. CFRI develops, compiles, and applies science-based knowledge that is locally relevant to managers, and develops reports and sponsors knowledge transfer activities to target managers who face similar issues in similar forest conditions.

Purpose 4: Increasing public acceptance of active adaptive ecosystem management practices.

CFRI regularly receives requests to participate in the planning, design, and monitoring and adaptive management of forest restoration and fuel reduction projects on federal and non-federal lands, primarily in the state of Colorado. These requests are due in large part to the credibility CFRI has with a variety of stakeholders, managers, and elected officials in providing unbiased, objective science-based information. For example, the GMUG national forest reached out to CFRI in spring 2015 to participate in a Science Team (along with the RMRS) that would develop and implement monitoring strategies for the SPEADMR project. CFRI's involvement has helped assuage concerns among many stakeholders about the US Forest Service's proposed 'adaptive implementation' strategy.

Since the 2009 SWERI Five-Year Review, CFRI has increasingly been invited to make presentations to state and federal elected officials, especially concerning the scientific basis for forest landscape restoration and fuel reduction, and to share monitoring results and lessons learned. Core concepts and ideas presented by CFRI have been incorporated into the Colorado Wildfire Risk Reduction Grant program and federal legislative proposals. This is evidence of CFRI's impact on increasing the acceptance of active adaptive ecosystem management practices.

Purpose 5: Achieving general satisfaction on the part of affected entities.

CFRI strives to maintain regular, active communication with affected entities, including federal and state forest land management agencies, water providers, non-governmental stakeholder groups, and other research institutions, such as the RMRS, other federal research institutions (e.g., US Geological Survey), and other universities.

The Ecological Restoration Institute in Arizona Report

Annual Work Plans Guide Institute Activities

Each year the ERI develops an annual work plan that describes a program of activities for our annual federal funding. In some cases, such as our biophysical and monitoring work, state or other funding is used to leverage federal funding. The commitment of funding from Arizona enables the ERI to provide a suite of services that increases the impact of the ERI beyond what is possible with only our federal funding.

The ERI designed the work plans to ensure that the best science available is used by land managers and stakeholders to develop and implement comprehensive, restoration-based forest treatments. Annual work plans of the ERI follow the guidance of the authorizing legislation and are approved by both the Forest Service SWERI Development and Executive Teams. The activities and deliverables in each work plan: (1) support forest restoration policy directives from the U.S. Forest Service, the Western Governors’ Association, the Department of the Interior, and other organizations; (2) serve the needs of land managers and other affected parties to implement action; and (3) anticipate emerging biophysical and social science questions. The ERI intentionally works at the interface of developing and transferring rigorous science to solve a significant natural resource challenge—restoring forests at the landscape scale.

Table 7: ERI Funding

Funding Source	2010	2011	2012	2013	2014	Total
Federal Work Plan	1,500	1,200	1,200	1,200	1,125	6,225
Additional Federal Projects	0	1,101	192	179	764	2,237
State	1,318	1,183	1,325	1,225	965	6,016
Total	\$2,818	\$3,484	\$2,717	\$2,604	\$2,854	\$14,478

Dollars in thousands

About the Ecological Restoration Institute

ERI-NAU is nationally recognized for mobilizing the unique assets of a university to help solve the serious problems of degraded forest health and unnaturally severe wildfire in the frequent-fire forests of the Southwest and Intermountain West. The mission of ERI is to serve as an objective leader in research, scholarship, education, and, in collaborative efforts, to help interested parties plan and implement restoration treatments for these forests and woodland landscapes. In this light, the ERI provides land management agencies and communities with applied scientific knowledge (i.e., comprehensive focused studies, monitoring and evaluation research, and technical support) about issues related to both the ecological and social aspects involved in restoration treatments.

ERI was formally established in 1997 by the Arizona Board of Regents and in 2004 by the federal legislation (Southwest Forest Health and Wildfire Prevention Act of 2004, P.L. 108-317). In 2005, ERI was formally chartered by the Western Governors’ Association. This action committed the three states and Universities named in the federal legislation to provide resources to advance landscape scale restoration. The ERI employs a staff of about 23 people including ecologists, administrators, professors, and outreach personnel. In addition, the ERI subcontracts with experts in other disciplines (e.g., ecological economics, conservation biology, sociology) to provide research and expertise in areas outside the core competencies of the ERI. The institute also provides

educational and field experiences to NAU undergraduate and graduate students. The ERI is funded by a combination of: NAU base budget; Technology, Innovation and Research funding (TRIF) from the Arizona Board of Regents; federal appropriations; federal projects; and, through competitive grants programs. More information about the ERI is available at <http://www.eri.nau.edu>.

To What Extent Did The Institute Meet The Duties Under The Act?

Duty 1: Develop, conduct research on, transfer, promote, and monitor restoration-based hazardous fuel reduction treatments to reduce the risk of severe wildfires and improve the health of dry forest and woodland ecosystems in the interior West.

During 2010-2014, ERI continued to assess unnatural and potentially catastrophic changes in frequent-fire landscape conditions, and test treatments designed to restore characteristic forest structure, ecological function, and more benign fire behavior. This work was accomplished through original studies of fire history, forest dynamics, plant community responses, wildlife responses, and social and economic aspects of forest restoration. In addition, the ERI developed a strong program in secondary research (i.e. evidence-based conservation) to compile, review, and analyze existing knowledge using rigorous, systematic methods. Lastly, the ERI forged new partnerships with the US Forest Service and US FWS to increase adaptive management through treatment monitoring.

Studies were carried out at sites throughout the Southwest and in more distant areas of the Intermountain West using leveraged state funds as well. A central component of the ERI's studies of restoration treatments are the LEARN. The network covers the ponderosa pine forests of Arizona from the Arizona Strip in the northwest through the eastern Apache-Sitgreaves National Forests on the Arizona-New Mexico border. Additional sites are located in Colorado and New Mexico. The network includes ponderosa pine and mixed conifer forests, as well as pinyon-juniper woodlands. Each site is set up as a stand-alone controlled, replicated experimental study testing a full restoration treatment (i.e., thinning young trees to restore historical density, spatial pattern, and species composition; treatment of fuels; re-introduction of low-severity surface fire), and an untreated control. The LEARN sites are located on public lands including U.S. Forest Service, BLM, National Park Service, Department of Defense (DoD), and state lands. The strong scientific design of the LEARN network resulted in many stand-alone contributions to the state of knowledge concerning restoration of frequent fire forests (see Appendix A). In addition, the network has recently enabled powerful new insights and provided broad inference through meta-analyses done across LEARN sites having similar treatments.

Early after passage of the Act, the ERI focused studies on restoration of southwestern ponderosa pine forests. More recently, the ERI has completed analysis of historical conditions and restoration priorities in mixed conifer forests and pinyon-juniper woodlands. Over the 2010-2014 period, the ERI increased efforts to better understand mixed conifer forests of the West through both primary (using leveraged state funding) and secondary studies. For example, restoration treatment comparisons were done at the LEARN site on the San Juan National Forest in Colorado, effects of wildfire on treated and untreated mixed conifer sites were studied within the Wallow Fire, and fire history and stand conditions of mixed conifer landscape on the Mogollon Rim were reconstructed. In addition, published

literature on understory responses to forest thinning and prescribed fire was systematically reviewed and analyzed.

Another important area of knowledge the ERI addressed in the 2010-2014 period concerned long-term effects and restoration of wildfire sites. Dynamics of hazardous fuels and development of stand structure were studied in both ponderosa pine forests and pinion-juniper woodlands, survival and success of post-fire tree planting was investigated on sites throughout Arizona and New Mexico, literature pertaining to effectiveness of post-wildfire seeding across the West was systematically reviewed, and information on long-term restoration strategies for severely burned sites was synthesized.

In the current work plan, the ERI is continuing long-term studies on restoration treatment alternatives in mixed conifer forests and is working with the US Forest Service on a new LEARN site located on the Mogollon Rim Ranger District in Arizona. The ERI is also strengthening a partnership with the US FWS and establishing monitoring plots to study effects of fuels treatments on Mexican spotted owl habitat and population responses near Flagstaff. Work to compare wildfire effects among areas receiving alternative restoration treatments is being done on the Apache-Sitgreaves National Forests. The effectiveness of wildfire managed for resource benefit is being studied on US Forest Service lands as well as within Grand Canyon National Park. Lastly, reference conditions are being reconstructed using remote sensing data (LiDAR), and metrics for monitoring landscape-scale restoration treatments are being developed.

For a comprehensive list of publications, please see the ERI Publications section at the end of the ERI self-assessment report.

Duty 2: Synthesize and adapt scientific findings from conventional research to implement restoration-based hazardous fuels reduction treatments on a landscape scale using an adaptive ecosystem management framework.

In order for restoration to make a significant impact on the multiple threats to forest ecosystem sustainability in the Interior West, treatment activities must move beyond small-scale experiments to large landscapes. As scale increases, there is increased need and opportunity to apply the best available science and use adaptive management to answer critical questions about effects on wide-ranging species.

Since 2010, the ERI has been collaborating with numerous stakeholders in the largest landscape-scale forest restoration effort proposed to date--a project covering 2.4 million acres of ponderosa pine forests in Arizona. The 4FRI spans four national forests in Arizona (Apache-Sitgreaves, Coconino, Kaibab, Tonto) with a broad goal of restoring natural processes to frequent-fire ecosystems to benefit the wildlife, native flora, watersheds and the human communities that depend on these attributes.

The ERI has provided leadership to the 4FRI stakeholder group, serving as co-chair and helping to facilitate the 30 plus member organization group to develop foundation documents, and timely input to a million acre Forest Service Environmental Impact Statement (EIS) analyses. In addition, ERI science and policy staff have contributed leadership to small-group work, including a landscape strategy working group, the science

and monitoring working group, the economics and utilization working group, the Draft EIS review working group, and the multi-party monitoring board. Products developed under this leadership include the landscape strategy, several drafts of the multi-party monitoring plan, comments on the Draft EIS and a revised charter. In addition to stakeholder support and science delivery, the ERI staff continues to work directly with the 4FRI Interdisciplinary Team (I.D. team) to understand and address science gaps and provide constructive comments on early drafts of the EIS. This work, again, is built on the foundation of knowledge and experience the ERI has acquired over the past fifteen years.

In 2011, ERI staff attended the NFF sponsored workshop to develop a set of national indicators for CFLRP projects. At this conference, ERI staff and partners initiated a CFLR monitoring network. Partnering with NFF to host webinars, this group has hosted eight webinars between Fall 2011 and Spring 2015 to share relevant science, lessons learned and success across the CFLR project landscape on a variety of monitoring topics, including collaboratively setting desired conditions and using best available science to select measurable indicators and metrics. Additionally, following the CFLR National Indicators workshop, ERI staff worked on a small team to refine the CFLR Ecological Indicator. Measures of landscape restoration success are novel in the literature. The effort to develop indicators relied on recent science, as well as identified gaps in the body of science. ERI has remained a consistent member of this group over the last five years, most recently serving on the Ecological Indicator expert panel to assist the 23 funded projects with the development of the CFLR 5-yr report.

In 2013, the ERI partnered with CFRI, the NFF, and the Uncompahgre Partnership to host a Forest Service Region 2 and Region 3 CFLRP workshop in Montrose Colorado. This workshop was attended by ~80 Forest Service staff and multi-stakeholder partners from the five CFLR projects found in the area. Outcomes included priorities for continued partnership and learning, including how to use best available science to inform monitoring indicators and associated metrics.

Also in 2013, ERI produced two publications aimed to assist collaborative forest landscape restoration collaborative groups. *Breaking Barriers, Building Bridges: Collaborative Forest Landscape Restoration Handbook* explored the various barriers to landscape-scale, collaborative forest restoration and the innovative ways to bridge those barriers. “Closing the Feedback Loop: Evaluation and Adaptation in Collaborative Resource Management” was co-published with several partners, including Sustainable Northwest, NFF, the Watershed Center, Forest Guild, and U.S. Forest Service. This sourcebook provides a selection of evaluation tools and change mechanisms for collaborative groups to consider and use and stimulates discussion of evaluation and adaptation in collaborative resource management.

Duty 3: Translate for, and transfer to, the affected entities any scientific and interdisciplinary knowledge about restoration-based hazardous fuels reduction treatments.

Since 2010, the ERI has translated scientific information to affected entities through: working papers, white papers, fact sheets, web site/e-Library, workshops, field trips, and presentations. The following is a summary of work in those outreaches areas.

Working Papers

The ERI Working Papers series presents and translates scientific findings from the research and observations of ERI researchers as well as researchers from other organizations and universities. ERI working papers are intended to deliver applicable science to land managers and practitioners in a concise, clear, non-technical format. These papers provide information critical for management decisions surrounding ecological restoration topics. Topics are chosen based on what land managers need to know, and they fill critical knowledge gaps in restoration science aimed to assist land managers. The ERI Working Paper series has published 13 papers during the past five years. Some of the topics include: fuel treatment longevity, protecting old trees from prescribed burns, evaluating reference conditions for mixed-conifer forests, evaluation of fire regime reconstruction methods, climate change and fire in the Southwest, and carbon cycling in southwestern forests. Working papers are distributed in person, during field trips, via mail, and electronically to almost 700 recipients throughout the Southwest and beyond. They are also posted on the ERI web site, in the ERI e-Library, and featured in bi-annual newsletters.

White Papers

The ERI White Paper series is designed to reach policymakers, social scientists, and appropriate land managers with information about socio-economic issues related to forest restoration and hazardous fuels reduction. During the past five years, the ERI has published nine white papers on a variety of topics. These include: a full cost accounting of the 2010 Schultz Fire, ecological restoration as economic stimulus, the history of the Four Forest Restoration Initiative, administrative and legal review opportunities for collaborative groups, and a case study on the Flagstaff Watershed Protection Project. White papers are sent by mail and/or electronically to almost 700 affected entities throughout the Southwest and beyond. They are also posted on the ERI web site and in the ERI e-Library.

Impact: ERI's white paper, "*Full Cost Accounting of the 2010 Schultz Fire,*" was published in partnership with the W.A. Franke College of Business at NAU and Coconino County. The study is a sobering analysis of the full cost of fire and post-fire flooding, and how the cost impacts the public and private sectors. It has been cited numerous times in media reports and other economic studies examining the full cost of fire. The results were also presented at a Congressional Hearing in 2013.

Fact Sheets

The ERI has produced 63 fact sheets during the last five years. These brief, informative documents have covered topics such as: stand structure and breeding birds, restoration in a warm/dry mixed conifer forest, effects of restoration on wildlife density, carbon costs of mitigating high-severity wildfire, systematic reviews and the quality of evidence, canopy cover and forest conditions, sediment yield after severe fire, and effects of tree cutting and fire on understory vegetation in mixed conifer forests. Fact sheets are often tiered off larger publications, such as peer reviewed journal articles, white papers or working papers, and they provide a non-technical snapshot of the outcomes and implications of scientific research on ecological restoration.

Rapid Assessments, General, and Technical Reports

ERI produces two or more Rapid Assessment reports a year. These reports are conducted by ERI's Agency Outreach team and capture site-specific field data for public land managers. Other technical reports include special reports to forest districts, like "Identifying priority treatment areas across the Apache-Sitgreaves National Forests" and "The Wallow Fire and its effects on mixed-conifer forests: A comparison with reference conditions", and monitoring reports, such as the White Mountain Stewardship Program monitoring reports.

