COLORADO FOREST RESTORATION INSTITUTE
2019 ANNUAL REPORT

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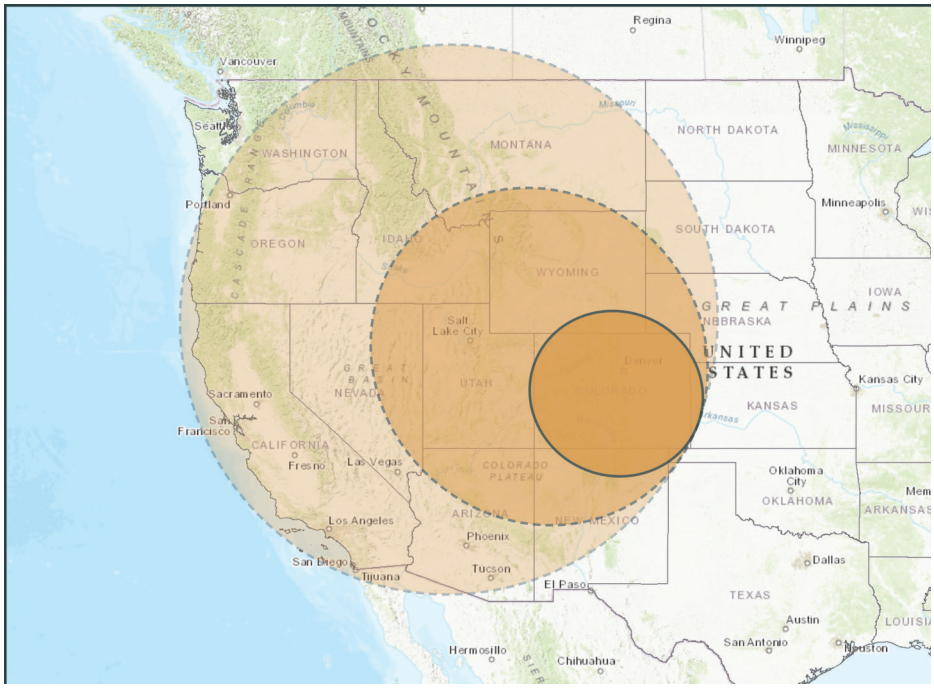
COLORADO FOREST RESTORATION INSTITUTE

FOREST AND RANGELAND STEWARDSHIP
COLORADO STATE UNIVERSITY

About the Colorado Forest Restoration Institute

The Colorado Forest Restoration Institute (CFRI) was established in 2005 as an application-oriented program of the Department of Forest & Rangeland Stewardship in the Warner College of Natural Resources at Colorado State University. CFRI's purpose is to develop, synthesize, and apply locally- relevant science-based knowledge to achieve forest restoration and wildfire hazard reduction goals in Colorado and the Interior West. We do this through collaborative partnerships involving researchers, forest land managers, interested and affected stakeholders, and communities. Authorized by Congress through the Southwest Forest Health and Wildfire Prevention Act of 2004, CFRI is one of three Institutes comprising the Southwest Ecological Restoration Institutes, along with centers at Northern Arizona University and New Mexico Highlands University.

The Colorado Forest Restoration Institute at Colorado State University receives financial support through the Cooperative and International Programs of the U.S. Forest Service, Department of Agriculture, under the Southwest Forest Health and Wildfire Prevention Act. In accordance with Federal law and U.S. Department of Agriculture policy, this institution is prohibited from discriminating on the basis of race, color, national origin, sex, age, or disability. To file a complaint of discrimination, write: USDA, Director, Office of Civil Rights Room 326-A, Whitten Building 1400 Independence Avenue, SW Washington, DC 20250-9410 or call (202) 720-5964 (voice & TDD).



Our Colorado-focused, field-based research informs and empowers local decision making and adaptive management processes. Throughout the Rocky Mountains and Intermountain West, we learn and share expertise about frequent fire forests, and convene collaborative groups across landscapes. Nationally, we bring science-based knowledge to decision makers at all levels.

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Background

Fire is an essential part of how forests renew and sustain. However, historic land uses and decades of fire suppression has excluded fire from millions of forested acres in Colorado and across the western United States. Since the early 1990s, the size and severity of wildfires have increased; human land use and development in fire-prone forests have also expanded. This combination of factors has resulted in the loss of life, property, and highly-valued natural, social, and economic assets from wildfires. This is forecasted to continue due to increases in average annual temperatures, the frequency, duration, and severity of drought, and human contributions to ignitions and complex forest management values on the landscape.

Restoration aims to reduce this vulnerability to forests and communities by applying mechanical, manual, and managed fire (both natural and planned ignitions) methods to alter or remove forest vegetation. By doing this, fires – when they do occur – can result in lower social and economic losses and costs, and serve their natural role in renewing forests. However, the cost, complexity, and controversy associated with forest restoration requires that forest managers and interested and affected stakeholders access and apply locally-relevant science-based knowledge to communicate and strategically identify the location, size, and types of restoration actions to produce the most benefits. While researchers in federal agencies and universities produce scientific findings relating to forest and fire ecology, it is not in their missions to engage with managers and stakeholders to localize these findings into project planning, analyses, design, and monitoring, and adapting future plans. Similarly, managers and stakeholders rarely have sufficient time and expertise to access, interpret, and localize scientific findings to inform effective forest restoration. Often the local forest and fire ecology does not align with desired ecosystem services and forest uses, creating complex tradeoffs and management decisions. What is needed are entities that can act as bridges and translators between research and management.

To address this gap, the Southwest Forest Health and Wildfire Prevention Act was enacted by Congress in 2004 (Public Law 108-317). The act authorized the establishment and federal funding support for university-based institutes in Arizona, Colorado, and New Mexico. As specified by the Act, the duties of each Institute are to:

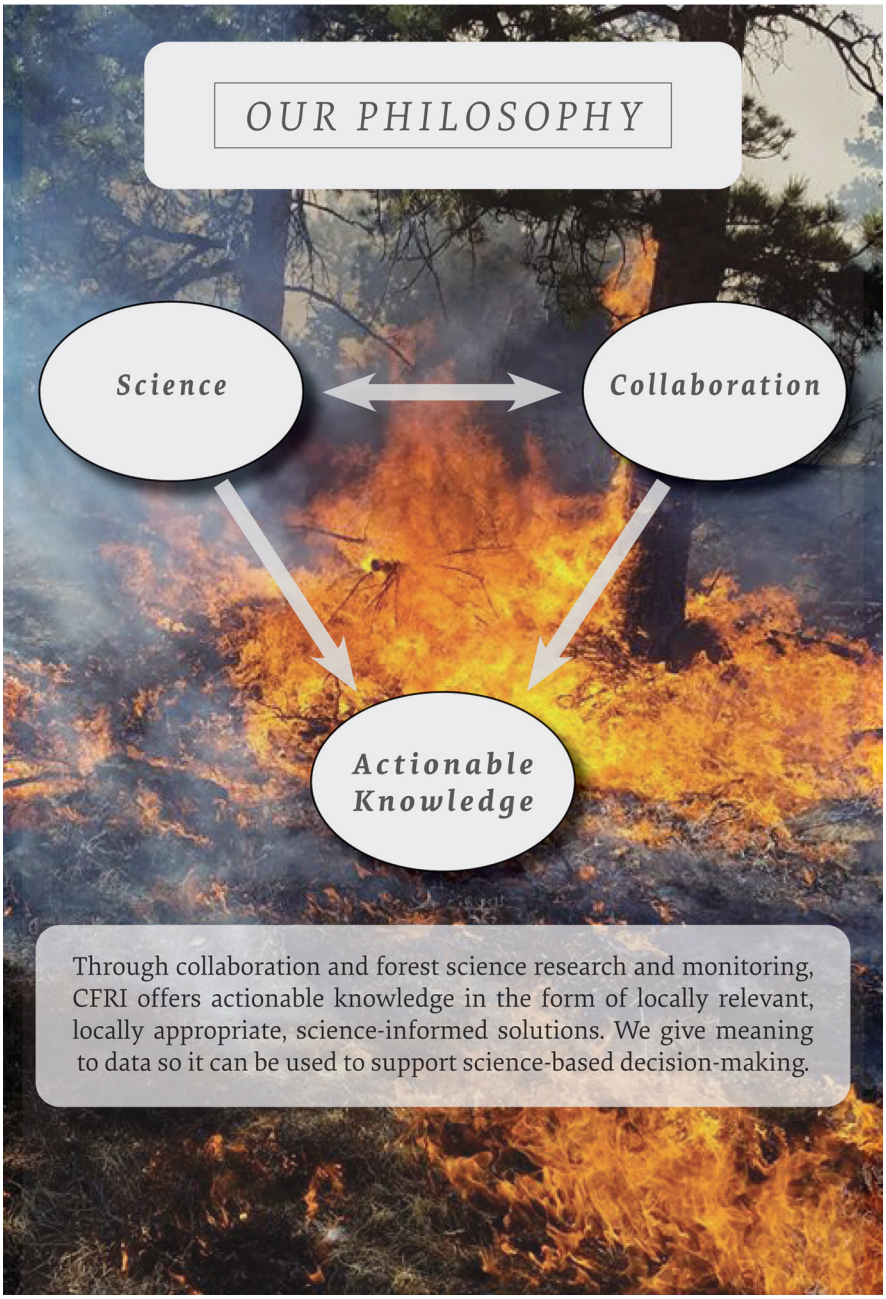
> (1) Develop, conduct research on, transfer, promote, and monitor restoration-based hazardous fuel reduction treatments to reduce the risk of severe wildfires and improve the health of dry forest and woodland ecosystems in the interior West;
>
> (2) Synthesize and adapt scientific findings from conventional 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.

