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Integrating Fire and Forest Planning: A Review of National Forest Plan Revisions

Hailey Graf
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INTEGRATING FIRE AND FOREST PLANNING:

A REVIEW OF NATIONAL FOREST PLAN REVISIONS

By

HAILEY DAWN GRAF

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Approved by:

Scott Whittenburg, Dean of The Graduate School
Graduate School

Martin Nie, Chair
Society and Conservation

Carl Seielstad
Forestry Management

Len Broberg
Environmental Studies

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Executive Summary

The purpose of this thesis is to determine how wildland fire and forest planning are integrated during forest plan revisions. Specifically, three overarching questions are answered: 1) what is the decision-making framework used in fire and forest planning?, 2) how are National Forests planning for wildland fire management?, and 3) what are the challenges and barriers to integrating fire and forest planning?. To answer these questions, three methods were used to iteratively collect and analyze data. A policy and literature review determined the decision-making framework. Based on the policy review, a rubric was developed to systematically evaluate forest plan revisions. Semi-formal interviews were also conducted to provide supplemental information and context to the data derived from the forest plan evaluations.

The decision-making framework to integrate fire and forest planning is highly complex. Forest planning requires a series of decisions and each is influenced by policy and science. In the United States Forest Service (USFS), forest planning is a three-tiered process. It begins with national direction from the National Forest Management Act and its Planning Regulations. The Planning Regulations determine the required content for all development, revision, and amendment of National Forest plans. Forest plans are then implemented through project- or incident-specific decisions. Each subsequent stage in the planning process must be consistent with the previous stages. That is, decisions made on an individual projects or fires must fulfill the intent of the forest plan and the forest plan must fulfill the requirements of the Planning Regulations and National Forest Management Act.

In 2012, new Planning Regulations, entitled '2012 National Forest System Land Management Planning Rule' (hereafter, Planning Rule), were adopted. The changes made to the new Planning Rule are pertinent to wildland fire management because they have created a window of opportunity to better integrate fire and forest planning. Forest plans that are now being revised will be written pursuant to these regulations.

There are four aspects of the Planning Rule that are most relevant to wildland fire and the planning process. First, the Planning Rule requires forest plan assessments to gather all relevant sources of information which are then used during the assessment to help determine current trends on the National Forest and establish the need for change. Second, the Planning Regulations require forest plans to include plan components that provide for ecological integrity, taking into account natural disturbance processes such as wildland fire, and opportunities to restore fire-adapted ecosystems. Third, the Planning Rule requires that forest plans account for multiple use requirements through integrated resource plan components. To meet this requirement, revised forest plans must consider dominant ecological processes including disturbance regimes such as wildland fire. Fourth, the Planning Regulations require each forest plan to have an associated monitoring strategy for key ecosystem characteristics and areas of the planning unit affected by climate change or other stressors.

The National Cohesive Wildland Fire Management Strategy (hereafter, Cohesive Strategy) is also very relevant to the decision-making framework. The Cohesive Strategy is an interagency agreement designed to provide regional information on the risks and possible management strategies for wildland fire. The Planning Rule requires all relevant sources of information, such as the Cohesive Strategy, to help inform the assessments. The Forest Service Directives, including the handbook and manual, further encourage the use of the Cohesive Strategy by describing it as an appropriate source of information for both the assessment and the development of plan components for fire-adapted ecosystems.

Evaluations of the revised forest plans show they have used a variety of approaches to integrate fire and forest planning. This diversity in approaches demonstrates the flexibility of the 2012 Planning Rule. That is, while it is prescriptive in its requirements for consideration of disturbance regimes and opportunities to restore fire-adapted communities, the 2012 Planning Rule provides the necessary flexibility for each National Forest to fulfill these requirements regardless of differences among the forests.

Every revised forest plan, so far, has considered wildland fire and its effects on the landscape in the assessments. Wildland fire is described as an integral system driver and disturbance regime. However, the assessments also describe that when fires burn outside their natural range of variation and are too extensive, severe, or frequent, they can transition from being a natural disturbance process to an ecosystem stressor. In nine of the revised forest plans, the interconnectedness of fire and forest planning is very clear. The plan components in these revisions portray the relationship between fire and the other forest resources. In these nine revisions fire was clearly an important consideration throughout the entire revision process. In the other two revisions, however, the discussion of fire is distinct from the planning efforts for other forest resources.

Throughout the plan revisions there are also trends in the types of plan components most used. For example, only three revised plans include standards that directly address the ecological benefits of fire, four revisions include guidelines, and five revisions include objectives. Every revision includes desired condition statements that discuss how fire effects ecological integrity but only eight include desired conditions that are specific and measurable. Many of the plan components, particularly desired conditions, are broad, generalized statements that lack specificity or may not be measurable in a 15-year planning cycle. The minimal use of restrictive and specific plan components may stem from an intent to maintain flexibility in decision-making during individual fire incidents.

At the time of research, eight National Forests had developed monitoring strategies associated with the revised forest plans. Six of these eight describe fire as a key ecosystem characteristic or dominant ecological process that should be monitored. These same six include fire in at least one monitoring question or as a monitoring indicator. Four revisions also use fire to monitor the plan area for changes related to climate change and other stressors. As additional forests continue the planning process and develop monitoring strategies, they can benefit from the monitoring strategies that include fire. Monitoring for trends in wildfires may prove challenging, especially in high- or mixed-severity fire

regimes or areas with long fire return intervals. To determine the effectiveness of plan components, monitoring strategies may need to consider time frames longer than the duration of the plan.

In the forest plan revisions, three distinct approaches have been used to spatially represent fire-specific plan components. In total, five revisions use area designations to describe, geographically, where fire plan components do and do not apply. The first approach, developed by the Francis Marion National Forest, uses two management areas to describe where prescribed fire is, and is not, appropriate as a management tool. The second approach, used by the Inyo, Sequoia, and Sierra National Forests, is to developed strategic fire management zones. These zones each have their own plan components that detail the most appropriate fire management strategies, given the risks identified in each zone. The Rio Grande National Forest plan revision also includes wildland fire management zones; however, these zones overlay the geographic areas. These zones do not have their own plan components but do have suggested management approaches that coincide with the plan components for the different geographic areas.

The Cohesive Strategy is not referenced in any plan components and is only referenced in four of the eleven assessments. However, the Cohesive Strategy is being used and it is influencing decision-making during the revision process. Interview participants explained that Cohesive Strategy can be too broad and generalized to fit well with the revision process but that it provides a good foundation. The Cohesive Strategy is largely being used for broad, landscape-scale planning before narrowing the decision-making during the forest plan revision.

Community Wildfire Protection Plans (CWPP's) are also rarely referenced in the revised forest plans. Of the eleven revisions reviewed, five include a discussion of CWPP's in the assessments but are not consistent in how CWPP's are used. One forest noted an increasing trend in the use of CWPP's to deal with higher severity fires near wildland urban interface. Two forests describe using established CWPP's to prioritize fuel treatments. One forest has the goal of having all forest lands covered by

CWPP's. Another forest recognized CWPP's as a current information gap that needs to be addressed and proposes the development of CWPP's as a management approach.

It is clear from the plan revisions and the supplemental interviews that one of the greatest challenges is balancing the need for specific guidance while maintaining flexibility in decision-making. The risks and the uncertainties associated with wildland fire management dictate some measure of flexibility be maintained to address the unique complexities of each fire. However, plan components must provide enough direction to guide the decision-making on National Forests. If desired conditions are written as broad, generalized statements then I recommend goals and management approaches be used to provide additional specifications and set priorities. When more restrictive plan components, such as standards and guidelines, are minimally used, revised forest plans should include specific and measurable objectives.

As forests are developing plan components, they must also consider the challenges of monitoring system cycles that far exceed the planning timeframe. Monitoring strategies should include fire but must be realistic in the types of data that can be collected over a fifteen-year planning cycle. This challenge may warrant additional consideration in the environmental impact statements and additional discussion in the monitoring strategy.

National Forests should also consider a more explicit discussion of the Cohesive Strategy and CWPP's within the revised forest plans. The larger social context of managing fire will always be a challenge and being more clear and transparent in the use of the Cohesive Strategy and CWPP's would be beneficial. Public perceptions of risk and negative associations still influence fire management; but, the Cohesive Strategy and CWPP's can help include the public throughout all stages of decision-making and at broad scales. They should be used to help educate the public on the ecological benefits of fire and to leverage partnership opportunities for cross-jurisdictional fire planning.

I also recommend that all forest plan revisions include some form of area designation for the fire-specific plan components. I recommend this because the Forest Service now has spatial fire planning requirements and having a geographic representation of what plan components apply where could be integrated into the Wildland Fire Decision Support System as part of these requirements. Area designations for fire could also assist with communicating the intent of the revised forest plan to the public. Lines on a map or a visual depiction may be more readily understood by a broader audience than a narrative description of where possible management approaches would be used.

When using fire-specific area designations, forests must provide clear description of how these areas relate to the rest of the planning unit and plan components. However, describing this relationship is clearly a challenge and was mentioned in numerous interviews. Above all else, I see this as an emergent issue where further guidance is needed from the USFS as an agency.

Overall, I am both optimistic and cautious about the progress made in forest plan revisions. The revisions, thus far, have been a massive effort and are worthy of commendation. The National Forests have done well to mold the requirements of the 2012 Planning to meet their unique ecological needs. These large-scale planning efforts will provide a foundation to support ecological integrity through consideration of natural disturbance regimes such as wildland fire and the restoration of fire-adapted ecosystems. However, forests plans represent only the second tier of a three-tiered planning process. Going forward, the individual decisions made on individual fires will be the final stage to determine if fire and forest planning can truly be integrated.

Integrating Fire and Forest Planning: Evaluative Rubric for Forest Plan Revisions				
Documents Reviewed & Stage of Documents:				
Chugach: Need for Change, Assessment, Proposed Action, & Monitoring Strategy Cibola: Need for Change, Assessment & Proposed Action El Yunque: Need for Change, Assessment, DEIS, Draft Plan, Monitoring Strategy Flathead: Need for Change, Assessment, DEIS, Draft Plan, Monitoring Strategy Francis Marion: Need for Change, Assessment, EIS, Final Plan, Monitoring Strategy Helena-Lewis & Clark: Need for Change, Assessment & Proposed Action				Inyo: Need for Change, Assessment, Joint DEIS, Draft Plan, Monitoring Strategy Nez Perce-Clearwater: Need for Change, Assessment & Proposed Action Rio Grande: Need for Change, Assessment, DEIS, Draft Plan, Monitoring Strategy Sequoia: Need for Change, Assessment, Joint DEIS, Draft Plan, Monitoring Strategy Sierra: Need for Change, Assessment, Joint DEIS, Draft Plan, Monitoring Strategy
Assessments				
Questions	Yes	Undetermined	No	Notes & Observations
Is wildland fire being considered in plan assessments? If so, How?	11			Fire is a natural disturbance process and an integral component of ecosystems on all of the National Forests, except the El Yunque which does not have fire adapted ecosystems. However, fires that burn outside their NRV can be catastrophic ecosystem stressors. Past management and fire suppression have disrupted the relationship of fire and ecosystems across the forests. Wildland fire is a needed and useful tool for forest management and restoration. Climate change is expected to influence fire characteristics.
Is the National Cohesive Strategy referenced and/or used in the assessments?	4		7	The Cohesive Strategy is referenced in less than half of the assessments. Of the assessments that do reference the Cohesive Strategy, it is discussed as platform for working with stakeholders and an information source for risk assessment and risk mitigation.
Do the assessments include information on system drivers, including dominant ecological processes, disturbance regimes, and stressors such as wildfire?	11			Every assessment includes information on wildland fire as a system driver. Every forest (except the El Yunque) describes wildland fire as a dominant ecological process that is integral for the function and integrity of ecosystems. However, fire can become an ecosystem stressor when it burns outside the NRV and is too severe, extensive, or frequent.
As per 219.5(a)(1), are community wildfire protection plans considered in the assessment?	5	1	5	Just under half of the assessments reference CWPP's and one forest makes a reference about working with communities but doesn't specifically discuss CWPP's. One forest noted an increasing trend in the use of CWPP's to deal with higher severity fires near WUI. Two forests describe using established CWPP's to prioritize fuel treatments. One