In 2014 and 2015, ERI partnered with the SWFSC and Forest Guild to publish overviews of the 2013 and 2014 fire season. These overviews have been well received by land managers looking for fire summary data based on the largest fires each year in Arizona and New Mexico.

Systematic Review

In response to persistent questions from the Office of management and Budget (OMB) and the Government Accountability Office (GAO), the ERI was asked by the U.S. Department of Interior's Office of Wildland Fire to conduct a systematic review of the economic and ecologic consequence of alternative hazardous fuel reduction treatment. "The Efficacy of Hazardous Fuel Treatments" demonstrated that overall hazardous fuel reduction and restoration treatments in frequent fire forests of the West are both economically and ecologically effective. The ERI presented the results of the study to Congress and the OMB in 2013. One agency official indicated that the study was helpful in their negotiations to restore full funding to the hazardous fuel treatment budget with OMB in FY 2014.

Web site/e-Library

The ERI web site at <http://www.nau.edu/eri> has gone through a content management system conversion in order to meet the evolving needs of ERI audiences, such as land managers, researchers, students and media. It features an extensive e-Library that holds more than 700 ERI publications and other outreach materials. A recent addition to the website is a Press Kit that features news items related to ecological restoration that is relevant to the current fire season. Additionally, the site's research information and LEARN page will be updated in the near future with more interactive visual features and elements.

In 2013 ERI sought to evaluate the overall reach and effectiveness of our e-newsletter, particularly as it relates to our recent publications. The ERI newsletter is distributed electronically twice a year. It is one of several approaches to deliver the most recent ERI publications — including fact sheets, working papers, white papers, journal articles, and reports — to interested parties, researchers, and practitioners. We tested whether or not having publication descriptions in addition to the citations increased a publication's click-through rate, which is a measure of how many people on an email list click on a particular link within an email. The newsletter featuring publication descriptions received a significantly larger amount of clicks, resulting in higher readership of publications.

Duty 4: Assist affected entities with the design of adaptive management approaches (including monitoring) for the implementation of restoration-based hazardous fuels reduction treatments.

The ERI actively supports monitoring to inform adaptive management throughout the

Intermountain West via our support of the CFLRP pilots (see #2 above).

In Arizona, the ERI assisted the White Mountain Stewardship Multi-Party Monitoring Board to measure outcomes from the nationally recognized White Mountain Stewardship Project (WMSP). The ten-year project was initiated in 2004 and ended in 2014. The contractor treated almost 70,000 acres in order to improve forest health, mitigate unwanted wildfire risk, treat high-risk burnable fuels and implement a diverse suite of ecosystem improvements through stewardship treatments. The ERI is coordinating the completion of a ten-year final report for the WMSP (Fall 2015) documenting the outcomes of the effort. This analysis and report will explore all aspects of the development, implementation and ecological, social and economic outcomes of the project. The majority of the acreage treated under the White Mountain Stewardship Project is located within the Wildland Urban Interface (WUI) of the White Mountain areas of eastern Arizona. These treatments were credited with preventing the Wallow Fire in 2011 from burning into towns such as Alpine and reducing impacts in other eastern Arizona communities.

The ERI also led the collaborative effort to develop the monitoring and adaptive management plan for the 4FRI EIS. The plan was adopted with minimal change as a part of the final document and Record of Decision.

Duty 5: Provide peer-reviewed annual reports.

The ERI prepares annual reports that are available at the following link:
<http://nau.edu/ERI/Resources/Annual-Reports-Work-Plans/>

The ERI also makes an annual visit to Congress and the Washington Office of the Forest Service to report summaries of our deliverables.

Achievement of the Purposes of the Act

The ERI has delivered five years of high quality service to achieve the Purposes of the Act.

Purpose 1: Implementing adaptive ecosystem management practices at the landscape level.

In the 2010 SWERI Assessment, the ERI highlighted groundbreaking work at the Mt. Trumbull Ecosystem Restoration project as an example of leadership toward implementing adaptive management practices at the landscape level. In 2009, the Trumbull project was the largest ecological restoration project in the Southwest at 3,700 acres.

In 2015, the ERI plays an integral role in the success of the 4FRI, the largest restoration pilot authorized under the CFLRP. The 4FRI Stakeholder Group and the four national forests that make up the initiative are collaborating to restore 2.4 million acres of ponderosa pine forest across northern Arizona. For its part, the ERI provides leadership (co-chair and work group leads), administrative support, technical support, and best available science to the Stakeholder Group and 4FRI Interdisciplinary Team. The ERI led the successful development of a Monitoring and Adaptive Management Plan for the first Environmental Impact Statement (EIS) analysis. This analysis looked at more than 900,000 acres and identified almost 600,000 acres for active ecological restoration. The Monitoring and

Adaptive Management Plan was included in the Final EIS and Record of Decision. In addition, the ERI plays a major role in the ongoing Multi-Party Monitoring Board that has already begun pre-treatment monitoring for the first EIS. The ERI will continue to provide leadership and science support during the second EIS analysis that is presently in data development.

The ERI is also involved in providing monitoring and adaptive management technical support across the 23 projects of the CFLRP through webinars, workshops, and one-on-one consultations. The ERI provided leadership to a CFLR stakeholder and Forest Service team to help develop the biophysical monitoring metrics for a Five-Year CFLRP progress report to Congress.

As noted earlier in this report, the ERI manages LEARN, which monitors outcomes of different restoration treatments across the Southwest. The monitoring data from these sites provides defensible scientific results and therefore “best available science” to inform restoration treatments.

Purpose 2: Reducing unnecessary planning costs.

The ERI provides a variety of services that improve the efficiency and effectiveness of planning thereby reducing planning costs. These services include: (1) The preparation of Rapid Assessments (RAPs) that are used by ID teams and other Forest Service professionals to develop science-based documents and treatment prescriptions; (2) One-on-one science support in response to information requests from agency personnel and stakeholders; (3) Publication of evidence-based reviews, working papers, white papers and fact sheets that synthesize the best available science for planners, specialists, and stakeholders. Recently, one of the members of the 4FRI ID Team said the following, “ERI Working Paper #32: Outstanding ... not to mention very helpful in reviewing Objections to the Final 4FRI EIS”; (4) Assistance to stakeholders throughout the CFLR network to help them advance restoration projects that will make it through the NEPA process (without litigation) and into implementation; and, (5) Workshops designed to assist land managers apply best available science.

Purpose 3: Avoiding duplicative and conflicting efforts.

Congress created the institutes to fill the gap that exists between research science and application on-the-ground. This gap exists because there are cultural differences between research scientists who talk in terms of metrics, and rigorous statistical design in order to improve certainty of results and land managers who think in English units of measure, are multi-tasking responsibilities, and have to make a decision whether outcomes are 100 percent known or not. To bridge this gap, the ERI offers a vertically integrated program of work. ERI begin with land managers who identify information voids or what they need to know to do their job. Once the question is clear we determine if the answer is available in the existing literature or if new scientific research is needed. If there is sufficient existing information to answer the question we will produce an evidence-based review, literature review, or other knowledge synthesis depending upon the resources available and the complexity of the question.

In other words, the ERI first assesses whether or not the answer is known before pursuing the expensive task of research. In addition, we participate in numerous networks and communicate with other research entities, such as the SWFSC or RMRS in order to avoid duplication. These relationships are valuable because they not only help avoid duplication but they stimulate partnerships that leverage funds and create synergy.

Finally, collaboration occurs annually between the institutes to avoid unnecessary duplication and to coordinate projects where resources can be leveraged. Currently, the three institutes are collaborating on the “Broader-scale Monitoring” project that will assist the Forest Service to identify monitoring variables that are larger than single national forests. This will help inform the broader-scale monitoring required in the 2012 Forest Planning Rule.

Purpose 4: Increasing public acceptance of active adaptive ecosystem management practices.

The ERI annual work plan includes deliverables focused on increasing public understanding and acceptance of active forest restoration and adaptive management. Outreach activities designed for the public include presentations, publications, the website, and active and passive engagement with print, television, and radio media. Dr. Wally Covington’s highly regarded research and advocacy for action makes him a favorite resource for reporters. The ERI also uses social media including Twitter, LinkedIn, and Facebook to connect, inform, and engage with a broad audience.

In 2013, the ERI helped coordinate a public forum at the Museum of Northern Arizona about the 4FRI. The public response was overwhelming and led to the conclusion that future 4FRI public meetings should be jointly sponsored by the Stakeholder Group (of which ERI is an integral member) and the Forest Service. This approach has helped reach significantly more members of the public than other public meetings sponsored exclusively by the Forest Service.

Purpose 5: Achieving general satisfaction on the part of affected entities.

If we are doing our job well, the interviews that inform this assessment will demonstrate satisfaction, if not enthusiasm and respect for the work done at the ERI. “Affected Entities” is defined in PL108-317 as land managers, stakeholders, concerned citizens, and states of the Interior West, including political subdivisions of the states. Below are examples of our impact and testimonials from the affected entities.

Land manager. A silviculturalist on the Apache-Sitgreaves National Forest stated that she found the paper “A Full Cost Accounting of the 2010 Schultz Fire” very helpful and included it in her specialist report for the A-S forest plan revision. She stated that in general she appreciates our research.

Land manager. “Thank you! The fact sheets with the link to the full article are so helpful to us ‘manager-types’ that need to quickly get to the punch-line. I appreciate you forwarding

this along.”

Stakeholder. Following the successful resolution with objectors of the Flagstaff Watershed Protection Project (FWPP) Final EIS and Draft Record of Decision, a city official stated that the ERI white paper “Administrative and Legal Review Opportunities for Collaborative Groups” (prepared in partnership with the Western Environmental Law Center) had been widely shared and valued by decision-makers within the City of Flagstaff to prepare them for potential legal action.

Concerned Citizens. It is a tribute to the quality of the science produced by the ERI that we are regularly asked to testify in Congress. Most important, we are asked to testify by both Republicans and Democrats. In 2013 and 2014, we testified in the House and the Senate on our report “The Efficacy of Hazardous Fuels Treatments: A Rapid Assessment of the Economic and Ecologic Consequences of Alternative Hazardous Fuel Treatments.”

ERI Publications

- Abella, S.R., E.C. Engel, J.D. Springer, and W.W. Covington. 2012. Relationships of exotic plant communities with native vegetation, environmental factors, disturbance, and landscape ecosystems of *pinus ponderosa* forests, USA. *Forest Ecology and Management*, 271:65-74.
- Abella, S.R., J.C. Hurja, D.J. Merkler, C.W. Denton, and D. Brewer. 2012. Overstory-understory relationships along forest type and environmental gradients in the Spring Mountains of southern Nevada, USA. *Folia Geobot*, 47:119-134.
- Abella, S.R., and J.D. Springer. 2012. Soil seed banks in a mature coniferous forest landscape: dominance of native perennials and low spatial variability. *Seed Science Research*, 22:207-217.
- Abella, S.R., C.W. Denton, R.W. Steinke, and D.G. Brewer. 2013. Soil development in vegetation patches of *Pinus ponderosa* forests: interface with restoration thinning and carbon storage. *Forest Ecology and Management*, 310:632-642.
- Abella, S.R., and J.D. Springer. 2014. Effects of tree cutting and fire on understory vegetation of mixed conifer forests. *Forest Ecology and Management*, 335:281-299.
- Barrett, K.J., E.L. Kalies, and C.L. Chambers. 2012. Predator occupancy rates in a thinned ponderosa pine forest, Arizona: A Pilot Study. *Wildlife Society Bulletin*, 36(2):232-239.
- Bickford, I.N, P.Z. Fulé, and T.E. Kolb. 2011. Growth sensitivity to drought of co-occurring *Pinus* spp. along an elevation gradient in northern Mexico. *Western North American Naturalist*, 71(3):338-348.
- Diggins, C., P.Z. Fulé, J.P. Kaye, and W.W. Covington. 2010. Future climate affects management strategies for maintaining forest restoration treatments, *International Journal of Wildland Fire*, 19(7) 903-913.
- Egan, D., M. Stoddard, and A. Formanack. 2015. Ecological and social implications of employing diameter caps at a collaborative forest restoration project near Flagstaff, Arizona, USA. *Forest Policy and Economics*, 52:39-45.
- Fulé, P.Z., J.E. Crouse, J.P. Roccaforte, and E.L. Kalies. 2012. Do thinning and/or burning treatments in western USA ponderosa or Jeffrey pine-dominated forests help restore natural fire behavior? *Forest Ecology and Management*, 269:68-81.
- Ha, W., T.E. Kolb, A.E. Springer, S. Dore, F.C. O’Donnell, R.M. Morales, S. Masek Lopez, G.W. Koch. 2014. Evapotranspiration comparisons between eddy covariance measurements and meteorological and remote-sensing-based models in disturbed ponderosa pine forests. *Ecohydrology*, DOI: 10.1002/eco.1586.
- Honig, K.A. 2012. Simulating the effects of climate change and ecological restoration on wildfire behavior in southwestern ponderosa pine forests. *International Journal of Wildland Fire*, 21(6):731
- Horncastle, V.J., R.F. Yarborough, B.G. Dickson, and S.S. Rosenstock. 2013. Summer habitat use by adult female mule deer in a restoration-treated ponderosa pine forest. *Wildlife Society Bulletin*, 37(4):707-713.
- Huffman, D.W., J.D. Springer, and W.W. Chancellor. 2015. Long-term herbivore exclusion for recovery of buckbrush (*Ceanothus fendleri*) populations during restoration of ponderosa pine forests in northern Arizona. *Ecological Restoration*, 33:274-281.
- Huffman, D.W., J.E. Crouse, W.W. Chancellor, and P.Z. Fulé. 2012. Influence of time since fire on pinyon-juniper woodland structure. *Forest Ecology and Management*, 274:29-37.

