Risk Assessment Decision Support (RADS) in Chaffee County, Colorado:

A COLLABORATIVE PROCESS CASE STUDY

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COLORADO FOREST RESTORATION INSTITUTE
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FOREST AND RANGELAND STEWARDSHIP
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February 2023 • CFRI-2303

The Colorado Forest Restoration Institute (CFRI) was established in 2005 as an application-oriented, science-based outreach and engagement organization hosted at Colorado State University (CSU). Along with centers at Northern Arizona University and New Mexico Highlands University, CFRI is one of three institutes that make up the Southwest Ecological Restoration Institutes, which were authorized by Congress through the Southwest Forest Health and Wildfire Prevention Act of 2004. We develop, synthesize, and apply locally relevant, actionable knowledge to inform forest management strategies and achieve wildfire hazard reduction goals in Colorado and the Interior West. We strive to earn trust through being rigorous and objective in integrating currently available scientific information into decision-making through collaborative partnerships involving researchers, land managers, policy makers, interested and affected stakeholders, and communities. CFRI holds itself to high standards of scientific accuracy and aims to promote transparency in the production and communication of science-based information. Always carefully evaluate sources for rigor and appropriateness before applying in your own work.

CSU Land Acknowledgment: Colorado State University acknowledges, with respect, that the land we are on today is the traditional and ancestral homelands of the Arapaho, Cheyenne, and Ute Nations and peoples. This was also a site of trade, gathering, and healing for numerous other Native tribes. We recognize the Indigenous peoples as original stewards of this land and all the relatives within it. As these words of acknowledgment are spoken and heard, the ties Nations have to their traditional homelands are renewed and reaffirmed. CSU is founded as a land-grant institution, and we accept that our mission must encompass access to education and inclusion. And, significantly, that our founding came at a dire cost to Native Nations and peoples whose land this University was built upon. This acknowledgment is the education and inclusion we must practice in recognizing our institutional history, responsibility, and commitment.

Document Development: This paper documents a case study describing the application of prioritization methodologies, approaches, and collaborative planning processes being used to enhance co-management of fire risk in Chaffee County. The aim of this report is to highlight actions that facilitated situating a rigorous analytical modeling approach within a collaborative planning framework. This project was initiated by CFRI staff to document the collaborative planning process in detail to serve as a companion to the technical reports that describe the spatial analysis framework. We hope this provides helpful insights and a template others can follow and modify to assess what social and collaborative ingredients are needed and appropriate for their own planning and evaluation purposes beyond technical analysis tools. Information and conclusions were compiled by reviewing meeting notes, interviews with project participants, and reflections of CFRI staff who participated in the process.

Acknowledgements: The authors would like to thank CFRI staff Ch'aska Huayhuaca-Frye, Tyler Beeton, Hannah Brown, and Tony Cheng for entertaining wandering conversations on collaborative planning processes and providing valuable feedback on earlier manuscript drafts. We thank Hannah Brown and Angela Hollingsworth for creating graphics and figures, and Angela for expert document layout and publishing. We thank members of Envision Chaffee County for providing assistance in locating information related to the Chaffee County CWPP collaborative process, helping identify additional participants for interviews, and sharing their own reflections for this case study. Special thanks to Kevin Barrett, Ben Gannon, and Matt Nykiel for their review and feedback on earlier drafts of this publication. Funding was provided by the Colorado Forest Restoration Institute through the Southwest Forest Health and Wildfire Prevention Act.

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Publication date: February 2023

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Suggested Citation: Dunn, J, Wolk, B. (2023). Risk Assessment Decision Support (RADS) in Chaffee County, Colorado: A Collaborative Process Case Study. CFRI-2303.

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Acronyms and Abbreviations

BLM – Bureau of Land Management

CFRI – Colorado Forest Restoration Institute

CLT – Chaffee County Community Wildfire Protection Plan Leaders Team

cNVC – Conditional Net Value Change

CO-WRA – Colorado Wildfire Risk Assessment

CPW – Colorado Parks & Wildlife

CSFS – Colorado State Forest Service

CWPP – Community Wildfire Protection Plan

Envision – Envision Chaffee County

eNVC – Expected Net Value Change

FIL – Fire Intensity Level

HVRA – Highly Valued Resources and Assets

NRCS – Natural Resource Conservation Service

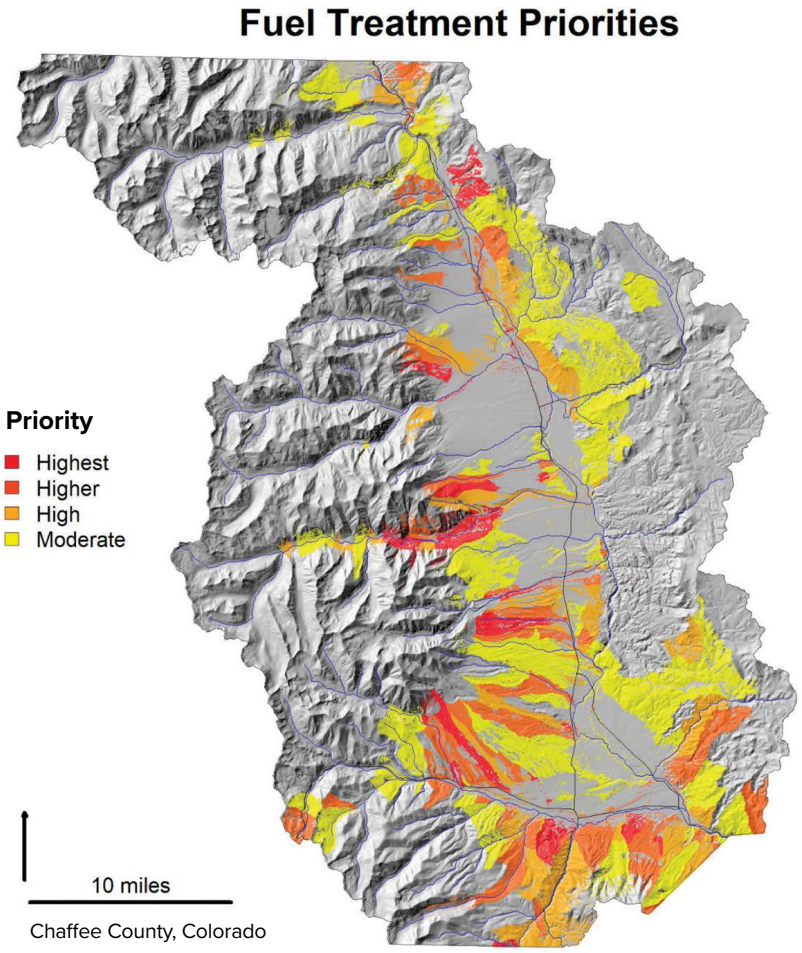
POD – Potential Operational Delineation

RADS – Risk Assessment Decision Support

USFS – United States Forest Service

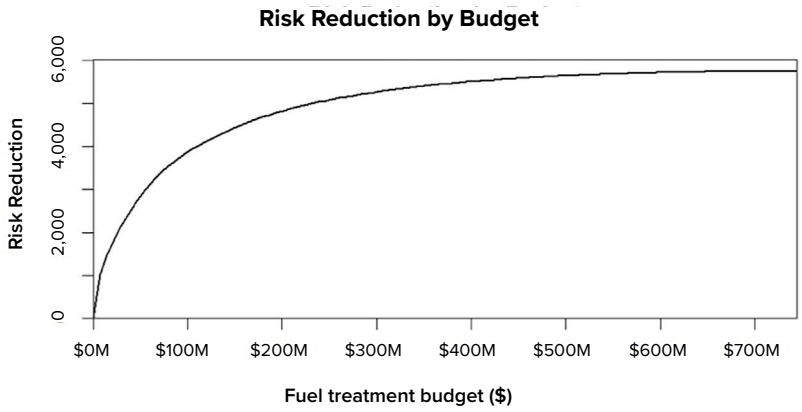
WUI – Wildland Urban Interface

EXECUTIVE SUMMARY



Increasing wildfire impacts across political, social, and ecological boundaries throughout the Western USA has necessitated collaborations between government agencies, communities, and their partners to co-develop and co-implement proactive wildfire risk reduction strategies. Outcome based collaborative prioritization frameworks can help articulate shared goals and create roadmaps for communities to implement their collective strengths across organizational and community boundaries. This case study details an application of CFRI's Risk Assessment and Decision Support (RADS) outcome based planning framework used during the development, revision, and implementation of Chaffee County's Community Wildfire Protection Plan (CWPP) 2020 update. The CWPP developed in Chaffee County resulted from integrating a rigorous science based modeling approach with a robust community-driven social process to inform where risk reduction per dollar invested is greatest (see figures on this page). Through participant interviews and review of meeting notes, this report details the collaborative framework and highlights the social collaborative outcomes from this effort. This case study is instructive for communities interested in developing or updating their CWPP or other wildfire risk planning efforts. It highlights the importance of social outcomes of the collaborative planning process integrated with the latest science to drive changes in how our communities and forests interact with wildfire.

Since completing the CWPP in early 2020, key outputs in the first year and a half include raising over $19 million to fund wildfire mitigation work, implementing 3,136 acres of forest management, and multi-jurisdictional projects covering 21,000 acres are in the planning pipeline. While the CWPP expedited fundraising and forest management actions to achieve these critical accomplishments, the collaborative planning process also enabled a broad social understanding of shared values, how those values interact with wildfire, and prioritized where and what kinds of forest management leads to the best bang for the buck to achieve wildfire risk reduction outcomes. Identifying shared wildfire values, combined with a communal understanding of the strengths and limits of different tools Chaffee County can deploy to co-exist with wildfire, helped clarify how each agency and community can best deploy their tools for the collective good. The CWPP process also identified limits of forest management to reduce wildfire risk, and inspired the need for additional activities that complement and enhance forest management to promote positive wildfire outcomes. This included fire adapted communities engagement and education, recreation planning, collaborative capacity building, land use planning, enhancing defensible space around structures, and aligning vegetation management strategies across different agencies and land ownerships. This case study illuminates that when the right ingredients of science and collaboration come together, a roadmap for social change to better co-exist with wildfire can be developed.



EXECUTIVE SUMMARY

RADS KEYS TO SUCCESS

Science Informed, Locally Relevant
Applying the best available science and spatial data provides scaffolding that builds group consensus. Co-verification of data augmented with local expertise fuses knowledge of the group with complex science to establish trust in outputs, catapulting colleagues and partners into shared action and understanding. Collective ownership of the where and why.

Tech-leads Team
Identify key leadership and subject matter experts to make tough decisions in a shared capacity that leads the larger group towards a final cohesive product.

Expectations for Momentum
Co-develop a schedule from start to finish that outlines expectations, roles, and identifies opportunities for participants to engage throughout the process. A designated neutral facilitator helps build trust, maintain momentum, and triangulates the location of the group on the roadmap to the finish line. Offering a roadmap extends meaning and motivation for seemingly tangential exercises and sets the stage for both frequent and irregular participants to collectively sustain momentum rather than rehashing past decisions.

Transparent Tradeoffs
Assess all values and priorities even if at first they seem challenging or incompatible with the process. Considering priorities from all perspectives helps participants feel their values are included, even if they end up only being indirectly utilized in the technical analysis. Structuring the process to identify unique values integrated with the latest science facilitates transparency in tradeoff decisions that yields acceptance and support for final outcomes.

Structured Inclusivity
Reach out to key partners, including potential advocates and roadblocks. An open, structured collaborative process buffers any one person or organization from having undue influence and offers incentive for broad participation.

Shared decision-space for the win-win
Collaborative risk assessment and decision support processes like the Chaffee County CWPP can expand decision-space for both leadership and communities. Prioritizing the actions needed to sustain shared values highlights responsibilities where each group member can best leverage their unique strengths, rather than choosing winners and losers where all resources will or won't be invested; the most bang for the buck.

INTRODUCTION

The increasing impacts of wildfires to communities and natural resources in the US is prompting government agencies and community stakeholders to develop and implement proactive wildfire risk reduction strategies. Increasingly, no one entity is capable of managing wildfire risk on their own. Wildfire risk is pervasive across large geographic areas, and the risk exceeds the financial and human resources available to mitigate impacts to ecosystem services and forest resilience. Collaborative strategic planning efforts motivate multiple organizations, communities, and individuals to leverage their expertise and capacity across political, social, and geographic boundaries to match the scale and intensity of wildfire risk. Science-informed analytical tools are paired with structured decision-making processes informed by local context to prioritize what types of management actions could be taken to reduce damages to the community's values with the resources available. This case study details such a collaborative strategic planning effort that took place during the development, revision, and implementation of Chaffee County's Community Wildfire Protection Plan (CWPP).

The purpose of this report is to highlight actions that facilitated situating a rigorous analytical modeling approach within a collaborative planning framework. We document the year-and-a-half long Chaffee County CWPP planning process, which resulted in socialization of complex science and ownership of new knowledge retained by local collaborators and the public. An underlying thread of this process was the necessity of both the modelers and local collaborators to co-create data and knowledge through responsiveness to each others' needs. This social process involved the collaborative effort to clearly communicate what was needed from the modeling process to achieve the desired outcome. The modelers worked with the collaborative group to ready the analytical framework to receive the relevant data to meet the group's needs. Like a stone being smoothed by a river, this iterative flow of information between the two groups coalesced into a solid integrated final product with a technical modeling process embedded within a social collaborative framework. Alternatively, the modeling could have been done independent of the social process, and similar results of priority areas on the landscape may have emerged. However, the process led to both buy-in and the galvanizing force that could point a collective finger to a precise spot on the landscape and all parties knew why this location was of the highest priority, and could easily communicate the reasons why with new partners and the public. This case study illustrates this process and is meant to be instructive for other communities and technical analysts interested in enhancing application of science informed wildfire risk planning frameworks.