				forest has the goal of having all forest lands covered by CWPP's. Another forest recognized CWPP's as a current information gap that needs to be addressed and proposes the development of CWPP's as a management approach.
Plan Components				
Questions	Yes	Undetermined	No	Notes & Observations
Do plan components incorporate wildland fire and land management planning?	9	2		In nine of the forest plan revisions, the relationship between wildland fire and forest planning is very clear. These plans have developed plan components which recognize the interrelatedness of wildland fire, vegetation, watersheds, recreation opportunities, etc. For these national forests, wildland fire has been clearly considered and integrated into the entire planning process. It's obviously a large focus of the revised plans. For two of the revised forest plans, however, wildland fire is often discussed as distinct from the rest of the forest plan. The plan components show some integration of fire throughout the rest of the plan but it is not obvious and requires information from the environmental impact statements to understand the relationship.
Do the plan components reference the Cohesive Strategy?			11	The Cohesive Strategy is not directly referenced in any of the plan components developed so far. However, it is important to note that many of the plan components do fulfill the three goals of the Cohesive Strategy.
Do the plan components identify wildland fire as a system driver that may influence the sustainability of resources and ecosystems within the plan area?	6	4	1	All of the forest plans include some discussion of wildland fire as a system driver and discuss wildland fire in the broader sustainability sections of the plans. However, only six revisions include individual plan components that refer to the influence of wildland fire on sustainability, specifically.
Do plan components take into account wildland fire and opportunities to restore fire adapted ecosystems?	9	1	1	The El Yunque National Forest does not have any fire adapted ecosystems and wildland fire, in all situations, is harmful to ecosystems. Therefore, their revised plan does not consider ways to restore fire adapted ecosystems. The Chugach National Forest, so far, describes that backcountry and wilderness areas wildland fire is still a primary driver. But, in areas near human communities, 99 percent of fires are human caused and maintaining ecosystems adapted to 600-year fire return intervals may be more about prevention than anything. All other plan revisions include numerous plan components that consider wildland fire and opportunities to restore fire adapted ecosystems.
Do the plans include components that recognize wildland fire as a way to maintain or restore ecological integrity, structure,	7	3	1	Seven of the revised forest plan include plan components that recognize wildland fire as a tool for restoring or maintaining ecological integrity. The forests categorized as undetermined either focus on prescribed fire to restore and maintain ecosystem integrity or describe that vegetation treatments (such as thinning) must be

function, composition, and connectivity?				implemented first before fire can be used. As described previously, the El Yunque plan revision is the exception.
Are plan components related to wildland fire structured "in a way that will allow for monitoring to test their effectiveness"?	8	3		Eight of the plan revisions include at least one plan component that is specific and measurable within the lifetime of the plan. However, many of the plan components, particularly desired conditions, are broad, generalized statements that lack specificity or may not be measurable in a 15-year planning cycle. Goals and management approaches are being used as option plan content to provide additional specificity and set priorities, particularly where there are gaps in information.
Will desired condition statements related to wildland fire help determine monitoring strategies and requirements?	7	3	1	Seven of the revised forest plans have at least one desired condition that is specific and measurable within the lifetime of the plan (15 years). But, broad, generalized desired condition statements are found in every revised forest plan. That is, desired conditions that will likely prove difficult to monitor are found throughout the forest plan revisions. This is difficult to answer, however, because the 2012 Planning Rule does not require every plan component to be included in the monitoring strategy, but it does require all plan components to be specific and measurable.
Management Area Designations				
Questions	Yes	Undetermined	No	Notes & Observations
Are management or geographic area designations related to wildland fire in the plan revision?	5		5	One plan revision uses management areas to delineate where different fire-specific plan components apply. Another revision has developed fire management zones that overlay the geographic areas within the plan. Three others have developed a new form of area designation. Titled 'Strategic Fire Management Zones', they each have their own plan components that delineate the most appropriate fire management strategy given the risks associated with each zone. One national forest is still early in the revision process and has not yet developed area designations.
Monitoring				
Questions	Yes	Undetermined	No	Notes & Observations
Is wildland fire identified as a monitoring question or associated indicator?	6	1	1	Six of the revised forest plans explicitly include wildland fire in monitoring questions and use some characteristic of fire as an indicator. One monitoring strategy includes questions and indicators referring to system processes, but not specifically wildland fire. One revised forest plan does not mention fire anywhere in the monitoring strategy. And three National Forests have not yet developed their monitoring sections.
Is wildland fire selected as an ecological condition to be	6		2	Similar to above, six revised forest plans have designated wildland fire as a key ecosystem characteristic that needs to be monitored. Two of the revised forest plans do

monitored? Or, as a key characteristic of terrestrial ecosystems?				not explicitly include wildland fire but do include disturbance regimes as key ecosystem characteristics in the monitoring strategies. And, three National Forests have not yet developed their monitoring sections.
Is wildland fire used to measure changes on the plan areas related to climate change and other stressors?	4	3	1	Four of the revised forest plans explicitly use wildland fire to monitor for changes related to climate change. Three of the national forests discuss the current and expected future status of fire on the national forest. While they do not specifically mention climate change as it relates to wildland fire in the monitoring strategy, the environmental impact statements do discuss the relationship. One revised forest plan does not consider the relationship of climate change and fire in the monitoring strategy. And, three National Forests have not yet developed their monitoring sections.

1. Introduction

A) Background

National Forests, managed by the U.S. Forest Service (USFS) are required by law to develop land and resource management plans, also known as forest plans. Forest plans determine appropriate management approaches for different resources across each National Forest. USFS planning regulations developed under the National Forest Management Act (NFMA) determine the process and content of forest plans. The planning regulations, titled the Land Management Planning Rule (hereafter, Planning Rule), were revised in 2012 and are now guiding planning efforts in the USFS. Forest plan revisions under the 2012 Planning Rule represent a much-needed opportunity to integrate fire and forest planning. Until recently, USFS planning regulations did not require forest plans to consider the ecological role of wildland fire because previous regulations were adopted before the importance and influence of fire on national forest lands was realized. Including fire in current forest planning efforts will be increasingly important to maintain and restore fire-adapted ecosystems. However, it is currently unknown how the USFS will approach this issue during the forest plan revision process. This research evaluates how wildland fire is being integrated into revised forest plans and demonstrates the learning opportunities presented by this on-going process.

Recent changes in policy offer opportunities to balance the ecological benefits of fire with fire suppression needs. Both forest planning and fire management policies could now provide an opening to restore the historic role of fire and prevent further ecosystem degradation. The previous planning regulations, written in 1982, required forest plans to incorporate the policy of "maximizing net public benefits," (36 C.F.R. §219 1982). In accordance, forest plans written under the 1982 Planning Rule focused on the economic and utilitarian benefits of national forests (Haber 2015). By contrast, the 2012 Planning Rule requires forest plans to maintain and restore ecosystems on national forest system lands and to provide for the sustainability of resources and ecosystems (36 C.F.R. §219 2012). The ecosystem

integrity section of the Planning Rule calls for plan revisions to consider "wildland fire and opportunities to restore fire adapted ecosystems" (36 C.F.R. §219 2012). Additionally, the Rule requires that plans consider stressors and natural disturbance regimes, such as wildland fire. This is a much more holistic view of ecosystems and focuses on the landscape-scale and approaches to restore and maintain systems.

The Planning Rule is also consistent with federal fire policy and other federal management practices in planning for wildfire (Joe H. Scott, Donald J. Helmbrecht & Matthew P. Thompson 2014).The National Cohesive Wildland Fire Management Strategy (hereafter, Cohesive Strategy) parallels the 2012 Planning Rule and highlights the need to consider the ecological benefits of wildfire. The Cohesive Strategy focuses on three main goals including, restoring resilient landscapes, creating fire-adapted communities, and appropriately responding to wildfires (USDA and USDI 2014b). These goals align with the 2012 Planning Rule mandate for including wildland fire in forest plan revisions. That is, the Planning Rule and the Cohesive Strategy can both be used to facilitate wildfire planning throughout the full spectrum of decision making from incident-level decisions to landscape-scale planning.

Currently, there are 68 forest plans that are past due for revision and 19 that are currently undergoing revision, pursuant to the recent policy changes. The planning regulations require all national forests to write forest plans determining the desired future conditions, objectives, standards, and guidelines that will shape how each forest is managed (16 USC § 1600). As described in the 2012 Planning Rule and the Cohesive Strategy, wildland fire should be a key component of this planning effort.

There are, however, challenges to integrating fire and forest planning. Wildland fire has inherent risks and uncertainties that create challenges to long-range forest planning processes. Perceptions of risk, organizational culture, resources and budgets, and social-political pressure are all commonly perceived as impediments to managing fires for resource benefit (Canton-Thompson *et al.* 2008; Doane *et al.* 2006; North *et al.* 2015). Overcoming or moving past the fire suppression culture is also likely to be a challenge. A suppression culture, where fire suppression is accepted as the social norm, is one of the

greatest barriers to having fire on the landscape (Doane *et al.* 2006). In the United States, approximately 98% of wildland fires are suppressed before they reach 300 acres (Calkin *et al.* 2005). Large, unplanned wildfires are also generally assumed to be unwanted or catastrophic fires (Keane *et al.* 2009; Williams, Laverty & States 2000).

Although USFS regulations and federal fire policy have tended to impede managing fires for resource benefits (Canton-Thompson *et al.* 2008; Doane *et al.* 2006). Barriers could be ameliorated with the adoption of the 2012 Planning Rule and the Cohesive Strategy. While there will always be policy challenges due to resource allocations and budgets, the 2012 Planning Rule and the Cohesive Strategy represent an important step forward. The USFS now has a significant opportunity to integrate fire and forest planning across multiple landscapes.

Wildland fire management should be an integral aspect of forest planning because forest ecosystems and fire are intimately linked on many national forests. Across the country, wildland fire has played a major role in shaping ecosystems. Wildland fire is a natural change agent that has influenced both ecosystem processes and individual species since plants first evolved in terrestrial ecosystems (Bowman *et al.* 2009). As fire burns across a landscape it directly changes the structure and pattern of vegetation, increasing heterogeneity. Fire can affect systems and processes at both forest stand and landscape scales (Keane *et al.* 2002). Hydrology, species composition, insect and disease spread, and forest structure are all influenced by fire (Keane *et al.* 2002). In colder regions, where decay is limited, fire can also be the primary source of nutrient cycling (Brown & Harris 2000).

Wildland fire influences different ecosystem uniquely and in turn is influenced by the ecosystem's characteristics. The severity and frequency of fire are influenced by climate at multiple spatial and temporal scales (Falk *et al.* 2011). Species composition, ignition sources, and topography can all dictate how fires function and, in turn, can determine the role of fire in ecosystems (Carol Miller & Gregory H Aplet 2015; Joe H. Scott, Donald J. Helmbrecht & Matthew P. Thompson 2014). For example,

fire may burn more readily in an ecosystem replete with flammable materials, but fire's consumption of the flammable materials may induce additional growth.

A common method for discussing the fire and ecosystem relationship is through fire regime classification. Fire regimes can be described based on the characteristics of the actual fire or by the effects caused by the fire (Agee 1996). Frequency, size, intensity, seasonality, type, and severity are all components of fire regimes (Flannigan, Stocks & Wotton 2000). Overall, fire regimes are the result of interactions between climate, topography, fuels, and weather (Flannigan, Stocks & Wotton 2000).

Across Forest Service lands, fire characteristics range from non-fire regimes, where the ecosystems lack enough flammable materials to support fires, to stand-replacing fire regimes, where dominant vegetation is largely killed by fire, substantially changing vegetation structure (Brown & Harris 2000). Northern ecosystems comprised largely of black spruce can experience stand-replacing fires that can be massive in extent but rare in frequency. The Chugach National Forest, for example, has a fire regime characterized by a fire return interval of 600 years (Chugach 2014). Eastern forests, particularly longleaf pine ecosystems, are characterized by understory low-severity, high frequency fire regimes where chiefly only the understory is killed by the fire (Brown & Harris 2000). The Francis Marion National Forest ecosystems epitomize these fire regimes (Francis Marion 2017). The Flathead National Forest is a prime example of a western forest with some ecosystems described as having mixed-severity fire regimes (Flathead 2014). Mixed-severity fire regimes vary between stand-replacing fires and understory fires, depending on current vegetation, fuel moisture, and weather (Brown & Harris 2000).

On national forest system lands, fire management policy was first implemented under the leadership of Gifford Pinchot (Stephens 2005). Under federal fire policy, fire exclusion became common practice as public lands began being managed for timber resources. After the catastrophic 1910 fires, federal land management agencies adopted full-suppression policies to protect valued timber lands by removing fire from the landscape (Calkin, Thompson & Finney 2015). These fire suppression tactics were

largely successful, resulting in overall reduced fire across the US. The average area burned each year decreased steadily until around 1960 when the extent of wildfires began to increase significantly (Brown, Hall & Westerling 2004).