Per the fifth (5) duty of the act, this annual report provides information about accomplishments of the Colorado Forest Restoration Institute (CFRI) at Colorado State University for calendar year 2019 for deliverables approved by the Southwest Ecological Restoration Institutes (SWERI) Executive Team and funded under the Act. In 2019, CFRI had three active agreements under the Act. Deliverable accomplishments for each are included in this report:

- FY17 CFRI annual work plan, active 8/8/2017 through 9/30/2019.
- FY18 CFRI annual work plan, active 7/1/2018 through 9/30/2020.
- FY19 CFRI annual work plan, active 7/1/2019 through 9/30/2021.

Organization

CFRI is hosted in the Department of Forest and Rangeland Stewardship, one of five academic departments in the Warner College of Natural Resources at Colorado State University. Tony Cheng is Professor in the Forest and Rangeland Stewardship department and serves as the director of CFRI. Dr. Cheng has been director since April 2008. In calendar year 2019, CFRI had twelve full-time employees (including Dr. Cheng) and approximately thirteen part-time or seasonal employees. Our seasonal and part time employees included undergraduate students, graduate students, and non-student staff. All CFRI employees report to Dr. Cheng. In turn, Dr. Cheng reports to the head of the Forest and Rangeland Stewardship department. Heads of all departments in the Warner College report to the college's Dean. In addition to staff who hold their primary appointment with CFRI, we leverage other CSU faculty, staff, and graduate students to add their specialized expertise for our projects on an as needed basis.



Accomplishments

Funding

CFRI funding comes from allocated dollars through the SWERI-approved work plan, agreements with federal and state government and nongovernmental sources, competitive research grants, and charitable gifts. SWERI workplan funding is used to incubate and support innovative new ideas, to augment existing CFRI agreements and projects where significant value can be added, and to support knowledge transfer and application between projects and partners. In this way we create a bridge between research and management, multiplying the impact of applied research and leveraging deep engagement in place based local monitoring and adaptive management processes to share cumulative broader impacts throughout the Intermountain West. Many of our agreements span multiple years. As a snapshot of our funding, the table below includes all CFRI funding sources and agreements signed during calendar year 2019.

Source	Project Title	Agreement Number	Amount
Oregon State University / Joint Fire Science Program	Co-managing Risk or "Parallel Play"? Examining Connectivity across Wildfire Risk Mitigation and Fire Response in the Intermountain West, MOD 1	L17AC00230 (prime); L0196B-A (subaward), MOD 1	$19,992
The Nature Conservancy / USFS State and Private	Developing and Implementing an Ecological Effectiveness Monitoring Strategy, and Developing and Evaluating a Process to Improve Wildfire Response in the Upper South Platte Watershed, MOD 1	Subaward G052017-CFRI (parent agreement 15-DG-11020000-069)	$150,000
US Forest Service, Grand Mesa-Uncompahgre-Gunnison NF	Monitoring Ecological, Social, and Economic Effects of the Uncompahgre Plateau Collaborative Forest Landscape Restoration Project, MOD 2	17-CS-11020400-023	$27,389
USDA Forest Service - Southwest Region	Colorado Forest Restoration Institute, FY19	19-DG-11031600-062	$750,000
USDA Forest Service - Rocky Mountain Region	Forest-to-Faucets Assessment and Monitoring, MOD 3	16-CS-11020000-062	$180,000
The Nature Conservancy, Fire Learning Network	Fire Planning and Capacity Building Support	CSU_CFRI_2019 A104749	$20,068
Mountain Studies Institute	Science Based Support To Inform The Planning, Monitoring, And Adaptive Management For Ecological Forestry Practices In Southwest Colorado	Institutional award number 007957-00002 for USFS Prime award 16-PA-11021300-039	$55,212
Peaks to People Water Fund	Support from Peaks to People Water Fund	Gift through CSU Foundation	$54,000
US Forest Service, Arapaho-Roosevelt NF/Pawnee NG	Science-Based Support to Sustain the Resilience of Colorado's Front Range Forests, Watersheds, and Communities to Wildfire MOD 2	17-CS-11021000-032	$352,934
US Forest Service, Rocky Mountain Research Station	Restoring resiliency in coniferous forests of the western united states	19-JV-11221633-198	$28,000
Jefferson County Open Space	Development of tools for assessing restoration effects on landscape-scale processes in Jefferson County Open Space	007990-00002	$9,524
US Forest Service, Rocky Mountain Research Station	Provide Science-Based Information to Aid the GMUG in Implementing Adaptive Management Strategies in Beetle Impacted Spruce-Fir Forests	15-CS-11221633-098	$57,000
		TOTAL	**$1,704,120**

In the past five years, CFRI has been successful at leveraging SWERI annual work plan funding to procure additional funds for support of project development, planning, monitoring, and adaptive management on federal (primarily National Forest Systems lands) and non-federal lands. The table below shows these amounts as evidence of the value added by CFRI to the federal SWERI annual workplan funding:

Year	SWERI Work Plan Funding ($thousands)	Additional Federally-funded projects ($thousands)	State funding and additional non-federally funded projects ($thousands)	Work Plan Leveraged Funding Ratio ($thousands)
2015	150	530	330	5.7
2016	150	590	372	6.4
2017	150	981	423	9.4
2018	450	698	512	2.7
2019	750	890	595	2.0
TOTAL	**1,650**	**3,689**	**2,232**	**5.2**

State Support

The State of Colorado, through its support to Colorado State University, provides financial support for CFRI facilities and administration, as well as 9 months of faculty salary to Tony Cheng to serve as Director of CFRI. In 2019, this support totaled approximately $531,000.

2019 Highlights

Case Studies: SWERI Funding Connects Partners and Projects to Amplify CFRI's Impact

At CFRI, our broad range of collaborative relationships facilitates problem solving, while our analytical capacity advances the application of science-based tools and solutions. These two case-study examples illustrate how CFRI leverages SWERI annual workplan funding along with research grants and on the ground application projects to multiply our impact. In this way, CFRI bridges science and management for our partners to do the right work, in the right places, at the right scale, advancing science informed forest restoration and wildfire hazard reduction across the west.

SWERI Funding Breaks Down Barriers: Cross-Boundary Fire and the Tools to Plan for It

Leveraging SWERI Funding to Support the Northern Colorado Fireshed and PODs

CFRI leverages SWERI annual workplan funds with independent agreements to make funding go further, fill critical gaps, and make knowledge and products accessible to everyone. This diverse funding and engagement approach multiplies CFRI's impact.

- Eager to use prescribed burns as learning opportunities, the Peaks to People Water Fund and Arapaho-Roosevelt National Forest funded CFRI to conduct pre- and post-burn effectiveness monitoring in Northern Colorado.
- Leveraging SWERI work plan funds, CFRI collaborated with local USFS to get partners in the same room and facilitate initial communications about burns.
- The Arapaho-Roosevelt National Forest funded key partners CFRI, RMRS, and CPRW to stand up the NoCo collaborative and deploy PODs across the forest.
- Joint Venture Agreement partnerships between CFRI, RMRS, and Colorado State University faculty fund co-development of fire modeling tools, applied science research, and engagement with national forests around the country as they create their own PODs networks.
- CFRI uses SWERI funding to document and disseminate PODs tools and processes across peer-reviewed publications, technical briefs, webinars, and blog posts to share lessons learned.
- Funding from The Nature Conservancy Fire Learning Network has expanded CFRI's burning without borders expertise throughout the Rocky Mountain region.

In 2017, the Arapaho-Roosevelt National Forest and The Nature Conservancy (TNC) were independently planning prescribed fires on adjacent lands. Engrossed in safely conducting their own burns, each organization was unaware of the others' plans until after the smoke had cleared. Had there been more cross-boundary communication in this case, these agencies could have pooled resources and worked together to complete a large-scale prescribed burn. This situation inspired conversations about how to develop solutions for land-

scape-scale management and improve collaborative cross-boundary burning. With inside knowledge of each agency's burn plans, Colorado Forest Restoration Institute (CFRI) was uniquely positioned to bridge the gap, and leveraged SWERI work plan funding to help multiple agencies—including the Arapaho-Roosevelt National Forest, USFS Rocky Mountain Research Station (RMRS), Coalition for the Poudre River Watershed (CPRW), and TNC, coalesce into the Northern Colorado Fireshed Collaborative. The NoCo Fireshed has blossomed into a leader in collaborative cross-boundary wildfire planning, and has accomplished more prescribed fire over the past 3 years than any other group on the Colorado Front Range.