The organizing framework for the Chaffee County CWPP is the Risk Assessment Decision Support (RADS) process deployed by the Colorado Forest Restoration Institute (CFRI) at Colorado State University. RADS imbeds a geospatial modeling tool within a collaborative process to help interdisciplinary partners identify areas of the landscape where risk reduction per dollar spent is greatest to protect values stakeholders and communities identify as important. The RADS process relies heavily on the risk assessment framework developed by Scott et al. (2013), and combines: (1) readily available geospatial data on vegetation type and land uses; (2) wildfire probability and behavior calculations tailored to the area's geography and recent fire history; and (3) locally relevant information, knowledge, and values. The parameterization and refinement of the model is a socially-driven process that is at the heart of RADS. Beyond the data and modeling, the community-informed participatory process develops shared priorities and language to communicate values important to the group. The Chaffee County CWPP RADS approach builds off of existing tools but was also unique to the Chaffee County context.

Project Timeline Summary

Chaffee County's first contact with CFRI in April 2018 was followed by several phone calls and presentations between CFRI technical experts and a small group of 3-5 community leaders from Envision Chaffee County (Envision), a consortium of governmental and non-governmental organizations focused on sustainability of the county's communities, economies, and natural resources. In October 2018, CFRI technical experts presented the RADS modeling approach and process to the larger Envision group. During a subsequent discussion, the group shared information about their needs, and started generating initial Highly Valued Resources and Assets (HVRAs) lists. Envision later administered a public survey to county residents to perform an initial assessment of HVRAs for the CWPP. Envision organized a CWPP Leaders Team (CLT) of 29 participants from 18 organizations, along with technical experts from CFRI and the interagency Wildfire Research team (WiRē), to develop HVRAs and refine the RADS data and model outputs through an iterative process. The CLT was comprised of leaders from diverse local interests including district rangers, fire management personnel, utility companies, county commissioners, recreation, wildlife, and conservation groups amongst others (for full list see Appendix C). The CLT was tasked with identifying HVRAs, potential impacts to HVRAs (either beneficial

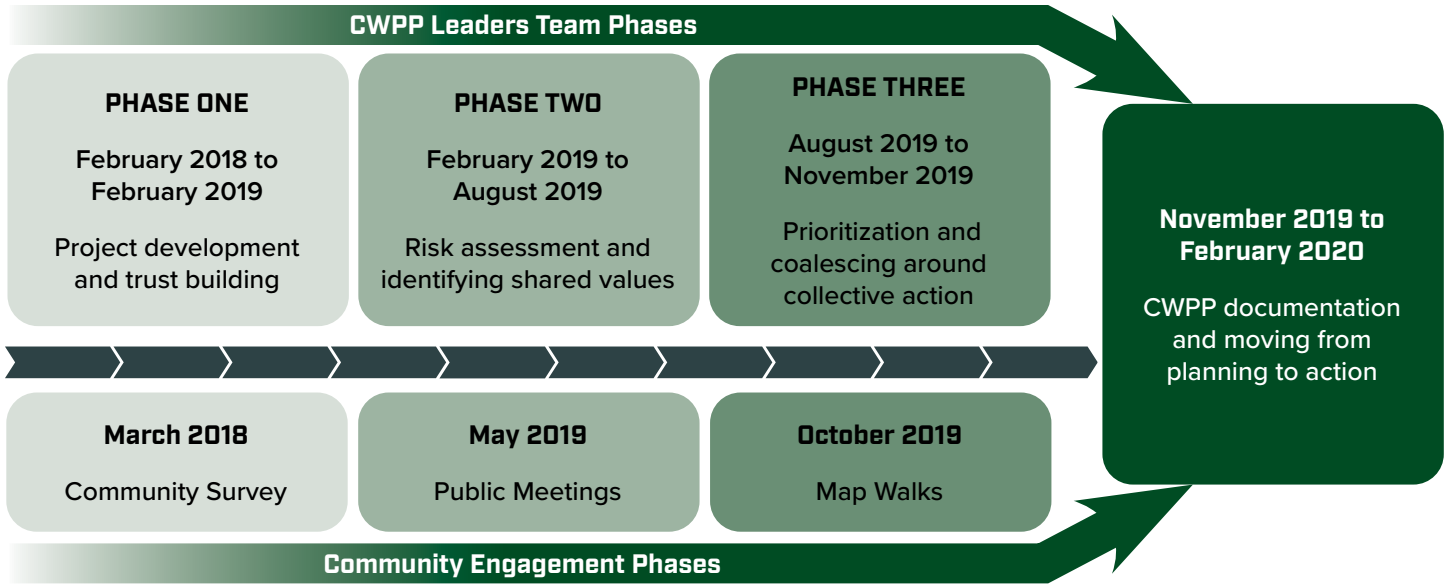


Figure 1. Project Timeline

or negative) from interactions with wildfire, and the feasibility and costs of wildfire mitigation treatments. The group had specific focus on prioritizing wildland vegetation reduction through mechanical or manual removal of vegetation and/or prescribed burning. Next, the public participated in a map walk providing feedback on mapped model outputs displaying wildfire risks to HVRAs and priority treatment areas and types. Adjustments were made to the model based upon public comment coupled with the expertise of the CLT. The Chaffee County CWPP development process concluded in February 2020 (Figure 1, detailed timeline in Appendix A). The final products were: (1) a science-informed prioritization map that was driven by local community interests; (2) a written plan detailing vegetation management priorities, along with other strategies beyond vegetation management that can be used to reduce wildfire risk and engage the broader community (e.g. community chipping programs and land use planning efforts). This framework informed the development of a community goal to treat 30,000 acres by 2030—this target addresses half of the risk that can be mitigated through forest vegetation management (Envision Chaffee County 2021). Through 2021, the council has raised $19 million to fund mitigation work, has treated 3,136 acres, and has multi-jurisdictional projects covering 21,000 acres in the planning pipeline (Figure 2).

Background

Chaffee County (Figure 3) has a population of 20,356 (U.S. Census Bureau 2021). Over 70% of Chaffee County's 1,015 square miles is public land—this includes the headwaters of the Arkansas River, which provides recreation opportunities and water to over 1 million people. Due to a regional increase in both frequency and severity of wildfires since 2000, in 2016 a group of concerned citizens came together to update the county's

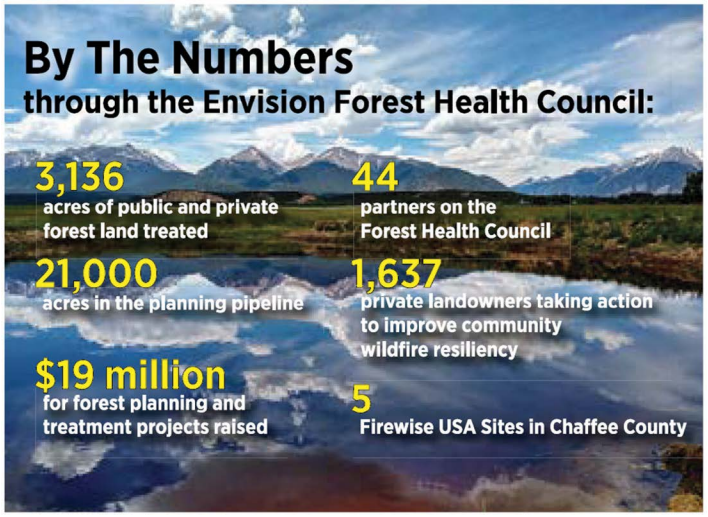


Figure 2. Year 1 outcomes of Envision Chaffee County CWPP. Source: Envision Chaffee County 2021.

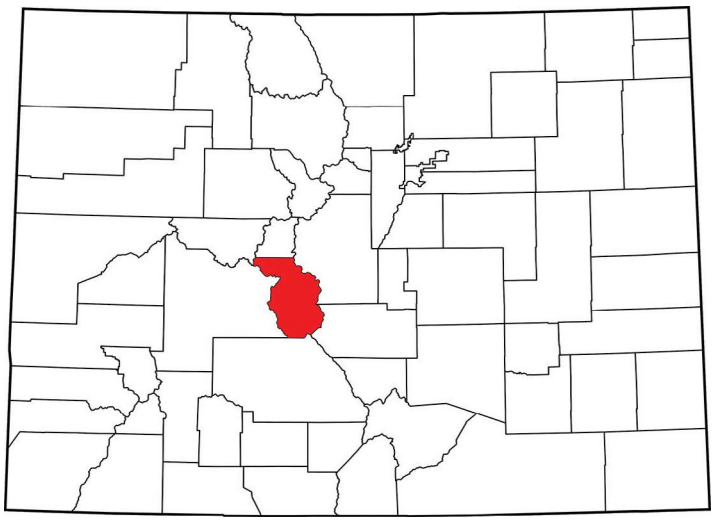


Figure 3. Location of Chaffee County, Colorado. Source: Nationalatlas.gov

2009 CWPP by incorporating new science and additional community input. Chaffee County's community leaders also recognized that rapid population and recreation growth had been creating negative impacts to the county's natural resources. In 2017, county commissioners signed a proclamation and provided funding to establish Envision Chaffee County to instigate grassroots, community-driven conversations about the future of Chaffee County, and develop a Community Action Plan. The Community Action Plan developed by Envision drives 40 programs and projects in the county, including the CWPP.

Envision first contacted CFRI in April 2018 to add science-based support for the grassroots community planning efforts. Several meetings took place over the next six months as CFRI staff engaged with a handful of Envision leadership staff. During this time, CFRI staff and Envision leadership got acquainted, Envision leadership familiarized themselves with the technical and collaborative aspects of the RADS model, and CFRI learned what Envision needed from the RADS framework. CFRI presented the RADS model to the CLT in October of 2018, and discussed challenges and opportunities for the group to move forward with the process. This discussion was critical to developing shared expectations between CFRI and the group about model capabilities and limitations, as well as roles and responsibilities in the planning effort (For an example of a detailed schedule see Appendix D). CFRI staff emphasized that while RADS creates a framework for groups to identify and prioritize values at risk with CFRI technical assistance, the hard decisions and effort of developing shared priorities remained with the group. Establishing expectations to co-develop knowledge and products empowers community groups to take ownership of the process and value the outcomes, while leveraging the latest science and technical modeling tools. The end products help simplify complex decisions and move the group to common action. Relying on an analyst to independently conduct a risk assessment may result in a similar final map, but the co-development of knowledge in the planning process often increases acceptance in the implementation of planned actions (Colavito 2021).

In February 2019, a second meeting was held with CFRI staff and the CLT to start identifying HVRAs and locating locally-relevant data. CLT members participated in CFRI-facilitated small group discussions to identify sub-HVRAs within thematic HVRA categories, (i.e wildlife, infrastructure, water resources, recreation, etc.). In the RADS framework, HVRA categories must be represented by spatially explicit data. Sub-HVRAs are the specific spatial components of HVRA categories (Figure 4). Much of this data was initially gathered from publicly available sources, such as recreation maps and wildlife data from state agencies. The group then augmented these public datasets with more detailed data, such as areas of intense dispersed camping or critical water utility infrastructure, to ensure the risk assessment was locally relevant.

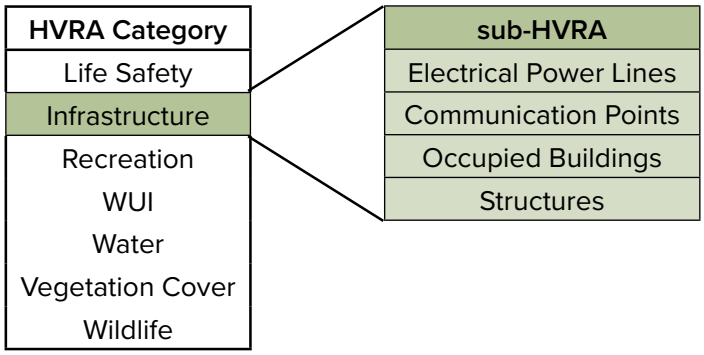


Figure 4. Connection between HVRA categories and their sub-HVRA's. For example, in an Infrastructure HVRA category, sub-HVRAs like power lines and structures can be spatially mapped. Then, the locations of these resources can be incorporated into risk assessment and spatial prioritization processes.

Initially no priority was discounted and a long list of potential HVRAs, potential data sources, and data needs was generated. In cases where data did not exist for specific HVRAs, CFRI staff helped guide discussions about potential data sources or alternate ways for HVRAs to be accounted for in the modeling process. Impacts of fire smoke was identified as an initial HVRA due to the dis-incentive for people to recreate in Chaffee County when smoke is present, as well as public health concerns. The group discussed that targeting mitigation in specific locations or capping total amounts of smoke would not be an effective strategy to mitigate impacts, since any presence of smoke would deter people from recreating in Chaffee County. Therefore no explicit spatial layer to represent smoke sources or dispersion trends was incorporated as an HVRA. However, smoke was indirectly incorporated into the planning process as one of the justifications for limiting prescribed fire to no more than 30% of the total implementation budget. While prescribed fire is an important tool for limiting future wildfire impacts and smoke, this struck a balance of maximizing prescribed fire capacity that minimized acute and persistent smoke impacts to Chaffee County. The small groups shared their initial lists with the full CLT to develop a list of joint priorities; every member of the group had the opportunity to describe and advocate for their priorities. The group moved towards developing a list of shared priorities that reflected a diversity of perspectives, yet was short enough to reasonably include in the technical modeling process. Through the collaborative process, every member of the group is able to see their priorities included in either the technical modeling or the final written plan, affirming

each individuals contribution and co-development of the priorities. However, the location and risk to each HVRA is a transparent data-driven process. This balances inclusion of ideas with science based modeling, ensuring the highest priority areas are not necessarily defined only by the most influential advocates.