The period of fire exclusion has had varied effects on ecosystems, depending on their historic fire regime. In general, areas typified by frequent, low-severity fires were potentially altered by fire exclusion. Fire suppression, while reducing fire in the short-term for these ecosystems, increased the amount of flammable vegetation across landscapes and created the potential for large-scale, more intense, and harder to control wildfires (Brown, Hall & Westerling 2004). The relationship between fire suppression, fuel accumulations, and increased fire potential is well known (Williams, Laverty & States 2000). It is important to note, however, that this generalized relationship is not necessarily applicable to all ecosystems. Areas characterized by infrequent, large fires have likely been minimally impacted by fire exclusion (Keane *et al.* 2009). Ecosystems, such as lodgepole pine forests in the Rocky Mountains, that historically experienced stand-replacing fires would naturally have a boom and bust cycle of vegetation build up and large-scale fires (Stephens 2005).

Other factors that influence fires across the U.S. include climate change and human-caused ignitions. Human-caused fires are contributing to the changes in fire regimes by influencing the frequency or location of ignitions and may compound the risk of uncharacteristically severe fires, even in high-severity fire regimes (Brown, Hall & Westerling 2004). Humans are a significant contributing factor to fire activity across the globe (Flannigan *et al.* 2009). In the United States, most wildland fires are human-caused, including both accidental and intentional ignitions (Flannigan, Stocks & Wotton 2000). The south-east (region 8) and California (region 5) experience the greatest amount of area burned due to human ignitions and the western region experiences the greatest relative number of human caused ignitions (Stephens 2005). Increases in human-caused fires are likely influenced by increased development and expansion into the Wildland Urban Interface (Stephens 2005)

Climate change may also be influencing fire regimes as climate affects both the amount of vegetation and its flammability. Climate, vegetation, and fire are interlinked where changes to one will affect the others (Brown & Harris 2000). For example, in the western U.S. average relative humidity is expected to decrease due to global climate change, increasing fuel flammability and increasing the number of high fire danger days (Brown, Hall & Westerling 2004). Climate-related temperature is one of the most significant factors influencing wildland fires. Warmer temperatures resulting from climate change will likely cause increased fire behavior (Flannigan *et al.* 2009). Ecosystems, and interrelated fire regimes, have always been in flux but human activities have increasingly affected both fire and vegetation across landscapes (Brown & Harris 2000).

When the characteristic role of fire is altered, consequences are often far-reaching and affect the sustainability and integrity of ecological systems. Disturbances, such as wildland fire, are a requisite component of ecosystems for maintaining biodiversity (Brown & Harris 2000). Ecosystems gain overall benefits, such as increased ecological integrity, when the role of fire within and ecosystem plays out naturally (Joe H. Scott, Donald J. Helmbrecht & Matthew P. Thompson 2014). Altering natural fire processes can have cascading effects on ecosystems such as increased hazardous fuel levels and a decline in ecosystem health (Keane *et al.* 2002). Forest composition, species diversity, and wildlife habitat can also be impacted by changes to the natural role of fire (Carol Miller & Gregory H Aplet 2015). Fire exclusion, increased human-caused ignitions, and climate change have all served to alter fire regimes and the role of fire in ecosystems.

Extensive wildland fire suppression efforts have also created a very costly fire management paradigm. The USFS assumes 70% of all federal fire suppression costs (Calkin, Thompson & Finney 2015). As the number and size of large wildfires have increased across the county, annual suppression costs have exceeded $1 billion in 15 of the last 18 years (NIFC 2016). Despite this expenditure, fires continue to burn increasingly large areas. Increased costs of suppressing unwanted wildfires parallels

increases in acres burned on National Forest lands (Calkin *et al.* 2005). Suppression efforts are increasingly costly and limit the ecological benefits that can be garnered from naturally burning fires.

The impact that forest management has on fire regimes and how altered fire characteristics can affect forest health will need to be addressed in forest plan revisions. National Forests are currently revising forest plans under the 2012 Planning Rule and Cohesive Strategy. Like a pilot program, a small group of National Forests were chosen to initiate the revision process. Termed early adopter forests, there is an expectation that their progress and approaches can offer learning opportunities to other National Forests. Evaluating the success and struggles of the early adopter forests will also facilitate adaptive learning and adaptive management on National Forests, as was intended by the 2012 Planning Rule (USDA 2017).

This thesis assesses how forest plan revisions being prepared pursuant to the 2012 Rule are approaching wildland fire management. As the first plans are written, it is exceedingly important to examine if, and how, they include fire within the revised forest plan. Integrating fire and forest planning will be tantamount to successfully fulfilling the intent of the Cohesive Strategy and the 2012 Planning Rule. Understanding the process and its impediments will help guide future plan revisions and ensure that the intent of recent policy changes is met. This research is timely and significant because of the need for improved and strategic wildfire planning at large spatial scales.

B) Research Objectives & Questions

The goal of this research is to determine how wildland fire management is being incorporated into current National Forest plan revisions. I will describe the approaches that different National Forests have used to date and provide context for the decisions made during the revision process. My intent is to provide learning opportunities for future planning efforts.

The first objective of this research is to provide a concise overview and introduction to the decision-making framework used to manage wildfire on the National Forests and to provide an overview

of the National Forest planning process and its relationship to fire management. For this objective, research focused on three specific research questions. These research questions guided a policy and literature review designed to establish the decision-making framework encompassing fire management decisions during the forest plan revision process.

1) What is forest planning and what is the 2012 Land Management and Planning Rule?
2) What are the most pertinent parts of the Planning Rule applicable to wildland fire?
3) What is the National Cohesive Wildland Fire Management Strategy and how is it incorporated into forest plan revisions?

The second objective of this research is to assess how forest plan revisions, currently underway, are planning for wildland fire and the different approaches used in this planning effort. Evaluations of each revised forest plan were used to determine how regulations and policies, including the 2012 Planning Rule and the Cohesive Strategy, are being applied and the specific aspects of forest plans that reflect these policies. To meet this objective, the evaluations were structured around three interrelated overarching research questions and related sub-questions.

1) How is wildland fire being addressed in forest plan revision being prepared pursuant to the 2012 Planning Rule?
    A. How do plan revisions incorporate the use of wildfire on the landscape as allowed by the 2012 Planning Rule?
    B. Is wildland fire recognized as a key characteristic of the dominant ecological process as defined in the Planning Rule?
2) How do the different aspects or stages of forest plan revisions incorporate wildland fire?
    A. Is wildland fire being addressed in the assessment phase of the forest planning?
    B. Are plan components – including desired future conditions, objectives, standards, and guidelines – being written with a focus on wildfire and ecological integrity?

C. Are management area designations being made with a focus on wildfire and ecological integrity?

D. Do the identified questions or indicators for the monitoring program include wildland fire as a key ecological process?

3) Are principles of the Cohesive Strategy represented in the revised forest plans?

A. Was the Cohesive Strategy risk assessment used in the forest plan Assessment?

B. Is the Cohesive Strategy directly referenced in the plan components?

C. Do revised forest plans include community wildfire protection plans as suggested by the Cohesive Strategy?

The Third objective of my research is to determine the emergent issues and challenges related to wildland fire use in forest plan revisions. My aim is to identify the most significant impediments to planning for wildfire management on National Forests and how those difficulties are addressed in Plan revision currently underway. This objective was designed to provide context to the approaches used to address wildland fire management in revised forest plans, thus far. To fulfill this objective my research focused around three research questions:

1) What are the most significant challenges to integrating wildland fire into forest plan revisions?
2) How can the development of forest plan revisions facilitate the restoration of fire-adapted ecosystems?
3) Related to wildland fire and forest plan revisions, what are the emergent issues and problems and how are they dealt with during the revision process?

2. Research Methods

The methods used for this research involved three specific steps – literature and policy review, forest plan evaluations, and interviews – that each added context and specificity to the conclusions. I used an iterative analysis process to analyze data and cross-examine presumptions and conclusions, following

recommendations by Corbin & Strauss (1990). The literature and policy review was applied to provide a base of understanding regarding the forest plan revision process and fire management and to determine the decision-making framework available to Interdisciplinary Teams. Forest plan evaluations were conducted through an evaluative rubric (provided in appendix) which guided my probing and assessment of each Plan. Finally, interviews supplemented the plan evaluations by providing context to the approaches used and the challenges experienced by decision makers during the plan revision process. Each of these three methods are detailed below.

A) Literature Review

To fulfill the first research objective, a literature review was conducted on the decision-making framework surrounding fire management and land management planning in the USFS. The literature gap this thesis fills is an understanding of the relationship between fire management policy and land management policy in the USFS. A review of land management as it has changed throughout the history of the USFS and the foundational laws and policies that previously guided the USFS and their more modern counterparts that currently direct agency decision making were all reviewed. The literature review also examined the national regulations and policies associated with National Forest planning, such as the National Forest Management Act (NFMA), and the 1982 and 2012 Planning Rules. Agency interpretation of these policies was also reviewed by exploring the USFS Directives, including the Handbooks and Manual, and relevant agency white-papers.

Next, literature regarding fire management in the USFS was reviewed. As wildland fire often necessitates multi-jurisdictional management, pertinent inter-agency documents were included in the review. This section of literature review included mostly grey-literature that comprised agency direction and guidance including the National Cohesive Wildland Fire Management Strategy, federal fire policies, and agency-specific fire management direction. This part of the literature review also focused on the political and institutional challenges to implementing ecological integrity through fire use in the context of natural resources management.

Finally, the literature review included scholarly literature on topics such as fire ecology and social science. Peer-reviewed literature, focusing on advances in science that have influenced changes in policy and agency guidance, were included. The topics reviewed included disturbance regimes, restoration ecology, human dimensions of resource conservation, natural resource conflict resolution, ecosystem resilience, and natural resource and environmental law.

B) Plan Evaluations

An evaluation was conducted on documents for each phase of the forest plan revision processes. I began my review by evaluating forest plan assessments which are the first phase in the revision process and detail current conditions and trends on the forest. The assessments provided background information about each forest and how fire has historically and recently effected ecosystems. "Need for change statements" and "proposed actions" were also evaluated as they explain the preferred management directions on each forest. Environmental impact statements (EISs), prepared pursuant to the National Environmental Policy Act (NEPA), were also reviewed and provided details and analysis of the environmental consequences and scientific justification of the proposed management strategies. Finally, eleven forest plans were evaluated to assess the specific approaches that would be used to manage wildland fire.

An evaluative rubric (provided in the Appendix) was created and used during the review process to consistently evaluate each forest plan and collect data necessary for analysis. The rubric uses language that is directly pulled from the 2012 Rule and Directives, thus keeping the review focused on the rule itself and not a more subjective set of considerations. Sections of the evaluative rubric included: Assessment, Plan Components, Management Areas/ Geographic Areas, and Monitoring. In each of these sections, I used questions as prompts for transcribing specific language from a revision or for noting my personal observations. Questions were derived from the wildland fire-specific sections of the Planning Rule and the objectives of the Cohesive Strategy.

Data collection began with the revised Francis Marion National Forest plan as it was the first plan completed under the 2012 Rule. Additional data was evaluated as revised draft plans became publicly available for the Flathead, Sierra, Sequoia, Inyo, El Yunque, and Rio Grande National Forests. Also included were proposed actions, which include an assessment and draft plan but lack a completed environmental impact statement or monitoring strategy. The Chugach, Cibola, Helena – Lewis & Clark, and Nez Perce – Clearwater National Forests have all completed proposed actions which were included in the evaluations.

The evaluative rubric was not used to rank revisions or to determine what was 'good' or 'bad'. The 2012 Rule provides national forests considerable discretion in how they approach wildland fire use, and my objective was to assess how early adopters were approaching this issue. There is no one-size-fits-all forest plan because national forests differ in both ecological and human characteristics. Recognizing these differences, I used the rubric to organize and compile notes and observations on the different approaches used by each National Forest but did not rank or rate them in any way.

C) Supplemental Interviews

To understand the process of integrating wildfire management into forest plan revisions, it was imperative to get direct input from the managers and decision makers involved in the process. To garner this input, I conducted semi-formal interviews with fourteen agency employees who contributed to a forest plan revision. I first contacted the forest plan revision team leader for each National Forest and requested interviews from anyone on the team who might be able to provide me with insight about how fire was approached during the plan revision. Through the team leaders I was put in contact with other team members, such as forest planners, fire specialists, and fuels managers, who agreed to participate in interviews. All interviews were conducted in-person or by phone.