Sharing maps and spatial analytical planning tools that inform decisions across all jurisdictions is at the heart of the group's efforts. The NoCo Fireshed uses a spatial wildfire planning framework called Potential Operational Delineations (PODs). PODs acknowledges that fire does not respect jurisdictional boundaries, and instead the framework builds on the longstanding practice of firefighters identifying features on the landscape which could serve as control lines during wildfire operations. This knowledge can be captured and enhanced with advanced wildfire modeling and spatial analysis before the fire season even starts, and used for collaborative planning. For example, PODs can show where mitigation treatments like prescribed fire or tree thinning could enhance control lines to reduce wildfire risk to communities or water infrastructure. PODs can be even more powerful when combined with other tools like multi-resource risk assessments that incorporate timber, wildlife, recreation, and other priorities onto one map that demonstrates how fire might positively or negatively impact a portion of the landscape. The PODs framework empowers agencies to work together at the scale of a wildfire, rather than within their boundaries alone.

With the help of CFRI and RMRS, over 20 National Forests are beginning to implement this planning framework, and some are already using it to make decisions. On the 2019 Amole fire in New Mexico, Taos Bureau of Land Management (BLM) staff responded to a fire on the Carson National Forest where CFRI and RMRS had helped develop PODs. With information about Carson National Forest's PODs network in hand, BLM staff recognized that this fire could be managed using indirect response strategies, and fire was reintroduced to over 1,900 acres, reducing fuels and fire risk for the rest of the Forest. This case in particular demonstrates how incorporating PODs and information sharing into preseason interagency planning facilitates shared stewardship and cooperative decision making.

On the Front Range, PODs efforts on the Arapaho-Roosevelt National Forest have instigated creation of a seamless PODs network for the adjoining Pike-San Isabel National Forest. PODs workshops that CFRI has helped facilitate have produced interagency cooperation, as Rocky Mountain National Park fire management staff have begun to apply the framework to the Park, which sits in the middle of the Arapaho-Roosevelt PODs network. CFRI uses science and analytical tools to empower the work of shared stewardship, and to identify collaborative opportunities across fire-adapted landscapes.

Power to the People in Chaffee County: Measuring Outcomes of Wildfire Risk Reduction Programs

How our funding goes further: taking lessons from our portfolio of work and applying them to new and innovative projects

CFRI leverages SWERI annual workplan funds with independent agreements to make funding go further, fill critical gaps, and make knowledge and products accessible to everyone. This diverse funding and engagement approach multiplies CFRI's impact.

2015

A McIntire-Stennis Grant funded a research project that calculated return on investment for a small portion of the Forest to Faucets Partnership (a collaboration between Denver Water and US Forest Service that aims to protect Denver's drinking water supply from wildfire impacts). An academic paper for this project was released in 2017.

2016

CFRI applied lessons learned from Forest to Faucets Partnership to engagement with the Peaks to People Water Fund and four Northern Colorado water providers to develop the Watershed Investment Tool using Peaks to People funding. This tool used input from local forest and water utility mangers to model post-wildfire erosion impacts on water infrastructure, identify where water resources were most at risk from wildfire, and economize the return on investment to incentivize downstream water users to protect upstream forests vulnerable to wildfire. Our science based analysis spatially prioritized where downstream investors got the biggest bang for the buck engaging in proactive forest management to protect water supplies before smoke is in the air.

2018

The Forests to Faucets Partnership funded CFRI and partners at CSU to leverage the framework developed for the Peaks to People Watershed Investment Tool to quantify the return on investment of the entire Forests to Faucets program, sprawling nearly 4 million acres across 3 national forests.

2019

Working with Envision Chaffee County, CFRI leveraged SWERI funding and expanded this framework to include additional values beyond watershed protection, prioritizing and measuring wildfire risk reduction outcomes at the scale of the county, watershed, or fireshed.

An initially small effort to add values of ecosystem services to CFRI's project level ecological monitoring has ballooned into a robust Risk Analysis and Decision Support (RADS) system that is the foundation for allocating county tax dollars towards forest management projects in Chaffee County. RADS takes measuring outcomes to a whole new level.

CFRI developed RADS through several pilot projects with Peaks to People Water Fund, Denver Water, and the US Forest Service measuring benefits of forest management to improve resilience of drinking water resources to wildfire. However, the Envision Chaffee County group saw greater potential for the locally driven, science-based watershed risk assessment tools we developed. CFRI's recent work in Chaffee County incorporates many more stakeholder values beyond watershed protection, including human safety, infrastructure and homes, water resources, wildlife habitat, and recreation. CFRI analyzed likely impacts from wildfire to all these values, and mapped community priorities in relation to wildfire risk, often in real time during community meetings. Participants could then collectively visualize and evaluate tradeoffs how prioritizing risk reduction to one value could impact another. Through compromise, discussion, and CFRI technical modeling expertise, the participants arrived at a plan in which everyone could see their values represented on the map, was amenable to the trade-offs made between priorities, and agreed on specific areas where forest management investments would yield the greatest bang for the buck to achieve their desired outcomes.

The collaborative planning process facilitated by CFRI analytical tools has paid off. Community leaders who participated in the planning sessions brought their consensus to the citizens of Chaffee County, and used CFRI maps and analysis to explain how they arrived at the shared priorities in the risk assessment. In 2019 voters in Chaffee County approved a sales tax increase to fund projects that reduce wildfire risk and improve ecological function in forest throughout the county. The advisory committee overseeing the Chaffee County Common Ground program is using CFRI's analysis to guide allocation of tax dollars and matching grants to projects that maximize impact towards shared outcomes. The County Commissioners and other partners unanimously approved the Community Wildfire Protection Plan informed by our analysis in February 2020.

RADS compliments CFRI's robust project level monitoring program by measuring outcomes across large landscapes and multi-million dollar forestry programs. The collaboration in Chaffee County served as a successful test case to demonstrate the RADS framework for communities to identify, prioritize, and measure program outcomes to protect values at risk with CFRI technical assistance. The RADS development process also illustrates how CFRI leverages SWERI resources with other projects such as Peaks to People Water Fund and Forest to Faucets Partnership to grow our impact into new areas. We are combining existing models in new ways, using our own technical modeling capacity and collaborative adaptive management expertise to empower and implement stakeholder decision-making processes that have tangible outcomes on the ground. Power to the people, in Chaffee County and beyond!

A Chaffee County fire official uses a CFRI data product to demonstrate treatment priorities to attendees at a community meeting.

Project deliverables

Following is a report on deliverables under three agreements active during calendar year 2019 that were authorized through the Southwest Ecological Restoration Institutes (SWERI) development and executive team workplan approval process for the Colorado Forest Restoration Institute to carry out the duties described in the Act:

For FY17 agreement number 17-DG-11031600-062, CFRI reports the following cumulative accomplishments toward each project deliverables in the work plan for dates while the agreement was active, including July 1st, 2017 through September 30th, 2019:

Deliverable	Status of Deliverables
Project 1: Supporting Collaborative Forest Landscape Restoration Projects	
1.1 Produce and disseminate 1-3 technical documents regarding multi-party monitoring strategies and results for the Front Range Collaborative Forest Landscape Restoration Project	Published paper: Cannon, JB, Barrett, KJ, Gannon, BM, Addington, RN, Battaglia, MA, Fornwalt, PJ, Aplet, GH, Cheng, AS, Underhill, JL, Briggs, JS, and Brown, PM, 2018. Collaborative restoration effects on forest structure in ponderosa pine forests of Colorado. For. Ecol. Manage. 424, 191-204. doi.org/10.1016/j.foreco.2018.04.026 https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/05/cannon-et-al-2018-FEM-CFLRP.pdf Developed and disseminated a discussion brief entitled, "Updated 'status of knowledge' for Front Range Roundtable fuel treatment goals and objectives". Accessible online at: https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/04/2018-FRRT-Status-of-Knowledge-matrix.pdf Spencer Elliot presented a poster on Spatial and Temporal effects of collaborative restoration on front range ponderosa pine dominated forests, titled: Elliott, S, Cannon, JB, and Briggs, JS. (2018) Spatial and temporal effects of collaborative restoration on Front Range ponderosa pine dominated forests. Front Range Student Ecology Symposium, Colorado State University, February 2018, Fort Collins, CO. The poster has been shared with many collaborative groups on the Front Range. https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/04/Elliott_FRSES_CFLRP_adaptive_management_spatial.pdf Schuetter, A, JB Cannon, and KJ Barrett. (2018). Effects of restoration treatments and adaptive management on forest structure in ponderosa pine forests of the Colorado Front Range. Celebrate Undergraduate Research and Creativity Showcase. April 2018. Fort Collins, CO. https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/04/Schuetter_CURC_CFLRP_adaptive_management.pdf
1.2 Produce and disseminate 1-3 technical documents	Completed report: Chambers, M. and Cannon, JB. (2018). Uncompaghre Plateau CFLRP Gambel oak understory response to mowing and prescribed burning treatments study summary. Colorado Forest Restoration Institute. CFRI-1801.