In order to broaden the HVRA identification process beyond stakeholders and policymakers (i.e. the CLT), Envision administered the online Envision Chaffee County Community Wildfire Survey during February and March of 2019 (Envision Chaffee County 2020). This survey was co-developed by Envision leaders with expertise from the USDA Forest Service (USFS) Rocky Mountain Research Station WiRē team. The survey allowed the public to directly inform the relative importance weighting of values, resources, and assets for approximately protection from wildfire. Over 1,000 people participated, 7% of county adult residents. 80% of respondents believed that major fire was likely or extremely likely in the next five years, and 80-86% supported land management to mitigate fire risk. Results from this community survey helped to smooth difficult discussions within the CLT, where participants had to balance advocating for their personal or organizational interests with shared community values. The most important values, resources, and assets identified by the survey are summarized in Figure 5. The survey and results are available on the Envision website; other groups may choose to adapt this survey for their local contexts, as occurred in Lake County, Colorado.

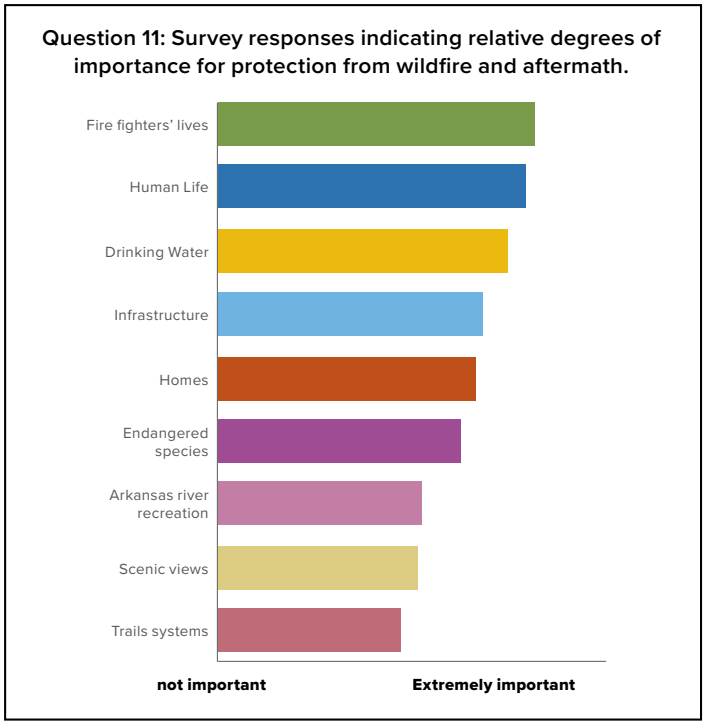


Figure 5. Results of Envision Chaffee County Wildfire Community Survey; Source: Envision Chaffee County 2020.

The community survey provided a buffer for difficult conversations around competing interests of the CLT, e.g. how much weight to put on water vs. recreation vs. WUI. The survey served as a starting point for the CLT to rank different values, and helped align the group with broader community priorities rather than having the loudest voice in the room drive decisions.

In May of 2019 a public meeting (1 of 3) took place at Poncha Springs Town Hall to continue engaging the broader community. Community members worked through a series of stations with fire professionals and community leaders to create wildfire readiness plans and were provided education on fire's role in maintaining ecosystem resilience. This public engagement provided an opportunity to follow up on the community survey with an in-person event and allowed community leaders to directly respond to information requests from the survey. Persistent and responsive engagement between the CLT and community through mechanisms such as the survey, in-person events, and local news stories helped build trust and a common understanding of mitigation priorities throughout the planning process. The process also developed a sense of the shared risk that exists for the entire community; perceived risk is a critical factor that influences how society interacts with the environment (Vickery et al. 2020).

WILDFIRE RISK ASSESSMENT

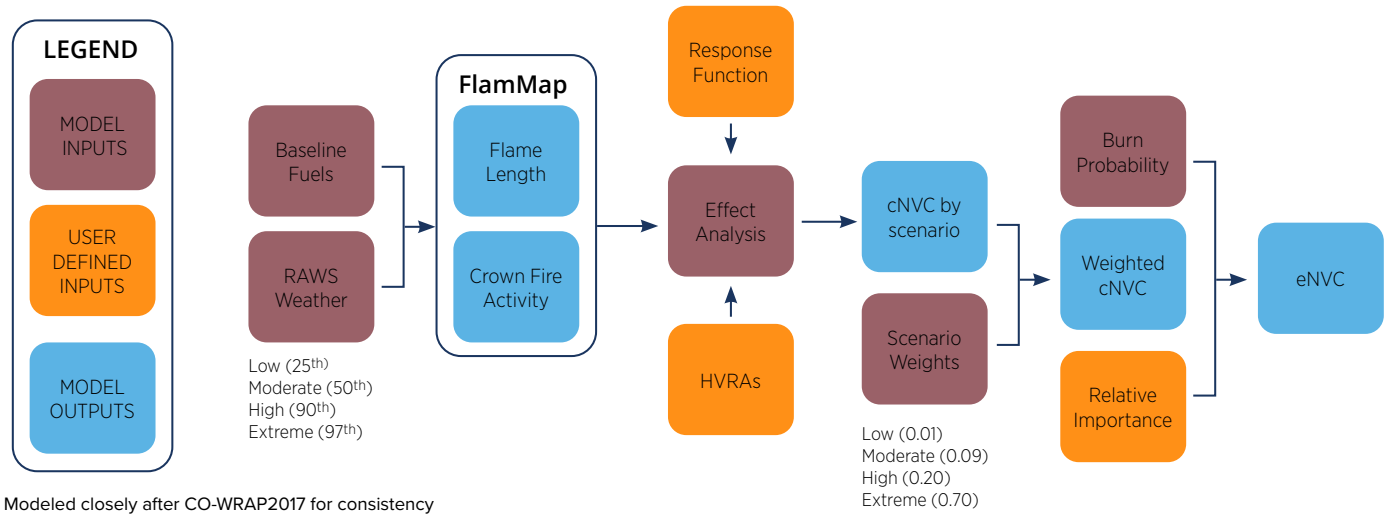
The next RADS meeting with the CLT (June 2019) focused on integrating input data for the RADS wildfire risk assessment model (Figure 6, Box 1). CFRI staff presented a roadmap of the wildfire risk assessment framework, and described how the information gathered from the meetings would be used in the modeling process. Providing the participants with a summary of where they are on the road map, what the expectations are of them in this particular context, and where they are going to end up is an essential part of project success.

The CFRI staff provided an overview of the risk assessment, including fire simulation modeling, response to fire, relative importance weights, and HVRA exposure. Prior to sharing fire behavior outputs with the entire CLT, local fire management officers from the USFS, BLM, and municipal fire chiefs reviewed data inputs and modeling assumptions with CFRI staff to provide feedback on making sure national data was applied appropriately to the local landscape. Involving stakeholders in developing data products builds confidence in and ownership of the planning process, and spreads knowledge amongst the group so collaborative participants besides the CFRI modelers fully understand and can communicate the concepts and data quality behind the risk assessment.

Data Details

Box 1: What's behind the modeling?

Wildfire risk assessment



Modeled closely after CO-WRAP2017 for consistency

Figure 6. RADS wildfire risk assessment model. Source: Gannon 2019

Risk in this assessment is captured jointly as the likelihood, intensity, and susceptibility to effects of wildfire on an HVRA (Scott et al. 2013). The baseline fuel data for the fire modeling came from LANDFIRE (https://LANDFIRE.gov/), a national database of landcover and fuel characteristics. This data was critiqued by local fire experts to ensure it accurately represented current forest conditions and recent management actions in Chaffee County. Fire weather variability was categorized into low, moderate, high, and extreme levels of fuel moisture and wind speed. FlamMap was used to model potential fire behavior, which is represented in two metrics: flame length and crown fire activity. Flame length and crown fire activity are used as a proxy for wildfire burn severity (Gannon 2019b). The wildfire risk assessment effects analysis uses flame length-based response functions to translate modeled flame length into a conditional net value change (cNVC) within each HVRA extent location (Technosylva 2018; Gannon 2019). cNVC is the net effect of damaging or beneficial impacts of fire intensity on the value of an HVRA. cNVC is a summary measure of the potential consequences of a fire to resources and assets (Thompson et al. 2016). Next, the cNVC measures for each HVRA are weighted, favoring the high and extreme fire intensity scenarios (Techosylva 2018; Gannon 2019). Finally, the cNVC measures are combined with burn probability and HVRA relative importance weights to produce a composite expected net value change (eNVC) map. The eNVC metric is a probability-weighted outcome, calculated by summing the product of the probability and magnitude of wildfire outcomes over the range of all possible consequences (Thompson et al. 2016) (Also see Box 3).

After participants understood the components of the wildfire risk assessment and developed an initial list of HVRAs, the CLT meeting participants joined small breakout groups aligned with their area of expertise and/or highest interests. Each group of experts then evaluated HVRA's and their likely response to wildfire (e.g. response functions), and assigned values of relative importance were for each HVRA. Before each breakout group the participants were provided an overview of why the data included was important to them, how the data would be used, and were able to ask questions about the process. Participants provided feedback for how each HVRA's response function and relative importance ranking influenced the overall wildfire risk relative to the values important to the group, and were able to iteratively see how their feedback changed risk maps during the meeting. This co-production of knowledge helps with ownership of the final products and empowers the stakeholders to articulate the results (Djenontin and Meadow 2018). The meeting concluded with draft composite risk maps and action planning for next steps in the process. Table 1 provides a crosswalk linking the risk assessment with the participants and their roles. The activities, outputs, and outcomes of this process are summarized in Table 2.

Wildfire Risk Assessment Activities and Outputs

Activity: Identify and assign response functions for HVRAs.

In the first session, small breakout groups refined the HVRA lists that were identified at previous meetings and developed response functions for each HVRA. Response functions are the HVRA's likely response to different intensities of fire behavior. Impacts to HVRAs may be different under different fire intensities (Box 2, Figure 7). For example, some HVRAs (e.g. buildings) are likely to respond negatively to all intensities of fire. Others (e.g. wildlife habitat) may respond positively to lower-intensity fires. The facilitator created four groups based on CLT participants' areas of expertise in the HVRA categories: recreation, wildlife, water supply, and wildland urban interface (WUI)/infrastructure. Each group was given a worksheet for their HVRA category, which contained initial HVRA response function values informed by a 2013 USFS Region 2 risk assessment and a review of scientific literature (Box 2). Participants were given 20 minutes to discuss and provide changes to the prepopulated table. Changes to the response function table were based upon the local knowledge and experience of the group combined with input from CFRI staff based on their science literature review. After identifying how each HVRA was likely to respond to wildfire, each group reported out their results and a larger group discussion was held to resolve any conflicts. CFRI staff captured a live table of revised response functions on screen during the discussion, updated the risk assessment, and produced new cNVC maps during the meeting that reflected team discussions on HVRA location and response functions. The maps were projected for participants to view, and participants moved on to weighting the relative importance of the community's HVRAs.

Activity: Identify primary HVRA categories' relative importance weights.

The next step in the process was to prioritize HVRAs based on their relative importance. CFRI staff described how relative importance weighting is used in the risk assessment, and meeting participants completed worksheets to revise HVRA relative importance rankings and provide comments. The category with the highest relative importance is commonly assigned a value of 100 to set a standard which other categories are weighted against. However, the percent of total weight is more important and represents the relative difference between HVRA's. For instance, in Chaffee County WUI (relative importance of 100) was weighted twice as important as protection of Wildlife (relative importance of 50). The table that CFRI staff presented (Box 2, Figure 7) was prepopulated with relative importance weights based on data from the Envision Chaffee County Wildfire Community Survey (Figure 5). One outcome of the relative importance weighting process was adding the category of Life Safety to the HVRA categories, and assigning a relative importance ranking of 120. This is consistent with the results of the community survey that listed human and firefighter life as the most important asset to protect in the event of a wildfire. The life safety category was represented spatially using important community evacuation routes.

Activity: Identify sub-HVRAs and assign relative importance weights.

There are two levels of relative importance for HVRAs: categorical (or primary) HVRAs and sub-HVRAs (Figure 9). Each categorical HVRA is examined by a group of specialists in that resource, who are qualified to provide feedback on the relative importance of each individual sub-HVRA within its respective category. These relative importance values must sum to 100. For example, in Chaffee County's Recreation category, Monarch Ski Area was given an initial relative importance rating of 20, indicating it was twice as important in priority as the Arkansas Headwaters State Park (Box 2, Figure 7). Each group reviewed hard copy maps of each HVRA and the relative importance worksheets (see Box 2), and made individual notes on any changes needed. Then, in a larger group conversation, participants agreed on a final version of relative importance that CFRI staff updated in a live table on a screen. Once the group agreed on the relative importance of the HVRAs, CFRI staff incorporated these values into the spatial analysis, and printed maps to hang on the walls for review. After reviewing how these changes in weights to HVRAs corresponded to changes in risk on the maps, the importance weights were adjusted by the group. For example, Monarch went down from 20 to 10, and the Arkansas Headwaters Recreation Area increased in importance from 10 to 27 (Figure 9). Through this iterative process CLT participants were able to adjust weights to ensure the final products reflected shared priorities that are balanced with objective measures of wildfire exposure. This deliberative process was critical for developing how wildfire interacts with HVRA's on the landscape, and achieving products that fostered a sense of ownership to work together towards shared priorities. The outputs of this session were hard copy maps for five resource areas of the risk assessment: Life Safety, WUI/infrastructure, water supply, wildlife, and recreation.