SWERI Five-Year Evaluation Report

- Huffman, D.W., M.T. Stoddard, J.D. Springer, J.E. Crouse, and W.W. Chancellor. 2013. Understory plant community responses to hazardous fuels reduction treatments in pinyon-juniper woodlands of Arizona, USA. *Forest Ecology and Management*, 289:478-488.
- Huffman, D.W., T.J. Ziegler, and P.Z. Fulé. 2015. Fire history of a mixed conifer forest on the Mogollon Rim, northern Arizona, USA. *International Journal of Wildland Fire*, 24:680-689.
- Hurteau, M.D., M.T. Stoddard, and P.Z. Fulé. 2011. The carbon costs of mitigating high-severity wildfire in southwestern ponderosa pine. *Global Change Biology*, 17:1516-1521.
- Ireland, K.B., M.M. Moore, P.Z. Fulé, T.J. Ziegler, R.E. Keane. 2014. Slow lifelong growth predisposes *Populus tremuloides* trees to mortality. *Oecologia*, 175:847-859.
- Kalies, E.L. and S.S. Rosenstock. 2013. Stand structure and breeding birds: Implications for restoring ponderosa pine forests. *Journal of Wildlife Management*, 77(6):1157-1165.
- Kalies, E.L., and W.W. Covington. 2012. Small mammal community maintains stability through compensatory dynamics after restoration of a ponderosa pine forest. *Ecosphere*, 3(9): Article 78.
- Kalies, E.L., B.G. Dickson, C.L. Chambers, and W.W. Covington. 2012. Community occupancy responses of small mammals to restoration treatments in ponderosa pine forests, northern Arizona, USA. *Ecological Applications*, 22(1):204-217.
- Korb, J.E., P.Z. Fulé, and M.L. Stoddard. 2012. Forest restoration in a surface fire-dependent ecosystem: an example from a mixed conifer forest, Southwestern Colorado, USA. *Forest Ecology and Management*, 269:10-18.
- Korb, J.E., P.Z. Fulé, and R. Wu. 2013. Variability of warm/dry mixed conifer forests in Southwestern Colorado, USA: Implications for ecological restoration. *Forest Ecology and Management*, 304:182-191.
- Kurth, V.J., S.C. Hart, C.S. Ross, J.P. Kaye, and P.Z. Fulé. 2014. Stand-replacing wildfires increase nitrification for decades in southwestern ponderosa pine forests. *Oecologia*, 175(1): 395-407.
- Kurth, V.J., N. Fransioli, P.Z. Fule, S.C. Hart, and C.A. Gehring. 2013. Stand-replacing wildfires alter the community structure of wood-inhabiting fungi in southwestern ponderosa pine forests of the USA. *Fungal Ecology*, 6:192-204.
- Kurth, V.J., N. Fransioli, P.Z. Fulé, S.C. Hart, and C.A. Gehring. 2013. Stand-replacing wildfires alter the community structure of wood-decay fungi in southwestern ponderosa pine forests of the USA. *Fungal Ecology*, 6:192-204.
- Laughlin, D.C., J.P. Roccaforte and P.Z. Fulé. 2011. Effects of a second-entry prescribed fire in a mixed conifer forest. *Western North American Naturalist*, 71(4):557-562.
- Laughlin, D.C., M.M. Moore, and P.Z. Fulé. 2011. A century of increasing pine density and associated shifts in understory plant strategies. *Ecology*, 92(3):556-61.
- Laughlin, D.C., P.Z. Fule, D.W. Huffman, J. Crouse, and E. Laliberte. 2011. Climatic constraints on trait-based forest assembly. *Journal of Ecology*, 99(6):1489-1499.
- Loberger, C.D., T.C. Theimer, S.S. Rosenstock, and C.S. Wightman. 2011. Use of a restoration-treated ponderosa pine forest by tassel-eared squirrels. *Journal of Mammalogy*, 92(5)1021-1027.
- McGlone, C.M., C.H. Sieg, and T.E. Kolb. 2011. Invasion resistance and persistence: established plants win, even with disturbance and high propagule pressure. *Biological Invasions*, 13:291-304.
- McGlone, C.M., M.T. Stoddard, J.D. Springer, M.L Daniels, P.Z. Fulé and W.W. Covington. 2012. Nonnative species influence vegetative response to ecological restoration: two forests with divergent restoration outcomes. *Forest Ecology and Management*, 285:195-203.
- Mueller, J.M. 2014. Estimating willingness to pay for watershed restoration in Flagstaff, Arizona using dichotomous-choice contingent valuation. *Forestry*, 87(2): 327-333.
- Ouzts, J., T. Kolb, D.W. Huffman, and A.J. Sánchez Meador. 2015. Post-fire ponderosa pine regeneration with and without planting in Arizona and New Mexico. *Forest Ecology and Management*, 354:281-290.
- Peppin, D.L., A.L. Mottek-Lucas, and P.Z. Fulé. 2014. Post-fire seeding in western United States forests: perspectives of resource managers. *Fire Ecology*, 10:31-42.
- Ramstead, K.M., J.A. Allen, and A.E. Springer. 2012. Have wet meadow restoration projects in the Southwestern U.S. been effective in restoring geomorphology, hydrology, soils, and plant species composition? *Environmental Evidence*, 1:11. 16 p.
- Roccaforte, J.P., D.W. Huffman, P.Z. Fulé, W.W. Covington, W.W. Chancellor, M.T. Stoddard, and J.E. Crouse. 2015. Forest Structure and fuels dynamics following ponderosa pine restoration treatments, White Mountains, Arizona, USA. *Forest Ecology and Management*, 337:174-185.
- Roccaforte, J.P., P.Z. Fulé, W.W. Chancellor, and D.C. Laughlin. 2012. Woody debris and tree regeneration dynamics following severe wildfires in Arizona ponderosa pine forests. *Canadian Journal of Forest Research*, 42:593-604.

SWERI Five-Year Evaluation Report

- Sánchez Meador, A.J., K.M. Waring, and E.L. Kalies. 2015. Implications of diameter caps on multiple forest resource responses in the context of the Four Forests Restoration Initiative: Results from the Forest Vegetation Simulator. *Journal of Forestry*, 113(2):219-230.
- Shive, K.L., C.H. Sieg, and P.Z. Fulé. 2013. Pre-wildfire management treatments interact with fire severity to have lasting effects on post-wildfire vegetation response. *Forest Ecology and Management*, 297:75–83.
- Springer, J.D., M.T. Stoddard, D.C. Laughlin, D.L. Crisp, and B.G. Phillips. 2012. Ecology of Rusby's Milkvetch (*Astragalus rusbyi*), a rare endemic of northern Arizona ponderosa pine forests. *Calochortiana*, 1:157-163.
- Springer, J.D., P.Z. Fulé, and D.W. Huffman. 2012. Long-term responses of *Penstemon clutei* (Sunset Crater Beardtongue) to root trenching and prescribed fire: clues for population persistence. *Calochortiana*, 1:164-171.
- Stella, K.A., C.H. Sieg, and P.Z. Fulé. 2010. Minimal effectiveness of native and non-native seeding following three high-severity wildfires. *International Journal of Wildland Fire*, 19:746–758.
- Stevens-Rumann, C., K.L. Shive, P.Z. Fulé and C.H. Seig. 2013. Pre-wildfire fuel reduction treatments result in more resilient forest structure a decade after wildfire. *International Journal of Wildland Fire*, 22(8) 1108-1117.
- Stoddard, M.T., A.J. Sánchez Meador, P.Z. Fulé, and J.E. Korb. 2015. Five year post-restoration conditions and simulated climate change trajectories in a warm/dry mixed-conifer forest, southwestern Colorado, USA. *Forest Ecology and Management*, <http://dx.doi.org/10.1016/j.foreco.2015.07.007>.
- Stoddard, M.T., C.M. McGlone, P.Z. Fulé, D.C. Laughlin, and M.L. Daniels. 2011. Native plants dominate understory vegetation following ponderosa pine forest restoration treatments. *Western North American Naturalist*, 71(2):206-214.
- Strahan, R.T., M.T. Stoddard, J.D. Springer, and D.W. Huffman. 2015. Increasing weight of evidence that thinning and burning treatments help restore understory plant communities in ponderosa pine forests. *Forest Ecology and Management*, 353:208-220.
- Tarancón, A.A., P.Z. Fulé, K.L. Shive, C.H. Sieg, A.J. Sánchez Meador, and B.A. Strom. 2014. Simulating post-wildfire forest trajectories under alternative climate and management scenarios. *Ecological Applications*, 24(7):1626–1637.
- Taylor, M.H., A.J. Sánchez Meador, Y.S. Kim, K. Rollins, and H. Will. 2015. The economics of ecological restoration and hazardous fuel reduction treatments in the ponderosa pine forest ecosystem. *Forest Science*, <http://dx.doi.org/10.5849/forsci.14-030>.
- Tuten, M.C., Sánchez Meador, A.J. and P.Z. Fulé. 2015. Ecological restoration and fine-scale structural regulation in Southwestern ponderosa pine forests. *Forest Ecology and Management*, 348:57-67.
- Waltz, A.E.M., M.T. Stoddard, E.L. Kalies, J.D. Springer, D.W. Huffman, and A.J. Sánchez Meador. 2014. Effectiveness of fuel reduction treatments: assessing metrics of forest resiliency and wildfire severity after the Wallow Fire, AZ. *Forest Ecology and Management*, 334:43–52.
- Wu, T. and Y.-S. Kim. 2013. Pricing ecosystem resilience in frequent-fire ponderosa pine forests. *Forest Policy and Economics*, 27:8-12.
- Wu, T., Y.-S. Kim, and M.D. Hurteau. 2011. Investing in natural capital: using economic incentives to overcome barriers to forest restoration. *Restoration Ecology*, 19:441-445.
- Wyatt, C.J.W., F.C. O'Donnell, and A.E. Springer. 2014. Semi-arid aquifer responses to forest restoration treatments and climate change. *Groundwater*, 53(2):207-16.
- Zegler, T.J., M.M. Moore, M.L. Fairweather, K.B. Ireland, and P.Z. Fule. 2012. *Populus tremuloides* mortality near the southwestern edge of its range. *Forest Ecology and Management*, 282:196-207.

Master's and Doctoral Theses

- Azpeleta Tarancón, A. 2012. Simulando trayectorias de sucesión post-incendio bajo alternativas de clima y gestión: caso de estudio Bosque Nacional de Apache-Sitgreaves, Arizona. Máster en Gestión y Restauración del Medio Natural, Universidad de Alicante, Spain.
- Cortés Moñtano, C. 2011. The treasure of the Sierra Madre: ecology of old-growth forests in Chihuahua, México. PhD dissertation, Northern Arizona University. Ann Arbor: ProQuest/UMI, 2011. (Publication No. 3490516.)
- Diggins, C. 2010. Modeling forest change, bird communities, and management alternatives on a restored ponderosa pine ecosystem. MS thesis, Northern Arizona University.
- Dowling, H.E. 2015. Mapped permanent quadrats: A window through time into herbaceous plant demography. MS thesis, Northern Arizona University. Ann Arbor: ProQuest/UMI, 2015. (Publication No. 1594001.)
- Ireland, K.B. 2013. Response of fire regimes and ponderosa pine and aspen forest communities to climate, Arizona. PhD dissertation, Northern Arizona University. Ann Arbor: ProQuest/UMI, 2013. (Publication No. 3562137.)
- Kurth, V. 2011. Long-term effects of stand-replacing wildfires on nutrient cycling and decomposition in southwestern ponderosa pine forests. PhD dissertation, Northern Arizona University. Ann Arbor: ProQuest/UMI, 2011. (Publication No. 3467056.)

SWERI Five-Year Evaluation Report

- Normandin, D. 2014. Assessing effects of large wildland fires in Mexican spotted owl protected activity centers. MS thesis, Northern Arizona University.
- Ouzts, J. 2014. Post-fire ponderosa pine plantings in the southwestern USA. MS thesis, Northern Arizona University. Ann Arbor: ProQuest/UMI, 2014. (Publication No. 1556779.)
- Rodman, K.C. 2015. Reference conditions and spatial dynamics in a southwestern dry mixed-conifer forest. MS thesis, Northern Arizona University. Ann Arbor: ProQuest/UMI, 2015. (Publication No. 1594148.)
- Sheridan, R.A.S. 2014. Using a socio-ecological systems framework to develop a community fire plan in rural Mexico. MS thesis, Northern Arizona University. Ann Arbor: ProQuest/UMI, 2014. (Publication No. 1556593.)
- Shive, K. 2012. Pre-fire treatments have persistent effects on post-fire plant communities. MS thesis, Northern Arizona University. Ann Arbor: ProQuest/UMI, 2012. (Publication No. 1511296.)
- Strahan, R.T. 2013. A functional trait perspective on demography, community assembly, and response to long-term grazing. PhD dissertation, Northern Arizona University. Ann Arbor: ProQuest/UMI, 2013. (Publication No. 3606840.)
- Wyatt, C.J.W. 2013. Estimating aquifer response following forest restoration and climate change along the Mogollon Rim, northern Arizona. MS thesis, Northern Arizona University. Ann Arbor: ProQuest/UMI, 2013. (Publication No. 1537821.)
- Yocom, L. 2011. Influence of climate and local factors on fire in high-elevation forests of Mexico. PhD dissertation, Northern Arizona University. Ann Arbor: ProQuest/UMI, 2011. (Publication No. 3467055.)

Fact Sheets

- Abella, S.R., and J.D. Springer. 2014. Effects of Tree Cutting and Fire on Understory Vegetation of Mixed Conifer Forests. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 3 p.
- Allen, J.A., and K. Ramstead. 2012. Evidence-Based Conservation Systematic Review: Effectiveness of Wet Meadow Restoration Projects. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Bryant, T. 2015. Implications of Diameter Caps on Multiple Forest Resource Responses in the Context of the Four Forest Restoration Initiative. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Crouse, J.E., E.L. Kalies, J.P. Roccaforte, and P.Z. Fulé. 2012. Meta-Analysis of Treatment Effects on Fire Behavior. ERI Fact Sheets. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Egan, D. 2011. Systematic Reviews and the Quality of Evidence. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 4p.
- Esch, B.E. 2015. Administrative Support in Collaborative Forest Restoration. ERI Fact Sheets. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Fulé, P.Z. 2014. Unsupported Inferences of High severity Fire in Historical Dry Forests of the Western United States: Response to Williams and Baker. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 3 p.
- Greer, W.J. 2012. Managing Sources of Conflict in Collaborative Settings. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University, 2 p.
- Ha, W., S. Masek Lopez, and A. Springer. 2014. Field Considerations for Measuring Evapotranspiration with the Eddy Covariance Method. Ecological Restoration Institute. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 4 p.
- Huffman, D.W. 2013. Influence of Time Since Fire on Pinyon-Juniper Woodland Structure. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2p.
- Huffman, D.W. 2013. Understory Plant Community Responses to Hazardous Fuels Reduction Treatments in Pinyon-Juniper Woodlands of Arizona, USA. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2p.
- Huffman, D.W. 2015. Fire History of a Mixed Conifer Forest on the Mogollon Rim, Northern Arizona, USA. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Huffman, D.W., Sanchez-Meador, A.J., and Greco, B. 2012. Canopy Cover and How it Relates to Other Forest Attributes as an Indicator of Forest Conditions. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 4 p.
- Hunter, M.E. 2011. Methods for Estimating Surface Live Fuel Loading. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 3 p.
- Hurteau, M.D., M.T. Stoddard, and P.Z. Fulé. 2010. Carbon Cost of Mitigating High-Severity Wildfires. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Kalies, E.L. 2011. Systematic Reviews and the Quality of Evidence. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 4 p.