regarding multi-party monitoring strategies and results for the Uncompahgre Collaborative Forest Landscape Restoration Project.	https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/03/2018-CFRI-Gambel-oak-understory-study-summary.pdf Completed technical summary brief, and delivered poster at 2018 UP CFLR Annual Stakeholder meeting titled: Cannon, JB, Chambers, M, and Cheng, A. (2017). Monitoring trends in forest spatial patterns: Uncompaghre Plateau Collaborative Landscape Restoration Program. Colorado Forest Restoration Institute. CFRI-1703. Link to summary: https://cfri.colostate.edu/wp-content/uploads/sites/22/2017/10/CFRI1703_UP_CFLRP_Spatial_pattern_monitoring_2017.pdf Link to poster: https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/04/Cannon_UP_CFLRP_spatial.pdf
1.3 Conduct and report on at least two (2) field-based workshops per CFLR project to review and deliberate treatment effects and desired conditions.	June 29th-30th, 2018, Marin Chambers assisted with organizing and leading the Collaborative Forest Landscape Restoration field trip on the Uncompahgre Plateau near Montrose, Colorado. Co-organized and conducted a field workshop for the Front Range CFLRP on September 26th, 2018, to review and deliberate CFLR results, and disseminate RMRS-GTR-373 forest restoration framework, attended by ~75 people.
1.4 Document and distribute CFLR treatment design and monitoring approaches to other place-based collaborative forest efforts	Worked with the Southern Fire Exchange to produce and disseminate technical brief entitled, "Effects of forest restoration treatments and wildfires on tree spatial patterns in the Colorado Front Range" to land managers, forest restoration stakeholders, and researchers engaged in place-based collaborative forest restoration efforts beyond Colorado. Accessible online at: https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/03/AFE2017_Research-Highlight_Cannon.pdf Brett Wolk organized, presented restoration principles, and moderated a webinar discussion for the Forsythe II Multiparty Monitoring Group. April 2nd, 2018. The webinar was titled: "Principles and Application of the Front Range Restoration RMRS-GTR-373 to the Forsythe II Project." https://cfri.colostate.edu/projects/forsythe-ii-multiparty-monitoring/april-2-2018-group-webinar/ Chambers, M., Freels, E. Ex, S. "Gambel oak understory response to mowing treatments". Southern Rockies Fire Science Network Gambel Oak Webinar Symposium. November 13, 2018. https://www.youtube.com/watch?v=niNF9CBORCA
Project 2: Addressing Knowledge Gaps for Post-Disturbance Forest Recovery and Future Forest Resilience	
2.1 In collaboration with Paula Fornwalt at the Rocky Mountain Research Station and Jeff	***Jeff Underhill left his position as Regional Silviculturist during this performance period. Additional RMRS colleagues have joined the research as co-authors and provided more data and reviews, requiring more time and funding to complete the paper. A paper being led by CFRI staff Marin Chambers examining regional tree regeneration patterns following high severity fire is in preparation, targeted for

Underhill, Regional Silviculturalist, produce and disseminate 1-3 status of knowledge summaries of vegetation response following large-scale forest mortality events	submission to peer-reviewed journal in early 2020. Preliminary results of the work have been disseminated to interested stakeholders, including this webinar: Disseminated initial findings with a webinar led by CFRI staff Marin Chambers: Chambers, M., Fornwalt, P., Redmond, M., Malone, S., Battaglia, M. "Post-fire conifer regeneration in ponderosa pine dominated forests of the southern Rocky Mountains, USA." Utah State University Forestry Extension Learn at Lunch Webinar. August 28, 2018. https://www.youtube.com/watch?v=miiMb-i78ho
2.2 In collaboration with Mike Battaglia at Rocky Mountain Research Station, produce and disseminate 1-3 technical reports or management briefs concerning the status of scientific knowledge about spruce management effects about spruce management effects	Published paper: Mattson, L. R., Coop, J. D., Battaglia, M. A., Cheng, A. S., Sibold, J. S., & Viner, S. (2019). Post-spruce beetle timber salvage drives short-term surface fuel increases and understory vegetation shifts. *Forest Ecology and Management*, *437*, 348-359. https://cfri.colostate.edu/wp-content/uploads/sites/22/2020/01/Mattson_et_al_post_sprice_beetle_timber_salvage.pdf
2.3 Conduct and report on at least one (1) workshop to facilitate knowledge exchange regarding post-disturbance forest management options and effects	Marin Chambers delivered presentation, "Patterns of conifer regeneration following high severity wildfires in Southern Rockies ponderosa pine-dominated forests" at the Natural Areas Conference, October 10-12, 2017. Marin Chambers delivered presentation, "Patterns of conifer regeneration following high severity wildfires in Southern Rockies ponderosa pine-dominated forests" at the 7th International Fire Ecology and Management Congress, November 28-December 2, 2017.
Project 3: Assessing Treatment Effectiveness	
3.1 Produce and disseminate between 1-3 written reports on fuel treatment	Published paper: Rhoades, C, Pelz, K, Fornwalt, P, Wolk, B, and Cheng, T. (2018) Overlapping Bark Beetle Outbreaks, Salvage Logging and Wildfire Restructure a Lodgepole Pine Ecosystem. Forests, 9. doi: 10.3390/f9030101. https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/02/Rhoades-et-al-2018-Forests-1.pdf

effects on landscape-scale fire behavior, forest vegetation dynamics, and/or watershed values	Published paper: Malone, S, Fornwalt, P, Battaglia, M, Chambers, M, Iniguez, J, and Seig, C. (2018). Mixed-severity fire fosters heterogeneous spatial patterns of conifer regeneration in a dry conifer forest. Forests, 9. doi: 10.3390/f9010045. https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/04/Malone-et-al.-2018-Forests.pdf
3.2 Conduct and report on between 1-3 field-based workshops to review and deliberate treatment effects and desired conditions	August 16, 2017, three CFRI staff conducted a field workshop at a CSFS project near Golden, Colorado, to deliberate treatment effects and desired conditions with CSFS staff and private land owners, and discussed application of monitoring from the Forest to Faucets program to private lands forestry management. Brett Wolk (CFRI staff) led discussion about desired conditions and applications for development of Community Wildfire Protection Plan update for Chaffee County. Brett traveled to Salida, Colorado, and delivered presentation to Envision Chaffee County collaborative group, titled: "Watershed Wildfire Risk Assessments: Strategies, Tools, Scope, and Resources for Envision Chaffee County." Envision Chaffee County working session, Salida, Colorado. October 1st, 2018.
Project 4: Supporting Collaborative Capacity-Building	
4.1 Conduct, convene, organize, and report on between 1-3 site visits or workshops that bring together research scientists from RMRS, other federal agencies, and universities with participants of place-based forest collaboratives to transfer knowledge about, and assist in the development of, science-based methods for multi-party monitoring	Organized and led a field workshop for the Natural Areas Conference, October 12th, 2017, in Fort Collins, Colorado. The workshop toured CFLRP restoration sites and discussed monitoring data and strategies. Approximately 38 people from across the USA attended, representing two other CFRLP programs outside of Colorado, the San Juan Headwaters Forest Health Partnership, Pennypack Ecological Restoration Trust, California State University - Davis, and several other organizations. Speakers included CFRI staff Brett Wolk, Jeff Cannon, and Ben Gannon; RMRS Research Scientist Matt Thompson; USGS Research Scientist Jenny Briggs; and CSU Faculty in watershed sciences Stephanie Kampf. Organized a special session on forest and fire impacts on watershed health, and contributed a presentation on watershed wildfire risk reduction decision support tools at the Sustaining Colorado Watersheds conference, October 9-11th, 2018, in Avon, Colorado. Chuck Rhoades, research scientist at RMRS, was invited to speak as part of the special session, as well as two cooperators from place-based forest collaborative groups.