Activity: Draft asset maps and review for group input

For the next session, large copies of the five maps were posted on the walls for the participants to review. CFRI

Table 1. Risk assessment crosswalk and meeting roles.

Risk Assessment Crosswalk with Roles and Contributions of Participants			
Wildfire Risk Assessment Components	**Participants**	**CFRI's Role**	**CLT's Role**
Baseline Fuels and RAWS Weather	CFRI staff; CLT subject matter experts	CFRI staff prepared data prior to RADS Risk Assessment meeting.	Data critiqued by local subject matter experts.
Flame Length and Crown Fire Activity	CFRI staff; CLT subject matter experts	Performed fire behavior modeling, presented results, incorporated feedback to ensure locally relevant results.	Data critiqued by local subject matter experts.
Effects Analysis: Response Functions and HVRA Locations	CFRI staff; CLT meeting attendees	CFRI staff provided initial HVRA list and response functions drawn from previous risk assessments and best available science.	Updated HVRA list and response functions, reviewed HVRA data for accuracy and/or provided local HVRA locations.
cNVC by Scenario	CFRI staff; CLT meeting attendees	Ran model based upon input of HVRAs and response functions to calculate cNVC.	Feedback and critique on accuracy.
Burn Probability Product and Relative Importance	CFRI staff; CLT meeting attendees	Provided existing national and state burn probability options, and interpreted the community wildfire survey to develop initial relative importance weights.	Provided feedback on burn probability products and updated relative importance for HVRAs.
eNVC	CFRI staff; CLT meeting attendees	Ran model to output eNVC maps, present to group for review. Compiled action item list for any additional data needs.	Review cNVC and eNVC maps. Provided data to CFRI staff for desired updates/ changes to map.

Table 2. Activities, outputs, and outcomes of the risk assessment process.

Activity	Outputs	Outcome
Identify HVRAs	List of shared values within the stakeholder group	The stakeholders develop an understanding of shared values amongst the group, and begin to establish agreed-upon desired conditions at the broad landscape scale.
Group HVRAs into categories and weight each category's relative importance	Spreadsheet list of each category of HVRA and its relative importance weight	An understanding develops around where common values align on the landscape, and how broad priorities will be communicated.
Develop HVRA response functions (i.e., determine how each HVRA is likely to respond to fire)	Spreadsheet list of HVRAs with responses to various fire intensity levels; HVRA maps	Stakeholders gain a better understanding of fire's role in their community and ecosystem. Stakeholders see that fire can have both positive and negative impacts on their values.
Identify sub-HVRAs within each category and assign relative importance weights	Spreadsheet list of sub-HVRAs and their relative importance weights; HVRA maps for resource areas: WUI/Infrastructure, Water Supply, Wildlife, Recreation	Stakeholders articulate specific values and begin to see where they overlap with values of other members in the group to better understand tradeoff decisions.
Draft asset map and review for team input	HVRA category maps; Assessment of missing data layers and action plan to acquire them	Stakeholders get a visual depiction of the data that has been gathered and begin to see how the data translates to a risk assessment map.
Process outputs and next steps	Composite wildfire risk maps for conditional wildfire risk (cNVC) and expected net value change (eNVC); a list of outstanding data needs.	An initial synthesis of tradeoffs emerges that helps participants bridge different priorities and identify specific locations where shared values are most at risk from wildfire.
Review updated relative importance and response functions worksheet; review current risk assessment maps	Spreadsheet update of relative importance and response functions based on feedback	Stakeholders are involved in the co-development of the model and gaining a mutual understanding of the collective risk across the landscape.

Data Details

Box 2: How are HVRA Response Functions and Relative Importance determined?

		Relative response (from -100% to +100%)							
HVRA-Recreation	Buffer (m)	FIL1 (< 2 ft)	FIL2 (2 < 4 ft)	FIL3 (4 < 6 ft)	FIL4 (6 < 8 ft)	FIL5 (8 < 12 ft)	FIL6 (12+ ft)	HVRA Relative Importance	Comments
Tourism Business	400	-10	-20	-40	-80	-100	-100	5	
Monarch Ski Area	0	0	-10	-10	-20	-50	-70	20	
USFS Recreation Opportunities	400	0	-10	-10	-20	-50	-70	20	
Trails	100	10	0	-10	-30	-40	-50	40	
Arkansas Headwaters State Park	100	10	0	-10	-30	-40	-50	10	
Brown's Canyon Wilderness SA	0	40	20	10	-10	-20	-40	5	

Figure 7. Initial worksheet results showing responses to various fire intensity levels (FIL1-6) and relative importance worksheets for sub-HVRAS in the Recreation HVRA category. Flame length increases with fire intensity such that 0-2 ft flame lengths represent the lowest intensity class and 12+ ft flame lengths represent the highest intensity. The final relative importance are shown in Figure 9. Source: CFRI

Category	Relative Importance	Revisions	Comments
Wildland Urban Interface	100		
Water	90		
Infrastructure	80		
Wildlife	50		
Recreation	40		

Figure 8. Initial worksheet provided showing relative importance of HVRA categories. As a result of the discussion, a Life Safety category was added and given a relative importance of 120, and other categories were adjusted iteratively throughout the process. The final relative importance are shown in Figure 9. Source: CFRI

Flame length or fire intensity level (FIL) is a proxy measurement for fire severity. The resource or asset has a response to each intensity level that is positive, negative, or neutral. A value of 0 is no change and -100 is complete loss; +100 is the upper bound for radical improvement of the HVRA from interacting with fire. Participants also discussed the buffer zone of fire influence (measured in meters), which represents the area around an HVRA where fire is most likely to directly impact that HVRA—for example, the distance around occupied structures that would be needed protect the asset.

Discussion in small groups brought stakeholders with different expertise together to determine what effects different levels of fire intensity would have on HVRAs. For example, within the wildlife HVRA category a fire professional could discuss what the effects of a fire with a 2-foot flame length would be on vegetation, then a biologist could interpret how these effects would impact wildlife habitat by assigning a value to the table.

The documentation of this process was kept in an Excel table for each HVRA and its response function in the Excel table, so it lives on with the assessment as metadata and informed the final report. An analysis was conducted for watershed impacts to account for secondary impacts of wildfire: post-fire erosion and sedimentation. This analysis modeled ecological processes connecting fire behavior impacts on post fire erosion and sediment transport through streams and rivers to better represent the impact of wildfire on watershed resources (Gannon 2019). The response functions for water resources were calculated by the secondary watershed modeling and varied across the landscape, and do not have the same linear relationship directly correlated with fire intensity level as other resources. While additional HVRA's are also sensitive to secondary fire effects not well represented by flame length, such as the role of embers igniting structures, this and other secondary fire effects were not included in the analysis.

Category	Relative Importance	Share of total (%)
Life Safety	120	24.7
Infrastructure	100	20.6
Water	90	18.6
Wildland Urban Interface	80	16.5
Wildlife	50	10.3
Recreation	45	9.3

sub-HVRA	Relative Importance (%)
Tourism Businesses	10
Monarch Ski Area	10
USFS Recreation Opportunities	20
Trails	25
Arkansas Headwaters Recreation Area	27
Brown's Canyon National Monument	3
Dispersed camping	5

Figure 9. Relative importance of Chaffee County HVRA categories and relative importance of sub-HVRAs within the Recreation category. Category relative importance should not add up to 100, but relative importance scores for sub-HVRAs within each category should sum to 100.

staff spent five minutes explaining the origin of the maps. Then, the facilitator created four breakout groups, each of which spent fifteen minutes at each map providing comments with sticky notes. Then the groups had ten minutes to review the posted comments and provide any additional input. This continued until each group returned to their starting map and took another five minutes to review all comments. Then each group presented their recommendations for any essential additions.

The burn probability product emerged as one area of contention with the group. The first burn probability product proposed was derived from an existing national modeling effort called the large fire simulator, or FSim (Short 2017), which used the most advanced fire modeling tools available. However, there was a seamline through the middle of Chaffee County where the modeling showed very different values due to the national extent of the product. As an alternative, CFRI staff demonstrated the statewide Colorado Wildfire Risk Assessment (CO-WRA) burn probability map. This map was seamless throughout Chaffee County, but showed extremely low fire probability in subalpine forests, with very high probability throughout the valley and lower elevations. The concern was that CO-WRA did not match the community's observations that extensive areas of spruce beetle-killed trees at higher elevations had changed the fuel profile. Nor did CO-WRA take into account that fires are occurring more frequently in subalpine areas due to a combination of changing fuels, increased use of indirect fire suppression tactics that emphasize firefighter safety, and climate change (Gannon 2019). Based on this feedback, CFRI staff defined burn probability empirically based on historical observations of area burned by vegetation type (see Appendix II of Gannon 2019 for detailed information). This exemplifies the importance of ensuring national and statewide data matches local conditions in order to gain support and trust in the process within the collaborative group. By providing a framework where feedback from local expertise was combined with analytical capacity, the team achieved a locally-relevant and scientifically grounded product (Box 3, Figure 10). The session concluded with the group identifying missing data layers, and agreeing on an action plan to acquire them.

Meeting outputs and next steps

In the final session of the day, CFRI staff showed the latest maps characterizing risk on the landscape based on the data obtained from the day's sessions from two perspectives: conditional Net Value Change (cNVC) and expected Net Value Change (eNVC) (Box 3, Figure 10). The facilitator held a general discussion to obtain feedback on the current risk map products and gave participants a chance to voice concerns. The meeting concluded with a discussion of next steps to build on this map and to create the next RADS product: a treatment priority map. CFRI staff also provided a list of remaining data needed, and the collaborative group formulated a plan to determine who would provide the needed data and by what date.

It should be noted that this was an extremely well organized and productive meeting with a focused and relatively small group of roughly 25 individuals. Often the above steps in the risk assessment process (determining response functions, adjusting relative importance weights, and revising model outputs) occur over the course of several meetings over weeks or months.

Tech-Leads Team Interim Project Engagement

After each meeting CFRI staff worked with the CLT leadership team to get feedback about the previous meeting, identify needs, and set up the agenda for the next meeting. CFRI also engaged with CLT members to gather and refine data, modify model inputs and parameters, and run iterative outputs. This interim time with technical experts and leadership was critical to move the process along and make future work sessions with the larger Envision group more productive.

Data Details

Box 3: The analytics of wildfire risk

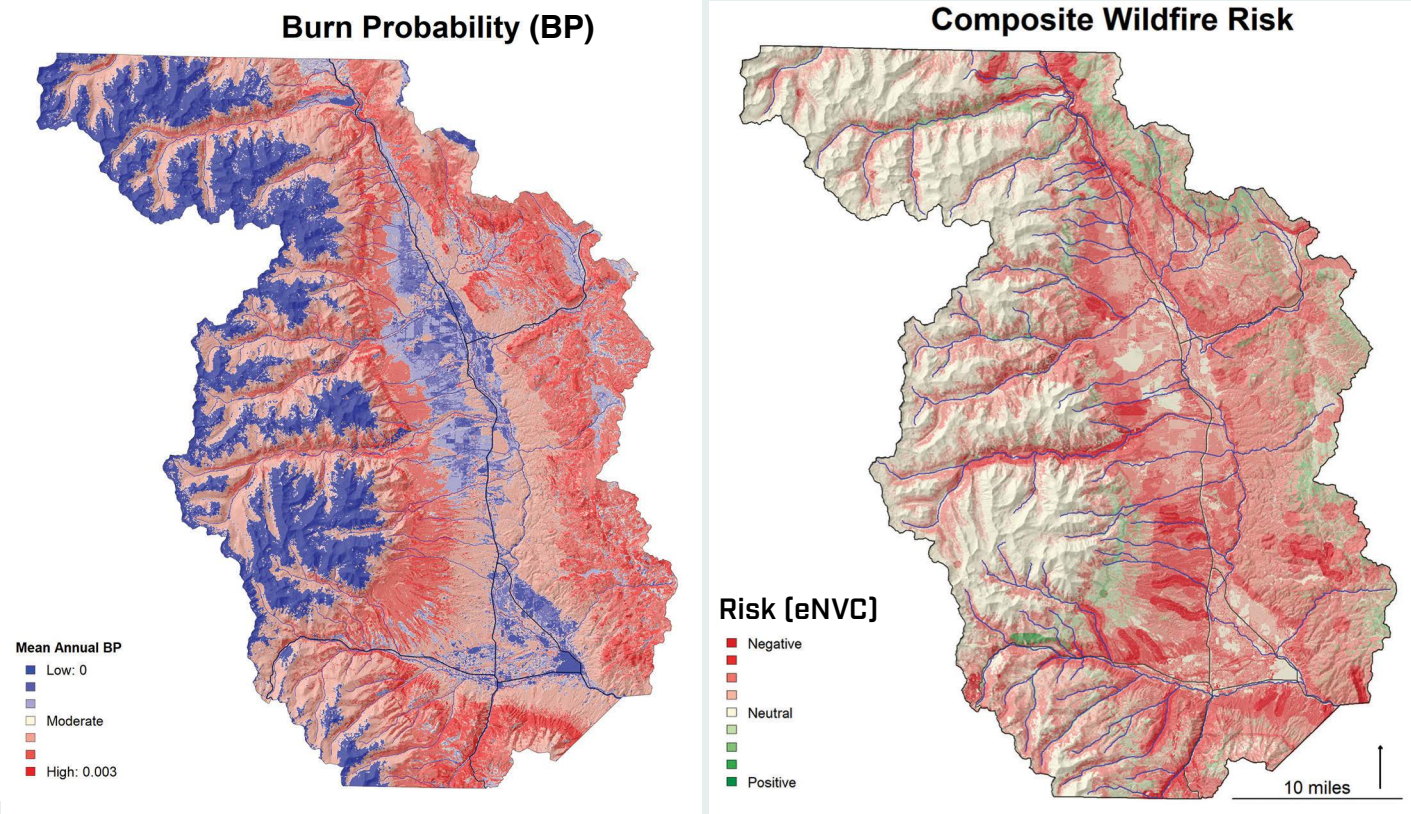


Figure 10. Burn probability and wildfire risk (eNVC) maps from the RADS process. Red areas on the burn probability map represent areas with the highest likelihood of a wildfire occurring. Negative eNVC (red) show where values are expected to experience loss from wildfire. Positive values (green) show where wildfire may be of net benefit to resources.