Before the interviews began, I compiled a list of seven broad questions to be used to guide the conversation during interviews (provided in Appendix). These questions were applicable to every

National Forest but I also prepared additional probing questions that were more specific to individual Forests based on my analysis of each revised forest plan. I began each interview by providing the interviewee with a background of my research and a description of how their insight would be used. I then explained the procedure for my interviews and emphasized that each interview participant was welcome to provide as much or a little information as they felt compelled to. I did not record the interviews but did take thorough notes. My notes from each interview were also expounded upon and typed up for future use immediately after each interview was completed.

The information gained from the interviews was used to add context to the forest plan evaluations. Discussing the plan revisions with the teams that developed them helped to shed light on why specific decision were made or why specific language was used within plan components. Each interview provided insight to the unique needs of each National Forest. The interviews also highlighted aspects of the revision process that teams found challenging and learning opportunities for other forests.

3. USFS Decision Making and Fire

A) National Forest Planning

Land management planning in the USFS is generally a three-tiered process. The planning process starts with national-level direction through the NFMA and planning regulations. The second tier, forest-specific planning, is guided by the NFMA and the planning regulations. Site-specific or project-level planning is the third tier and is based on the management direction established in the forest plan. Each level of planning must be consistent with all previous tiers including the NFMA. All site-specific decisions must be consistent with the forest plan which is written pursuant to the planning regulations which was directed under the NFMA. Through this tiered process, changes to the planning regulations influence the development and revision of forest plans and how those plans are then implemented. The relationship between the planning regulations and forest plan revisions is the focus of this research, specifically the additions to the 2012 Land Management Planning Rule encouraging fire management to

be incorporated into forest plan revisions by planning for wildland fire to restore or maintain ecological integrity.

Forest planning has evolved throughout the life of the USFS. Prior to the guidance provided by the NFMA and the Planning Rule, the USFS experienced an era of broad agency discretion. Originally operating under the USFS Organic Administration Act of 1897, the USFS enjoyed significant discretion in how its lands were managed. (Coggins 1987). Under the Organic Act, which simply mandated that forest reserves be managed to supply favorable water flows and a continuous supply of timber, the USFS maintained a culture of autonomous foresters (Wilkinson & Anderson 1985). During World War II the demand for timber from the National Forests increased significantly, further cementing the discretion of foresters to manage the lands for timber production. The Organic Act, under which the foresters acted, lacked the specificity and could not provide USFS managers with detailed objectives or guidelines for managing National Forests in any other way (Coggins 1987).

With the adoption of the Multiple Use and Sustained Yield Act (MUSYA) of 1960, The USFS's purpose was given more breadth but little clarity describing how to implement that purpose. While still allowing significant agency discretion, the MUSYA added outdoor recreation, range, timber, watershed, wildlife, and fish to the purposes of National Forest management (Rasband 2004). This requirement marked the beginning of a shift in national forest planning as it required the management of multiple, sometimes conflicting, resources across the national forest lands (Wilkinson & Anderson 1985). While the MUSY Act required the USFS to consider each of these uses, Congress gave no indication as to the weight of each resource and the agency was left to decide what uses had priority and where it preferred to allow each use (Wilkinson & Anderson 1985). The MUSY Act served more to codify the agency's discretion than to require its inclusion of other uses in forest management (Rasband 2004). Through this continued discretion, the USFS implemented the requirements of MUSY through planning efforts by writing separate management plans for each mandated use and by beginning the practice of zoning areas as suitable for one purpose or another (Wilkinson & Anderson 1985).

The Renewable Resources Planning Act of 1974 was next to significantly impact USFS planning. Nationally, it required an assessment and inventory of all resources every ten years with proposed resource goals every five years (Wilkinson & Anderson 1985). It originally required unit-level plans to be developed every five years across the USFS. These plans, however were too general and didn't function well for comprehensive planning (Coggins 1987) and were later expounded upon in the NFMA (Wilkinson & Anderson 1985).

The NFMA was written as an amendment to the Renewable Resources Planning Act and was adopted in 1976 during a period of significant change in environmental law. When the NFMA was adopted, public values and sentiment towards forest management were changing to reflect more values than the previously seminal timber industry. At the same time, the influential Bolle Report and the renowned court opinion known as the Monongahela Decision, determined that National Forests were not doing enough to manage for other resource values besides timber and were in violation of the Multiple Use and Sustained Yield Act (Wilkinson 1997). Caught between the still influential timber industry and other increasingly influential public values, Congress enacted the NFMA to serve as a compromise (Coggins 1987). Despite the USFS's previous autonomy, the NFMA served to limit the agency's discretionary power (Wilkinson 1997) and is comprehensive enough to function as a new organic act for the USFS (Coggins 1987).

The overarching goal of the NFMA was to create reform in national forest management without impeding technical, site-specific land management decisions (Wilkinson 1997). It addressed several of the contentious issues of the time including even-aged management, allowable cut, allocation of USFS resources, and public participation (Stoel 1978). The NFMA required the promulgation of planning regulations to develop forest plans in accordance with the principles of the (16 USC § 1600 1976). The NFMA established the procedures the USFS must follow during the forest plan development, revision, and amendment process (Gippert & DeWitte 1996). Importantly, many of these substantive and

procedural components of the NFMA are implemented through the forest plans developed under the planning rule (Coggins 1987).

B) The 2012 Land Management Planning Rule

The Planning Rule is the planning regulation promulgated pursuant to NFMA requirements. Its intent is to provide the direction for forest plan revisions and amendments "that will enable land managers to consistently and efficiently respond to social, economic, and ecological conditions" (16 USC § 1600). It is a set of detailed regulations that specify the process and content requirements for forest plans (Rasband 2004). The NFMA controls most of the decision making in the USFS through the Planning Rule. As described in the NFMA, the Planning Rule prescribes plans that determine the suitability of lands for timber, account for all resources uses described in the MUSY Act, and are supported by public participation (16 USC § 1600). The Planning Rule functions to harmonize the content of planning processes in the USFS by ensuring that forest plans are written pursuant to the purpose and requirements of the NFMA (Gippert & DeWitte 1996).

Upon its enactment, the NFMA required the Secretary of Agriculture to develop planning regulations for the USFS, incorporating the principles of the MUSY Act, within two years (16 USC § 1600). The first regulations were issued in 1976 but were quickly superseded by the 1982 regulations under which all forest plans were written until the adoption of the revised 2012 Planning Rule (36 C.F.R. §219). In 1989, rapidly following the implementation of the 1982 regulations, a comprehensive Critique of Land Management Planning suggested several amendments and additions (Haber 2015). Changes were suggested to the 1982 rule due to the perception that it made the planning process too complex, lengthy, and costly (36 C.F.R. §219). The first Planning Rule revision was proposed in 1995 but never finalized. New regulations were again developed in 2000 but a transition provision allowed forests to continue using the 1982 rule until a new rule was issued (Haber 2015). In 2005 and 2008, additional attempts were made to revise the Planning Rule but were invalidated in court (Nie & Schembra 2014). A final Planning Rule was adopted in 2012 with the purpose to "provide the direction for National Forests and Grasslands

to develop, amend, and revise land management plans that will enable land managers to consistently and efficiently respond to social economic, and ecological conditions" (36 C.F.R. §219).

The 1982 and 2012 versions of the planning regulations differ significantly with their approach to ecosystem sustainability and integrity. The 2012 Planning Rule was developed, in part, to be a more science-based approach to planning (Federal Advisory Committee 2016). To this aim, ecosystem integrity is a cornerstone and principal value of the 2012 Rule It provides the broad vision for the Rule and how its provisions are supposed to work together and be implemented. Ecosystem integrity is defined by the 2012 Planning Rule as "the quality or condition of an ecosystem when its dominant ecological characteristics (for example, composition, structure, function, connectivity, and species composition and diversity) occur within the natural range of variation and can withstand and recover from most perturbations imposed by natural environmental dynamism or human influence" (36 C.F.R. §219 2012).

This emphasis on ecological integrity is significant to the management of fire because the Rule recognizes that wildland fire plays a key role in ecosystems. Previously, the 1982 version of the Planning Rule mentioned fire only seven times and each was in reference to controlling fire or mitigating the damage from fire (36 C.F.R. §219 1982). Conversely, wildland fire, as a natural process, is explicitly referenced in the new planning regulations. The 2012 Planning Rule now contains provisions that recognize the ecological importance of incorporating wildland fire into large-scale planning efforts in the USFS. It provides opportunities to integrate fire and forest planning because it authorizes and encourages fires to be managed for ecosystem benefits and be included as part of the forest plan revision process. That is, in the 2012 Planning Rule, wildland fire is now recognized as an integral component of ecosystem integrity.

In the 2012 Planning Rule, ecosystem integrity is operationalized through the incorporation of the natural range of variation (NRV) of ecosystems. NRV embraces the complexities of ecosystems and uses historic ecology to describe spatiotemporal variability and how it relates to contemporary ecosystem

management. It is important to note a differentiation in terms from those used in the 2012 Planning Rule and those used by the scientific community. When variability within ecosystems was first being researched and applied, early terms for the concept included wording such as "natural variability," "natural variation," "natural range of variation," and "historic variability" (Romme, Wiens & Safford 2012). Today, much of the contemporary, scientific literature has adopted the term historic range in variability (HRV). The 2012 Planning Rule, however, uses the term natural range of variation. In referring to NRV, I consider the two terms interchangeable as the Planning Rule and forest plans have done.

Previous to the use of NRV, practitioners often ignored the mechanisms that contribute to ecosystem dynamics, processes, and functions. This ignorance often led to extractive management rather than sustainable management of ecosystems (Christensen *et al.* 1996). Historic reconstructions of community structure and disturbance regimes have shown that unsustainable deviation from natural conditions have led to many of our contemporary natural resource problems (Parsons, Swetnam & Christensen 1999). However, ecosystems that are functioning within the NRV are more likely to provide sustainable ecosystem services (Baker 2009). Using NRV to develop management goals and desired future conditions can shift management from unsustainable resource extraction to sustainable ecosystem management. Furthermore, NRV can be used as a frame of reference for developing lower-impact management strategies (Baker 2009). It also provides a benchmark for understanding if observed changes are human-caused (Landres, Morgan & Swanson 1999). Understanding the mechanisms which drive ecosystem variability can help managers understand ecosystem change and more holistically manage forests for ecosystem sustainability and integrity.

In contrast to the 1982 Planning Rule, the new regulations also support adaptive management principles. Adaptive management is an iterative, cyclic process of planning, implementation, monitoring, and amending actions or assumptions. The three phases of the planning process – assessment, planning, and monitoring – can provide a platform for adaptive management (USDA 2017) as long as trends

identified during monitoring trigger amendments to forest plan direction. Under the new planning regulations, forest plan revisions are required to have corresponding monitoring programs to assess forest progress and the need to amend forest plans (36 C.F.R. §219 2012). According to the USFS Directives, "monitoring forms the basis for continuous improvement of the plan and provides information for adaptive management" (USDA 2017). With regards to wildland fire, realizing this adaptive management cycle throughout forest planning will require continuously assessing current and expected fire trends, developing appropriate management strategies, monitoring effectiveness, and amending fire management actions.

Within the 2012 Planning Rule, there are four regulatory sections most relevant to wildland fire management: assessment, sustainability, multiple use, and monitoring. Definitions provided within the rule are also pertinent for fire management as they add context and depth to specific regulatory language. Each of these regulatory areas are concise but provide significant opportunities to incorporate managing wildland fires for ecological benefits into the planning process. Specific sections from the 2012 Planning Rule that are relevant to wildland fire management are described below in Table 1.

The Planning Rule describes the process and content for developing an assessment, the first phase of a forest plan revision (36 C.F.R. §219 2012). In this section, the regulations require an assessment to consider information from all relevant sources. One of the non-governmental information sources the Planning Rule specifically mentions is the information found within Community Wildfire Protection Plans (CWPP). The inclusion of CWPP's is pertinent to wildfire because it encourages collaboration between agency fire managers and at-risk communities. Using CWPP's, communities can work with the USFS to establish Wildland Urban Interface (WUI) boundaries and set priorities for hazardous fuels reduction projects surrounding the community (Williams *et al.* 2012).