For agreement number 18-DG-11031600-052, CFRI reports the following cumulative accomplishments toward each project deliverables in the work plan for dates while the agreement was active, including July 1st, 2018 through December 31st, 2019:

Deliverable	Status of Deliverables
Project 1: Supporting collaborative monitoring and adaptive management to streamline environmental analysis and decision-making for forest landscape restoration and resilience	
1.1 Produce and disseminate 1-3 technical documents regarding multi-party monitoring strategies and results for the Front Range Collaborative Forest Landscape Restoration Project	Developed a series of technical briefs to support the two GTR-373 field workshops held in September, 2018, in Red Feather Lakes area and Conifer area. Documents covered field based ecological monitoring strategies, and adaptive management processes and lessons learned from the Front Range CFLRP. These briefs included: - Barrett, KJ, Cannon, JB. Front Range CFLRP: Assessing changes in stand-scale forest structure and composition. - Cannon, JB, K Pelz. Ecological restoration in the Colorado Front Range: Research to aid planning and monitoring at multiple scales. - Wolk, BH, Aplet, G, Briggs, J. Adaptive management processes and lessons learned. Produced Association for Fire Ecology Research Highlight: Cannon, JB, Briggs, JS, and Chambers, ME. (2018). Effects of forest restoration treatments and wildfires on tree spatial patterns in the Colorado Front Range. 2017 Fire Congress Research Highlight. https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/03/AFE2017_Research-Highlight_Cannon.pdf Produced technical paper: Brown, PM, Gannon, B, Battaglia, MA, Fornwalt, PJ, Huckaby, LS, Cheng, AS, and Baggett, LS. (2019). Identifying Old Trees to Inform Ecological Restoration in Montane Forests of the Central Rocky Mountains, USA. Tree Ring Research 75 (1), 34-48. doi.org/10.3959/1536-1098-75.1.34 https://cfri.colostate.edu/wp-content/uploads/sites/22/2019/04/Brown_et_al_2019_identifying_old_trees.pdf
1.2 Produce and disseminate 1-3 technical documents regarding multi-party monitoring strategies and results for the Uncompahgre Collaborative Forest Landscape Restoration Project.	Developed a series of technical briefs summarizing ecological, economic, social impacts, and the UP CFLR high school internship program. - Chambers, M. (2018) Uncompahgre Plateau Collaborative Forest Landscape Restoration Program: High School Internship Programs. CFRI-1804. https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/10/UP_CFLRP_High-School-Internship_final_1804.pdf - Chambers, M. (2018) Uncompahgre Plateau Collaborative Forest Landscape Restoration Program: Social Impacts & Contributions. CFRI-1805. https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/10/CFLRP_social_brief_final.pdf - Chambers, M. and Cannon, J. (2018) Uncompahgre Plateau Collaborative Forest Landscape Restoration Program: Ecological Impacts. CFRI-1806.

	https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/10/UP-CFRLP-Ecological_brief-final_.pdf - Chambers, M. and Speas, C. (2018) Uncompahgre Plateau Collaborative Forest Landscape Restoration Program: Economic Impacts & Contributions. CFRI-1807. https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/10/CFLRP_economic_brief_final_1807.pdf
1.3 Conduct and report on at least two (2) field-based workshops per CFLR project to review and deliberate treatment effects and desired conditions.	August 14-15th, 2018, Brett Wolk and Marin Chambers assisted with organizing a field workshop with the Uncompahgre CFLR project to discuss results with partners and USFS Washington Office staff, attended by ~20 people. August 7th, 2019, Marin Chambers assisted with organizing, leading, and presenting monitoring data and adaptive management for the UP CFLR annual field trip. August 15th, 2019, several CFRI staff assisted with organizing, leading, and presenting monitoring results at the Front Range Roundtable Landscape Restoration Team Field Trip on Pike National Forest. Attended by approximately 20 people from a variety of agencies.
1.4 Document and distribute between 4-6 monitoring methods and results (where applicable) to multi-stakeholder collaborative initiatives focused on forest health and wildfire risk mitigation	Published written protocols for monitoring impacts of prescribed fire of vegetation and fuel loading: Monitoring Immediate Postburn Vegetation and Fuel Characteristics Protocol. 2018. Colorado Forest Restoration Institute. CFRI-1808. https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/10/ImmediatePostburnProtocol_Mothership_2018.pdf Updated integrated monitoring approaches and detailed protocols for monitoring changes in forest composition, structure, and fuel loading in Colorado forests. - 2018 Mothership Plot Protocol. Colorado Forest Restoration Institute. CFRI-1810. https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/10/2018-Mothership-Protocol.docx - 2018 Simple Plot Protocol. Colorado Forest Restoration Institute. CFRI-1809. https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/10/2018-Simple-Plot-Protocol.docx CFRI staff Brett Wolk and Marin Chambers visited with San Juan Headwaters Forest Health Partnership on August 29-31st, 2018, to distribute and discuss monitoring approaches for mixed conifer forest ecology and management. September 4th, 2019, CFRI staff Brett Wolk and Kat Morici distributed monitoring methods and results to Washington Department of Natural Resources staff and their contractors, and discussed best practices developing fuel treatment effectiveness monitoring program. Kevin Barrett presented technical poster from Front Range CFLRP monitoring methods and data, and discussed results with stakeholders at the Association for Fire Ecology 8th International Fire Congress, November 18-22, 2019, Tucson, AZ. "Changes in forest structure in Ponderosa pine-

	dominated ecosystems following restoration treatments". https://cfri.colostate.edu/wp-content/uploads/sites/22/2019/12/Barrett_AFE_Poster_2019.pdf Marin Chambers presented technical poster from Uncompahgre Plateau CFLRP monitoring methods and data, and discussed results with stakeholders at the Association for Fire Ecology 8th International Fire Congress, November 18-22, 2019, Tucson, AZ. "Collaborative Forest Landscape Restoration monitoring results following mechanical and prescribed burning treatments on the Uncompahgre National Forest, CO."
Project 2: Translating National Cohesive Wildland Fire Management Strategy principles in practice	
2.1 Produce and disseminate between 2-4 written reports describing linkages between Potential Operational Delineations and fuel treatment effects on landscape-scale fire behavior and potential post-fire soil erosion for the purpose of pre-positioning fire response and coordinating future landscape-scale, cross-boundary forest vegetation treatments	Published paper: Thompson, MP, Liu, Z, Wei, Y, & Caggiano, MD. (2018). Analyzing Wildfire Suppression Difficulty in Relation to Protection Demand. In Mihai, FC & Grozavu, A (Eds.), *Environmental Risks.* DOI: 10.5772/intechopen.76937. https://www.intechopen.com/books/environmental-risks/analyzing-wildfire-suppression-difficulty-in-relation-to-protection-demand Published paper: Addington, RN, Tavernia, BG, Caggiano, MD, Thompson, MP, Lawhon, JD, Sanderson, JS. (2019). Identifying opportunities for the use of broadcast prescribed fire on Colorado's Front Range. Forest Ecology and Management 458. https://doi.org/10.1016/j.foreco.2019.117655. https://cfri.colostate.edu/wp-content/uploads/sites/22/2020/01/Addington_et_al_opportunities_for_broadcast_prescribed_fire.pdf
2.2 Produce and disseminate between 1-3 written reports describing lessons learned and best practices for cooperative cross-boundary prescribed fire	Produced, printed, and disseminated paper describing collaborative process and best practices for developing Potential Operational Delineations: Caggiano, MD (2019). Collaboratively Engaging Stakeholders to Develop Potential Operational Delineations. CFRI-1908. https://cfri.colostate.edu/wp-content/uploads/sites/22/2019/08/PODs-Collaborative-Engagement-Final-Report.pdf
2.3 Conduct and report on between 4-6 field-based workshops to review and deliberate treatment effects and desired conditions with cross-boundary partnerships.	March 26th, 2019, CFRI staff Kat Morici presented fuel treatment effectiveness monitoring results from non-federal lands in Colorado, and led discussion of fuel treatment effectiveness monitoring methods at the Coalition for the Poudre River Watershed quarterly meeting. April 15th, 2019, Mike Caggiano presented information about local PODS spatial fire planning efforts with the Colorado Big Thompson Headwaters Partnership in Estes Park, Colorado. Caggiano led a discussion about opportunities to incorporate POD spatial fire planning with CBT mechanical fuel reduction projects to align fuels and fire management efforts. CFRI staff Kat Morici presented fuel treatment effectiveness monitoring results and trained others on monitoring protocols at the San Juan Prescribed Fire Training Exchange (TREX) September 10-24th, 2019, in the vicinity of Durango, Colorado.