Conditional Net Value Change (cNVC) = Summary of the consequences of fire on any given resource

cNVC is a summary measure of the potential consequences of a fire on HVRAs. This assessment tool uses the flame-length based response functions discussed in Box 2 to translate flame length into fire effects. cNVC makes the assumption that fire will touch every part of the landscape, and does not take into account that some places are more or less likely to experience wildfire than others.

Wildfire Risk = Expected Net Value Change (eNVC)

cNVC (consequences of fire) is combined with burn probability (the likelihood of fire actually occurring in any given area) to map the eNVC, or composite expected wildfire risk. eNVC incorporates not only the likely impact of wildfire on any given area, but also the probability that it will burn at all. eNVC is an actuarial measure of risk to the HVRAs; it incorporates their relative importance, and all possible benefits and losses that may be incurred by coming into contact with varying intensities of wildfire.

For more, see: Thompson et al. 2016; Technosylva 2018; Gannon 2019; Scott et al 2013.

Activity: Review and update relative importance and response functions worksheets, review risk assessment maps

The next CLT meeting occurred in August 2019, where the goal of the first work session was to finalize the wildfire risk assessment. CFRI staff presented slides on the current fire simulation products, response functions, relative importance weights, and HVRA exposure maps. Then, facilitators broke the meeting of roughly 20-30 attendees into three groups to discuss the data and outputs presented by CFRI staff. The facilitators handed out hard copies of the worksheets containing the current relative importance and response functions for the HVRAs. The categories of HVRAs were life safety, infrastructure, WUI, water, wildlife, and recreation. The participants took ten minutes to discuss concerns within their groups,

then spent fifteen minutes sharing and discussing with the other groups. The worksheets provided space for the participants to make notes and changes to relative importance and the response functions of the HVRAs. Conversations included discussion of fire behavior and resource-specific modifications, and hazards around water infrastructure. Local critique illuminated that the Chalk Creek area was not represented accurately in the soils data. In the next iteration of the modeling, soil erodibility was increased by a factor of five to account for the extreme erosion hazard in that area (Envision Chaffee County 2020). Local knowledge incorporated into the modeling created a more accurate representation of local conditions, allowed participants to better understand and explain model processes, and increased confidence and motivation for participants to utilize the model results.

MOVING FROM RISK ASSESSMENT TO PRIORITIZATION

The next step of the RADS process is moving from the wildfire risk assessment to creating a shared treatment priority plan and map. Wildfire probabilities and impacts to HVRAs are only one part of RADS; if the modeling stopped there, Chaffee County would have been left with a lot of red areas where HVRAs would be negatively affected by fires, but no way of knowing which areas would be the most critical to mitigate first, given limited financial and human resources.

RADS simplifies complex decisions and tradeoffs by providing a framework to identify how specific geographic areas within the county will be prioritized for wildfire risk mitigation. Collaboratively identifying shared values and constraints supports the development of shared priorities and empowers collective action amongst all stakeholders. Within RADS is an optimization model that incorporates the costs of and constraints on different types of treatment options that could reduce wildfire impacts to the HVRAs. The goal of the optimization model is to identify spatially explicit management units where risk reduction per dollar spent is maximized (Figure 11). In short, it shows where, and what types of treatments the community should complete to get the most bang for their buck. A crosswalk of the prioritization model and roles are provided in Table 3.

Prioritization Meeting Activities and Outputs

The meeting in August 2019 began with another RADS process overview, a roadmap of the entire process and recap of the action since the last CLT meeting, and current products showing preliminary outputs. Activities, outputs, and outcomes of the prioritization process is summarized in Table 4.

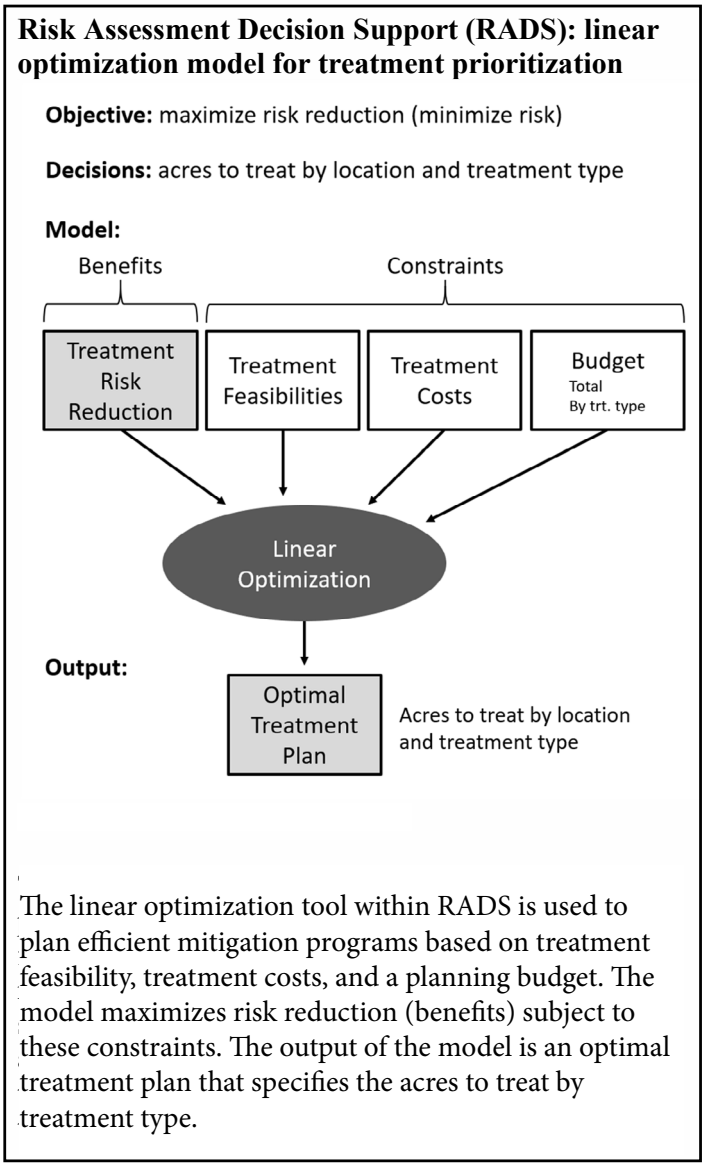


Figure 11. RADS linear optimization model.

Activity: Treatment costs and constraints worksheet

It's not only important to do work in the right places, but also to do the right kind of work. Mechanical thinning techniques, prescribed fire, and mastication are feasible and appropriate under different circumstances; one fuel treatment method may be more effective than another in a certain forest type, or access may constrain use of certain treatment options (Fight and Barbour 2006). The goal of this session was to gather local cost and constraint information about various treatment options to increase local relevancy of the prioritization. CFRI staff provided an overview of existing information about treatment cost and constraints for prioritization of treatment areas (e.g., access, forest types, wilderness area regulations, etc.). The facilitators handed out worksheets and led working groups to capture feedback and gather local data on the

Table 3. Prioritization crosswalk with roles and responsibilities.

Prioritization Crosswalk with Roles and Contributions of Participants			
Optimization Model Components	**Participants**	**CFRI's Role**	**CLT's Role**
Treatment Risk Reduction	CFRI Staff; CLT meeting attendees	Prepared data prior to RADS prioritization meeting based on empirical literature.	Review and confirmation by CLT subject matter experts.
Treatment Feasibilities	CFRI Staff; CLT meeting attendees	Performed feasibility analysis prior to meeting for review and updated with local feedback.	Updated feasibility data through worksheets.
Treatment Costs	CFRI Staff; CLT meeting attendees	CFRI Staff provided initial treatment costs from Northern Colorado.	Updated treatment cost data to match local economic conditions using worksheets.
Budget	CFRI Staff ; CLT meeting attendees	Generated cost-benefit ratio curves for CLT review based on risk reduction outcomes.	Agreed on desired risk reduction outcome targets and reviewed modeled budget.
Optimal Treatment Plan	CFRI Staff; CLT meeting attendees	Ran optimization model to produce prioritization maps by treatment type. Presented to group for review. Compiled action item list for any additional data needs. Then updated final model outputs for CWPP.	Provided feedback on final prioritization products. Confirmed data and outputs aligned with local knowledge.

Table 4. Activities, outputs, and outcomes of the prioritization process.

Activity	**Output**	**Outcome**
Treatment cost and constraints worksheet	Cost range estimations by treatment type, list of constraints to treatments; draft treatment priority maps	Stakeholders have the opportunity to refine and expand the options for treatment, gain knowledge about how treatments impact risk reduction across HVRAs, and clarify expectations for vegetation management to protect values at risk.
Review draft maps by treatment type	Treatment priority area map; list of action items and data needs	Provides stakeholders a visual opportunity to see how local feedback and priorities interact with fire modeling by translating results into a spatial prioritization map. Builds ownership in communicating and understanding results of the planning process.
Meeting outputs and next steps	Treatment priority maps	Communicates shared priorities and catapults the group and community into action planning.

feasibility and costs of treatments (Box 4). Participants also had the opportunity to respond to and comment on the initial feasibility constraints presented by CFRI.

CFRI staff suggested two initial treatment options that broadly characterize forest vegetation management strategies: mechanical thinning (Mechanical), and prescribed fire (Rx fire). CFRI modelers added two additional treatment options as result of feedback from the group: 1. mastication and 2. a complete option of mechanical thinning followed by prescribed fire. Mastication (mulching of fuels) is a type of mechanical treatment that participants suggested would be uniquely effective on parts of the local landscape. The wildfire risk assessment showed that much of the wildfire risk in Chaffee County was concentrated in pinyon-juniper forests, where mastication is a common treatment type.

Next, cost estimates for each treatment type were elicited from the group. CFRI staff provided cost estimations from other projects as a starting point. Discussions within the group helped to develop trade-offs and resulted in

Data Details

Box 4: Defining Treatment Constraints and Costs

Treatment Type	Hard Feasibility Constraints	Cost Constraints (based on accessibility, operability, etc.)
Mechanical	• No Wilderness • No upper tier roadless • Must have trees to cut (LANDFIRE canopy cover > 10%)	• Range: $2,500-10,000/acre • Cost increases beyond 800 m from roads and beyond 40% slope
Rx Fire	• Not near homes (> 250 m from WUI structures) • Limited to frequent fire forest types that can be burned with Rx fire as a first entry treatment	• Assumed constant cost of $1000/acre • Spending limited to 30% of total budget
Mastication	• LANDFIRE canopy cover greater than 10%; forest type must be pinyon-juniper; slopes must be less than 40% • No treatments in wilderness or upper tiered roadless; and no treatment in special designation areas (Gannon 2019a).	• Spending limited to 20% of total budget • Cost increases with slope>20% (Jain et al. 2018) and beyond 800m from roads • Maximum of $5000/acre
Complete Treatment	• Mechanical treatment followed by prescribed fire	• Cost = sum of thinning & Rx fire costs

Worksheet used to determine treatment constraints and costs. Highlighted areas in pink indicate the changes made by the CLT during the prioritization process.

Data Sources Feasibility Constraints	Mechanical thinning is not permitted in wilderness or upper tier roadless areas (North et al. 2015).	**Data Sources Cost Constraints**	Per-acre estimates for mechanical thinning were taken from a model developed in Northern Colorado (Gannon et al. 2019b).
	No burning within 250 meters of structures in the WUI (Caggiano et al. 2016).		Prescribed fire costs are difficult to estimate and not consistently recorded (Eliott et al. 2021). Based on expert opinion, a flat-rate estimate of $1000 per acre was provided (Gannon 2019a).

additional local constraints to the model. For example, there was concern that widespread mastication treatments would be detrimental for certain wildlife species, so a constraint that limited spending on mastication to 20% of total budget was added to the model. Stakeholders had concerns over prescribed fire smoke and its impact on hunting. October is the prime time of year in the area for both prescribed fire treatment and hunting for ungulates. The CLT also recognized that it would not be practical to increase prescribed fire budgets in the short term, so an additional constraint was added to limit prescribed fire to 30% of the budget (Gannon 2019). This ensured that large proportions of the budget could not be unrealistically allocated to prescribed fire.

Participant's feedback from the treatment constraints and costs activity are used to customize the RADS model to determine specific areas to treat. Outputs of this session were a spatial prioritization heat map of risk reduction by budget (Figure 12), and a draft table showing how many acres could be managed using each treatment type at different available budget levels to get the best bang for the buck (Table 5). By placing the strategic locally-appropriate treatment in the community-identified highest-priority locations, wildfire risk to community values can be reduced while expending minimal resources.