The Planning Rule also specifies that assessments must be prepared by identifying and evaluating information regarding system drivers such as, dominant ecological processes, disturbance regimes, and

stressors (36 C.F.R. §219 2012). In this section, wildland fire is provided as an example of one system driver that should be evaluated during the assessment. Identifying wildland fire as a system driver can influence the rest of the planning process if plan components and corresponding monitoring strategies are written to reflect the influence of fire on forest ecosystems.

The Sustainability section within the Planning Rule is also very relevant to wildland fire management and planning. It requires the incorporation of wildland fire management into plan components, including standards and guidelines, to provide for ecological sustainability. To meet this requirement, plan components must be designed to restore or maintain ecosystem integrity, considering system drivers including, dominant ecological processes, disturbance regimes, and stressors. Wildland fire is again explicitly provided as an example of a system driver. The sustainability section of the Planning Rule also requires that plan components be written to provide for ecosystem integrity through maintaining or restoring forest structure, function, composition, and connectivity by considering wildland fire and opportunities to restore fire-adapted ecosystems.

The monitoring section of the Planning Rule prescribes the guidelines for developing a strategy to monitor a forest's progress (36 C.F.R. §219). The monitoring strategy should be designed to measure the effectiveness of the forest plan and any changes that need made to trend the forest towards the desired conditions (USDA 2017). To be measurable, monitoring strategies must include monitoring questions and associated indicators that are linked to plan components, but not every desired component needs to have a corresponding monitoring question (36 C.F.R. §219 2012). Monitoring questions and indicators should be based on key ecosystem characteristics (USDA 2017). Given this stipulation, if wildland fire is considered a key characteristic of a forest's ecosystems, then the monitoring strategy should contain wildland fire-specific questions and indicators. If, however, wildland fire is not a key characteristic, then wildland fire may not be an important element for monitoring on that specific forest. In this regard, the monitoring strategy and its relevance to wildland fire are likely to vary by National Forest.

Table 1: Key Provisions of the 2012 Planning Rule Related to Fire

§219.6 (a)(1)	Assessment	"The responsible official shall: (1) Identify and consider relevant existing information… Such sources of information may include…community wildfire protection plans…"
§219.6 (b)(3)	Assessment	"In the assessment for plan development or revision, the responsible official shall identify and evaluate existing information relevant to the plan area for the following:…(3) System drivers, including dominant ecological processes, disturbance regimes, and stressors, such as… wildland fire…"
§ 219.8 (a)(1)(iv, v)	Sustainability	"(a) Ecological sustainability. (1) Ecosystem Integrity. The plan must include plan components, including standards or guidelines, to maintain or restore the ecological integrity of terrestrial and aquatic ecosystems and watersheds in the plan area, including plan components to maintain or restore structure, function, composition, and connectivity, taking into account:… (iv) System drivers, including dominant ecological processes, disturbance regimes, and stressors, such as …wildland fire… (v) Wildland fire and opportunities to restore fire adapted ecosystems."
§ 219.10 (a)(8)	Multiple use	"When developing plan components for integrated resource management…the responsible official shall consider:…(8) System drivers, including dominant ecological processes, disturbance regimes, and stressors, such as…wildland fire…"
§ 219.12 (a)(5)(ii, vi)	Monitoring	"Each plan monitoring program must contain one or more monitoring question and associated indicators addressing each of the following:…(ii) The status of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems…(vi) Measurable changes on the plan area related to climate change and other stressors that may be affecting the plan area."

C) Forest Plans

Forest plans are the second tier of the USFS planning process. Forest plans guide the overall direction of national forests, ensuring a balance between the use and protection of national forest resources (Federal Advisory Committee 2016). Under the Planning Rule, forest plans serve as framework for providing broad-scale management guidance to site-specific or project-level decisions (Gippert & DeWitte 1996). Forest plans do not compel specific agency decisions, nor do they authorize or prohibit any specific actions (Rasband 2004). Rather, they function much like zoning regulations that determine the geographic areas where specific actions may or may not be suitable (Rasband 2004). They provide the

necessary flexibility to tailor decisions to each project given its unique ecological characteristics (Gippert & DeWitte 1996). Forest plans can provide strategic guidance through establishing desired conditions and instigate limitations on actions that would move conditions farther from desired conditions.

A national forest assessment is the first phase to the forest plan revision process, required under the Planning Rule. The assessment phase is a short, focused process intended to gather information relevant for forest plan revision (Federal Advisory Committee 2016). In developing an assessment, the objective is to establish a base of information to guide the revision, develop an understanding of social, economic, and ecological trends, and develop a working relationship with the public and stakeholders before starting the revision process (USDA 2017). The assessment is used to establish current conditions and trends and incorporates information from all relevant sources including other agencies, tribes, and the states (36 C.F.R. §219 2012). Public participation and information gathered from the general public should also be included in the assessment (Federal Advisory Committee 2016).

As part of the assessment phase, a need for change document is also developed. To revise a forest plan, information from the assessment is reviewed to establish the components in the existing plan that need changed (36 C.F.R. §219 2012). The specific reasons for changing the current plan, and what parts of it will be changed, are described by the need to change document (Federal Advisory Committee 2016). The need for change document must make clear to the public what the proposed changes would be (USDA 2017). It then guides and informs the development of plan components in the revised forest plan.

As discussed previously, the 2012 Planning Rule includes new requirements for assessments that relate to wildland fire management. The assessment should include information on ecosystem drivers and stressors such as fire and information from CWPP's (36 C.F.R. §219 2012). This information should, in turn, be used to develop the need for change document. By including fire management in the need for change, forest plans can include direction to restore the ecological role of fire on landscapes. That is,

through the need for change document, there should be a direct link from the assessment to the plan components.

Every forest plan must also define either geographic areas or management areas, or both. geographic areas are spatially contiguous land areas, whereas management areas do not need to be spatially contiguous, but are identified as having the same set of applicable plan components (36 C.F.R. §219 .19). For example, a national forest may define a geographic area based on watershed, basin, valley, or even popular recreation area. A designated management area, however, could be checkerboarded across the plan area but include all the locations where fire management strategies can safely include resource benefit fire.

The designation of geographic areas or management areas could prove to be very important for integrating fire and forest planning. Geographic area and management area designations could be used to develop landscape-scale fire management strategies (North *et al.* 2015). Management areas designations can be used to prioritize restoration and silvicultural treatment areas designed to reduce the spread rate or severity of fire. Once areas were treated, fire management strategies could be shifted from full suppression to managing fires for resource benefit. Designating areas for priority treatment in revised forest plans could effectively reduce suppression costs and prevent ecosystem degradation through fire exclusion (North, Collins & Stephens 2012).

Developing plan components is the next phase of the forest plan revision process. The 2012 Planning Rule establishes the required plan components for all revised, amended, or newly developed forest plans. Plan components "guide what future site-specific projects and activities may take place, where they can occur, and under what conditions" (Federal Advisory Committee 2016). Every Plan is required to contain each of the following plan components: desired conditions, objectives, standards, guidelines, and suitability of lands (36 C.F.R. §219 .7). The entire suite of plan components, taken

together, must fulfill all requirements of the Planning Rule (Federal Advisory Committee 2016). The Planning Rule (36 C.F.R. §219) defines each component as follows:

"*Desired condition.* A desired condition is a description of specific social, economic, and/or ecological characteristics of the plan area, or a portion of the plan area, toward which management of the land and resources should be directed. Desired conditions must be described in terms that are specific enough to allow progress toward their achievement to be determined, but do not include completion dates."

"*Objectives.* An objective is a concise, measurable, and time-specific statement of a desired rate of progress toward a desired condition or conditions. Objectives should be based on reasonably foreseeable budgets."

"*Standards.* A standard is a mandatory constraint on project and activity decisionmaking, established to help achieve or maintain the desired conditions or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements."

"*Guidelines.* A guideline is a constraint on project and activity decisionmaking that allows for departure from its terms, so long as the purpose of the guideline is met. Guidelines are established to help achieve or maintain a desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements."

"*Suitability of lands.* Specific lands within a plan area will be identified as suitable for various multiple uses or activities based on the desired conditions applicable to those lands. The plan will also identify lands within the plan area as not suitable that are not compatible with desired conditions for those lands."

The 2012 Planning Rule also describes goals as an optional plan component. Goals are defined as "broad statements of intent, other than desired conditions, usually related to process or interaction with the public. Goals are expressed in broad, general terms, but do not include completion dates" (36 C.F.R. §219). According to the USFS Directives, goals may be appropriate when scientific information is

currently inadequate to provide the specificity needed for developing desired conditions, but goals should never be used in lieu of desired conditions (USDA 2017).

Like the need for change, plan components must be linked back to the assessment. Plan components must be used to move the national forest in the desired direction, accounting for modern social and ecological trends identified in the assessment (USDA 2017). Desired conditions describe "the aspirations or visions of what the plan area (or portions thereof) should look like in the future and drive the development of the other plan components" (USDA 2017). The other plan components describe the steps that need to be taken, or the actions that can't be allowed, in order to achieve the desired conditions.

When revising a forest plan, the USFS may also include optional plan content. The 2012 Planning Rule states, "a plan may include additional content, such as potential management approaches or strategies and partnership opportunities or coordination activities" (36 C.F.R. §219). The optional content is used to provide a narrative or explanation to add context to the plan components. It is not an addition to the mandatory plan comments, but rather, a way to provide supplemental material, general principals, or management approaches that may be of use during project implementation (USDA 2017). The USFS Directives describe that optional plan component can also be used to provide a sense of priorities or realistic expectations for progress towards desired conditions (USDA 2017).

Forest plans are also required to have a corresponding monitoring program. Forest planning is designed to be an iterative, adaptive management process where outcomes are monitored and plans reevaluated based on results (Federal Advisory Committee 2016). Monitoring programs are developed during forest plan revisions and informed by the assessment process (36 C.F.R. §219). The monitoring program should then determine if plan components need amended and provide feedback on the planning cycle (USDA 2017). Within the monitoring program, monitoring questions and indicators are established. The monitoring questions and indicators evaluate the effectiveness of plan components and the forest's

progress towards desired conditions (USDA 2017). The monitoring program is also based on best available science and should be amended if new scientific information comes to light (USDA 2017).

Plan components, developed during the forest plan revision, should be designed to translate into monitoring questions. The point of monitoring is to assess the effectiveness of plan components and inform adaptive management of the plan area (USDA 2017). For this reason, plan components must also be written so that progress can be measured. For example, a desired condition that is too vague or directionless will not translate well into a monitoring program because progress towards it may not be measurable or determinable. The monitoring program should also specify triggers for when actions need changed. Only through a complete cycle of planning, implementation, monitoring, and amendment, can forest plan revisions follow adaptive management principles as outlined in the USFS Directives.

D) Incident-Level Decision-Making & WFDSS

Once an ignition has occurred and fire is on the ground, the third tier of forest planning is triggered. Implementation of the forest plan occurs during wildland fire management and corresponding decision-making during fires. Natural ignition fires and prescribed fires, collectively referred to as wildland fires, require significantly more reactive decision making. Wildland fire management decisions are especially important because it is where national policy and unit-level plans are implemented. These decisions are also often made during time-sensitive and stressful fires. As Zimmerman (2012) summarizes, “these decisions frequently occur in settings that place decision makers under considerable time pressure, bring active external attention and scrutiny, involve possible serious consequences, are pervaded with uncertainty because of inadequate information, occur in dynamic conditions, involve complex and seemingly contradictory issues, and are required by decision makers regardless of their range of experience.”

To combat these issues, the USFS utilizes a structured format on all incidents for information management, risk assessment, and decision documentation. This is provided through the Wildland Fire

Decision Support System (WFDSS) (Thompson 2015). WFDSS is a web-based system designed to help guide managers while developing operation plans and making wildland fire tactical decisions. The use of WFDSS "will provide situational assessment, analyze hazards and risk, define implementation actions, and document decisions and rationale for those decisions," (USDA 2014). The Forest Service began transitioning to this system in 2014-2015, and as of 2016, WFDSS is required on all fires.

To use the WFDSS process, fire and forest managers preload plan components into the system to create a spatially organized planning platform. The risk assessments and management options provided in the Cohesive Strategy are also included to inform decisions during incidents and ensure consistency with the national goals and the Cohesive Strategy vision statement (USDA and USDI 2016). Other values, such as endangered species information, insect damage, or points of interest can also be added to WFDSS which will help fire managers make decisions incorporating the most up to date information (Wildland Fire Decision Support System 2015).