SWERI Five-Year Evaluation Report

- Kalies, E., and W.W. Covington. 2011. Effects of Restoration on Wildlife Density and Populations. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Kalies, E.L. 2012. Restoration Effects on Small Mammals and their Predators. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Kalies, E.L. 2014. Stand Structure and Breeding Birds: Implications for Restoring Ponderosa Pine Forests. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Lucas, A.M., Y.S. Kim, E.J. Davis, C. Moseley, M. Nielsen-Pincus, and T. Bilek. 2014. The Impacts of the Woody Biomass Utilization Program in Eastern Arizona. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Masek Lopez, S. 2013. Forest Change and Water Balance: Investigating Forest Restoration Treatment Effects on Soil Water Storage, Evapotranspiration, Groundwater Recharge and Surface Water Discharge. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Nielsen, E., and F. Solop. 2013. Forest Health and Water Supply Protection Project Ballot Measure: Exit Poll Results. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Ouzts, J.R., and T.E. Kolb. 2014. Genetic Considerations for Restoring Forests of the Southwest after Severe Disturbance. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 4 p.
- Peppin, D.L. 2011. Effectiveness of Post-Wildfire Seeding in Western US Forests. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Roccaforte, J.P., P.Z. Fulé, W.W. Chancellor, and D.C. Laughlin. 2011. Post-Wildfire Regeneration Dynamics. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Roccaforte, J.P. 2012. Assessing Restoration Objectives Following a Second-entry Prescribed Fire in an Unharvested Mixed Conifer Forest. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2p.
- Roccaforte, J.P. 2014. Planting to Restore Ponderosa Pine Sites Burned by High-Severity Fire. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 4 p.
- Rodman, K., and A.J. Sánchez Meador. 2014. Characterizing Spatial Reference Conditions in Southwestern Warm/Dry Mixed-Conifer Forests. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 3 p.
- Sensibaugh, M., and D.W. Huffman. 2014. Managing Naturally Ignited Wildland Fire to Meet Fuel Reduction and Restoration Goals in Frequent-Fire Forests. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 3 p.
- Springer, J.D. 2012. Conserving Rare Plants in National Parks and Protected Areas. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Springer, J.D. 2012. Exotic Species Management at Landscape Scales. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University, 2 p.
- Springer, J.D. 2014. Ecology of Rusby's Milkvetch (*Astragalus rusbyi*), a Rare Endemic of Northern Arizona Ponderosa Pine Forests. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Springer, J.D. 2014. Long-Term Responses of *Penstemon Clutei* (Sunset Crater beardtongue) to Root Trenching and Prescribed Fire: Clues for Population Resistance. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Springer, J.D. 2014. Post-Wildfire Restoration of Structure, Composition, and Function in Southwestern Ponderosa Pine and Warm-Dry Mixed-Conifer Forests. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 3 p.
- Springer, J.D. 2014. Soil Seed Banks in a Mature Coniferous Forest Landscape: Dominance of Native Perennials and Low Spatial Variability. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Stoddard, M. 2012. Herbaceous Vegetation Responses Six Years after Restoration Treatments. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Stoddard, M.T. 2011. Historical Forest Structural Characteristics Review. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 7 p.
- Stoddard, M.T. 2013. An Example of Forest Restoration in a Warm/Dry Mixed-Conifer Forest. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Stoddard, M.T. 2015. Ecological and Social Implications of Employing Diameter Caps at a Collaborative Forest Restoration Project near Flagstaff, Arizona. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Swetnam, T. and D. Falk. 2015. Carbon Cycling in Southwestern Forests: Reservoirs, Fluxes, and the Effects of Fire and Management. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Vosick, D. (Ed.). 2012. Estimating Flagstaff Residents' Willingness to Pay for Forest Restoration in the Lake Mary and Upper Rio de Flag Watersheds: A Pilot Study. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.

SWERI Five-Year Evaluation Report

- Vosick, D. 2011. Lessons from the Wallow Fire. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 1 p.
- Vosick, D. 2013. Efficacy of Hazardous Fuel Treatments: A Rapid Assessment of the Economic and Ecologic Consequences of Alternative Hazardous Fuel Treatments. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Waltz, A.E.M. 2014. Effectiveness of Fuel Reduction Treatments: Assessing Metrics of Forest Resiliency and Wildfire Severity after the Wallow Fire, AZ. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Waltz, A.E.M. 2012. Impacts of Fire Hazard Assessment and Fuel Reduction Priorities on Mega-fire Outcomes: A Hypothetical Test Using the Wallow Fire in Arizona. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 3 p.
- Wyatt, C.J.W. 2013. How Restoration Thinning Treatments on Conifer-Dominated Watersheds Affect the Water Budget. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Wyatt, C.J.W. 2013. Interpretive Model of Regional Semi-Arid Aquifer Responses to Large-scale Forest Restoration Treatments and Climate Change. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.
- Yarborough, R.F. 2014. Summer Habitat Use by Adult Female Mule Deer in a Restoration-Treated Ponderosa Pine Forest. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University: Flagstaff, AZ. 2 p.
- Yarborough, R.F., and Loberger, C. 2013. Tassel-Eared Squirrel Habitat Use and Abundance in Managed Forests within the Wildland Urban Interface. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2 p.

Working Papers

- Egan, D. 2011. Protecting Old Trees from Prescribed Burning. ERI Working Paper No. 24. Ecological Restoration Institute, Northern Arizona University. 3 p.
- Egan, D. 2015. The 2012 Mexican Spotted Owl Recovery Plan Guidelines for Forest Restoration in the American Southwest. ERI Working Paper No. 33. Ecological Restoration Institute, Northern Arizona University. 11 p.
- Gaylord, M.L. 2014. Impact of Forest Restoration Treatments on Southwestern Ponderosa Pine Tree Resistance to Bark Beetles. ERI Working Paper 30. Ecological Restoration Institute, Northern Arizona University. 9 p.
- Gaylord, M.L. 2014. Climate Change Impacts on Bark Beetle Outbreaks and the Impact of Outbreaks on Subsequent Fires. ERI Working Paper No. 31. Ecological Restoration Institute and Southwest Fire Science Consortium, Northern Arizona University. 7 p.
- Kalies, E.L., and C.L. Chambers. 2010. Guidelines for Managing Small Mammals in Restored Ponderosa Pine Forests of Northern Arizona. ERI Working Paper No. 23. Ecological Restoration Institute and Southwest Fire Science Consortium, Northern Arizona University. 7 p.
- Kent, L.Y. 2014. An Evaluation of Fire Regime Reconstruction Methods. ERI Working Paper No. 32. Ecological Restoration Institute and Southwest Fire Science Consortium, Northern Arizona University. 15 p.
- Kent, L.Y. 2015. Climate Change and Fire in the Southwest. ERI Working Paper No. 34. Ecological Restoration Institute and Southwest Fire Science Consortium, Northern Arizona University. 6 p.
- Margolis, E.Q., D.W. Huffman, and J.M. Iñiguez. 2013. Working Paper 28: Southwestern Mixed-Conifer Forests: Evaluating Reference Conditions to Guide Ecological Restoration Treatments. ERI Working Paper No. 28. Ecological Restoration Institute and Southwest Fire Science Consortium, Northern Arizona University. 8 p.
- Reif, S., R.F. Yarborough, S.S. Rosenstock, E.L. Kalies, and S. Hedwall. 2013. Wildlife Habitat Values and Forest Structure in Southwestern Ponderosa Pine: Implications for Restoration. ERI Working Paper No. 26. Ecological Restoration Institute, Northern Arizona University. 8 p.
- Springer, J.D. 2013. Post-Wildfire Restoration of Structure, Composition, and Function in Southwestern Ponderosa Pine and Warm/Dry Mixed-Conifer Forests. ERI Working Paper No. 29. Ecological Restoration Institute, Northern Arizona University. 9 p.
- Springer, J.D., and D. Egan. 2012. Strategies for Enhancing and Restoring Rare Plants and Their Habitats in the Face of Climate Change and Habitat Destruction in the Intermountain West. ERI Working Paper No. 25. Ecological Restoration Institute, Northern Arizona University. 8 p.
- Swetnam, T. and D. Falk. 2015. Carbon Cycling in Southwestern Forests: Reservoirs, Fluxes, and the Effects of Fire and Management. ERI Working Paper No. 35. Ecological Restoration Institute and Southwest Fire Science Consortium, Northern Arizona University. 15 p.
- Yocom, L. 2013. Fuel Treatment Longevity. ERI Working Paper No. 27. Ecological Restoration Institute and Southwest Fire Science Consortium, Northern Arizona University. 8 p.

White Papers

SWERI Five-Year Evaluation Report

- Brown, S.J. 2015. Administrative and Legal Review Opportunities for Collaborative Groups. ERI White Paper—Issues in Forest Restoration. Ecological Restoration Institute, Northern Arizona University and the Western Environmental Law Center. 12 p.
- Combrink, T., C. Cothran, W. Fox, J. Peterson, and G. Snider. 2013. ERI White Paper—Issues in Forest Restoration. Full Cost Accounting of the 2010 Schultz Fire. Ecological Restoration Institute, Northern Arizona University. 44 p.
- Combrink, T., W. Fox, and J. Petersen. 2012. Workforce Needs of the Four Forest Restoration Initiative Project: An Analysis. ERI White Paper—Issues in Forest Restoration Ecological Restoration Institute, Northern Arizona University. 19 p.
- Egan, D. 2011. Integrating Domestic and Wild Ungulate Grazing into Forest Restoration Plans at the Landscape Level. ERI White Paper—Issues in Forest Restoration. Ecological Restoration Institute, Northern Arizona University. 12 p.
- Egan, D., and E. Nielsen. 2014. The History of the Four Forest Restoration Initiative: 1980s–2010. ERI White Paper—Issues in Forest Restoration. Ecological Restoration Institute, Northern Arizona University. 27 p.
- Fitch, A., Y.S. Kim, and A.E.M. Waltz. 2013. Forest Restoration Treatments: Their Effect on Wildland Fire Suppression Costs. ERI White Paper—Issues in Forest Restoration. Ecological Restoration Institute, Northern Arizona University. 12 p.
- Huang, C.H., and C.D. Sorensen. 2010. Exploring the Potential of Obtaining Carbon Credits for Restoration Activities on Navajo Tribal Forest Lands. ERI White Paper—Issues in Forest Restoration. Ecological Restoration Institute, Northern Arizona University. 12 p.
- Kim, Y.S. 2010. Ecological Restoration as Economic Stimulus: A Regional Analysis. ERI White Paper—Issues in Forest Restoration. Ecological Restoration Institute, Northern Arizona University. 12 p.
- Mottek Lucas, A. 2015. Flagstaff Watershed Protection Project: Creating Solutions through Community Partnerships. ERI White Paper—Issues in Forest Restoration. Ecological Restoration Institute, Northern Arizona University. 28 p.

General and Technical Reports

- Crouse, J.E. and A.E.M. Waltz. 2013. Identifying Priority Forest Treatment Areas across the Apache-Sitgreaves National Forests. Special report to the Apache-Sitgreaves National Forests, USDA Forest Service, Region 3. Ecological Restoration Institute, Northern Arizona University. 50 p.
- Ecological Restoration Institute. 2013. The Efficacy of Hazardous Fuel Treatments: A Rapid Assessment of the Economic and Ecologic Consequences of Alternative Hazardous Fuel Treatments: A Document for Policy Makers. Northern Arizona University. 28 p.
- Egan, D. and Dubay, T. (eds.). 2013. Breaking Barriers, Building Bridges: Collaborative Forest Landscape Restoration Handbook. Ecological Restoration Institute, Northern Arizona University, 212 p.
- Evans, A. 2015. 2014 Wildfire Season: An Overview, Southwestern U.S. Flagstaff, AZ: Ecological Restoration Institute and Southwest Fire Science Consortium, Northern Arizona University. 20 p.
- Evans, A.M. 2014. 2013 Wildfire Season: An Overview, Southwestern U.S. Ecological Restoration Institute and Southwest Fire Science Consortium, Northern Arizona University: Flagstaff, AZ. 12 p.
- Greco, B. and M. Sensibaugh. 2014. Rapid Assessment Report: Upper Rocky Arroyo Restoration Project, Lakeside Ranger District, Apache-Sitgreaves National Forests. Ecological Restoration Institute, Northern Arizona University. 34 p.
- Huffman, D.W., B. Greco, W.W. Chancellor, J.E. Crouse, J.D. Springer, A.E.M. Waltz. 2013. White Mountain Stewardship Program Monitoring Report. Special report to the Apache-Sitgreaves National Forests, USDA Forest Service, Region 3. Ecological Restoration Institute, Northern Arizona University. 33 p.
- Moote, A. 2013. Closing the Feedback Loop: Evaluation and Adaptation in Collaborative Resource Management. Ecological Restoration Institute, Northern Arizona University, 44 p.
- Roccaforte, J.P. 2013. The Wallow Fire and Its Effects on Mixed-Conifer Forest: A Comparison with Reference Conditions. Special report to the Apache-Sitgreaves National Forests, USDA Forest Service, Region 3. Ecological Restoration Institute, Northern Arizona University. 17 p.
- Roccaforte, J.P., M.T. Stoddard, P.Z. Fulé. 2013. Preliminary Results from the Mineral Ecosystem Management Area (EMA) Experimental Block Study: One-Year post-treatment. Special report to the Apache-Sitgreaves National Forests, USDA Forest Service, Region 3. Ecological Restoration Institute, Northern Arizona University. 18 p.
- Sensibaugh, M., B. Greco, W.W. Chancellor, M.T. Stoddard. 2013. Larson Forest Restoration Project Historic Range of Variation (HRV Reference Conditions) Assessment Report. Special report to the Apache-Sitgreaves National Forests, USDA Forest Service, Region 3. Ecological Restoration Institute, Northern Arizona University, 20 p.
- Sensibaugh, M., W.W. Chancellor, J.E. Crouse, D.W. Huffman, J.D. Springer, and A.E.M. Waltz. 2015. White Mountain Stewardship Program Monitoring Report. Special report to the Apache-Sitgreaves National Forests, USDA Forest Service, Region 3. Ecological Restoration Institute, Northern Arizona University. 28 p.

Springer, J.D. 2013. Prolonged Vegetative Dormancy in Rare Plant Species of the Southwest. The Plant Press, Arizona Native Plant Society. Fall 2013.

Appendix B — Responses of Institutes to Recommendations from the 2005-2009 Report

Responses of NMFWRI to Recommendations — 2005-2009 Report

At the time of the first SWERI Five-Year Evaluation Report, the affected entities that were interviewed for the evaluation offered a number of recommendations that apply to SWERI. This section addresses those recommendations.

1. Broaden the Scope of the Institutes to Other Ecosystems and Larger Landscapes.

NMFWRI fully supports the idea of landscape-level work. The “watershed” in the Institutes name indicates the initial organizers desire to include pinyon-juniper woodland in restoration. The latest Forest Inventory and Assessment (FIA) report showed that pinyon-juniper woodlands comprise 41% of the total forest land or over 10 million acres of forest land in New Mexico. NMFWRI serves as a catalyst by bringing groups together, helping with initial planning, identifying partners and potential funding sources, and closing the feedback loop on results.

2. Consider Some Specialization by the Institutes.

NMFWRI has or has had four areas of specialization: pinyon-juniper woodland restoration, technical assistance to non-Forest Service groups, GIS, and the mechanics of tree removal.

NMFWRI has developed strong partnerships with state agencies, tribes, soil and water conservation districts, and the BLM, which has broadened their support base and diversified their funding base.

NMFWRI has a strong GIS group. The first director recognized the strength of GIS, and two of the original six employees were GIS specialists. One of them left the institute in 2013 to head a dedicated GIS lab at NMHU, where he continues to cooperate closely with NMFWRI. As a result NMHU has as strong a GIS program as any organization in New Mexico.

NMFWRI has worked closely with the forest industry because they are critical to restoring the forest landscape. NMFWRI had an employee who worked on the mechanics of restoration, especially safety training for thinning crews. NMFWRI was the only institute that did this type of workforce training. The employee quit two years ago, and since other work was more critical and was not being carried out, the position remains unfilled.

Finally, our current staffing duplicates some capacity at the other institutes. For example, the skills of our new collaboration specialist overlap with that of the CFRI Director. Given the large areas and the long distances between projects in the southwest each institute has core staff to cover their state. Some duplication of capacity is necessary.

3. Assess Funding Levels and Discrepancies in Funding among the Institutes.

As one of the two institutes getting by on one-tenth of the annual allocation, NMFWRI would like a more equitable distribution of funding. Given the work and the leveraging of state funding

by CFRI and NMFWRI, the current budget division seems to be as much an artifact of traditional congressional and agency practice as it is a reflection of accomplishment or the demand of services.

Reducing ERI's budget to give more to NMFWRI and CFRI would be an unsatisfactory solution. ERI's work in the ecology of restoration, and the resulting continuous stream of publications, allows NMFWRI to demonstrate to stakeholders that the underlying science is sound. Their staffing capacity for fieldwork and data analysis means that requesting agencies can get help immediately.