Activity: Review draft maps by treatment type and Q & A Session

The next session included a presentation of printed posters of risk reduction by treatment type informed by cost and feasibility. The facilitators divided the participants into two groups to review the posters and provide comments. Comments were documented, and participants created

Priority	Budget	Risk Reduction (eNVC)	Thin only (acres)	Rx fire only (acres)	Complete (acres)	Mastication (acres)	Total (acres)
Highest	$10M	1,184	174	3,000	1,484	2,593	7,252
Higher	$50M	2,848	141	13,652	8,565	12,361	34,719
High	$100M	3,873	141	22,180	18,816	24,524	65,661
Moderate	$200M	4,827	141	44,987	37,615	47,778	130,521

Table 5. Table of risk reduction by budget and treatment type. This table includes and summarizes the expected risk reduction to HVRAs, which takes into account the probability of wildfire. Source: Gannon 2019a

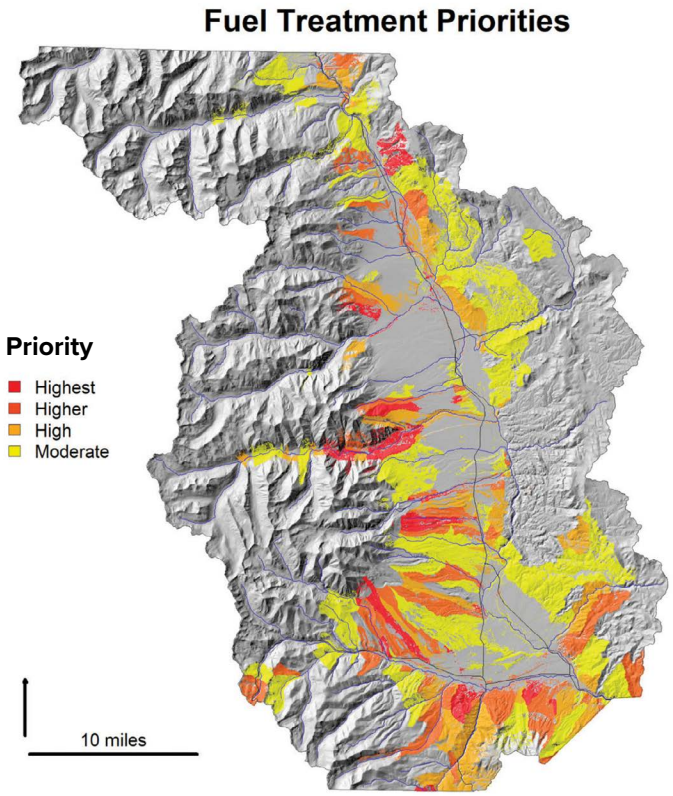


Figure 12. Bang for the buck prioritization map of risk reduction by budget. Source: Gannon 2019a

an action plan for any outstanding data needs. CFRI staff provided an explanation of costs versus risk reduction by budget (Figure 13). The points on the risk reduction by budget curve represent different levels of risk reduction per dollar invested in fuel mitigation treatments. Initial investments in fuel treatments yield large returns in risk reduction, for instance treating areas of high risk with easier access (near roads, less steep slopes). The steepest section of the risk reduction curve represents the greatest amount of risk reduction per dollar invested. Investments past this point will still reduce risk, but with less efficiency. The CLT examined the risk reduction by budget curve (Figure 13), and points on the curve were translated into cutoffs mapped as highest, higher, high, and moderate priorities on the map (Figure 12). The highest priorities represent where the most risk reduction can be achieved per dollar spent relative to the expected wildfire impacts on HVRAs (i.e., biggest bang for the buck, and not simply the cheapest places on the landscape to mitigate wildfire impacts). Using RADS outputs from the risk reduction by budget curve and priority map, the group was able to establish overall budget goals, establish acre targets for management, and begin planning mitigation treatments in specific locations to achieve the risk mitigation outcomes that would best protect shared values.

Meeting outputs and next steps

The meeting concluded with a discussion of next steps and outputs. Outputs included a table of remaining data needs, timelines, and parties responsible. The next steps included another round of public engagement through a series of public meetings. These meetings included a map walk, where the public was invited to view multiple paper maps in a community center. In these meetings, the CLT provided illustrations of the RADS process and outputs, opportunities for the broader community to discuss the maps with members of the CLT, and a group question-and-answer session. A final CLT meeting was scheduled to incorporate public feedback collected into the final RADS products.

Public Meetings 2 and 3

In October 2019 two two-hour public meetings were held on successive evenings at two different locations: the Poncha Springs Town Hall, and the Buena Vista Community Center. The CLT gathered contact information from public participants to keep them updated on project progress. At each meeting, a CLT representative provided an introduction with context about the RADS process and direction for meeting participants. CFRI staff were not present at these meetings; the CLT had the empowering opportunity to communicate the RADS process and model outputs to the public (Figure 14). In both meetings drafts of the RADS products were displayed to the public. Maps included: fire probability, fire intensity, composite wildfire risk, and fuel treatment prioritization. Two additional posters summarizing the methods of the wildfire risk assessment and fuel treatment prioritization were also displayed. The facilitator gave instructions to the map

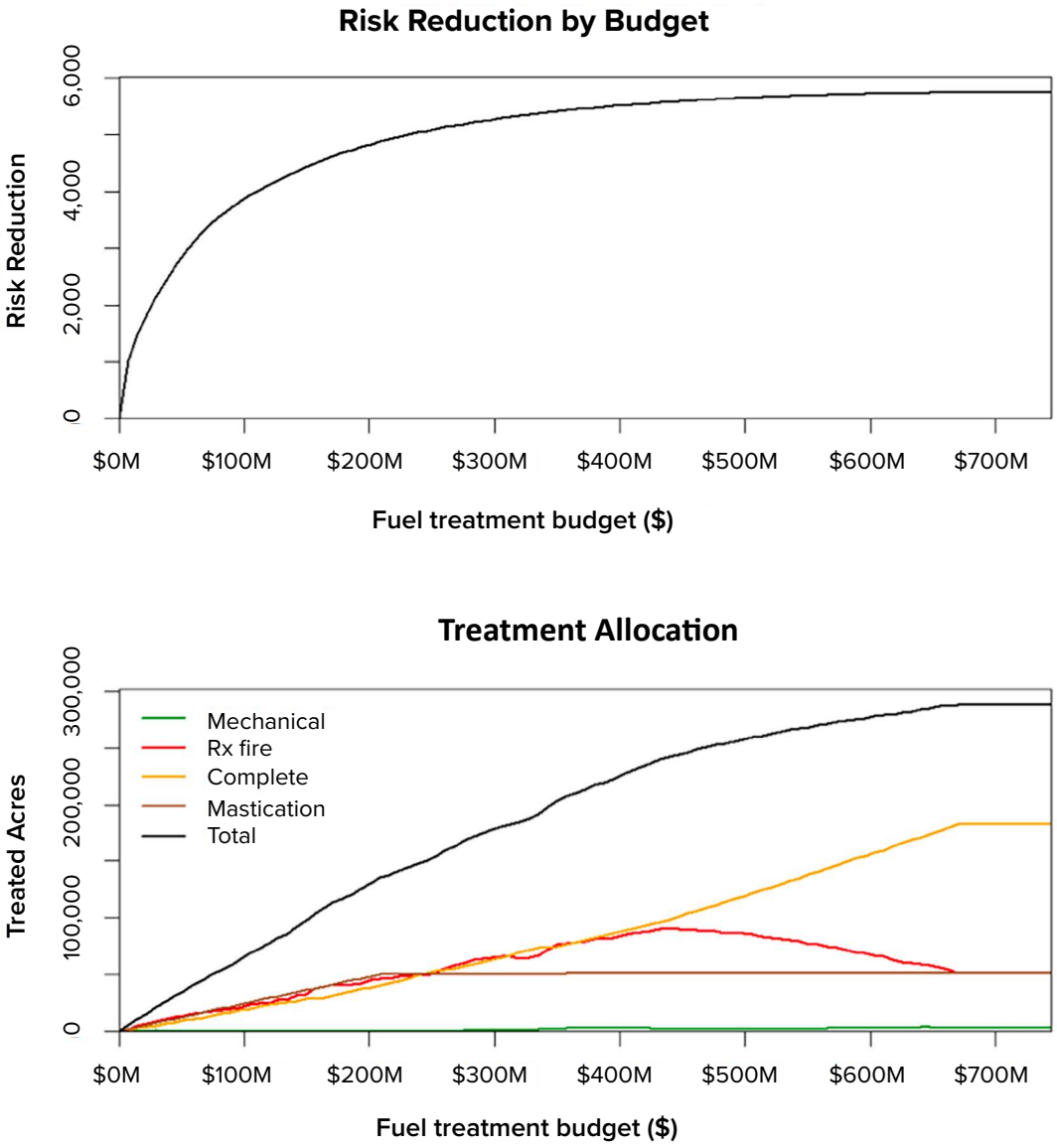


Figure 13. Risk reduction by budget and treatment allocation by budget. Source: Envision Chaffee County 2020.

walk participants to grab a pen and sticky notes, divide evenly amongst the map areas, and spend approximately fifteen minutes at each map. Participants were encouraged to write down their thoughts, concerns, questions, and insights. Agency personnel from the CLT were available to answer questions. Participants provided 220 comments. The facilitators gathered the sticky notes and identified the top questions received. These questions guided a Q & A session during the meeting. Participants also discussed a community chipping program to aid homeowners in mitigating their private property against the threat of wildfire. This conversation helped spur the Chaffee Chips program—an initiative to coordinate slash removal from neighborhood homes and engage landowners with an overall landscape strategy through education and outreach. Finally, the facilitators organized comments for further discussion into three categories: 1. Fire behavior; 2. Things we value at risk; and 3. Action—where to treat.

INCORPORATING PUBLIC FEEDBACK AND FINALIZING PRODUCTS

The CLT met in November of 2019 to finalize the RADS spatial products. CFRI staff presented a summary of how they had integrated feedback from the public and meetings with the tech-leads team that had taken place since the CLT RADS prioritization meeting. Changes to the model as a result of this input include:

- Updated burn probability based upon recent observed rates of burning by forest type:

  Due to climate change, changes in fuel profiles, and fire suppression strategies that emphasize firefighter safety through increased use of indirect fire suppression tactics, higher elevation forests are more likely to experience fire in the future. An informal vote took place to approve this change for the risk assessment.

- Updated the prioritization to include mastication as a treatment option and added budget constraints to mastication and prescribed fire treatment options to ensure the model would not assign these options to the whole landscape.
- Modified density in the WUI HVRA category:
  The model originally had three levels of WUI density: high, medium, and low to reflect different levels of hazard in WUI based upon prevalence of structures. These categories were adjusted to only include two levels: high and low, where high density was defined as WUI with 1.5 structures per acre or greater, and low density was below this threshold. The density breakpoint was informed by a case study of the Waldo Canyon Fire (Maranghides et al. 2015), in response to feedback from local fire chiefs that the mapping was not taking into account their considerations when fighting structure fires in a wildland setting.

At the conclusion of the meeting, CFRI staff asked the leaders of the CLT for a final round of feedback in which participants could suggest any final modifications. CFRI staff instructed them to review the final products and communicate via email with any final changes.

The final risk reduction graphics for the Chaffee County CWPP are shown in Figure 13. This graphic shows estimated risk reduction by budget (levels of risk reduced per dollar spent), and how the treatment types are allocated by budget. For Chaffee County, progressive budgets for fuel treatments of $10 million, $50 million, $100 million, and $200 million were chosen to represent a range of desired outcomes of risk reduction per dollar invested. These results helped the group set outcome-based goals to reduce half of the wildfire risk in Chaffee County through forest management. Then the group used this information to set goals of acres treated, identified treatment types, and estimated a budget of $50 million over 10 years needed to achieve those goals (Envision Chaffee County 2020).

OUTCOMES, LESSONS LEARNED, AND RADS PRODUCTS UTILIZATION

CFRI conducted interviews between March and April of 2021 to gather insights about the Chaffee County RADS process, including feedback related to project outcomes and any lessons learned. Interviewees included federal and public land managers, CFRI staff, and the project's facilitator.

Equity in prioritization

Stakeholder and public engagement are an essential component of the RADS process—without this engagement, RADS is simply a hypothetical data-analytic

Figure 14. Public meeting "map walk" engagement for RADS process in Chaffee County. Source: Envision Chaffee County 2020.

exercise. Participants noted that the RADS process promoted unification and an environment that allowed an equal voice to all concerns in the risk assessment and fuel treatment prioritization. Starting at the ground floor and creating space for everyone to provide input built common ground, and led to acceptance and enthusiasm for the final product. Participants were able to resolve conflicts such as "What is more valuable, the power line or the irrigation ditch?" in a collaborative setting. Each resource group (wildlife, WUI, etc.) was given the opportunity to provide feedback on what was most important for them during the HVRA characterization process (i.e. identification, relative importance, and response functions). The process enabled participants to integrate different resources of concern into a larger treatable landscape, and "took a lot of angst out of the system." This environment also created less competition between the resource asset groups, as they unified into one group speaking with one voice and moving toward a common goal: prioritized shared risk reduction.

While there was good engagement from many community members, the group acknowledged there was also room for improvement. In particular, there were minimal opportunities for engagement or feedback from Spanish speaking community members, as well as residents without internet connection who were not able to access the community survey. There was also no effort to engage native americans who are ancestrally linked to the land. These are areas for improvement in future community-based collaborative planning and prioritization processes.

Grant writing and management planning

RADS results have supported grant writing, funding opportunities, and planning treatments in multi-ownership landscapes. The different maps produced by the risk assessment and fuel treatment prioritization

process can be used to highlight funding opportunities for different categories of HVRAs. For instance, a map that shows recreation priority areas can be used to leverage funds that are earmarked for recreation-specific resource improvement goals.