During a wildland fire, these resources, values, risks, or area constraints are automatically depicted within the WFDSS program when personnel are developing incident objectives. These incident objectives then define the course of action for management (Zimmerman 2012). Using "strategic objective shapes" and "management requirement shapes," WFDSS directly links resource management objectives within forest plans to fire management and decision implementation. Standards and guidelines, (such as areas to avoid putting fireline), objectives (such as total area to be burned each year), and desired conditions (such as frequent, low intensity fires in loblolly pine forests), can all be spatially represented and used to determine fire management tactics. The goal of this spatial fire planning process is to "inform and assist line officers in making strategic and tactical decisions when implementing the objectives and decisions from the [forest plan]" (USDA 2014).

The use of spatial fire planning through WFDSS represents an important link between fire management and forest planning. Plan components in revised forest plans will be uploaded into WFDSS

and used during decision-making on site-specific projects or incidents. If the revised forest plans include plan components that consider wildland fire as an ecosystem process and opportunities to restore fire-adapted ecosystems, then fire managers will have this direction during incident decision-making. However, if the desired conditions, standards, guidelines, or objectives fail to incorporate fire, incident-level decisions may not reflect the intent of the 2012 Planning Rule.

E) The National Cohesive Wildland Fire Management Strategy

The Cohesive Strategy is pertinent to integrating fire and forest planning because it provides direction similar to that found in the 2012 Planning Rule but is inter-agency in scope. Like the Planning Rule, the Cohesive Strategy offers opportunities to manage fire across landscapes and benefit from its natural role in ecosystems. Unlike the Planning Rule, however, the Cohesive Strategy also provides options and priorities for different regions, considering the current social and ecological needs of individual areas. While the Cohesive Strategy is not prescriptive in nature, it provides valuable insight that could be incorporated into forest plan revisions.

Federal fire policies were first established in response to the 1910 fires and mostly encouraged full suppression tactics to prevent resource and economic losses from wildfires (USDA and USDI 2001). "In its earliest stages, [fire policy] focused solely on fire control with a principal objective of excluding fire from wildland to protect and preserve natural resources and human developments" (Zimmerman 2012). In response to advances in ecological understanding, land management agencies began to manage fire as well as suppress it. Prescribed burning was considered a beneficial method for using controlled fire to prevent wildfires. In 1995, federal policy was consolidated and clarified to become the *1995 Federal Wildland Fire Management Policy & Program Review*. This review produced the first comprehensive federal fire policy for the Departments of the Interior and Agriculture. The 1995 Federal Fire Policy, for the first time, recognized the essential role of fire in maintaining natural systems(USDA and USDI 2001).

In 2009, the Federal Land Assistance, Management and Enhancement (FLAME) Act directed the development of a cohesive wildfire strategy. In response, the Secretary of Agriculture and Secretary of the Interior, as members of the intergovernmental Wildland Fire Leadership Council, committed to a three-phased analysis and planning effort. The National Cohesive Wildland Fire Management Strategy was the result (USDA and USDI 2014b). Generally referred to as the Cohesive Strategy, it began with a scientific review of fire in the U.S. then evaluated the modern complexities of fire planning and community involvement. The three-phased effort culminated in the "National Strategy" and the "National Action Plan."

Broadly, the Cohesive Strategy provides a set of guidelines and management options for planning fire activities (USDA and USDI 2014a; USDA and USDI 2014b; USDA and USDI 2014c). In developing the strategy, the Wildland Leadership Council developed a vision for the next century of fire management. That vision is, "to safely and effectively extinguish fire, when needed; use fire where allowable; manage our natural resources; and as a nation, live with wildland fire," (USDA and USDI 2014c). Through collaboration and community involvement, three overarching goals were also established and agreed upon by the wildland fire managers. These goals represent both challenges and areas of opportunity and are the primary factors focused on in the Cohesive Strategy. They include: restore and maintain resilient landscapes, create fire-adapted communities, and respond to wildfires effectively and efficiently (USDA and USDI 2014a; USDA and USDI 2014b; USDA and USDI 2014c).

To meet these three goals, Regional Strategy Committees were created. These committees included a broad group of collaborators and stakeholders. Working with the National Science and Analysis Team, the committees mapped the current wildfire situation in three regions across the nation and established goals, and core values. The National Strategy explains that success requires finding a balance that "is not a scientific optimization problem, but a sociopolitical exercise which science can advise," (USDA and USDI 2014c). Recognizing that science alone cannot dictate policy and

management, they used biophysical and socioeconomic data to determine locations of strategic opportunities and barriers.

In the context of the USFS, the Cohesive Strategy is designed to provide fire managers with regional alternatives to inform decision making. The National Strategy provides "national-level spatial and temporal prioritizations" for fire management decisions (USDA and USDI 2014c). It provides a broad range of possible actions and highlights areas where they are most likely to be beneficial and effective. The Cohesive Strategy portrays areas of risk and the management options that are most likely to be successful in minimizing that risk. These priority areas and management options were developed through a comparative risk assessment framework established by the National Science and Analysis Team. This science team compiled data recognizing regional differences in the status of wildland fire. According to the science team, "a comparative risk assessment framework enables analysis of strategic alternatives across planning scales and facilitates exploration of tradeoffs across multiple objectives" (Calkin 2011).

This scientific analysis was used to inform the National Strategy and the National Action Plan. "Comprehensive data sets from multiple sources were combined through a rigorous analytical classification process to group counties along two central themes: landscape features and community risk" (USDA and USDI 2014c). The National Strategy summarized management challenges into four categories and provides USFS fire managers with management options to address each national challenge. The four greatest challenges to fire management were described as vegetation and fuels; homes, communities and values at risk; human-caused ignitions; and effective and efficient wildfire response (USDA and USDI 2014a). A set of national maps was also developed to display the potential use of these management options by county. The National Strategy describes risk factors, such as arson, that can inform fire managers about conditions contributing to areas of increased risk of wildfire. Four national priority maps depict each county's wildfire risk and can be used in conjunction with the opportunity maps to determine what management actions will be most effective and where (USDA and USDI 2014c).

The Cohesive Strategy has provided a foundation for USFS fire management moving forward and a starting point for implementation of the Wildland Fire Leadership Council's vision (USDA and USDI 2014c). The risk assessment framework will continue to improve USFS decision making as research progresses (Calkin 2011). The Cohesive Strategy provides decision makers with value- and scientific-based information to inform and support their decisions and is referenced in the USFS Directives as a relevant source of information to be used during forest plan assessments (USDA 2017). Using this information, USFS fire managers and forest plan revision teams can more effectively integrate fire and forest planning.

Conclusion

The decision-making framework for fire management and forest planning in the USFS is highly complex. Each decision must be made in accordance with multiple policies. The array of policies affects decisions at every level of planning from national strategies, forest planning, and incident-level decision-making. Adding to the complexity, the overall purpose of the 2012 Planning Rule and the Cohesive strategy vary slightly. The Planning Rule considers wildland fire an aspect of ecosystem integrity and sustainability. Wildland fire is one of the many ecosystem components that must be managed to ensure the continued health of our national forests and to provide a sustainable flow of ecosystem services. In contrast, the Cohesive Strategy is much more focused on the human dimensions of fire – risks to firefighters and communities affected by fire – and how to create cross-jurisdictional partnerships for fire management. The principals of each policy, however, are generally parallel. Each allows, or even encourages, wildland fire to be used for resource benefit while balancing protection needs. How wildland fire will be managed in the USFS will be determined one ignition at a time and by individual decision-makers. Nevertheless, these decisions are supported by the current national forest planning efforts. When fire management is guided by the principles of the Cohesive Strategy and incorporated in forest plan revisions, spatial fire planning through WFDSS will equip fire managers to make appropriate decisions.

4. Review of Forest Plan Revisions

Revised forest plans were evaluated to determine the approaches used to integrate fire and forest planning. Each of the Forests is unique in their approach and specific management direction, however, there are some common themes among them. Most notably is a common discussion of changes to fire regimes from human influences such as fire suppression, grazing, timber, and development. Many of the Forest plans reviewed here reference disparities in current fire characteristics such as severity and extent. These Plans recognize the beneficial role of fire in ecosystems and have incorporated fire management strategies into the planning process to allow fire to play its natural role. There is a general recognition of the need to manage or restore vegetation to reduce fuels and fire severity, especially around WUI and neighboring lands, but many of the Forests seek to balance protection with managing fires for resource benefits.

Managing unplanned, natural ignition fires for multiple objectives or for resource benefit is also a common thread throughout many of the revised forest plans. Natural ignitions, generally from lightning, are often referenced as beneficial tool for restoring or maintaining ecosystem integrity, function, or capacity. The risks of unplanned wildfires are also commonly discussed. In general, managing natural ignition fires for resource benefit is allowed across National Forests but only when conditions (weather, fuels, location) are conducive to minimize risks. Areas farther from infrastructure and WUI, such as wilderness and roadless areas, tend to support more resource benefit strategies whereas front-county areas favor stronger suppression strategies. The El Yunque National Forest, where fire is not a natural ecosystem process, is one notable exception as it maintains a full suppression strategy across all lands.

The role of the public is also a discussion common amongst the revised forest plans. Frequently, the revised forest plans recognize that human values, such as smoke-free air, unimpaired scenery, and perceptions of risk, may be in direct conflict with managing fire for resource benefit. A public that is more knowledgeable about fire ecology and more approving of fire management strategies other than

suppression is a common desired condition. To this end, several of the Plans reference the guidance provided by the Cohesive Strategy and the incorporation of CWPP's into planning efforts.

Each revised forest plan is structured specifically to meet the individual needs of the Forest. In general, forest-wide plan components provide direction on the appropriate circumstances for managing fires for resource benefit. Several of the National Forests have designated zones for different fire management strategy preferences. Others have incorporated fire management strategies directly into Management Area or Geographic Area designations. Each approach is unique to a National Forest, except where the Inyo, Sequoia, and Sierra National Forests collaborated during the revision process. Each approach is designed to recognize the unique role of fire within individual landscapes.

What follows is a descriptive accounting of the individual approaches used by each National Forest. For each national forest, a narrative describing the different approaches used and a table with the key plan components are provided. It is important to note that at the time of writing, the only completed forest plan revision is the Francis Marion. All other forest plans are drafts and as such, may change. The Chugach, Cibola, Helena – Lewis & Clark, and Nez Perce – Clearwater Plans are likely to change significantly as they are only proposed actions and do not have completed Environmental Impact Statements. Nonetheless, this is also an opportune time to assess the forest plan revisions in process, as there are valuable lessons from these early adopter forests.

A) Chugach National Forest

Much of the Chugach National Forest consists of ecosystems that lack the fuels to support fires. Areas of the Forest that can carry fire, are adapted to long-duration fire return intervals. Of the areas that can support fire, significant portions are also relatively inaccessible and are largely uninfluenced by humans. For these areas, fire is considered a natural, if infrequent, disturbance regime affecting aquatic and terrestrial ecosystems. The Kenai Peninsula is the most accessible and populated area on the Forest. Human-caused fires on the peninsula have resulted in altered fire regimes and vegetation patters (Chugach 2014). The differences between areas influenced by human-caused fires and areas not impacted

have led to dichotomous fire management strategies being incorporated into forest planning efforts. Despite this dichotomy, strategies are consistent with recent policy changes and are unique to a Forest with fire return intervals that exceed human planning capabilities and lifespans.

Backcountry and wilderness ecosystems and landscape patters across the forest are largely driven by natural processes and disturbance regimes, including lightning-ignited fires. However, natural fires are infrequent and generally the result of drought conditions which lead to intense, stand-replacing fires. Across the ecosystems that can support fire, the fire return interval averages at 600 years (Chugach 2014). Available charcoal records demonstrate a significant time between fires, ranging from the shortest fire return interval of 80 years in black spruce habitat to the longest fire return interval of 1,000 years in non-forested wetlands.

The vast majority of fires that occur within the Chugach National Forest occur on the Kenai Peninsula, with 99 percent of the fires being caused by human activities (Chugach 2015). On the Kenai Peninsula, current vegetation patterns reflect approximately 100 years of frequent, human-caused fires. The abundance of these fires has created areas of early successional plant communities, and altered vegetation patterns. As the number of people using the national forest lands increases and climate change occurs, the Kenai Peninsula and neighboring lands will likely experience increased fire frequency and intensity.

Of the Chugach National Forest, 96 percent of the area is managed to allow natural ecological processes to occur with little to no human influence. Current ecosystems have been largely shaped by glaciers, tectonic movements, and climate. Within these areas, fire is a necessary component of ecosystem processes and integral to ecosystem integrity. The revised forest plan reflects this. For example, under the first goal of the plan, ecosystem sustainability, desired conditions call for the natural functioning of disturbance regimes, including fire, as the primary ecosystem drivers. Another desired

condition is that “wildland fires burn within their natural range of severity, frequency, and intensity, allowing terrestrial ecosystem to function in a sustainable manner” (Chugach 2015).