Restoration to reduce the risk of catastrophic fire and to improve ecosystem function is a Forest Service priority and increasing the funding to and capacity of all three SWERIs should be integral to that objective.

4. *Improve Coordination and Build more Partnerships with Other Agencies and Research Entities.*

NMFWRI history of collaboration with federal agencies, especially at the USDA, could be improved. NMFWRI has lacked technical capacity to assist them. The Institute has hired new staff to address that shortfall.

The BLM/NMFWRI partnership project in the Rosa and Carrizo areas was an innovative use of high-resolution imagery and ground truthing that produced detailed vegetation maps on a watershed scale.

NMFWRI has emphasized outreach and partnership with the research community but there is room for improvement. NMHU is a teaching institution, and most of the faculty is fully occupied with classes. NMFWRI has established productive relations with the natural resources faculty at NMHU, and our presence gives them some leverage to be able to pursue research. The Society of American Foresters accreditation process also provides similar opportunities. In February 2013, the director of the RMRS visited NMFWRI and Highlands to discuss partnerships. More recently, developing links between NMHU and Department of Interior agencies may lead to an increase funding for applied research.

Through a partnership with BLM the NMFWRI is providing educational opportunities for students in forest inventory on landscape scale in northern New Mexico.

NMFWRI's two new hires create opportunities that were not foreseen during the search process. The collaboration specialist has a forestry background and strong orientation to community development. The monitoring specialist came to us from ERI, and closer links with researchers there and at NAU are inevitable. He has a background in range management which NMFWRI has lacked.

Responses of CFRI to Recommendations — 2005-2009 Report

At the time of the first SWERI Five-Year Evaluation Report, the affected entities that were interviewed for the evaluation offered a number of recommendations that apply to SWERI. This section addresses those recommendations.

1. Broaden the Scope of the Institutes to Other Ecosystems and Larger Landscapes.

Many interviewees talked about the need for a broader perspective beyond ponderosa pine and pinyon-juniper ecosystems. For example, the bark beetle epidemic and aspen decline are pressing forest ecosystem management issues that extend beyond restoration imperatives in dry, frequent-fire forest types. The mandate for a broader perspective is not reflected in the legislation that established the institutes, but there is a perceived imperative to scale up restoration efforts in the face of intersecting forces such as climate change and rapid population growth in fire-prone landscapes. The institutes can play a critical role in supporting a broader array of long-term forest health issues beyond large-scale ecological restoration, but their effectiveness may be limited by too narrow an ecological scope. For example, treatments on upland ecosystems can change the dynamics of runoff and impact adjacent or related ecosystems, such as mid-elevation grasslands, woodlands, and wetlands that are threaded throughout ponderosa pine forests; all of these landscapes should be considered when assessing treatment effectiveness.

A natural expansion would be to extend the geographic scale of restoration efforts to encompass watersheds. The broadening of scope should include outreach and active management as well as research, i.e., the kinds of things others are unable to do, but for which there is a critical need. It would also require partnering with many more land management entities than is currently the case and, in some situations, working across state boundaries. Thus far, state boundaries are seen as impeding on-the-ground jurisdictional cooperation. There is a great opportunity, and urgency, for the institutes to make a real difference in western ecosystems by expanding the reach of the institutes through watershed approaches, partnering with scientists in other institutions across the West, and other creative mechanisms. One concrete suggestion to enhance cooperation across state lines was to call upon the Western Governors' Association to jointly sponsor and organize an initiative to examine the role of the institutes and others who need to cooperate in landscape scale ecological restoration.

CFRI'S small operating budget has prevented us from expanding beyond Colorado. Two minor exceptions are worth mentioning: 1) ongoing communication and interaction with RMRS scientists on hazard reduction in southern Wyoming (Dr. Charles Rhoades); and 2) collaboration with RMRS/Dr. Michael Battaglia on a project assessing historic forest structure and fire regime that extends into southern Wyoming and the Black Hills of South Dakota. Forest restoration and wildfire risk mitigation issues are similar in these geographic areas to those in Colorado.

Beyond ponderosa pine/dry mixed-conifer forests, CFRI continues to be involved in helping federal and non-federal land managers address the impact of large-scale insect outbreaks. As CFRI's engagement with the Colorado Bark Beetle Cooperative has tailed off due to the decline in the mountain pine beetle outbreak in the central Rocky Mountains, our engagement with management response proposals to address the rising spruce beetle outbreak in southern Colorado are increasing. Forest landscape change and fire risk in higher elevation forest types

remain one of the more vexing challenges for managers, and CFRI remains committed to engaging in these issues.

2. Consider Some Specialization by the Institutes.

Questions were raised in a few of the interviews about possible duplication of effort among the three institutes (as well as with various academic institutions and other research entities). To avoid these problems and to create more effective synergy among the institutes, several interviewees suggested some strategic specialization, which to some extent is already occurring. For example, CFRI has demonstrated particular strengths in facilitation, collaboration and conflict resolution – high value services because large landscape restoration efforts are necessarily cross-jurisdictional, involving many diverse stakeholders who do not always agree or coordinate; NMFWRI has developed strong capacity in GIS and workforce development, including training in mechanical treatments; and ERI has a well-developed track record in ecological research and outreach. It would behoove the institutes to work together on a forward looking strategic plan that would address choices and future priorities. Specialization should not come at the cost of any individual institute's ability to meet needs within its state. All of the institutes should build and retain broad enough capacity to provide site-specific ecological restoration assistance.

Regarding requests from affected entities that require CFRI to develop and grow expertise in the natural and social sciences, CFRI has personnel trained in forest and fire ecology, plant community ecology, social and economic impact analysis, and collaborative planning and management. All of these skillsets and areas of expertise are required to meet affected entities' requests, especially regard to expectations for CFRI to be the go-to entity for ecological and socio-economic monitoring of projects.

CFRI has been developing specialized capacity to assist the U.S. Forest Service in the national forest planning process. CFRI has brought in faculty and students with expertise in the legal-regulatory requirements surrounding national forest planning, with specific expertise on monitoring and adaptive management, NEPA, and conservation of threatened and endangered species.

CFRI has specialized interest and expertise in NEPA, specifically regarding public engagement, case law, adaptive management, and cumulative impact analysis.

3. Assess Funding Levels and Discrepancies in Funding among the Institutes.

The interviewees agreed that additional funding would enable the institutes to perform more of the valuable work they are already doing, expand the scope of their contribution to large-scale landscape restoration, and allow them to help respond to looming imperatives such as climate change. Several interviewees suggested increasing funding especially for CFRI and NMFWRI, on the assumption that not only are additional services in high demand, but that current funding levels are barely sufficient to maintain their institutional integrity. There were mixed views as to the ability of the two smaller institutes to absorb a rapid increase in funding – some interviewees suggested that a large infusion of additional resources would not be effectively utilized in the near term, while others maintained that those institutes do indeed have the institutional foundation to be able to grow quite rapidly.

CFRI has seen its base operating budget decline from \$250,000 in FY10 to \$150,000 for FY11-15. Fortunately, CFRI has been able to develop financial agreements with individual national forest units and the Rocky Mountain Region regional office, the RMRS, and state and non-governmental entities on a project-by-project basis. Since FY10, we have leveraged our \$1.35 million in annual base operating funding from the US Forest Service to garner an additional \$2.73 million. An increase in base operating funding would greatly help CFRI to sustain its obligations and partnerships with affected entities. It would also allow CFRI to be more proactive rather than being reactive, and provide greater leadership on addressing forest restoration and wildfire risk reduction challenges in Colorado and across the interior West.

4. *Improve Coordination and Build more Partnerships with Other Agencies and Research Entities.*

It was apparent from the interviews that relationships with other agencies and research entities have not always been easy. There is still a real reluctance in some places to take advantage of the services and expertise of the institutes. In some cases the institutes are seen as outright competitors, in others as diluting the authority/control by local jurisdictions over projects. However, interviewees report concerted recent efforts at improved communication and dialogue. There is interest in developing CFRI projects with other federal agencies in addition to the U.S. Forest Service. Relationships could be further improved by additional outreach, as well as continued examination and articulation of the institutes' highest value niche in the ecological restoration arena relative to other players.

Due to our limited personnel and funding we have opted to prioritize our U.S. Forest Service projects. The two CFLR projects in Colorado comprise a large portion of CFRI workload. Additional requests from individual national forest units and the RMRS, as well as the state of Colorado and municipal water providers make up the remainder of our workload. We interact with managers from the U.S. Department of the Interior's BIA, BLM, and National Park Service, and will continue to seek opportunities for collaborative projects with them.

Responses of ERI to Recommendations — 2005-2009 Report

The first SWERI Five-Year Evaluation Report (Meridian Institute and US Institute for Environmental Conflict Resolution) published in October 2009 included four recommendations. In response to the four recommendations the ERI took the following actions.

1. *Broaden the Scope of the Institutes to Other Ecosystems and Larger Landscapes.*
(Examples given include encompassing watersheds, taking an all lands approach, and broadening outreach)

Despite a downward trend in both federal and state funding the ERI is designing and implementing treatments in dry mixed conifer vegetation types. This work is essential in order to protect habitat and recover the threatened Mexican Spotted Owl—the source of significant litigation since 1995. In addition, ERI is examining treatment approaches in low elevation ponderosa pine in response to requests from multiple national forests. Treatments in lower elevation conditions stimulate a shrubby understory response that contributes to volatile fuels build up. Proper management to reduce the shrubby understory is not well understood in the Southwest. This information will inform action in the Southwest and other parts of the Intermountain West.

In 2012 the residents of Flagstaff, Arizona, voted overwhelmingly to pass a bond to provide \$10 million over 10 years to restore the forests in and around Flagstaff (almost 74% of the electorate voted yes). The goal is to restore forest health in order to improve watershed conditions and avoid catastrophic fire that can lead to downstream flooding and infrastructure damage. The ERI provided scientific information to support the need for the bond and will monitor vegetation in order to evaluate outcomes. Leveraged funding to support this work comes from the City of Flagstaff, state of Arizona and US Forest Service funding under PL 108-317. Another example of ERI's response to the need for a watershed approach is a collaborative project developed with the Salt River Project (SRP), one of the nation's largest energy and water suppliers. The SRP is working with the ERI to understand surface and ground water yield responses to different forest restoration treatments. In order to conduct this work the SRP has contributed almost \$900,000 to the ERI over the last four years, further leveraging federal funds.

With respect to the need for an “all lands approach” the ERI provides technical support to all affected entities. This includes the state of Arizona, Tribes including the Hopi and San Carlos and White Mountain Apache and other entities as needed. In addition, the ERI provides monitoring support to many of the CFLRP pilots across the West.

2. *Consider some specialization by the Institutes.* *(Avoid duplication with other academic institutions and research entities).*

Financial resources and technical expertise have led to some specialization between the three institutes. The ERI, due to its larger and more diverse staff is known for its biophysical science but also has the capacity to support collaboration, monitoring, and investigations in policy and economics.

The ERI bases its program of work on needs expressed by affected entities or in anticipation of future information needs—such as restoration approaches in dry mixed conifer. In addition, the ERI networks with many organizations throughout the West to understand what others are doing

in order to avoid redundancy. In most cases organizations are creating partnerships to stretch their resources. For example, the ERI collaborates with NFF on webinars, white papers and workshops. The same is true for the SWFSC, under the USFS, Joint Fire Science Program). ERI works with investigators at other institutes, organizations or the research stations to ensure that the best expertise contributes to work products. Presently, the ERI is discussing a new cooperative project with RMRS, state of Arizona and Region 3 of the Forest Service to test strategies for creating effective “all lands” approaches to lowering fire risk and restoring forest health.

3. *Assess funding levels and discrepancies in funding among Institutes.*

The sponsors of The Southwest Forest Health and Wildfire Prevention Act expected funding to gradually increase so that at all three institutes could achieve the purposes of the Act. This goal has not been fulfilled.

Efforts to elevate funding include working together to find federal year-end funds when year-end funds are available. All three institutes are utilizing 2014 year-end dollars to fund a project to design a “Broad-scale Monitoring” framework to meet the requirements of the 2012 Planning Rule.

The lack of certainty in year-to-year federal support, as well as flat and the declining funding has impacted the ability of all three institutes to meet the needs of the affected entities.

4. *Improve Coordination and Build more Partnerships with Other Agencies and Research Entities.*

Five years ago affected entities were still discovering the services provided by the ERI. Today our partners recognize that the ERI occupies a unique service niche for science development, translation and transfer. Research partners, such as the RMRS, acknowledge that the ERI has a unique strength in capacity to get the best available science in the hands of land managers— and more importantly seeing that the best available science influences management action on the ground.

The ERI actively coordinates and collaborates with organizations like NFF, SWFSC, RMRS, TNC and the collaborative groups associated with the CFLRP to advance landscape scale restoration.

Appendix C — Interviewees (2015)

Greg Aplet, Senior Science Director
The Wilderness Society

Michael Bain
General Manager
Twin Willows Ranch

Jamie Barbour
National Implementation Lead for Inventory,
Monitoring and Assessment
USDA-Forest Service

Jon Boller
Senior Staff Attorney
NM Legislative Council Service

Anne Bradley
Forest Conservation Program Manager
The Nature Conservancy

Lindsay Buchanan
Collaborative Forest Landscape Restoration
Program Coordinator
United States Forest Service

Edward W. Collins
District Ranger, Forest Service
Apache-Sitgreaves National Forests

Doug Cram
Extension Wildfire Specialist
NMSU Cooperative Extension

Rob Davis
Forest Energy Corporation
Show Low, Arizona

Jim deVos
Assistant Director
Arizona Game and Fish Department

Jonas Feinstein
State Conservation Forester
Natural Resource Conservation Service, USDA-
NRCS Colorado

William Ferranti
Natural Resources Specialist
Alamo Navajo School Board, Inc.

Nancy Fishering
Policy and Outreach
Colorado Timber Industry Association

Dick Fleishman
Assistant Team Leader
4FRI Coconino National Forest

Chris Furr
District Ranger
Tres Piedras RD, Carson National Forest

John Galvan
Tribal Forester
Pueblo of Jemez, Department of Natural Resources,
Jemez Pueblo

Todd Haines
District Forester
NMSF-Bernalillo District

Stephen Horner
Area Manager
Campbell Global LLC

Jeremy Kruger
Forestry Program Lead
Bureau of Land Management

Linda LaGrange
PhD Associate VP Academic Affairs
Office of Research and Sponsored Programs
New Mexico Highlands University

Linda L. Lind
Arizona State Liaison
Southwestern Region

Michael Lujan
State Forester — Timber Management Office
USFS-Las Vegas Ranger Station

SWERI Five-Year Evaluation Report

Tom Mackin
Immediate Past President
Arizona Wildlife Federation

Mark L. Martin
Ecosystem Management Group
Arapaho & Roosevelt National Forests
and Pawnee National Grassland

Sara Maybe
Renewable Resource Staff Officer
USFS-Pike-San Isabel National Forest

Mark Meyers
Forester
New Mexico State Land Office

Pam Motley, Outreach Coordinator
Uncompahgre Partnership

Tom Osen
Forest Supervisor
USFS-Apache-Sitgreaves National Forests

Brent Racher
Owner
Restoration Solutions, LLC

Chuck Rhoades, PhD
Research Biogeochemist
Rocky Mountain Research Station

Clay Speas
Forest Monitoring Lead
USFS-Grand Mesa, Uncompahgre, and Gunnison
National Forest

Paul Summerfelt
Wildland Fire Management Officer
Project Manager
Flagstaff Watershed Protection Project
City of Flagstaff Fire Department

Madeleine West
Assistant Director, Parks, Wildlife and Lands
Colorado Department of Natural Resources

Jeff Whitney
Arizona State Forester
Arizona State Forest

Appendix D — Summary of Affected Entity Interviews (2015)

A summary of responses from the interviewee list found in Appendix C follows this list of questions asked in the survey and phone interviews.