Because the polygons that are lit up for prioritization by the RADS model "do not care about ownership," the RADS outputs provide guidance for planning fuel treatments across jurisdictional boundaries over multi-year time horizons. A concerted effort was made with local foresters to incorporate all previous forest treatments across all land ownerships into the fire behavior modeling. This ensured the prioritization identified areas based on the most current landscape conditions. Implementation of multi-jurisdictional treatments in Chaffee County involves multiple management agencies: federal (the USDA Forest Service and Bureau of Land Management), state, and county (Colorado State Forest Service, Colorado Parks and Wildlife, Natural Resource Conservation Service, fire protection districts, and private landowners.). All of these agencies have different mandates and management objectives, and they possess different tools for implementing treatments, but the RADS process (and its outputs) brings agencies together and empowers them to focus their specific management expertise in a collaborative way. The RADS results validated manager's assessment of areas where they already thought treatment was important, brought up areas not previously considered, and importantly gave them a broader planning framework to justify not treating in lower priority areas within their agencies, with project partners, and with the public. The process catapulted the group into shared communication and cross-boundary action planning towards common goals.

Visual communication tool

Land managers have used RADS products to communicate management goals and objectives in a visual manner: "you can talk about it [risk reduction] until you are blue in the face, but if I don't have that graphic, I can't go to public meetings and wing it." The RADS prioritization outputs communicate treating the right acres to the community in a way that they can "quickly grab ahold of and get excited." The risk reduction maps are also being used to communicate accomplishments of treatments, so that agencies can demonstrate risk reduction and return on investment for funded projects.

Opportunities for improvement

A substantial amount of time was spent getting all participants on the same page, so starting the process with an example of how RADS has worked in other areas would be helpful. One identified challenge was that each agency has different data tracking mechanisms, so trying to pull data together across the landscape was difficult.

Participants also mentioned that it would be valuable to understand how RADS results fit in with a variety of other newer prioritization and risk assessment frameworks, such as the Colorado State Forest Service Forest Action Plan and US Forest Service scenario investment planning. There was also confusion about how Potential Operational Delineations (PODs) as a management tool compares/relates to RADS. As the CLT was working through the Envision Chaffee County RADS process, the Pike and San Isabel National Forest was concurrently developing the PODs fire planning framework on parts of the same landscape. The RADS and PODs frameworks can be integrated (Caggiano, 2022). For example, PODs can function as a management unit, while RADS can describe the values at risk within each POD. RADS can illuminate an area where it's crucial to reduce risk to water infrastructure; PODs can demonstrate where targeted fuel treatments along a POD boundary could help prevent fire from burning into the area. In future RADS processes, facilitators could provide meeting participants with information and opportunities to discuss other assessment frameworks with which they are familiar, and describe how RADS relates to, differs from, and integrates with those assessments.

RADS Applications Beyond the CWPP

The RADS process provided a framework to guide a large diverse group to prioritize where risk reduction per dollar invested is greatest. During the RADS process, participants such as County Commissioners and other CLT members realized the confluence of bringing together data and decision-makers could be leveraged in other processes, such as recreation planning and updating county land use codes. In addition to leveraging products for the CWPP, the RADS framework of situating spatially explicit science within a collaborative decision-making process was adapted to inform recreation planning in Chaffee County. The Chaffee County Recreation in Balance program helps maintain the outdoor experiences and economic benefits of tourism in Chaffee County.

CFRI staff and the Recreation in Balance team adapted concepts from the RADS CWPP planning process to co-develop a new tool aimed at building community consensus around recreation opportunities and wildlife habitat conservation. This provided a science-based approach to support community strategies that enhance recreation opportunities while minimizing wildlife impacts. The tool uses geospatial models to identify where the most important wildlife habitats are at highest risk for recreation pressure in Chaffee County. Adapting

key RADS components of melding spatial analysis with collaborative decision support processes helped ground potentially contentious conversations in science, and provided a clear pathway and sideboards to integrate community values with leadership priorities into a plan of action. This has helped Envision and community leaders build support for the plan, and identify key areas to focus recreation improvement to mitigate impacts to wildlife, such as seasonal restriction strategies and re-directing recreation use patterns.

RADS is a monitoring tool that not only helps prioritize the most effective areas for forest management, but also measures effectiveness of forest management actions to reduce wildfire risk. Incorporating measures of effectiveness helped convey the limits of forest management to reduce wildfire impacts to values at risk. This helped Chaffee County Commissioners and other CLT partners realize that additional activities such as developing fire adapted communities, integrating fuels management with wildfire response tactics, updating county use codes, and other actions were essential compliments to forest management. Robust conversations with the CLT about fuel treatment effectiveness and diverse strategies to reduce wildfire risk, combined with the RADS effort to gather large amounts of data, served as a catalyst to identify opportunities for updating land use codes and other county level actions. The Chaffee CWPP included recommendations to land use codes including driveway/road widths updates with steepness guidelines to improve firefighter access, and requiring reflective non-combustible road signage in WUI neighborhoods (Envision Chaffee County, 2021). The CWPP process also led to the development of the Chaffee Chips program, which has improved defensible space on over 600 homes in the county in the first two years.

From recreation planning to land use codes to community engagement and home protection, the RADS framework has helped to catalyze action far beyond forest acres treated that is contributing to a science informed holistic land management approach in Chaffee County.

CONCLUSION

The RADS framework was integral in the development of the Chaffee County CWPP. The RADS process drove the prioritization of wildfire mitigation efforts through a social process that integrated best available science with social values. While the outputs produced by the RADS model are important, the social dynamics intrinsic in the process are equally valuable. The process elucidates a social distribution of risk across the landscape that knows no jurisdictional boundaries, confirming that wildfire risk is not just a federal problem or a private land problem, but a wider social-ecological problem. The prioritization process aided in conflict resolution and provided participants with the confidence to go out and use the results with a wide array of audiences. The RADS prioritization maps provide a spatial representation of where investments can generate the greatest return in the form of risk reduction through vegetation management. The results have been used as a communication tool and have also proven to be useful in obtaining funding, fuel treatment planning, and as a catalyst for other activities that compliment and enhance forest management outcomes.

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APPENDIX A: CHAFFEE COUNTY CWPP PROJECT TIMELINE

Date	Meeting Topics	Parties Involved	Notable Key Developments
4/3/18	Initial contact Envision Chaffee County (Envision) and Colorado Forest Restoration Institute (CFRI).	Envision leader, CFRI staff	CFRI director is notified of modeling interest for Chaffee County CWPP.
6/29/18	Identify potential Highly Valued Resources and Assets (HVRAs) for Chaffee County, discuss methods for public engagement.	Envision leader, CFRI staff	Identified potential partners for collaboration and public engagement.
7/3/18	Discussion of main project goals.	Envision leader, CFRI staff, US Forest Service (USFS) personnel, Colorado State Forest Service (CSFS) personnel, County Commissioner, Colorado Natural Heritage Program (CNHP)	Initial goal established of treating 40,000 acres over 10 years.
9/5/18	Community level survey initial development.	CFRI staff, USFS social scientist, CSU social scientist	Social science research methods and local information needs combined.
9/24/18	Discussion of county-level tax being proposed to fund restoration work (Common Ground Tax Fund).	Envision leader, county commissioners, community leaders	Concurrent development of an implementation mechanism and the RADS management planning process.
9/25/18	First draft run of the RADS technical model to demonstrate potential results.	CFRI Staff	CFRI staff learn data needs that help inform structuring the collaborative process.
10/1/18	Presentation to CLT how RADS could be used for developing a multi-resource planning and prioritization framework.	CLT, CFRI staff	Develop understanding of roles and responsibilities amongst the group, RADS opportunities and limitations.
12/17/18	Phone meeting discussing using survey to assess public's values at risk.	CFRI staff, Envision leader	CWPP will help guide funding provided from municipal tax revenue raised for restoration treatments.
2/4/19	Prep meeting for Envision Chaffee County.	CFRI staff, Envision leader	
2/8/19	CWPP Leaders Team Meeting	CLT, CFRI staff	Create initial list of HVRAs and shared values important to the community.
2/19-3/19	Online survey administered (Envision Chaffee County Community Wildfire Survey).	USFS social scientist, CLT, public	Public guidance for HVRA relative importance.
4/15/19	Planning meeting for Envision Chaffee County.	CFRI staff, Envision, USFS, County Commissioner, Fire Chief, Recreation Specialists	Will use previous USFS risk assessment as baseline for RADS model.
5/16/19	Public Meeting Poncha Springs Town Hall.	Envision CLT, public	Public further engaged in the process.
6/11/19	Prep meeting for CLT RADS Phase 1: Wildfire Risk Assessment.	CFRI staff, Envision leader	Agenda for Phase 1 meeting.
6/19/19	CLT RADS Meeting Phase 1: Wildfire Risk Assessment.	CLT, CFRI staff	cNVC, eNVC draft maps.
Various 6/19/19-8/5/19	Feedback from Phase 1 meeting, gathering and refining data, setting agenda for CWPP Leaders Team Meeting Phase 2.	CLT, CFRI staff, Envision leader	Agenda for Phase 2 meeting.
8/5/19	CWPP Leaders Team Meeting Phase 2.	CLT, CFRI staff	Draft treatment priority maps.
9/3/19	RADS and Chaffee County Common Ground tax.	CLT	RADS will be used as a decision point for tax revenue allocation.
10/3/19	Public Meeting Poncha Springs Town Hall.	CLT, public	Public comments on RADS products.
10/4/19	Public Meeting Buena Vista Community Center.	CLT, public	Public comments on RADS products. Chaffee Chips program.
Various 8/5/19-11/1/19	Discussion of project progress, data collection, processing public feedback, planning for RADS products finalization.	CLT, CFRI staff, Envision leader	Agenda for Phase 3 meeting.
11/1/19	CWPP Leader Team Meeting Phase 3.	CLT, CFRI staff	Finalized priority maps.
2/4/20	Chaffee County Next Generation CWPP signed.	CLT	Finalized CWPP.

APPENDIX B: CHAFFEE COUNTY CWPP HIGHLY VALUED RESOURCES AND ASSETS (HVRAs)

HVRA categories and sub-HVRAs spatial data by type, buffer distance, relative importance, and wildfire response functions.

HVRA Category	Sub-HVRA	Type	Influence zone (m)	Rel. Imp. (%)	FIL1 0-2 ft	FIL2 2-4 ft	FIL3 4-6 ft	FIL4 6-8 ft	FIL5 8-12 ft	FIL6 > 12 ft
Life Safety	Evacuation routes	Polyline	400	100	-20	-40	-80	-100	-100	-100
Infrastructure	Aircraft Landing Facilities	Point	200	5	0	0	-10	-50	-80	-90
	Communication Facilities	Point	200	35	0	0	0	-30	-100	-100
	Electric Power Transmission Lines	Polyline	200	35	0	0	0	-30	-40	-40
	Emergency Service Stations	Point	200	15	-10	-30	-60	-80	-100	-100
	Schools	Point	200	10	-10	-30	-60	-80	-100	-100
Wildland Urban Interface	Low density WUI	Raster	0	47	-20	-40	-80	-100	-100	-100
	High density WUI	Raster	0	53	-40	-80	-100	-100	-100	-100
Water	Critical Water Supplies	Raster	0	65	NA	NA	NA	NA	NA	NA
	Surface diversions	Raster	0	3	NA	NA	NA	NA	NA	NA
	Ground diversions	Raster	0	2	NA	NA	NA	NA	NA	NA
	CSU Pipelines	Polyline	200	10	0	-20	-50	-80	-100	-100
	CSU Buildings	Point	200	20	-10	-20	-40	-100	-100	-100
Wildlife	Bighorn Sheep Winter Range	Polygon	0	5	40	20	10	-10	-60	-80
	Black Bear Fall Concentration	Polygon	0	10	40	20	10	-10	-60	-80
	Elk Migration Corridors	Polygon	0	5	40	20	10	-10	-60	-80
	Elk Winter Range	Polygon	0	10	40	20	10	-10	-60	-80
	Aquatic Habitat	Raster	0	50	NA	NA	NA	NA	NA	NA
	Mule Deer Migration Corridors	Polygon	0	5	40	20	10	-10	-60	-80
	Mule Deer Winter Range	Polygon	0	10	40	20	10	-10	-60	-80
	Lynx	Polygon	0	5	0	-10	-20	-40	-80	-100
Recreation	Tourism Businesses	Point	400	10	-10	-20	-40	-80	-100	-100
	Monarch Ski Area	Polygon	0	10	0	-10	-10	-20	-50	-70
	USFS Recreation Opportunities	Point	400	20	10	-10	-10	-20	-50	-70
	Trails	Polyline	100	25	10	0	-10	-30	-40	-50
	Arkansas Headwaters Recreation Area	Polygon	100	27	10	-10	-10	-30	-50	-70
	Brown's Canyon National Monument	Polygon	0	3	40	20	10	-10	-10	-10
	Dispersed camping	Polygon	0	5	10	0	-10	-30	-40	-50

APPENDIX C: 2020 ENVISION FOREST HEALTH COUNCIL MEMBERS

The 2020 Envision Forest Health Council members include 18 organizations and the current 29 participants listed below. The organizations are expected to remain stable over time, although participating members may change.