	November 22, 2019, Tony Cheng and Brett Wolk led field based review of fuels treatments, presented monitoring results, and discussed strategic landscape management planning approaches with The Nature Conservancy Restoring America's Forest annual meeting in Estes Park, Colorado. Kat Morici delivered an oral presentation and discussed methods and results from analysis of fuel treatment effectiveness monitoring on non-federal lands in Colorado with stakeholders at the Association for Fire Ecology 8th International Fire Congress, November 18-22, 2019, Tucson, AZ. "Adaptive Management in Action: Evaluating Fuel Treatment Effectiveness with Field-Based Monitoring and Fire Modeling".
Project 3: Providing Decision Support for Collaborative Landscape-Scale Assessment and Strategic Prioritization	
3.1 Convene and report on the structure and functioning of between 2-4 collaborative landscape analysis teams involving managers, researchers, and stakeholders	**Peaks to People Water Fund:** Published paper with co-authors from The Nature Conservancy and USFS Rocky Mountain Research Station describing functioning and effectiveness of Peaks to People Water Fund. Gannon BM, Wei Y, MacDonald LH, Kampf SK, Jones KW, Cannon JB, Wolk BH, Cheng AS, Addington RN, and Thompson MP. (2019). Prioritising fuels reduction for water supply protection. International Journal of Wildland Fire. DOI: https://doi.org/10.1071/WF18182. https://cfri.colostate.edu/wp-content/uploads/sites/22/2019/05/Gannon-et-al-IJWF-2019-Water-Supply-Protection.pdf To increase accessibility of the peer-reviewed publication, CFRI developed a two-page summary and application of the Risk Assessment and Decision Support process used with Peaks to People Water Fund. Gannon BM, Brown, H, Wolk, BH. (2019). The Right Work in the Right Places: Prioritizing Fuels Reduction to Protect Water Supplies. CFRI-1905. https://cfri.colostate.edu/wp-content/uploads/sites/22/2019/05/CFRI_wRADS_2Pager_May2019.pdf **Envision Chaffee County** CFRI expand methodologies developed with the Peaks to People Water Fund to lead the Envision Chaffee County interagency collaborative group through a multi-resource wildfire risk assessment. Our assessment methods were published as CFRI technical documents, as well as posters to easily communicate the structure and functioning of the risk assessment to stakeholders, the public, and other planning groups. The final products were included in the updated Chaffee County Community Wildfire Protection Plan, which will inform the allocation of county sales tax dollars that were recently approved by voters to fund fire mitigation work across all land ownerships in the county. *CFRI technical reports:* - Gannon BM. (2019). Chaffee County Wildfire Risk Assessment. CFRI-1913. https://cfri.colostate.edu/wp-content/uploads/sites/22/2020/02/Gannon_2019_Chaffee_RA_Methods.pdf - Gannon BM. (2019). Chaffee County Fuel Treatment Prioritization. CFRI-1914. https://cfri.colostate.edu/wp-

	content/uploads/sites/22/2020/02/Gannon_2019_Chaffee_FTP_methods-1.pdf *Posters:* - Gannon BM. (2019). Chaffee County Fuel Treatment Prioritization. Poster. CFRI-1911. https://cfri.colostate.edu/wp-content/uploads/sites/22/2020/02/Gannon_2019_Chaffee_FTP_methods.pdf - Gannon BM. (2019). Chaffee County Wildfire Risk Assessment. Poster. CFRI-1912. https://cfri.colostate.edu/wp-content/uploads/sites/22/2020/02/Gannon_2019_Chaffee_RA_methods.pdf
3.2 Convene and report on between 2-4 peer-to-peer learning workshops involving collaborative landscape analysis teams that have utilized the strategic prioritization approach and multi-stakeholder groups interested in applying the approach.	CFRI engaged with the interagency Envision Chaffee County collaborative team to carry out a series of risk assessment and prioritization workshops to inform cross-boundary collaborative development of a county-wide Community Wildfire Protection Plan. The CWPP informs priorities for a county tax passed by residents to support cross-boundary forest management activities. This process involved CFRI staff participating in multiple workshops help in Salida, Colorado, to review treatment effects and desired conditions with the group. The end result was an updated CWPP that relied heavily on CFRI led risk assessment. - February 7th, 2019, Brett Wolk traveled to Salida, Colorado and discussed desired conditions with Envision Chaffee County cross boundary management group to help develop shared goals and desired conditions for an update to their Community Wildfire Protection Plan. - April 15th, 2019, Brett Wolk and Ben Gannon led a discussion via conference call for the Envision Chaffee County collaborative planning group meeting to help stakeholders incorporate local values into advanced wildfire risk assessment and prioritization processes. - June 19th, 2019 Ben Gannon presented initial risk assessment results with the group in Salida, CO, and updated priorities of highly valued resources and assets with the group. - August 5th, 2019, CFRI staff Ben Gannon, Brett Wolk, Tony Cheng, and Marin Chambers attended a meeting in Salida, CO, to refine risk assessment and applications with the community wildfire protection plan. - November 1st, 2019 Ben Gannon and Brett Wolk presented custom fire modeling results to incorporate local knowledge into the fire probability and intensity predictions. These modification we're meant to account for new firefighting tactics and climate change impacts on compounding forest disturbances in high elevation forests. Results of this process and our reports are summarized in the final *Community Wildfire Protection Plan*: - Chaffe County Community Wildfire Protection Plan Summary: Envision Chaffee County – A future Built on Common Ground. Published by the Central Colorado Conservancy. 12 p. https://e5778e01-37cb-4a06-a2c6-

	10384194ae9e.filesusr.com/ugd/afd1f8_c0ead1039f4a496fa49e8485559c3fde.pdf - Chaffee County Next Generation Community Wildfire Protection Plan. 2020. Report compiled and edited by Envision Chaffee County and Central Colorado Conservancy (C. Williams, K. Marquis, T. Flanagan, Z. Tucker) with generous input and guidance from the Envision Forest Health Council. Published by the Central Colorado Conservancy. 206 p. https://csfs.colostate.edu/media/sites/22/2020/02/Chaffee_Co_Next_Gen_CWPP_2-5-20.pdf
3.3 Report on the outputs of strategic prioritization data, methods, and tools for 2-4 projects to Forest, Regional, and Washington Office, water providers, watershed coalitions, and forest collaboratives.	November 15th, 2019: Convened a conference call with USFS Washington office staff Carl Lucero, Luanne Lohr, Erin Connelly, and Kenli Kim; Jen Hayes (RMRS Assistant Station Director), Heidi Huber-Sterns (Ecosystem Workforce Group), CFRI staff and Ecological Restoration Institute staff to discuss research findings on scenario planning tools and coordinate future strategic investment research projects. CFRI staff Ben Gannon attended the Sustaining Colorado Watersheds Conference, October 7-10, 2019, Avon, Colorado. Ben delivered a presentation on lessons learned from developing and applying strategic prioritization tools that balance fire management and watershed protection, and served on an expert panel titled: Forests, Fires, and Water: Exploring how Colorado Communities can Better Co-exist with Wildfire.
Project 4: Supporting Region 2 forest vegetation program planning	
4.1 Compile currently available data and analytical tools on changes in forest conditions for between 1-3 pilot national forests or areas within a single national forest. These forests or areas will be determined by the collaborative working group convened by CFRI.	***Jeff Underhill, USFS Region 2 Silviculturist and primary stakeholder for this project, left the USFS during this time. Given Jeff Underhill's departure from USFS, we pursued two avenues to address this project: 1. In coordination with Pike National Forest District Ranger Brian Banks and Biologist Mikele Painter, CFRI staff Brett Wolk helped develop a funded proposal and participated in a working group to explore applying LiDAR data and other remote sensing methods to update veg condition maps that support forest planning and monitoring on South Platte District of the Pike National Forest. The project was awarded funding to work with the USFS Geospatial Technology and Applications Steering Committee (GeoTASC) on a project titled: Utilizing LiDAR data to assess and plan landscape-scale forest restoration and wildfire mitigation activities in the Upper South Platte watershed of central Colorado. Wolk and CFRI staff Kevin Barrett contributed CFRI field data to validate LiDAR and remote sensing analysis, and guided the group on data applications for fire behavior modeling. CFRI coordinated with RMRS scientists Mike Battaglia and Andy Hudak, as well as CSU Associate Professor Wade Tinkham, to contribute relevant data and participate in the working group. 2. CFRI staff Marin Chambers is co-leading a regional Burn Scar Restoration team to analyze data examining changes in forest conditions and tree regeneration patterns following high severity wildfire. The group consists of several RMRS Scientists based in Fort Collins, CO, and Flagstaff, AZ; USGS Scientist Jens Stevens; staff from New Mexico Highlands university, and The Nature Conservancy