The other four percent of the forest, primarily on the Kenia Peninsula, is more accessible and is managed for multiple social, economic, and resource benefits. The second goal of the forest plan is to contribute to social and economic sustainability and is directed mostly at this geographic area. The desired conditions under this second goal emphasize that fire management activities will prioritize protection objectives, above ecological desired conditions. Close coordination with neighboring landowners and the incorporation of CWPP’s are also encouraged to create fire-adapted human communities.

Few other plan components directly incorporate fire management. The only standards and guidelines are designed to limit the impact of suppression actions. The organization of the revised Plan is also minimally influenced by fire. Management areas were determined based on the suitability of uses for each area and no specific geographic areas are designated. Wildland fire is also not included in the monitoring strategy.

Ecosystems on the Chugach National Forest are adapted to exceptionally long fire return intervals, but wildland fire is recognized in the revised forest plan as an integral aspect of these ecosystems. In remote areas, plan components promote the natural role of fire on the landscape to maintain ecosystem integrity as specified by the 2012 Planning Rule. Front-county areas, however, require significantly different fire management strategies. Fire management strategies incorporated in the Plan revision for the Kenia Peninsula more closely reflect the Cohesive Strategy’s objective to create fire-adapted human communities. The two fire management strategies are incongruent but reflect the distinct needs of the Chugach National Forest while fulfilling differing aspects of relevant policy changes.

Table 2. Plan components from the Chugach National Forest Proposed Action that are important for integrating fire and forest planning.

Chugach National Forest

Plan Component Type	Plan Component Code	Specific Language
Goal	Goal 1	**Provide for Ecological Sustainability:** "The Chugach National Forest contributes to ecological, social, and economic sustainability by maintaining the integrity and productivity of plan area ecosystems. This integrity is achieved when native species and habitat features of ecosystems are present and functioning in a manner that is resilient to natural and human induced disturbances and retains the capacity to adapt to longer-term changes in the natural environment (e.g., climate change)."
Desired condition	FW-G1-DC-05	"Natural disturbance regimes (e.g., glacial action, snow avalanches, earthquakes, floods, insects and pathogens, windthrow, lightning-caused fire, and climatic variations) remain the primary drivers of shifting patterns of species composition and structure within and between watersheds."
Desired condition	FW-G1-DC-14	"Wildland fires burn within their natural range of severity, frequency, and intensity, allowing terrestrial ecosystems to function in a sustainable manner."
Goal	Goal 2	**Contribute to Social and Economic Sustainability:** "The Chugach National Forest contributes to the ecological, social, and economic sustainability of the plan area by maintaining intact, resilient ecosystems and their associated services, benefits, and uses."
Desired condition	FW-G2-DC-06	**Fire-adapted human communities:** "Risk to human life, primary residences, inhabited property, and community-dependent infrastructure from wildfire is low…There is close coordination with State and private land owners for wildland fire response and hazardous fuels reduction activities conducted within or near the national forest. Vegetation treatments within the wildland urban interface (WUI) and Community Wildfire Protection Plan (CWPP) areas are based on wildfire protection objectives, which may override ecological desired conditions."
Objective	FW-OB-05	**Ecological Sustainability:** "Use appropriate fuels treatments, including prescribed fire and mechanical methods, to improve 800 acres of wildlife habitat and reduce 400 acres of hazardous fuels annually near communities."

B) Cibola National Forest

Fire plays and integral role in the ecosystems of the Cibola National Forest and is recognized as a primary ecosystem driver. However, current conditions on the forest do not support wildland fires that burn comparably to historic conditions which is affecting fire-adapted ecosystems. The overall

management strategies in the proposed action incorporate the management of wildfires for resource benefit to restore ecosystem integrity. The Cibola National Forest recognizes that wildland fire, either prescribed or naturally occurring, is the most cost-effective method to remove hazardous fuels and reduce the threat of uncharacteristically severe fires. The proposed action integrates fire and forest planning through desired conditions, guidelines, and management approaches. A more knowledgeable and accepting public and the implementation of CWPP's are also discussed in the proposed action. Management areas or geographic areas as well as the monitoring strategy have not yet been determined so it is still unknown if, or how, wildland fire management will be represented in these forest plan sections.

The Cibola National Forest is primarily a dry-forest ecosystem in which pinyon-juniper woodland and ponderosa pine forests constitute most of the vegetation. Other vegetation types include mixed conifer forests and semi-desert grasslands with elevation and precipitation largely determining the extent of each vegetation type. Wildland fire, along with climate, insects, and natural succession, are the primary system drivers (Cibola 2015).

Vegetation on the Cibola National Forest currently has fewer large trees, more early-seral stands, and has significantly more closed canopies in the forests and woodlands than historically. Historical timber harvests, livestock grazing, and fire suppression are responsible for these changes as younger, denser vegetation replaced historically dispersed vegetation (Cibola 2016). The continuity of fuels, both laterally and vertically, has increased, promoting fire movement across landscapes (Cibola 2015). These historical activities have led to a significant change in fuels across the forest and now create the potential for uncharacteristically severe wildfires (Cibola 2016). Wildfires now occur less frequently but are significantly larger and cause much greater impacts.

Current ecological integrity and risks to ecological integrity were assessed by comparing current conditions to reference conditions and evaluating trends. Ecological resources that were assessed to have a trend moving them farther away from reference conditions were determined to be at the most risk and

helped inform the need for change statements and overall plan revision direction (Cibola 2015). Social trends were also assessed and it was determined that there is increased demand for use of the Cibola National Forest through recreation, military activities, mining, and grazing. The continued use of National Forest Lands is dependent upon the health of ecosystems therein, which are currently departed from reference conditions (Cibola 2015). There has also been increased residential development on the lands bordering National Forest System Lands. Increased use and development create added complexity and risk from wildland fires. However, there is also a trend for additional at-risk communities to respond to increasingly severe wildfires through Community Wildfire Protection Plans.

Plan components in the proposed action were designed to move the forest structure and composition towards conditions that favor fire regimes similar to historic reference conditions. One desired condition, for example, is for wildfire frequency and intensity to be within the natural range of variation and for the threat of uncharacteristically severe wildfires to be minimized. Another desired condition is for wildland fire to function in its natural ecological role, maintaining and enhancing natural resources. Two guidelines in the proposed action also provide direction for restoring natural fire conditions through natural ignition fires. The first example refers to using prescribed fire to create conditions which would allow unplanned fires to burn naturally in the future. The other example simply states that natural ignition wildland fires can be managed for multiple ignitions which includes managing the fires for resource benefit.

These plan components link directly to proposed management approaches which outline the methods with which the forest can achieve the desired conditions. In the management approaches, the Cibola National Forest explains that wildland fire is an important management tool for restoring the Forest's fire-adapted ecosystems. In some situations, such as backcountry areas or steep terrain, natural ignition fires may be the only feasible management tool. The proposed management approaches further describe that strategies for managing natural ignitions should consider suppression costs and resource benefits to manage wildland fires for multiple objectives.

In the proposed action, the Cibola National Forest also integrated fire and forest planning through efforts to work with the public and neighboring lands. A desired condition is for the public to have a greater understanding of wildland fire as a natural and necessary ecological process. A corresponding management approach suggests that informational, educational, and transformational processes should be used to inform the public and increase their understanding about their responsibilities. CWPP's and management plans from neighboring agencies are also suggested as needing regular integration into forest plans to mitigate fire threats across all lands. Management approaches in the proposed action describe that integrating these plans can help set management priorities based on input from communities and stakeholders and encourages communication between agencies and with the public.

At the time of writing, the proposed action for the Cibola National Forest does not yet include land designations or a monitoring strategy. The inclusion of a monitoring strategy and either management areas or geographic areas is required in forest plans, but these sections are incomplete. Based on the importance of wildland fire throughout the rest of the proposed action, fire will likely play a part in these next sections. A placeholder for management areas is currently depicted in the proposed action, indicating that management areas, but not geographic areas will be designated. The proposed action also indicates that the monitoring strategy will be developed using core themes from the assessment, of which wildland fire is a part. Currently, however, it is unknown how the Cibola National Forest will choose to integrate fire into the area designations or monitoring strategy.

Table 3. Plan components from the Cibola National Forest Proposed Action that are important for integrating fire and forest planning.

Cibola National Forest		
Plan Component Type	**Plan Component Code**	**Specific Language**
Desired condition	Wildland Urban Interface #1	"Wildland fire in the Wildland-urban interface sustain characteristic ecosystem function while preserving property and human health and safety. Wildland fires in the wildland-urban interface are low-intensity surface fires, because ladder fuels are nearly absent. Firefighters are able to safely and efficiently suppress wildfires in the wildland-urban interface."

Desired condition	Fire and Fuels #2	"Wildland fire maintains and enhances resources and functions in its natural ecological role."
Desired condition	Fire and Fuels #4	"Wildfire intensity and frequency are within the natural range of variability. Uncharacteristic high-severity fires rarely occur and do not burn at the landscape scale."
Desired condition	Fire and Fuels #5	"Wildland fire is understood, both internally and by the public, as a necessary disturbance process integral to the sustainability of the Cibola National Forest's fire-adapted vegetation types."
Guideline	Fire and Fuels #2	"Planned ignitions should create conditions that enable future unplanned ignitions to mimic their historical role or to serve as a tool to achieve resource objectives."
Guideline	Fire and Fuels #6	"Natural ignitions may be managed for multiple objectives."

C) El Yunque National Forest

Ecosystems on the El Yunque National Forest are not fire-adapted. Most wildfires on the Forest are associated with human activities and can have significant negative consequences to ecosystem integrity. Prescribed burning is also not practiced as fire is not a natural disturbance and is not a characteristic of natural ecosystems. For these reasons, fire is not a primary focus of the revised forest plan and the opportunities found within recent policy revisions cannot reasonably be explored within the El Yunque's forests.

Wildfires can be extremely destructive to ecosystems within the El Yunque. They can cause high canopy mortality and consume the thick organic soil layers. In several of the ecosystems on the El Yunque, fire is extremely detrimental and can alter microclimates, allowing more-flammable, invasive species to colonize, creating a negative feedback loop (El Yunque 2014). In ecosystems such as mountain cloud forests, this feedback loop prevents the re-establishment of native species after a fire and creates more intense and wide-spread fire, causing further damage to ecosystems.

As climate change progresses, it will likely alter fuel loadings and the flammability of fuels. These changes could then magnify the threat from human-caused fires by increasing the severity and probability of wildfires. Climate change could also influence the cloud-to-ground lightning and would

lead to increased ignitions that were historically rare (El Yunque 2016). Land use changes will also likely interact with climate change to further increase the threat from detrimental wildfire.

The 2012 Planning Rule calls for restoring or maintaining ecosystem integrity through consideration of fire as a natural disturbance and opportunities to restore fire-adapted ecosystems. However, within the El Yunque National Forest, fire is detrimental to ecosystem integrity. Unlike the Plans written for fire-adapted forests, the revised El Yunque National Forest plan is designed to limit fire on the landscape and prevent the deleterious impacts of fire.

Organization of the plan and plan components was not influenced by fire as fire is not a key ecosystem characteristic. Management areas, as designated in the revised plan, were developed with a focus on human-use and proximity to communities. Geographic areas were designated based on their unique ecosystem characteristics, of which fire is not associated. Plan components, including desired conditions, standards, and guidelines, were developed to limit or mitigate the negative impacts of fire and prevent additional fires from occurring. The proposed management activities were also established to reduce the susceptibility of resources to the threat of fire.

In monitoring the forest's progression towards desired conditions, fire is included in the monitoring strategy. Trends in disturbance patterns, including wildfire, that are caused by changing climate are designated as indicators for the Forest's climate change response plan components. Trends in fire occurrence are monitored because of its negative impacts on ecosystems and its potential to prevent the forest from moving towards desired conditions.

Recent policy changes have provided prospects to integrate fire management and land management planning but because of the natural ecosystem characteristics on the El Yunque National Forest, the only fire management included in planning efforts is suppression. Fire is detrimental to ecosystem integrity and management strategies seek to prevent its presence or mitigate its impacts. Other avenues for integrating fire management and planning, such as the Cohesive Strategy and CWPP's, are

not mentioned within the El Yunque revised forest plan. It is clear that opportunities found in recent policy changes are inappropriate for National Forests that do not naturally contain fire-adapted ecosystems.