- Arkansas Headwaters Recreation Area Manager Rob White;
- Arkansas River Watershed Collaborative, Lead Forester Andy Lerch;
- Buena Vista Fire Department Chief Dixon Villers;
- BLM-Rocky Mountain District Manager Cathy Cook, Fire Mitigation Specialist Ed Skerjanec, Fire Management Officer Ty Webb, and John Markalunas, Assistant Fire Management Officer for the Front Range Fire Management Unit;
- Central Colorado Conservancy Executive Director Adam Beh;
- Chaffee County Commissioners Greg Felt and Keith Baker;
- Chaffee County Office of Emergency Management Director Richard Atkins;
- Chaffee County Fire Protection District Chief Robert Bertram and Battalion Chief Kent Maxwell (also Director of Colorado Firecamp);
- Colorado Parks and Wildlife Area Wildlife Manager Jim Aragon; Colorado Springs Utilities: Watershed Planning Supervisor Mark Shea and Forest Program Manager Eric Howell;
- Colorado State Forest Service: Southwest Area Manager Damon Lange, Supervisory Forester Adam Moore, Supervisory Forester Sam Pankratz and Forester J.T. Shaver;
- Envision Chaffee County Co-Leads: Commissioner Greg Felt (also Board of County Commission Chair) and Cindy Williams (Chair, Central Colorado Conservancy) and Envision Project Coordinator Kim Marquis;
- National Forest Foundation Vice President Marcus Selig;
- Natural Resources Conservation Service District Conservationist Bill Gardiner;
- Mesa Antero Water Association President Rick Hum;
- US Forest Service: District Ranger Jim Pitts, Fire Management Officer Chris Naccarato and Mountain Zone Fuels Specialist Andrew White

Ongoing partnership with experts at the Colorado Forest Restoration Institute at Colorado State University (Director Tony Cheng, Assistant Director Brett Wolk and Spatial Analyst Benjamin Gannon) and the US Forest Service Rocky Mountain Research Station WiRē Wildfire Research Team (Patty Champ and Hannah Brenkert-Smith) will continue to support program success.

Source: Adapted from Envision Chaffee County (2020) Community Wildfire Protection Plan.

APPENDIX D: LAKE COUNTY CWPP GANTT CHART

This Gantt chart was initially developed by Kim Smoyer of Smoyer and Associates and Cindy Williams of Envision Chaffee County in collaboration with CFRI staff to develop a roadmap for Lake County, Colorado, to replicate the CWPP collaborative planning process that occurred in Chaffee County. This chart was regularly re-visited and updated throughout the Lake County process and represents actual timelines of events with details about intermediate steps and responsible parties. Similar to the CLT and Forest Health Council for Chaffee County, the Lake County process was centered around a tech-leads team of technical experts and community/agency leaders that met every other week throughout the process, with the larger Lake County Forest Health Council meeting approximately every 2 months. Many other activities and work occurred in between. We include the Gantt chart here because the structure very closely approximates the Chaffee County process with useful detail that was not documented for Chaffee County. Our hope is other groups may find it valuable to adapt and use in their own planning processes to establish a timeline with clear expectations of roles and responsibilities for group members.

All names of individuals were redacted from the chart to protect privacy. General position titles and organizations were retained so that other groups embarking on similar outcome based planning processes can build teams involving people with similar technical and leadership positions across a breadth of organizations. All collaborative processes will look slightly different, and we encourage adaptation of this chart to your local context.

Consultant: Smoyer and associates was hired as a consultant to provide 3rd party facilitation services for the Lake County process. Their role was to create meeting agenda's, schedule and facilitate meetings, take meeting notes, and follow up with individuals to complete action items.

CFRI had 3 main staff members involved in the Lake County process, including staff with expertise in fire behavior modeling, spatial analysis, optimization, watershed science, and collaborative planning processes. At least 5 additional CFRI staff contributed to the process through occasional note taking at meetings, facilitating small group discussions, GIS and mapping support, and observing meetings.

TASK	RESPONSIBLE PERSONS	START DATE	END DATE
Phase 1 Community Survey: Develop, administer and report out on a Lake County Wildfire Survey			
Get cost estimate by 24 March to Envision Chaffee County Rep / 01 March meeting (develop funding to start survey)			
Develop draft the Lake County Wildfire Survey. This will include no more than 20 questions to be curated from tested questions used in the Envision Chaffee County and Chaffee Wildfire and Chaffee Rec Surveys.	Consultant Drives / Envision Chaffee County Input	3/1/21	3/15/21
Get survey questions to Envision Chaffee County Rep for all 3 surveys.	All	3/1/21	3/15/21
Team meeting with Core Team (Consultant, County Commissioner for Lake County, Lake County GIS staff, Envision Chaffee County Rep) to agree questions	Consultant schedules/facilitates input in 1 hour meeting with County Commissioner for Lake County, Lake County GIS staff, Envision Chaffee County Rep	3/15/21	3/21/21
Develop and administer the Lake County Wildfire Survey in Survey Monkey	Consultant	3/21/21	4/10/21
Distribute the Lake County Survey to the community (eg. via emails, media lists, news paper notice etc.). (Q - does the County need help to do this? - target 500 responses)	Facilitator for the LCOSI Lake County Open Space Initiative, County Commissioner for Lake County	3/21/21	4/15/21
Close survey. Develop brief summary report of results.	Consultant	4/15/21	4/25/21
Develop a proposed list of Lake County HVRAs based on the survey data and using the tool on Table 5, Appx C Chaffee Co CPPW. Small group meeting with CFRI, Lake County Commissioner, Lake County GIS staff, Envision Chaffee County Rep)	Lake County GIS staff coordinates this meeting with Envision Chaffee County Rep	4/25/21	4/30/21
Communicate results to the community via a press story with link to report	Facilitator for the LCOSI Lake County Open Space Initiative, County Commissioner for Lake County	4/25/21	5/25/21

TASK	RESPONSIBLE PERSONS	START DATE	END DATE
Phase 2: Develop Composite Risk and Draft Treatment Priority Maps			
2A: Develop Composite Risk Maps			
Technical Team Meeting: CFRI, Lake County, Envision Chaffee County, Consultant -Introductions, agree general scope/schedule, agree on steps for phase I work.	Consultant arranges a 45 minute meeting to captures actions into this Project Gantt Plan. Note consultant tracks GantPlan progress, sends reminders if critical throughout.	4/27/21	4/30/21
Compile local geospatial layers that represent Highly Valued Resources and Assets, using Chaffee CWPP Appendix C, Table 2 as the template and adding other critical local layers) and set up in a map book for team input	Lake County GIS staff	4/26/21	5/5/21
Curate needed data layers for wildfire behavior modeling and burn probability modelling using the Chaffee CWPP Templates and set up in a map book for team input	CFRI with Lake County GIS staff supporting	4/26/21	5/5/21
Develop LCOSI+EFHC Team contact List building on the existing Envision Forest Health Council list with contacts provided by Lake Co/LCOSI and set up as a google drive xls file	Consultant with Envision Chaffee County, LCOSI, Lake Co	4/26/21	5/5/21
Schedule Meeting 1 Lake County Forest Health Council: Schedule meeting 1 (or all meeting with 2 monthly cadence) via doodle poll	Consultant	4/26/21	4/28/21
Incorporate as work group of LCOSI - Have LCOSI schedule meeting	Discuss with Facilitator for the LCOSI Lake County Open Space Initiative - and have him schedule meetings also or use standing LCOSI		
- Meeting 1 Lake County Forest Health Council - (April): Agree HVRAs priorities, data layers			
Meeting 1 Lake County Forest Health Council: Agenda: introductions, context of Chaffee CWPP and general plan (Envision Chaffee County-10mins), Agree what are the Highly Valued Resources and Asset categories for Lake County and importance weights (use tool on Table 5, Appx C Chaffee Co CPPW)-15 Mins, Review curated layers for HVRAs (Lake County GIS staff - 20 mins) - team to identify any key missing layers and agree plan to get them (20 Mins), Review response functions for HVRAs (from Chaffee County and develop for any added layers)- 20 Mins, Review wildfire behavior models for input (CFRI) and capture any concerns and actions to address concerns - 30 Mins, Agree next steps Meeting Time - 2-2.5 hours.	Consultant (Develop meeting agenda, facilitate, capture action items in Gantt plan). Lake County GIS staff/CFRI/Envision Chaffee County present content.	5/12/21	5/12/21
Develop draft Wildfire Composite Risk Map			
Develop Geospatial layer for one way in/out egress and ingress similar to Chaffee	CSFS Rep with Lake Co Fire	5/6/21	7/1/21
Develop any other needed spatial layers based on Meeting 1	CFRI with Lake County GIS staff	5/6/21	7/1/21
Follow up on meeting 1 by ensuring collection of all outstanding layers based on meeting notes	Lake County GIS staff coordinates with CFRI	5/6/21	7/1/21
Develop draft composite maps (Habitat Composite, Data Layers, Composite Risk Map)- CFRI	CFRI	5/6/21	7/1/21
- Meeting 2 Lake County Forest Health Council: Input on draft Risk Maps			
Meeting 2 Agenda: Introductions, Present draft composite risk products for input as follow: Fire Behavior Maps including probability and behavior - 30 mins, HVRA maps for groups (eg. habitat composite) - 30 mins, draft Composite Risk Map. Use all Chaffee County CWPP formats and process. Capture input on all maps and agree any needed adjustments and the action plan to make them happen (45 mins). Roughly 2.5 Hr. Meeting.	Consultant (Develop meeting agenda, facilitate, capture action items in Gantt plan). Lake County GIS staff/CFRI/Envision Chaffee County present content.	7/7/21	7/7/21
Acquire additional data layers locally if needed	Lake County GIS staff	6/7/21	7/7/21
Acquire additional data layers or modify as needed for fire behavior / composite models	CFRI	6/7/21	7/7/21

TASK	RESPONSIBLE PERSONS	START DATE	END DATE
Develop final Composite HVRA and Composite Wildfire Risk Map	CFRI	8/16/21	9/16/21
Update Chaffee County Treatment Cost Table	CFRI with CSFS	8/16/21	9/16/21
- Meeting 3 Lake County Forest Health Council: Approve Composite Risk Map / Treatment Priority Map Inputs			
Lake County Forest Health Council Meeting 3. Agenda: review final Composite Risk Map - vote to endorse as "good enough" or capture any final tweaks (30 mins), Develop inputs for Treatment Priority Map (cost table, any others inputs on local treatment feasibility using Chaffee County templates. Estimated 2 Hr. meeting.	Consultant (Develop meeting agenda, facilitate, capture action items in Gantt plan). Lake County GIS staff/CFRI/Envision Chaffee County present content.	9/13/21	9/13/21
Develop draft Treatment Priority Model	CFRI - Lake County GIS staff supports if any local map products needed	9/15/21	10/15/21
- Meeting 4 Lake County Forest Health Council: Approve Composite Risk Map / Treatment Priority Map Inputs			
Meeting 4 -Provide input on Draft Treatment Priority Model: Agenda: Present any changes to the data/models from meeting 3, present draft treatment priority model/map (CFRI), team input on the map, capture any needed changes and action items to achieve them, plan for Community Map Walk. Estimated 2.5 hr. meeting.	Consultant (Develop meeting agenda, facilitate, capture action items in Gantt plan).	11/17/21	11/17/21
Phase II - Community Engagement Option - Community Map Walk for Treatment Priority Map			
Plan and facilitate one community map walk seeking input on the Treatment Priority Map and Composite Risk Map. This would be a 2 hour evening session with Team Leaders speaking to the planning work to date and a focus on enabling community members to ask questions and post questions/ comments on the maps. Follow up by posting the questions and general responses to be provided by Lake County Forest Health Council members	Consultant (Develop meeting agenda, facilitate, capture action items in Gantt plan).	10/13/21	10/13/21
Develop a meeting venue for the map walk, promote the event to the community including a press announcement, provide feedback to the community on FAQs post event	LCOSI facilitator and County Commissioner for Lake County and Team	10/1/21	10/13/21
Core Team Meeting (CFRI, ARWC, CSFS, others as needed). Discuss the community map walk feedback and decide if any rises to the level or requiring changes to the final models. Agree on any final changes. 1 hr. meeting.	Consultant plans, facilitates	10/15/21	11/19/21
Phase III Finalize Maps, Document, Create Implementation Plan			
Finalize Treatment Priority Model / map based on all inputs above	CFRI	12/31/21	1/27/22
Prepare ideas on draft goals / objectives based on Chaffee Plan (sub team CSFS/Envision Chaffee County/Lake County) - be sure OEM is involved	Consultant facilitated meeting 1 hour brainstorm	11/30/21	12/30/21
- Meeting 5 Lake County Forest Health Council : Finalize Treatment Priority Map, Develop draft Goals/Objectives, brainstorm actions			
Meeting 5 (Jan). Finalize Treatment Priority Map with formal sign off from all attendees similar to Chaffee County, Input on draft goals and objectives working off the Chaffee Plan and draft from meeting above, action planning round I - brainstorm on actions. Estimated 2 hour session.	Consultant (Develop meeting agenda, facilitate, capture action items in Gantt plan). Lake County GIS staff/CFRI/Envision Chaffee County present content.	1/12/22	1/12/22
Develop documentation of CFRI model (use Appendix C Chaffee County CWPP as a format)	CFRI	12/30/21	1/14/22
Develop draft goals/objectives and action plans based on Meeting 5 results and provide to Lake County Forest Health Council for input/comment via a pallet tool	Consultant with CSFS, Envision Chaffee County	12/30/21	1/14/22

TASK	RESPONSIBLE PERSONS	START DATE	END DATE
Meeting 6 Lake County Forest Health Council - Finalize Implementation Plan, Plan for SiGanttories			
- Meeting 6 Lake County Forest Health Council :			
Meeting 6 (Feb.. Agree final goals/objectives, build on year 1 action plan to "good enough" - to include implementation plan and reporting, agree plan to write up work and get siGanttories. Note: use the Chaffee CWPP model which has a 2.5 page action plan. Estimated 2.5 hr. meeting.	Consultant (Develop meeting agenda, facilitate, capture action items in Gantt plan).	3/16/22	3/16/22
Develop short (not more than 7 page) summary report similar to the Envision Chaffee County CWPP summary documenting general process/community input, key map products, goals, objectives and actions. The survey document and the CFRI technical report to be included as appendices and siGanttory pages to be added.	Consultant coordinates with CSFS/Envision Chaffee County technical input	3/1/22	6/1/22
Provide report to siGanttories / sign off	Lake County Forest Health Council Members	6/1/22	6/14/22
Close out	Consultant with Lake County	6/15/22	6/15/22
Advance to implementation per the plan			