	Colorado Chapter, among others. Chambers has led an effort to collect and compile data on post fire tree regeneration regional patterns across ponderosa pine ecosystems from South Dakota, Wyoming, Colorado, New Mexico, and Arizona. A peer-reviewed publication is in preparation for submission. The group is collecting and analyzing survival data from USFS tree plantings, meets regularly with forest managers and other stakeholders to develop seed technologies for hand planting and drone reforestation in high severity burn areas, has implemented and monitored first planting trials, and will continue ongoing assessment of data and post fire planting strategies.
4.2 Convene and report on collaborative learning events involving managers, researchers, and stakeholders to assess and validate forest condition changes	Marin Chambers led the planning, coordination, and facilitated a field trip with the Burned Area Learning Network near Colorado Springs, Colorado, May 7-8th, 2019. A group of ~25 people representing diverse agencies toured the Hayman Fire Burned Area, discussed post-disturbance forest management conditions, management options, and data gaps to inform planning future forest restoration. This workshop was part of a larger series that was documented with an ESRI storymap, which Marin Chambers contributed content to. https://foreststewards.maps.arcgis.com/apps/Cascade/index.html?appid=db2481bff458430c8910e0d380db2f05 Marin Chambers helped organize a special session at the North American Forest Ecology Workshop, Flagstaff, AZ, June 23-27, 2019, to validate data and interpretations of post fire forest regeneration. Marin delivered a presentation: Chambers, M.E. Ponderosa pine regeneration following high-severity wildfires is driven by overstory, topo-climatic, and ground layer conditions.
4.3 Convene and report on between 1-3 peer-learning workshops to facilitate knowledge exchange between managers and stakeholders engaged in this project with managers and stakeholders interested in replicating the process on their national forest or geographic area.	CFRI staff Marin Chambers provided forest ecology technical expertise, science delivery guidance, and participated in planning events as part of a series titled "Preparing Today's Boulder Forests for Tomorrow's Wildfires". Marin attended and presented forest ecology information related to post fire tree regeneration at 1 fieldtrip and the classroom workshop. The series was convened by the University of Colorado Center for Sustainable Landscape and Communities, and altogether 100 people participated in these activities. Other experts providing insights included: 10 land managers, ecologists, and fire specialists from Boulder City and County; research scientists from CU and CSU, and 2 managers from the Arapaho-Roosevelt National Forest. https://www.colorado.edu/center/sustainable-landscapes-and-communities/preparing-todays-boulder-forests-tomorrows-wildfires-events - Field trip September 22nd, 2018 - Field trip September 29th, 2018 - Classroom workshop September 26th, 2018
Project 5: Supporting Collaborative Capacity-Building and Peer-Learning	
5.1 Conduct, convene, organize, and report on between 4-6 site visits or workshops that bring together research scientists from RMRS, other federal	Organized, facilitated, and delivered meeting 2019 Prescribed Fire Download in Fort Collins, CO, February 28th, 2019, to discuss the 2018 prescribed fire season: successes, challenges, lessons learned, prescribed fire research and monitoring, and upcoming plans. Approximately 30 people attended the event, and presentations were made by USFS Arapaho-

agencies, and universities with participants of place-based forest collaboratives to transfer knowledge about, and assist in the development of, science-based methods for collaborative assessment, monitoring, and adaptive management.	Roosevelt NF fire staff, The Nature Conservancy, Forest Stewards Guild, CFRI staff Mike Caggiano and Emma Williams, and others. CFRI sponsored and helped organize 3 special sessions on forest and fire restoration science at the High Altitude Restoration Science and Practice Conference, March 12-14th, 2019, in Fort Collins, Colorado. The conference was attended by ~225 people representing research, management, policy, and private industry fields. CFRI invited and sponsored Keynote speaker Dr. Don Falk's participation to provide expertise in forest ecology and management in light of changing climates to support collaborative capacity building and peer learning with forest restoration stakeholders. The session was moderated by CFRI staff Brett Wolk, Don's presentation was followed by a presentation from RMRS Research Scientist Paula Fornwalt, and several others. Other CFRI staff presentations during the conference: - Kevin Barrett: "Effects of collaborative restoration and adaptive management on forest structure and composition in the Colorado Front Range." - Jeffery Cannon: "Modeling the effects of heterogeneous restoration treatments on understory light environments in a mixed-conifer forest." Conference program available at: https://sites.warnercnr.colostate.edu/restoration-conference/ Organized a CFRI FireLab meeting March 27th, 2019, in Fort Collins Colorado, including 20+ people from academic institutions, federal and non-federal agencies, and non-governmental place based collaborative group leaders. Laurie Huckaby (RMRS Scientist) delivered a presentation titled: "Historical forest type conversions along an elevational gradient in Colorado Front Range Forests". Brett Wolk delivered a presentation and participated in a panel discussion to discuss forward looking forest restoration strategies during a special session at the North American Forest Ecology Workshop, Flagstaff, AZ, June 23-27, 2019. Brett delivered a presentation titled: Restoring Colorado front range forests: knowledge co-production and tools for shared stewardship. Hannah Brown delivered oral presentation and discussed best practices for science communication with stakeholders at the Association for Fire Ecology 8th International Fire Congress, November 18-22, 2019, Tucson, AZ. "Science, management, and implementation of forest restoration concepts: What works?" Katarina Warnick delivered a poster presentation and discussed methods and results from analysis of spatial distribution of forest restoration treatments with stakeholders at the Association for Fire Ecology 8th International Fire Congress, November 18-22, 2019, Tucson, AZ. "Changes in forest structure in Ponderosa pine-dominated ecosystems following restoration treatments". https://cfri.colostate.edu/wp-content/uploads/sites/22/2019/12/Warnick_AFE_Poster_2019.pdf

	Andrew Slack participated in a special session on forest resilience to fire at the Association for Fire Ecology 8th International Fire Congress, November 18-22, 2019, Tucson, AZ. Andrew delivered a presentation titled: "Contingent resistance in longleaf pine (Pinus palustris) growth and defense 10 years following smoldering fires".

For agreement number 19-DG-11031600-062, CFRI reports the following cumulative accomplishments toward each project deliverables in the work plan for dates while the agreement was active, including July 1st, 2019 through December 31st, 2019:

Deliverable	Status of Deliverables
Project 1. Supporting strategic prioritization, monitoring, and adaptive management of cross boundary wildfire risk co-management strategies to operationalize the Shared Stewardship approach.	
1) Document and report on 2-4 successful examples of science based Shared Stewardship implementation in forests of the intermountain West.	In Progress.
2) Assist in the identification and facilitation of partnership engagement in a Colorado all-lands wildfire risk assessment process led by USFS Region 2. This includes working with targeted partners to identify the High Values, Resources, and Assets (HVRA's) that will help frame the risk assessment outputs.	On December 5, 2019, CFRI staff (Cheng, Wolk, Caggiano, Gannon, Beeton) organized and hosted a Colorado All-lands Risk Assessment meeting with USFS Region 2 fire staff Brian Keating and Sarah Synowiec, USFS Washington Office staff Jim Menakis and Rick Stratton, Pyrologics, and Colorado State Forest Service Jeff Underhill, Kristin Garrison, and Amanda Fordham. The goals of the meeting were to: 1) Discuss and develop a strategy for the partnership engagement aspect of the HVRA component of the risk assessment process; and 2) Discuss the role of CFRI to serve as a "non-agency" partner who can help all agencies both identify and engage with the appropriate level of partnership involvement we need to be successful.
3) Advise the Colorado State Forest Service with applying and interpreting prioritization tools to inform their Statewide Forest Action Plan revision.	CFRI has been in communication with CSFS Director for Science and Data, and will provide feedback on the draft Forest Action Plan in early 2020.
4) Working with RMRS, support development, implementation, and integration of cross boundary landscape planning and prioritization tools in 2-4 new landscapes, with a focus on linking spatial fire planning (PODS) with prioritization of forest and fuels management objectives (e.g. RADS, RESTSIM, etc.) across multiple scales of planning and implementation.	Initiated discussions with the Medicine Bow-Routt NF fire, fuels, and administrative staff in Laramie, WY 10/30/19. This was the first in-person meeting with the staff and administration on the utility of PODs for the lands they manage and a timeline for developing PODs. Mike Caggiano led the meeting with RMRS scientist Matt Thompson.

5) Complete 2 written summaries documenting case study examples describing the application of prioritization methodologies, approaches, and planning processes being used to enhance co-management of fire risk. Focus on lessons learned that provide guidance for diverse stakeholders to assess what risk assessment and prioritization tools are appropriate for different planning and evaluation purposes. The case studies will be coordinated with ERI to augment their West-wide inventory to determine if and how these tools are being used more broadly to inform restoration and all-lands management planning and implementation.	Completed CFRI publication summarizing process and lessons learned collaboratively integrating multiple prioritization models in a single landscape: Caggiano, MD (2019). Northern Colorado Fireshed Model Prioritization and Project Planning Workshop. CFRI-1915. https://cfri.colostate.edu/wp-content/uploads/sites/22/2020/03/Caggiano_NoCo_Fireshed_Model_Comparison_Report.3.11.20.pdf In Progress, writing up lessons learned from leading risk assessment and prioritization process for Envision Chaffee County.
6) Deliver 2-4 presentations, meetings, peer to peer learning events, etc. to report on the range of methodologies, approaches, and planning processes being used to enhance co-management of wildfire risk in the western US to Forest, Regional, and Washington Office units, water providers, watershed coalitions, forest collaboratives, or other affected entities.	September 25th, 2019, CFRI staff Brett Wolk, Ben Gannon, and Andrew Slack met with Jefferson County Open Space staff in Golden, Colorado, to discuss landscape planning and prioritization tools, and collaborative processes for implementing them. (Contact: Drew Rayburn). FY19 SWERI December 11th, 2019, CFRI staff Brett Wolk, Tony Cheng, and Kat Morici met with Colorado Department of Natural Resources assistant director Tim Mauck, and staff Amy Moyer and Angela Boag to discuss fuel treatment effectiveness and operationalizing a Shared Stewardship strategy with the state of Colorado. December 17th, 2019, CFRI staff Mike Caggiano delivered a presentation and discussion at the New Mexico Collaborative Forest Restoration Program annual meeting sharing lessons learned from his work on cross-boundary burning efforts. Over 100 diverse stakeholders were in attendance. Presentation titled: "Supporting cooperative burning in New Mexico: The Collaborative Forest Restoration Program".
7) Produce 3-5 training resources (technical briefs, blog posts, videos, etc.) to facilitate the broader application of analytical tools and collaborative planning processes that	In progress.