1. Name, Title, Organization, and Phone Number (For follow-up phone interviews only.)
2. What has been the role of affected entities in the institute's planning and program development process?
3. What has been the experience of affected entities in terms of the institute's responsiveness to their needs (timeliness, quality of response, effectiveness)?
4. What issues or concerns have emerged in your interactions with the institutes?
How were these issues addressed?
5. What recommendations do you have for improving the institute's service in the future?
6. What has been the institute's role in promoting, implementing, and gaining wider acceptance for landscape scale restoration?
7. In what ways has the institute contributed to reducing planning costs, duplication, and/or avoiding conflicts?
8. In what ways has the institute promoted improved cooperation with local entities?
Regionally? With Federal agencies?
9. Are there any other insights or suggestions regarding past or future work of the institutes?
10. What has been the value-added contribution of the institute? What difference have the institute's contributions made?

Summary of Interviews with Respect to New Mexico Forest and Watershed Restoration Institute

1. What has been the role of affected entities in the institute's planning and program development process?

The institute has successfully collaborated on numerous projects and encouraged cooperation among federal, state, local, and tribal government agencies and other participants involved in the forest and watershed restoration, maintenance, and monitoring efforts and natural resource management. The institute has actively partnered to transfer knowledge and expertise through education, outreach opportunity, and tech transfer.

- The institute provides technical assistance to BLM land managers with forestry program students who have conducted forest inventory and vegetation mapping on public lands in the Taos and Rio Puerco Field Offices.
- The institute has applied their expertise in the planning and designing of landscape planning projects.

2. What has been the experience of affected entities in terms of the institute's responsiveness to their needs (timeliness, quality of response, effectiveness)?

- The institute has been very responsive to returning phone calls, request for data and information, organizing meeting, and facilitating communications. They have consistently been called reliable and dependable. Requests have been received in a timely manner and data has been of quality and relevance. For example, the institute has set up a portal that houses information and preparation plans that the Alamo team members can access to store and exchange data.
- The institute has provided timely responses. An example is coordination of access to state land to conduct pre- and post-treatment monitoring of forest restoration and fuels treatment activities.

3. What issues or concerns have emerged in your interactions with the institutes? How were these issues addressed?

- The institute's good communications and planning have addressed the challenges of obtaining permission from landowners to access target sites. (Explanation added by NMFWR: This refers to work done with the NM State Land Office (SLO), where we needed to cross private land to reach the SLO land, and we needed to coordinate with the SLO grazing lessee before working on the SLO land.)
- Efforts have been made by the institute to address funding gaps for forest restoration on a landscape scale but this still remains an issue.

4. What recommendations do you have for improving the institute's service in the future?

- The majority of recommendations for improving the institutes' service are to increase budget/funding for programs and increase staff. Vacancies in staff and shortages of

personal have been an issue in the past. The institute has been noticeably short staffed in the past and slow to fill vacant positions.

- Increasing scientific expertise and education for landscape scale restoration.
- One staff member's leaving caused a college program to die. It is important to reestablish the implementation of college course programs. "It would be beneficial to have the course revisited in an effort to get it off the ground. It would serve our crew members quite well and would give them even more skills when trying to find jobs in the forestry industry or as continuing education credits for pay raises."
- That the institute continues to be the intermediary in establishing communications for projects that need permission from landowners to access target sites.

5. What has been the institute's role in promoting, implementing, and gaining wider acceptance for landscape scale restoration?

- The institute has played a key role in coordinating the efforts of local governments (such as counties, soil and water conservation districts, and land grants), the forest products industry, state agencies and environmental organizations to develop legislation to formalize the planning process for forest and watershed restoration efforts.
 - The institute has an integral role in procuring long-term funding for forest restoration in the state of New Mexico.
 - The institute promotes and assists the NM Prescribed Fire Council in meeting its mission of promoting prescribed fire.
 - The institute continues to develop and promote the latest science as it relates to restoration. They have formed multiple partnerships and relationships with other players in NM as it relates to restoration. Most recently, they worked closely with the NM legislature on important restoration policy.
 - The institute has served as a strong collaborator in ongoing landscape plans and strategies. Partnerships such as the Rio Grande Water Fund and the CFRP improve understanding of the fire dynamics in the habitat of the endangered Jemez Mountains Salamander.
 - The institute has shown leadership in giving presentation on restoration topics and specific lessons learned to agencies and citizens in Northern New Mexico.
- 6.** The institute was instrumental in helping the New Mexico Forest Industries Association (NMFIA) pass a bill through the state legislature for annual funding. The bill was passed unanimously through both houses but was vetoed by Governor Martinez.

7. In what ways has the institute contributed to reducing planning costs, duplication, and/or avoiding conflicts?

- The institute encourages and provides resources for various entities (agencies) to work together on projects, share resources and better communicate with each other to address forest restoration and management on a landscape scale. Those efforts are reducing duplication across agency boundaries.
- The institute provides GIS mapping and technical reviews.
- Utilizing students to assist with forest inventory work reduces the per-unit cost of forest inventory.
- The institute brought agencies and citizens together to discuss water quality, quantity and forest/watershed health issues, which reduced duplication in plans and provided a conduit for open communications and understanding.
- The institute has coordinated the compilation of information for an unbiased report by a third party that was based on the data gathered by the Alamo crew, which the BIA accepted with fewer questions.
- The institute has coordinated planning, monitoring, and data collection at local/regional levels by leveraging them to larger statewide efforts and providing methodologies that will allow integration at a larger scale.
- The institute brought conflicting parties together to improve collaboration and conflict resolution.

8. In what ways has the institute promoted improved cooperation with local entities? Regionally? With federal agencies?

- The institute has been a key participant in educating the legislature on forest and watershed restoration issues. It promotes cooperation among local, state and federal agencies, and public and private agencies.
- The director is a reliable adviser in the relationships of cross-jurisdictional programs and projects in the forest restoration community in New Mexico.
- The institute has a reputation for providing sound advice and credible technical assistance through their consistent attendance at project work-up meetings.
- With the Institute's partners, such as the Prescribed Fire Council, CFRP and the BLM, cooperation among local entities has improved.
- The institute has improved cooperation by serving as a go-between, being at the table. They are a levelheaded, unbiased voice of reason.
- The institute acts as an information gathering entity on issues such as insurance, forest workers safety, promoting landscape scale projects, helping in the state legislature, and identifying long-range goals.

- The institute has been a very effective conduit between federal agencies and stakeholders at the local, regional, and state level.

9. Are there any other insights or suggestions regarding past or future work of the institutes?

- Without the institute, the New Mexico State Land Office (NMSLO) would have an increased challenge in meeting forest restoration and management objectives.
- Turnover of good employees (every 2-3 years) leaving for “better opportunities” requires rebuilding, reinventing the wheel, and loss of momentum.
- NMHU lacks the research infrastructure and programs that could otherwise support a significant research program for the Institute.
- A lack of clarity on what each institute offers and who can ask for help.
- More information on what funding is available for what services, especially what is available for watershed projects.
- Avoiding funding gaps would be huge.
- Promoting a non-biased approach to grazing management on federal lands considering that the health of rangeland comes before the exploitation of the asset.
- The NMFWRI will continue to be the leader in collaboration between agencies that are working to resolve watershed and forest health issues across New Mexico. With a full staff they will continue to share lessons from other projects (state and national) that will assist us in improving our management on the ground.
- “The institutes are a great partner to have and hopefully will be here for the long run.”
- Expand the safety training programs that are critical for forest related industries to keep the associated insurance costs down, which can make the difference between an employer staying in business and/or hiring more employees.
- Look into the “systems approach” to integrate the needs of landscape scale restoration as it fits with the urban/rural public, businesses, government, and national/global development.

10. What has been the value-added contribution of the institute? What difference have the institute’s contributions made?

- Improvements have been noted in the level of cooperation and communication among local agencies (municipalities, counties, soil and water conservation districts, land grants), state agencies, environmental organizations, private industry and federal agencies in the planning process that has led to a decrease in finger-pointing and an increased focus on problem-solving.

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- The Institute has brought resources and expertise to complement the forest restoration efforts of the NMSLO. This partnership has expanded the opportunity for adaptive management and implementation of effective treatments on the landscape.
- The institute's involvement with the NM legislature was highly significant and important in forging ahead on NM's policy on forest and watershed restoration.
- A number of under-resourced communities have benefitted by training and advice on forest businesses provided by NMFWRI.
- The institute is perceived to be more neutral by some groups that are distrustful of conservation organizations. When we have a joint message to communicate, the institute may be the better messenger.
- The institute director took on a central role in working on legislative funding strategies for the Rio Grande Water Fund. While the governor vetoed the last legislatures' proposed funding bill, we have built good relationships and are optimistic about future efforts.
- The institute assists in coordinating and implementing projects and assist in roles where they may be needed.
- The institute being located on campus has allowed for academic collaborations that have benefitted the students, faculty, and institute employees. Most importantly, it exposes our students to the understanding that forests and watersheds have to be managed well in order to maintain their ecological health.
- Dr. Reid has been at every meeting for the collaborative and provides input to the group.
- The conservation and land health situation in New Mexico is definitely better off with the institute.
- Partnerships with the NMFWRI increased the BLM's capacity for conducting forest inventory and provided valuable data for project and land management planning efforts.
- The NMFWRI has been instrumental in keeping agencies communicating and working together. The Institute's professionalism improved working relationships during emergency situations (flood and fires) resulting in better management.
- An important value of the institute is that they act as a bridge between the public and private sectors. The institute can provide an unbiased and scientific opinion that sometimes carries more weight than it would when coming from an agency.
- The institute has contributed to hands-on-training in safety, marking, cruising, and monitoring.
- Alamo Natural Resources has put \$600,000 into the local economy over the past three years. Without the institute's help, the Integrated Resources Management Plan (IRMP) would not have passed. The IRMP will help Alamo obtain funding for projects in many diverse areas. The institute has also assisted Alamo with its Woodland Management Plan.

The institute helped Alamo by compiling reports, providing access to other successful programs and serving as an information warehouse.

- The institute has been a consistent presence in various aspects of forest/watershed restoration and landscape scale restoration. This is important in a world where many scientific/academic institutions focus on piece-meal research, technology transfer, and outreach.

Summary of Interviews with Respect to Colorado Forest Restoration Institute

1. What has been the value-added contribution of the institute? What difference have the Institute's contributions made?

The primary value-added contribution of CFRI to affected entities between 2009 and 2014 was providing scientific expertise and advice to affected entities. Respondents reported that CFRI advances the science of forest restoration and plays a leading role in the Colorado Front Range CFLRP. Interviewees responded that CFRI's leadership includes connecting researchers with broader stakeholder groups and people involved in community restoration projects and citizen scientist monitoring groups.

"I don't know where we would be in the Front Range Roundtable without CFRI. If the Roundtable had had to organize leadership of the project, we might still be without a monitoring plan, without an adaptive management process, without monitoring data, or any sense of program accomplishments or improvement."

"The Colorado Front Range CFLR project is one of the few CFLR programs that can report real advances in restoration practices, evaluation, and a scientific approach to adaptive management."

"They provide us access to the best science because they keep up with the latest science and provide a nongovernment point of view. Having them participate in our landscape monitoring group has been really helpful—I hope they keep doing it."

Other value-added services CFRI contributed to affected entities is assisting with the Department of Natural Resources' Forest Mitigation Monitoring Program. CFRI prepared monitoring protocols for all the grant recipients and conducted an analysis of landscape scale benefits to the grant program. These services were useful to the grant manager as well as the grant recipients. CFRI gives grant recipients working on fire mitigation projects a broader awareness of risk reduction from these treatments that is beyond cutting down trees.

"The community-based groups doing smaller scale fire mitigation projects give CFRI staff rave reviews."

2. What has been the role of affected entities in the institute's planning and program development process?

As part of the Roundtable process, affected entities were able to identify priority areas of work and research that advance ecological restoration in Colorado, and CFRI has begun work and research in those areas. Other interviewees said their role was primarily to provide funding to CFRI to support their monitoring of the CFLR project.

"Tony gives us an annual briefing of his plan for the year and where we can work together—we provide feedback and suggestions and help them plan for their time. We help them help us in a sense. They bounce their ideas off us and we provide feedback. They also participate in the Front Range roundtable discussions."

3. What has been the experience of affected entities in terms of the institute's responsiveness to their needs (timeliness, quality of response, effectiveness)?

Interviewees said CFRI is very responsive and that they are “continuously impressed” with CFRI's responsiveness to their needs. “When the CFRI has the charge to develop a product or provide assistance, they are professional, engaged, and timely.” Survey participants indicated that CFRI is very timely in their responses and that the responses are good quality and very effective. Interviewees said that CFRI has taken on an important leadership role in Colorado at a time when it was needed for landscape restoration.

“They are a great partner to work with because they understand when and where to talk about science during field trips. Their work dovetails with our research projects and broader programs.”

One interviewee responded that CFRI is a key part of their research work. “When we plan projects, we usually start with ‘We do this piece, CFRI does that piece’—that is very important.”

CFRI helped one interviewee create a database to track projects on public and private land. CFRI provided ideas and staffing to build the database program. “Their responsiveness is always timely and supportive. We keep going back to work with them because they provide information we can trust. We count on them. Our experience has been really positive.”

One respondent stated that while CFRI has been responsive to their needs, the nature of their work makes benefits longer term. It took two years to get results from the first round of grants. CFRI needed results to make recommendations. The respondent stated that now that the institute has the results, they expect CFRI to produce more this spring.

4. What issues or concerns have emerged in your interactions with the institute? How were these issues addressed?

Most interviewees said they didn't know of any concerns and had to think about it awhile before responding. Interview results suggest more funding and more clearly defined roles could improve the effectiveness of the institutes

Interviewees stated that CFRI plays a dual role—landscape restoration facilitation and research to improve the process. “Should they be spending resources on the work that is needed to increase the pace of landscape scale restoration in Colorado, or should they be analyzing it in order to improve its effectiveness? We need both, and they have the talent to do both, but resource limitations put them in the position of trying to do them coincidentally, when they really need to be separate functions.”

Interviewees stated that CFRI is underfunded and could do more with additional funding. “CFRI is sorely and consistently underfunded to meet the full needs for the development and support of the fundamental research, a robust monitoring program, and an effective and impacting outreach and education program.”

One respondent stated that they wonder how lower funding amounts might limit their ability to do the work in the future, So far, they haven't noticed any lack of responsiveness or break

down in work, even when CFRI had some staffing issues due to lower funding than the other institutes.

5. What recommendations do you have for improving the institute’s service in the future?

Increasing the funding to the institute seems to be the primary recommendation on how to improve future service.

“Get more money so they don’t have to chase dollars to stay afloat.”

“CFRI has a critical role to play in advancing restoration in Colorado, but they are resource-limited. As a result, they have to expend valuable resources trying to secure operating funds. This also has the potential to force them into ‘mission creep’ in which they pursue funding because it is available, not because the work is what is most needed to advance restoration. Thankfully, I have not observed this yet, but I am concerned about the potential. One way to increase support for CFRI might be for it to host an annual or biennial meeting of stakeholders to report on accomplishments, solicit feedback, and plan for the future. This would help build community around CFRI and a stake in its success. CFRI works largely ‘behind the scenes’ now, but a higher profile may lead to greater political support and, conceivably, greater financial support.”