support strategic investments in cross boundary forest and fire management.	
Project 2. Supporting knowledge transfer of monitoring, adaptive management strategies, and outcomes for collaborative forest landscape restoration and resilience	
1) Produce and disseminate between 1-3 technical documents regarding multi-party monitoring strategies and results for the Front Range Collaborative Forest Landscape Restoration Project.	In Progress.
2) Produce and disseminate 1-3 technical documents regarding multi-party monitoring strategies and results for the Uncompahgre Plateau Collaborative Forest Landscape Restoration Project.	Completed report: 2019 Uncompahgre Plateau Collaborative Forest Landscape Restoration Project: Forestry Internship Program (FIP) Progress Summary. https://cfri.colostate.edu/wp-content/uploads/sites/22/2019/10/FIP-Progress-Summary.pdf
3) Conduct and report on at least one field-based workshop per Colorado CFLR project (2) to review and deliberate treatment effects and desired conditions.	In Progress, field trips are planned for summer 2020.
4) Convene stakeholders, compile and analyze monitoring data, and support reporting for 10 year accomplishments with Front Range and Uncompahgre Plateau CFLR projects.	Uncompahgre Plateau CFLR: Data has been cleaned and prepared for analysis, will start work on analysis and report in 2020. Attempted to convene stakeholders, but have determined along with Todd Gardner (GMUG CFLR coordinator) that there is little interest amongst stakeholders to have annual meeting and participate in reporting. Front Range CFLR: Coordinating with Jim Gerleman and Kevin McLaughlin to organize data and contribute to reporting. Will organize stakeholders at 2020 Monitoring JAM session to compile and report monitoring data.
5) In collaboration with the other SWERI institutes, convene a workshop with land managers, researchers, and their stakeholders to develop strategies that facilitate the application of lessons learned from collaborative forest landscape management	Scheduled for March 2-4th, 2020, in Albuquerque, New Mexico.

planning, implementation, monitoring, and adaptive management in the intermountain west and southwest.	
6) Working with the Rocky Mountain Research Station, document, produce, and disseminate 1-3 applied scientific publications that leverage data and adaptive management process from collaborative forest landscape management projects.	In progress.
7) Convene and report on between 3-5 webinars or peer to peer learning events documenting and distributing monitoring methods, results, and adaptive management processes to multi-stakeholder forest landscape management initiatives focused on forest health, wildfire risk mitigation, or watershed protection.	November 21, 2019, CFRI staff Brett Wolk and Tyler Beeton presented lessons learned and best practices for collaborative forest landscape restoration on the USDA Forest Service CFLR all hands webinar.
Project 3. Translating ecologically-based forestry principles into practice	
1) In coordination with the Rocky Mountain Research Station, develop, produce, and deliver 2-4 workshops supporting applications of forest restoration principles.	A workshop to apply concepts for tree marking and project layout is in the planning stages.
2) Convene, deliver, and report on 4-6 peer to peer learning exchanges or presentations to deliver localized forest restoration science to place based restoration organizations, planners, or leadership and high level decisionmakers.	In progress.

3) Develop, produce, and distribute 3-5 science briefs, and create multimedia resources such as videos, ESRI story-maps, etc., that facilitate application of science based strategic cross-boundary forest restoration principles in Colorado frequent fire forests.	In progress.
4) Collaborating with Rocky Mountain Research Station and partners, facilitate improving existing websites and/or building a new website to host information that facilitates application of forest restoration principles in Colorado frequent fire forests.	Content and design has begun on a Front Range forest restoration resources website. Major upgrades to the CFRI website have been added, including updating information about existing collaborative groups engagement.
5) Working with the Rocky Mountain Research Station, co-produce and disseminate 1-3 applied scientific publications to inform collaborative planning, implementation, monitoring, and/or adaptive management of restoration principles for ponderosa pine forest types in Colorado.	Working with Mike Battaglia, RMRS research silviculturist, published study describing implications of restored forest structures on tree regeneration growing environments. The study was conducted within the Colorado Front Range CFLRP Upper Monument Creek project. Cannon, JB, Tinkham, WT, DeAngelis, RK, Hill, EM, and Battaglia, MA. (2019) Variability in Mixed Conifer Spatial Structure Changes Understory Light Environments. Forests 10 (11) doi:10.3390/f10111015. https://cfri.colostate.edu/wp-content/uploads/sites/22/2019/11/Cannon_et_al_Variability.pdf
6) Complete 1-3 written reports that document the application of forest restoration principles for forest types other than ponderosa pine and dry mixed conifer forests, such as Gambel oak, wet mixed conifer, or subalpine forests.	In progress, working with partners in Southwest Colorado to document application of forest restoration principles in upper-montane mixed conifer forests.
Project 4. Supporting planning, monitoring, and adaptive management to improve fuel treatment effectiveness and forest resilience under changing precipitation and rising temperatures.	
1) Document and report on 2-4 monitoring methods, and collect monitoring data that facilitates leveraging existing monitoring	Updating of CFRI monitoring protocols is in progress.

networks to enhance fuel treatment effectiveness and maximize fuel treatment longevity.	
2) Develop, document, apply, and report on prescribed fire monitoring methods for Colorado forests.	Prescribed fire monitoring data was collected at the Elk Fire in Northern Colorado during fall 2019. Reporting of results and methods are forthcoming. CFRI staff Mike Caggiano and Kat Morici attended the Colorado Prescribed Fire Council meeting in Durango, Colorado, September 2019, to share monitoring methods and results with stakeholders.
3) Complete 1-3 reports summarizing fuel treatment effectiveness and treatment longevity in forest types in Colorado and the intermountain west.	In progress.
4) Provide technical assistance and training in monitoring data collection, analysis, and/or application of results for assessing monitoring data trends for the Colorado State Forest Service and 2-4 additional organizations or forest, fire, or watershed collaborative groups.	Ongoing conversation with CSFS staff Wilf Previant and Zach Mellema to coordinate monitoring sampling methods and analysis technique, including tablet data collection and processing. Communicated with Program Manager Diana Selby to provide feeback for the Forest Restoration and Wildfire Risk Reduction Grant advisory committee on fuel treatment effectiveness and allocation of resources for effective grant program outcomes. Scheduled to meet with the advisory committee in January, 2020. Provided Daniel Bowker (Coalition for the Poudre River Watershed) with a basic summary and interpretation of results of CFRI monitoring plots that burned in the Red Feather unit 28 RX. This information was presented at a public field tour of prescribed fires in the Red Feather area. CFRI has provided Bowker with monitoring protocols, datasheets, and advised on analysis of data using Forest Vegetation Simulator analysis programs.
5) Work with 1-2 forest collaborative groups to develop and document forest management strategies that balance fire risk reduction and forest resilience under changing precipitation patterns and rising temperatures.	In progress.
Project 5: Supporting Collaborative Capacity-Building and Peer-Learning	

1) Conduct, convene, organize, and report on between 7-9 site visits, peer to peer learning events, webinars, or workshops that bring together research scientists from RMRS, other federal agencies, and universities with participants of place-based forest collaboratives to transfer knowledge about, and assist in the development of, science-based methods for collaborative assessment, monitoring, and adaptive management.	Organized a FireLab meeting October 10th, 2019, in Fort Collins Colorado, including 40+ people from academic institutions, federal and non-federal agencies, and non-governmental place based collaborative group leaders. Mike Caggiano (CFRI Research Associate), Katie Donahue (USFS), and James White (USFS) delivered a presentation about Potential Operational Deliniations (PODS) and their development for the Arapaho-Roosevelt National Forest. Organized a FireLab meeting December 17th, 2019, in Fort Collins Colorado, including 40+ people from academic institutions, federal and non-federal agencies, and non-governmental place based collaborative group leaders. CFRI staff Ben Gannon delivered a presentation discussing wildfire risk reduction strategies to protect drinking water supplies. Presentation title: "Murky waters: adding rigot to wildfire-water supply risk assessment". CFRI staff Stephanie Mueller participated in a special session on forest resilience to fire and climate at the Association for Fire Ecology 8th International Fire Congress, November 18-22, 2019, Tucson, AZ. Stephanie delivered a presentation titled: "Climate relationships with increasing wildfire in the southwestern US from 1984 to 2015".