“I hope they work with me in future as my program morphs.”

Another recommendation is that CFRI remain flexible to embrace new research ideas and areas. Right now, CFRI is seen as “the Front Range people,” but they should not get too entrenched in one area so they can expand and grow.

One interviewee suggested CFRI share what it is doing with other groups as a way to improve communication.

“They were planning on conducting a workshop this fall because a citizen’s group was questioning a project we were doing in a national forest. They were going to do a workshop to bring the public in and get their feedback. However, Tony lost some staff so the workshop had to be postponed until 2016. Sometimes staffing is an issue. On field trips, they give the academic perspective, which is great. It says our work is supported by current science.”

6. What has been the institute’s role in promoting, implementing, and gaining wider acceptance for landscape scale restoration?

Interviewees stated that CFRI has been a leader in promoting, implementing, and gaining wider acceptance for landscape restoration. Because CFRI is university-based, it lends credibility to landscape restoration, especially where politics are involved in the process. “There is a tremendous amount of discipline and institutional based pushback on ecology, restoration, and a science based framework. If the CFRI was not here, I would not be able to have the support to push the science and implementation of both the scale and magnitude of ecology based treatments.”

“Having CFRI based out of the university gives them a voice that is both respected and largely free of suspicion about their motives. This has allowed CFRI to take the reins of planning, monitoring, assessment, and evaluation of restoration projects in a way that I don’t think stakeholders would have allowed if those tasks had been taken on by others. As such, CFRI has brought stability and confidence to stakeholder collaborative relationships, which has allowed stakeholders to focus on the work, rather than on who will benefit from it. This has helped promote restoration, facilitated implementation, and gained it wider acceptance.

One respondent stated that CFRI has a good reputation for providing landscape scale risk assessment. CFRI can take a bunch of smaller projects and roll up the data into an assessment of how these projects reduce risk at the statewide scale.

CFRI publishes the results of its monitoring data in articles and scientific papers, which helps to build credibility with stakeholders. CFRI participates on various teams and in roundtables to transfer this knowledge to others. In addition, CFRI helps facilitate meetings with collaborative groups (private citizens, cities, local government agencies, county governments and federal agencies). Several interviewees said that having CFRI facilitate the discussion helped to build an inter-disciplinary approach to the work of affected entities.

“For the last decade, CFRI is the ‘go-to scientific group in CO’ for landscape scale restoration. That’s really important. Landscape scale restoration is very much a long-term commitment—it’s new to people and they don’t always understand how it effects standard forestry work. The idea that it might take 5 to 10 years isn’t apparent to all people. I hope this institute has a long life span to address the long-term issues. CFRI is a respected partner and leader in lots of projects.

“I’ve seen Tony brought in as a key witnesses and contributor to projects conducted at the state level. It’s important for credibility purposes that the information comes from a respected institute rather than just some professor at a university. CFRI is engaged in lots of work with people at the research station here. Their life means new ideas and options come along.”

7. In what ways has the institute contributed to reducing planning costs, duplication, and/or avoiding conflicts?

Interviewees reported that the key contribution CFRI has made to reducing planning costs, duplication of effort, and reducing conflict has been the leadership role they have taken in the Roundtable.

“CFRI has been the ‘go-to’ organization for monitoring, planning, hosting workshops, etc., for the Front Range Roundtable. I suspect that having a trusted, professional, competent organization to take on these tasks has reduced planning costs and helped avoid conflicts. I suppose it is possible that we would have been able to find other institutions to take on these tasks, but being able to go to CFRI as the obvious choice has greatly increased efficiency.”

For reducing conflict, CFRI acts as moderator at public meetings, some of which can be contentious. “The public doesn’t trust the government. They help to confirm what we are saying so the public trusts us.”

On respondent stated that having the current science to work from has reduced some planning costs.

8. In what ways has the institute promoted improved cooperation with local entities? Regionally? With federal agencies?

The interviewees indicated that CFRI serves as a data repository for research findings and analysis, which is an important element of cooperation among local and federal agencies. CFRI helps other organizations and state and federal agencies clarify research findings as they relate to the implementation of ecological principles. “Having a third-party, university-based institute collect and analyze data provides transparency to the process and improves communication among stakeholders.”

Interviewees reported that CFRI works collaboratively with all entities and serves as a bridge to bring these organizations together.

Other ways CFRI has promoted improved cooperation with local, regional, and federal agencies is by participating in roundtable groups and landscape restoration monitoring teams. Some of the monitoring teams are small groups focused on community protection on private land, but there is public land adjacent to that private land. CFRI works with all the agencies (local, state, fed) on these projects to coordinate work.

CFRI is involved in cross agency work between Colorado State University and the U.S. Forest Service. “They work really well in that space. CFRI talks to lots of federal and state land managers. As a federal researcher, I don’t always have the best connections with federal land managers. CFRI helps to fill that gap. They provide outreach to stimulate communication back and forth between stakeholders, especially at the local community level.”

9. Are there any other insights or suggestions regarding past or future work of the institute?

CFRI is a respected organization for providing scientific data to affected entities as well as assisting with monitoring and outreach. However, a few interviewees said they would like to see CFRI take a more active role in promoting and facilitating restoration, including expanding the institutes’ role as a dedicated advocate for restoration projects.

“The Front Range Roundtable has benefited greatly from the ‘one-two punch’ of TNC and CFRI, wherein TNC runs the trap lines to set up restoration projects, and CFRI comes in with the administrative support for monitoring, etc. This has worked well so far, but it cannot be relied on as a long-term solution. NGO priorities change. I fear a day when we will be left without an effective protagonist for restoration projects. I would like to see CFRI play a more active role in promoting and facilitating restoration work. I realize that resources are tight, and CFRI is doing what it can, but I think Colorado would benefit from a dedicated advocate for restoration in the form of CFRI in the future as long as it was kept separate from the research/evaluation role, which is also needed.”

The contract structure between CSU and CFRI could be improved to allow CFRI to get more work. CSU takes a high overhead percentage of their work, making it difficult to give them more work, according to one interviewee.

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“Having CFRI available is helpful for our forest and the CFLR project because they work across all those boundaries with us—they help us see different options to what we are doing out there. Hopefully that will keep going forward.”

The ideas behind restoration are still evolving. CFRI is consulted for problem solving when issues come up.

“CFRI is doing a great job. I hope they keep on keeping on. They are an important partner and hopefully will remain there. If there program collapses, there will be a big gap to fill.”

Summary of Interviews with Respect to the Ecological Restoration Institute in Arizona

1. What has been the value-added contribution of the institute? What difference have the institute's contributions made?

Many survey respondents stated that ERI's value-added contribution has been significant for providing the best available science and simplifying/translating the science in order for it to be easily understood by all parties. The institute is also well respected in the community, according to interviewees, and provides the third-party verification needed to support U.S. Forest Service work in the area with stakeholder groups.

“ERI's contributions have made a difference because they are accessible, responsive, proactive, and respected in Arizona. The pace and scale of restoration in AZ would not be where it is today without the contributions of ERI.”

“The institute has been and continues to be hugely beneficial to the Uncompahgre Plateau CFLR project. The amount of forest restoration work that we are achieving would never have been possible without their guidance and involvement.”

“I strongly believe that without the institute's leadership and organizational skills, we would not be where we are today relative to commencing landscape scale restoration. The stakeholder groups, the Forest Service, and even the contractor are not as well organized and capable of providing the leadership and coordination necessary to meet the challenges of this effort.”

“Value added contribution in my opinion has been enormous.”

One interviewee stated that ERI is consulted every time a landscape level environmental analysis is conducted because the institute can provide a rapid assessment of the ponderosa pine and pinyon-juniper woodlands on restoration projects. “ERI did a rapid assessment of two large areas in the last five years. One was the Timber mesa (140,000 acres) where the institute did a rapid assessment of the transition between ponderosa pine and pinyon-juniper areas. ERI provided scientific historical data on the area to help guide efforts.”

“ERI is very credible with the public. When we were proposing treatments in these areas, we didn't have much in the way of advice on how to do that. ERI was very important for us in the Environmental Analysis to help us restore the area the way Mother Nature did it.”

ERI helped to accelerate work on the Upper Rocky Arroyo Restoration Project—33,000 acres near Lakeside Arizona in the Apache-Sitgreaves National Forest. The project was not intended to start until 2015. In 2014, ERI offered treatment assistance that helped move the project up one year. “We were in a mad dash for data collection and they really helped with that. They collected data and gave us a rapid assessment that was really helpful on the district level.”

ERI communicates its scientific knowledge through research reports and other forms of communication. “They routinely send out new science and research that has been completed and published with interpretation and how that science is important to the ecosystems that we

work with. They are willing to come out anytime for service trips to help with additional interpretation if we need it.”

2. What has been the role of affected entities in the institute’s planning and program development process?

A wide variety of stakeholders in Arizona work with ERI including non-profits, environmental advocacy groups, the timber industry, science organizations, and federal and state agencies. “Because ERI engages as one of the many stakeholders in Arizona, they are extremely responsive and proactive to what they hear and observe. This is clearly reflected in the planning and development of ERI programs.”

ERI also gets input from affected entities by participating in the Natural Resources Working Group, which some interviewees also attend. The interviewees said they provide input to ERI at those meetings.

ERI assisted the Uncompahgre Plateau collaborative group in discussing and developing forest restoration efforts that turned into the Uncompahgre Plateau Collaborative Forest Landscape Restoration Project. “Their input was very valuable in our efforts.”

ERI provides a centralized location for scientific information on landscape scale restoration. “With the excellent communication tools provided by ERI, my organization has been able to find information and answers to many of our questions and concerns at one centralized location. This has been very helpful when gathering data and developing internal as well as external communications for my organization. The ERI openly solicits feedback and input when they’re developing new or existing programs and it allows us to provide our position in such a manner that it will be included and distributed broadly.”

ERI has worked closely with the U.S. Forest Service on monitoring efforts for the White Mountain Stewardship Project. They also assisted with data gathering and biological assessments on other restoration projects during the NFMA (National Forest Management Act) stage.

3. What has been the experience of affected entities in terms of the institute’s responsiveness to their needs (timeliness, quality of response, effectiveness)?

Overall, the interviewees said the institute was very responsive to their needs. ERI staff consistently provides timely responses to inquiries and other needs, according to several interviewees. They also follow up to ensure affected entities are getting the information they need and provide links to online sources of additional information.

“In my experience ERI has been very responsive to the multitude of agencies and organizations in Arizona. They also have an important role in creating connectivity to regional and national level issues and/or needs.”

“They are one of the few academic/science organizations that I have interacted with during my career that seems to truly understand how to translate the science to on-the-ground realities in the field. ERI has also been proactive in contributing to the diverse ecological

needs within Arizona. They have not forgotten the southern portion of the state, which is often in the shadows of the largest CFLR project in the country.”

4. What issues or concerns have emerged in your interactions with the institutes? How were these issues addressed?

All the interviewees stated that their interactions with ERI have been both personal and positive and their inquiries and needs were met in a timely and adequate manner.

5. What recommendations do you have for improving the institute’s service in the future?

Interviewees stated they recommend continued funding support to ERI, but they did have a few recommendations for improving the institute’s service:

One interviewee stated he/she would like to see more coordination and integration with the RMRS.

“It would be great if the institute had the funding that would allow them to be more deeply engaged.”

“Alignment to Forest Service databases is important.”

One interviewee said they would like ERI to hold another training session similar to the one they held in Flagstaff with Charlie Denton. The interviewee said that workshop was incredibly effective at transferring the science to the field work. The person interviewed stated “I would find a way to get all my people to those kind of sessions.” ERI shares information electronically via their website, newsletters, etc., but workshops are great for people who prefer face to face communication.

6. What has been the institute’s role in promoting, implementing, and gaining wider acceptance for landscape scale restoration?

ERI serves as the central organization for collecting and disseminating scientific information regarding restoration. They provide leadership, direction and resources and serve as a catalyst for other groups and organizations that may not be as well equipped to do so. The information they provide affected entities is “not tainted by financial, political or personal goals or viewpoints.”

“I believe the institute has played a critical role in all things restoration!”

“ERI has been instrumental in providing academic credibility to the restoration work being done throughout Arizona by the U.S. Forest Service and other partners. Although they often focus on the science and on-the-ground application, they also provide context for the socioeconomic importance of landscape level restoration. They continue to be a leader in all things restoration, and are quite effective in engaging the broad base of publics and partners in AZ, the region, and in Washington, DC. A great advocate and partner for the Forest Service!”

ERI acts as third-party scientific institute that provides guidance and input into the development and implementation of forest restoration efforts and monitoring programs. Their

participation in monthly group meetings of various organizations, including the Natural Resource Working Group, has helped communities gain wider acceptance to forest restoration by bringing the scientific viewpoint to different aspects of landscape scale restoration projects.

An example of how ERI has contributed to wider acceptance of landscape scale restoration is their work on the Mineral Project, an area of forest where ERI designed the restoration treatments to test different intensities of thinning. Data were collected before and after treatments. In 2014, the San Juan Fire ignited near the project area and burned 7,000 acres. The fire started on a reservation and crossed into the Springerville Ranger District. “The fire was strong and wind-driven. It nuked when it hit the untreated forest stands (mixed conifer and ponderosa pine). When it hit the Mineral Project treated area, that brought the fire back to the forest floor and the level of damage was far less severe. ERI went out and evaluated what they did and will let us know how they treated that area, which will be incredibly helpful to ranger districts.”

7. In what ways has the institute contributed to reducing planning costs, duplication, and/or avoiding conflicts?

The institute actively engages stakeholders/partners on an ongoing basis in order to remain current on all things restoration and/or natural resources in Arizona. They often are the ones that identify areas of duplication and/or ways in which costs could be reduced through more coordinated efforts, and are never afraid to offer their services as a third party neutral partner organization.

“I believe that ERI leadership and staff have been instrumental in the success of the 4FRI stakeholder process, and continue to be a leader in helping to resolve conflicts that arise within this very diverse group. ERI has shown they are an effective (almost neutral) organization having the diplomatic skills to work in an ever changing environment here in AZ—environmental, economic and political.”

The ERI’s involvement and assistance has allowed the forest to successfully complete large scale, broad-brush NEPA documents (17,000-acre and 138,000-acre). This has been a huge help in getting work done on the ground. In addition, having a third party scientific institute involved has helped reduce conflict.

The institute has served as the main organizational entity, providing effective and timely communications, developing and maintaining a clearinghouse for information and consistently providing capable and professional leadership and support staff to keep the ultimate goal of landscape restoration at the forefront of our efforts.

I feel they bring a balanced approach to the discussions and planning for NFMA efforts, etc.

When land managers take a project on, ERI is there to fill a void. For two projects—the Arroyo and Upper Rocky—ERI completed some data and analysis the ranger district couldn’t get anywhere else, according to one interviewee.

“They provide us with information we can’t get or don’t have the skill to pull out of databases. Every time they talk to us, they talk about efficiency and over collection of data.

They meet with us before we begin to find out what we need and how to provide it in the most efficient way possible.”

8. In what ways has the institute promoted improved cooperation with local entities? Regionally? With federal agencies?

ERI is often looked to by many partners as a convener because they have a “neutral” connection to so many local organizations and agencies, according to one interviewee. “I get the impression that there could be more regional coordination with the Forest Service and the RMRS. They have a remarkable rapport with the six national forests in Arizona, as well as local and state level entities.”

“In my opinion, the open, timely and professional actions of the institute makes it very easy for all entities, across all levels, to receive consistent information based on best practices and science. The institute welcomes and respects all entities, large and small, government and NGO alike, and encourages participation by all. The institute has also been a leader in coordinating and in many cases staffing visits to Washington, Region 3 headquarters and elsewhere as needed.”

ERI is useful in collaborative conservation efforts. “When we worked with the Natural Resources Working Group (NRWG), many groups were opposed to what we were trying to do.” Stakeholders that participate in collaborative conservation efforts include the Arizona Game and Fish Department, the governor’s office, county governments, environmental groups, industry representatives (timber and livestock), federal agencies, and other broad and far reaching groups. ERI brought in NAU for an academic perspective. “NAU helped at first, but ERI continues to provide that scientific expertise at these meetings. They also attend the regional meetings.”

9. Are there any other insights or suggestions you would like to share regarding past or future work of the institute?

The area of economic analysis and viability of restoration in Arizona needs more attention, as the forests in Arizona are not considered typical “high value” timber producers, according one interviewee. “There needs to be a better understanding and balance of the economic viability of restoration as part of the Forest Service planning and contracting processes. ERI has the capacity, credibility, history, and relationships to play a key role in coordinating this effort with a number of key partners in Arizona currently looking at this issue/gap in information/knowledge.”

“I believe ERI could be an ongoing source for facilitation and conflict resolution services in collaborative stakeholder work across the state.”

“Because landscape scale restoration will be taking place over several decades, it’s my hope that the institute will continue with the efforts that they’ve made in the past and that they’ll always be able to attract the high caliber staff that we’ve enjoyed working with to this point.”

“It would be a loss if they go away. We have really benefited from the information and help they provide. And on the groups that have the ability to say no (to restoration projects)—but because of the collaboration underway, these groups elected not to say no.”

One interviewee stated that ERI's assistance with the treatment areas is an example of how catastrophic fire prevention is important in Arizona, because most cutting and thinning of forest trees has stopped in the Southwest. As a result, several very large fires, such as the Rodeo-Chediski and the Wallow fires, two of the worst fires in Arizona history, could have been less severe if the surrounding national forest areas had been treated with landscape scale forest restoration. "We volunteered to do that with the White Mountain Stewardship Project—we were an example in Arizona and the region—for people to see treated areas—we would schedule fieldtrips for people to see it. We were the only game in town. Visually the public doesn't get it until you show them a treatment area versus a burned area. Then they see it."

ERI's involvement in public tours has helped groups understand why more than just the forest understory needs to be thinned. In fact, too many trees in the forests of Arizona are not natural to the region, according to an interviewee who worked with ERI on the Blue Ridge Demonstration Project, which involved three levels of forest treatment. "On the tour, Dr. Covington discussed ERI's prescription to mimic what the forest looked like before the settlers arrived in the early 1870s. We talked about what happens when you don't do a treatment—the forest nukes out—unless you start thinning and removing some of that fuel. Dr. Covington showed us that we didn't have an opening in the canopy so we needed to improve our next phase. We still needed to remove 60 percent of the trees to get close to what the forest looked like 140 years earlier—we needed to break up openings in the forest canopy, not just thin the bottom. The way he presented it was a teachable moment for me and a whole lot of people on the tour. He explained 140 years ago, the forest in this area was a savannah-like forest with 25 trees to the acre. Now there are 100s to 1,000s per acre. One hundred years ago, the grass took most of the moisture so the trees couldn't reproduce—frequent fires helped thin forest—every three to seven years a fire would come through and consume the grass. Mother Nature sustained more open forest. After the settlers arrived, they brought in large numbers of cows and sheep to eat the grass and unintentionally overgrazed the area so grass couldn't provide the fire preventive measures it did when there was much more. People had an anti-fire mindset back then. But every seven years or so, we have above average moisture years, which leads to pine seeds which breeds pine trees."

Appendix E — Acronyms

BIA – Bureau of Indian Affairs

BLM – Bureau of Land Management

CFLRP – Collaborative Forest Landscape Restoration Program

CFRI – Colorado Forest Restoration Institute

CFRP – Collaborative Forest Restoration Program

CSFS – Colorado State Forest Service

DoD – Department of Defense

EQIP – Environmental Quality Incentives Program

ERI – Ecological Restoration Institute

ERI-NAU - Ecological Restoration Institute at Northern Arizona University

FTE – Full-Time Equivalent

FWS – U.S. Fish and Wildlife Service

GIS – Geographic Information System

LEARN – Long-term Ecological Assessment and Restoration Network

NFF – National Forest Foundation

NAU – Northern Arizona University

NFMA – National Forest Management Act

NGO – Non-Governmental Organization

NMFWRI – New Mexico Forest and Watershed Restoration Institute

NMHU – New Mexico Highlands University

NMSLO – New Mexico State Land Office

NRCS – Natural Resource Conservation Service

RMRS – Rocky Mountain Research Station

SWERI – Southwest Ecological Restoration Institutes

SWFSC – Southwest Fire Science Consortium

TNC – The Nature Conservancy

WHO – New Mexico Forest and Watershed Health Office

WUI – Wildland-Urban Interface

Appendix F — State Government Charter

Charter for the Southwest Ecological Restoration Institutes

This Charter clarifies the goals, duties and operating procedures for the SOUTHWEST ECOLOGICAL RESTORATION INSTITUTES, and their respective states, as envisioned in PL 108-317. This Charter is entered into by and among the Governors of the States of Arizona, Colorado and New Mexico, and the Presidents of Northern Arizona University, Colorado State University and New Mexico Highlands University, on behalf of their respective governing boards, hereafter referred to collectively as “the Parties”.

1. PURPOSE

A. The purpose of the SOUTHWEST ECOLOGICAL RESTORATION INSTITUTES (“SWERI”) is to bring the unique strengths of the member universities, individually, collectively and in cooperation with other institutions to help support land managers and their collaborators working to achieve comprehensive ecological restoration treatments on the ground.

B. To assure that ecological restoration treatments are effective and efficient, the institutes identified by PL 108-317 will develop, translate and transfer practical, operation-oriented scientific knowledge to land managers, collaborative community groups and others who cooperate in the design and implementation of ecosystem restoration treatments. A key mission is to assure, through systematic collaboration and coordination of resources, that all levels of government and stakeholders from the local to the state, regional, and national levels have the best information available to ensure that collaborative ecosystem restoration treatments are implemented in the most effective and efficient manner for restoring the ecological, economic, and social integrity of the greater ecosystems of the Interior West.

C. The SOUTHWEST ECOLOGICAL RESTORATION INSTITUTES are established by Northern Arizona University, Colorado State University and New Mexico Highlands University. The respective states will be involved and represented, at a minimum, by their State Foresters. The institutes will have many diverse stakeholders who are involved in the design and implementation of ecological restoration treatments in frequent fire forests and associated woodlands. These stakeholders may include when appropriate, but are not limited to: the federal land management agencies; state governments; tribes; elected officials; local governments; and nongovernmental entities that include collaborative community groups and environmentalists, the Western Governors’ Association, and business.

D. The SOUTHWEST ECOLOGICAL RESTORATION INSTITUTES has no regulatory authority and recognizes that all legal authority is reserved by its members in accordance with existing law. It also recognizes that the institutes, by virtue of their affiliation with universities, may have duties beyond those specified in this agreement.

2. BACKGROUND

A. The need for restoring ecosystem health in the Southwest has been evident for decades, especially for its ponderosa pine and drier mixed conifer forests. As a result of disruption of the natural frequent fire regime and past harvesting and grazing practices, forests became dense and vulnerable to unnaturally severe, stand-replacing fires. In many watersheds, over 90% of these

forests are considered at moderate or high risk for crown fires due to dense stand structure and accumulated fuels. Fire acreage and size have been steadily increasing, culminating in the largest fire in southwestern history, the 468,000-acre Rodeo-Chediski fire in 2002, a fire that devastated watersheds and economies over an entire region. Entire states and regions are now at risk of losing the ecological and environmental benefits of greater ecosystems at the scale of millions of acres.

B. Many managers, from resource specialists to land managers, feel that science shows that thinning, burning, and other forest restoration techniques can be effective in restoring forest health and reducing the threat of unnatural fire in the frequent fire forest types of the Interior West. A central question is how to use the best science to get restoration done in the most effective and efficient way possible, while learning how to improve our treatments as we move forward. Although there are clear needs for the discovery of additional scientific information, the flood of existing scientific literature, the disconnected sources of information, and the complexity of environmental analysis can overwhelm the resources of practitioners, stakeholders and decision-makers. Wildland ecosystems and their dependent human communities are the ultimate victims if managers cannot mobilize the critical information for rapid, thorough, and scientifically defensible environmental analysis.

3. STRUCTURE

A. Goals and Legislative Intent

3.1. Goal. The goal of the SOUTHWEST ECOLOGICAL RESTORATION INSTITUTES is to obtain, summarize, and transfer relevant and accurate scientific information to managers and other key stakeholders.

3.2. Legislative Purpose of PL 108-317 as published is:

- a. To enhance the capacity to develop, transfer, apply, and monitor, and regularly update practical science-based forest restoration treatments that will improve the health of dry forest and woodland ecosystems and reduce the risk of severe wildfires, in the Interior West;
- b. To synthesize and adapt scientific findings from conventional research programs to the implementation of forest and woodland restoration on a landscape scale;
- c. To facilitate the transfer of interdisciplinary knowledge required to understand the socioeconomic and environmental impacts of wildfire on ecosystems and landscapes;
- d. To require the institutes established under this Act to collaborate with Federal agencies--
 - i. to use ecological restoration treatments to reverse declining forest health and reduce the risk of severe wildfires across the forest landscape;
 - ii. to design, implement, monitor and regularly revise wildfire treatments based on the use of adaptive ecosystem management;
- e. To assist land managers in--

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- i. Treating acres with restoration-based applications; and
- ii. Using new management technologies (including the transfer of understandable information, assistance with environmental review, and field and classroom training and collaboration) to accomplish the goals identified in--
 1. The report entitled '10-Year Comprehensive Strategy: A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment' of the Western Governors' Association;
 2. The report entitled 'Protecting People and Sustaining Resources in Fire-Adapted Ecosystems-A Cohesive Strategy' (65 Fed. Reg. 67480); and
 3. The National Fire Plan.
- f. To provide technical assistance to collaborative efforts by affected entities to develop, implement, and monitor adaptive ecosystem management restoration treatments that are ecologically sound, economically viable, and socially responsible; and
- g. To assist Federal and non-Federal land managers in providing information to the public on the role of fire and fire management in dry forest and woodland ecosystems in the Interior West.

B. Duties

3.3. Institutes. Each institute shall engage in the following activities to the extent funding for such activities has been appropriated pursuant to PL 108-318 or is otherwise made available:

- a. Provide an annual work plan as a condition to receive federal funds for each fiscal year **on a date to be determined by the US Department of Agriculture-US Forest Service in consultation with the Department of the Interior.** The work plan will follow the template provided by the Secretaries.
- i. The annual work plans will be developed in consultation with the Secretary of Agriculture/US Forest Service, the Secretary of Interior, the State Foresters and the stakeholders as described in paragraph 1.C above.
- ii. The work plans will contain assurances and performance measures that are satisfactory to the Secretaries and reflect that the activities will serve the legislative purpose of PL 108-317
 - b. Develop, conduct research on, transfer, promote, and monitor ecosystem restoration treatments including restoration-based hazardous fuel reduction prescriptions to reduce the risk of severe wildfires and improve the health of dry forest and woodland ecosystems in the Interior West;

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- c. Synthesize and adapt scientific findings from conventional research to implement restoration-based hazardous fuel reduction treatments on a landscape scale using an adaptive ecosystem management framework;
- d. Translate for and transfer to affected entities any scientific and interdisciplinary knowledge about restoration-based hazardous fuel reduction treatments;
- e. Assist affected entities with the design of adaptive management approaches (including monitoring) for the implementation of restoration-based hazardous fuel reduction treatments;
- f. Provide for continuing education, formal coursework, and public education as necessary and useful;
- g. Convene one or more meetings among the institutes annually to share lessons learned and to coordinate activities so as to avoid undesirable duplication;
- h. Subject to the availability of federal funding, convene, state-by-state, one or more meetings annually of the stakeholders identified in paragraph 1.C above to: define and prioritize science needs; identify and prioritize information needs that can be synthesized from existing information; and, identify audiences that will benefit from the services provided by the institutes. If a representative body able to perform these functions already exists in the state, an institute may use its services to fulfill this requirement;
- i. Provide peer-reviewed annual reports to the university presidents, the Governors, the Secretary of Agriculture and Chief of the Forest Service and Secretary of Interior;
 - i. For purposes of this Charter, peer review means a meeting of the stakeholders identified in paragraph 1.C to review the annual report and work conducted by each institute.
 - ii. The annual peer-review will be conducted by October 31 following the end of the federal fiscal year. A final report will be prepared by December 31st of the same year.
- j. Notwithstanding any provision of this Charter to the contrary, no institute shall be prohibited from performing its duties described herein and other functions by contracting for their performance.

3.4. States. The state funding for the institutes required under this Section 3.4 may be provided by the annual University budget or funding for the institutes may be provided by other sources as may be available and appropriate. Each state:

- a. Shall provide facilities for the institutes; and
- b. Shall provide state funding to support a portion of the operations of the institutes.

C. Charter Implementation

3.5. Coordinating Committee. There is hereby created a Coordinating Committee whose membership and purposes shall be:

- a. The Coordinating Committee shall consist of the Executive Director(s) of each institute, the State Forester from each state, a designated representative of each state Governor and a representative of the Western Governors Association.
- b. The primary purpose of the Coordinating Committee is to implement the purposes and intent of this Charter by providing management and administrative guidance on matters affecting all the Parties.
- c. The Coordinating Committee shall adopt its own procedures and determine the frequency of its meetings.
- d. Examples of matters affecting all the Parties include, but are not limited to:
 - (i) Establishing protocols for communications among all three institutes;
 - (ii) Identifying opportunities for leveraging resources;
 - (iii) Addressing common interests and opportunities for mobilizing critical information for rapid, thorough and scientifically defensible environmental analysis;
 - (iv) Determining how the institutes should collectively model collaboration as a primary value.
- e. Subject to the availability of funds, each institute will fund its own participation in the annual meeting, travel, communications and incidental expenses of the Coordinating Committee.

4. Amendment

This Charter may be amended only by an instrument in writing executed by an authorized representative of each Party.

5. Termination

If, as a result of the monitoring and evaluation five years following enactment of PL 108-318, the Secretary, in consultation with the Secretary of the Interior, determines that an institute does not qualify for further Federal assistance under this Act, the non-qualifying institute shall receive no further Federal assistance under this Act, and shall cease to be a Party to this Charter, until such time as the qualifications of the institute are reestablished to the satisfaction of the Secretaries.

6. Participant signatures

NOW, THEREFORE, in consideration of the mutual promises set forth above, the undersigned Parties do hereby execute this Charter, which shall become effective on the date on which it has been signed by all Parties.

On behalf of the States:

Governor Janet Napolitano, Arizona	Date
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Governor Bill Owens, Colorado	Date
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Governor Bill Richardson, New Mexico	Date
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On behalf of the Institutes:

President John Haeger, Northern Arizona University	Date
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President Larry Edward Penley, Colorado State University	Date
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President Manny Aragon, New Mexico Highlands University	Date
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