Table 4. Plan components from the El Yunque National Draft Revised Forest Plan that relate to fire and forest planning.

El Yunque National Forest		
Plan Component Type	**Plan Component Code**	**Specific Language**
Desired condition	3.1.1	**Ecological Sustainability and Diversity of Plant and Animal Communities – Climate Change Response:** "The Forest resources and operational management are resilient to the influences of a changing climate. Management activities reduce the susceptibility of resources to multiple threats, including drought, invasive species, disease, and wildfire."
Monitoring	DC 3.1.1	**Question:** "Is climate change, including changes in variability, influencing maintenance and restoration of ecosystems, including the ability to respond to increases in visitor use and associated impacts on ecosystems?" **Indicator:** "Trends in climate, including extremes, disturbance patters, cloud-base elevation, and long-term ecological processes."

D) Flathead National Forest

Wildland fire is recognized a key characteristic of the ecosystems on the Flathead National Forest. Through recognizing the importance of fire on the landscape, the forest plan was revised to consider ecosystem integrity and resilience and its relationship to wildland fire. In the revised forest plan, the Flathead National Forest uses an all-lands approach to integrate fire management and landscape-scale forest planning. The all-lands approach promotes collaboration among cooperators and a balance of terrestrial, riparian, and aquatic resources in the broader landscape (36 C.F.R. §219 2012). Influenced by fire, vegetation is in a dynamic mosaic across the entire landscape promoting ecosystem integrity (Flathead 2016b). The benefits of wildland fire are recognized across all landscapes, but fire management is balanced with risks to personal safety and threats to values. Balancing resource benefits and resource protection parallels the intent of both the 2012 Planning Rule and the Cohesive Strategy.

Ecosystems on the Flathead National Forest are considered fire-driven with wildland fire influencing vegetation structure, composition, and pattern across the landscape. The interactions between climate and ecosystems has produced five fire regimes across the Forest. A fire regime is defined as the role of fire in ecosystems and its interaction with dominant vegetation and the periodicity and pattern of naturally occurring fires in a particular area or vegetation type (Flathead 2016b). Of the five natural fire regimes found on the forest, the majority of the Forest is represented by mixed and high severity fire regimes with a 35- >100-year fire return interval (Flathead 2014).

Fire, as a primary driver of ecosystems on the Flathead National Forest, also greatly influences ecosystem integrity. It is largely responsible for the proportion and range of vegetation dominance types across the Forest. Ecosystem integrity is assessed through dominant ecosystem functions, composition, structure, and connectivity (Flathead 2016a). The assessment estimates that vegetation dominance types are within the 80 percent of the historic range of variation (Flathead 2014). With this high percent, the overall integrity of Flathead National Forest ecosystems remains intact, indicating that wildland fire is fulfilling its natural role on the landscape.

In the revised forest plan, wildland fire is recognized as having potential ecological benefits across all lands. Managing wildland fires for resource benefit is allowed on all sections of the Forest except a designated special area with an ecosystem not adapted to fire. According to the environmental impact statement, "managing fires for resource objectives allows fire to resume its natural role in the ecosystem under pre-identified objectives and conditions. By allowing this to occur, the results could be a more resilient ecosystem (Flathead 2016a). In this regard, the revised forest plan is not geographically structured around fire because all areas could be managed for fire, given the right circumstances. Management areas were developed with an emphasis on proximity to adjacent lands and the suitable uses of the lands, not fire management strategy. However, the different management areas do suggest different responses to wildfire being more likely, based on risk to communities or values. The wilderness areas, for example, strongly support natural ecological possesses including fire and limit human impacts.

Individual plan components also reflect this all-lands approach. Forest-wide, desired conditions call for fire managers to use the full range of management activities, including prescribed fires and wildland fires across all areas of the forest. A Forest-wide guideline for fire also requires managers to "use wildfires forest-wide to meet multiple resource management objectives where and when conditions permit and risk is within acceptable limit" (Flathead 2016b). Managing unplanned ignitions for resource benefit is also one of the possible management approaches for trending the forest vegetation towards desired conditions.

While the revised forest plan allows the use of fire forest-wide, it acknowledges that potential ecological benefits musts be balanced with possible risks and resource protection needs. The Forest-wide standards require response to wildland fires to be based on strategies which account for risks to life and property as well as resource impacts. Fire management actions are required to be commensurate with their risks, costs, and potential values to be gained. In areas where risks are greater, mechanical treatments can be used to reduce the intensity or severity of wildland fire when it occurs. The environmental impact statement explains that risk, both short- and long-term, must be managed by recognizing the potential for negative and positive consequences of fire.

The revised forest plan also recognizes the importance of working with neighboring lands and communities. Acknowledging that other land owners may not support wildland fire on their property, the Plan contains a desired condition of reduced hazards near adjacent lands and keeping fire on USFS lands when necessary. While the Flathead Forest recognizes its responsibility to mitigate hazards to other landowners, another desired condition also expects adjacent landowners and communities to understand the ecological benefits of fire and to become fire-adapted communities.

The monitoring strategy focuses on three different ways to monitor fire. The first focus is landscape patterns and the status of fire regimes across the forest. This is measured through acres burned forest wide in each severity class as well as the acres which have not burned since 1980. The second

monitoring strategy is an accounting of how many unplanned ignitions are managed for ecological, social, or economic benefits as opposed to managed with the primary goal of suppression. The third monitoring strategy is an accounting of the number of planned ignitions managed for ecological, social, or economic benefits.

The revised forest plan integrates fire management and land management planning by managing fires on a continuum between meeting protection objectives and resource objectives. The opportunities for integrating fire and forest planning are realized in the revised forest plan for the Flathead National Forest. This planning process clearly demonstrates an effort to balance the social and ecological needs of fire management on USFS lands and is consistent with the intent of both the 2012 Planning Rule and the Cohesive Strategy.

Table 5. Plan components from the Flathead National Forest Draft Revised Forest Plan that are important for integrating fire and forest planning.

Flathead National Forest		
Plan Component Type	**Plan Component Code**	**Specific Language**
Desired condition	FW-DC-FIRE 03	"The full range of fire management activities, including wildland fires (prescribed fire and wildfire), are recognized and used by forest administrators as an integral part of achieving ecosystem sustainability, including interrelated ecological, economic and social components such as improved ecosystem resilience and wildlife habitat, protection of property and other values at risk, and public safety."
Desired condition	FW-DC-FIRE-04	"Wildland fires burn with a range of intensity, severity, and frequency that allows ecosystems to function in a healthy and sustainable manner and meets desired conditions for other resources. Wildland fire is accepted as a necessary process integral to the sustainability of the forest's fire-adapted ecosystems."
Desired condition	FW-DC-FIRE-05	"Fire management uses an all lands, landscape approach, which is risk-based, consistent with the current national policy guidance and strategy, responsive to the latest fire and social sciences and adaptable to rapidly changing conditions. The Forest Service concurrently recognizes its responsibility to mitigate hazardous fuel accumulations adjacent to private land and structures where feasible so that fires originating on National Forest System Lands have the opportunity to be contained or

		reduced in intensity before crossing on to other ownerships or move from other ownership on to the Forest."
Standard	FW-STD-FIRE-02	"Manage unplanned fires safely, employing tactics that are cost effective and commensurate with values to be protected or benefits to be accrued."
Guidelines	FW-GDL-FIRE-02	"Use wildfires forest-wide to meet multiple resource management objectives where and when conditions permit and risk is within acceptable limit. Meeting resource objective generally means progress toward or maintaining desired condition."
Monitoring	MON-TE&V-02	**Question: "**Disturbances – Fire. What is the status of fire regimes?" **Indicator:** "Forestwide acres burned by wildfire by severity class (low, medium, high) and acres not burned (since 1980)."
Monitoring	MON-FIRE-02	**Questions:** "To what extent is unplanned fire used to achieve desired ecological, social or economic conditions?" **Indicator:** "Number of unplanned natural fire ignitions managed for ecological, social or economic reasons, and the number of unplanned natural ignitions managed with the primary goal of suppression."
Monitoring	MON-FIRE-02	**Questions:** "to what extent is planned fire (prescribed fire) used to achieve desired ecological, social or economic conditions?" **Indicator:** "Number of planned natural fire ignitions managed for ecological, social or economic reasons."

E) Francis Marion National Forest

In the revised Francis Marion National Forest plan, wildland fire is a central theme. Wildland fire is considered a key ecosystem characteristic and its integration reflects the objectives of the Cohesive Strategy as well as the ecological integrity section of the 2012 Planning Rule. It was the focus for developing desired conditions, designating management areas, and working with local communities and stakeholders.

Across the Francis Marion National Forest, many of the ecosystems are fire-adapted. Longleaf Pine ecosystems especially require wildland fire to sustain their ecological integrity. They were historically the most prevalent system on the Forest, representing 55 percent of the total forest acreage (Francis Marion 2013). These longleaf ecosystems are considered fire-dependent and require frequent burning to maintain their structure and function. The Assessment established that significant portions, up to 50 percent, of habitat on the National Forest lack ecological integrity. Wildland fire was determined as

the most critical factor for maintaining these systems and is identified as a dominant ecological process and system driver (Francis Marion 2013).

Natural ignition (lightning) and human-caused fires have historically both played an important role in the fire ecology on the Francis Marion National Forest. Increased development, land fragmentation, and the drastic expansion of WUI areas, however, have created barriers and challenges to maintaining frequent fires in many areas. Past management and fire suppression policies have significantly altered fire regimes and led to more dangerous and more destructive wildfires (Francis Marion 2017). The changing land use makes it increasingly difficult to effectively manage wildfire while also protecting values at risk. During interviews, managers expressed that due to the fragmented nature of the landscape, the national forest lands also receive far fewer lightning ignitions than historically, requiring the increased use of prescribed fire programs to mimic natural fires.

Across all ecosystems, the desired condition is for frequent, low-intensity fires to be returned to the landscape, restoring natural fire regimes. Objectives are to use prescribed fire to mimic natural fire regimes where land fragmentation and development prevent natural ignition fires. Constraints are placed on this objective through standards and guidelines designed to reduce fire management impacts to soil and water and promote the benefits to habitat.

To overcome land-use challenges and to successfully sustain fire-dependent ecosystems, the revised Francis Marion National Forest plan focuses strongly on working with neighboring lands and developing fire-adapted human communities. The usefulness and need for additional CWPP's is considered integral to effective fire management on the Francis Marion. CWPP's can promote cooperation across landownerships, establish priorities for hazardous fuels reduction, and reduce the risk of wildfires catastrophically impacting communities. Fire-adapted communities as a desired condition directly links fire and land management planning and reflects the objectives of the Cohesive Strategy.

Fire management is also integrated into landscape-scale forest planning through the organization of the revised forest plan. Two distinct management areas were developed with the primary difference between them being the ability to safely implement frequent, low-intensity prescribe fires to maintain or restore fire-adapted ecosystems. Management Area 1 includes the areas where the forest can effectively mimic natural fire regimes through prescribed burning while mitigating risks to infrastructure and surrounding communities. Management Area 2 emphasizes protection of human communities where mechanical treatments and herbicides are more likely than prescribed fire to be used.

The monitoring strategy reflects the revised forest plan's focus on using prescribed fire and working with neighboring lands and communities. For fire-adapted ecosystems, the indicators used to monitor ecological processes included the seasonality and extent of prescribed fire. To monitor the progress with ecological restoration and maintenance, the indicator is acres represented in each fire regime condition class. Monitoring questions and indicators are also included to measure the use and effectiveness of CWPP's through indicators such as acres treated and proximity to infrastructure.

In the revised forest plan, the Francis Marion National Forest has taken advantage of recent policy changes and opportunities to restore fire to the landscape. Compared to the other forest plans reviewed, this revision is unique due to the limitations on natural ignition fires. The extensive prescribed burning program is designed to mimic historic, natural fires and may offer the most feasible compromise between needing fire for ecosystem integrity and needing to protect infrastructure and neighboring lands.

Table 6. Plan components from the Francis Marion National Forest Final Revised Forest Plan that are important for integrating fire and forest planning.

Francis Marion National Forest		
Plan Component Type	**Plan Component Code**	**Specific Language**
Desired condition	DC-ECO-2	"**Ecological Processes.** Landscape-level; low-intensity fire averaging every 1 to 3 years common during the dormant season, but growing prescribed burn occur periodically…Prescribed burning mimics the spread of natural fire, beginning in the uplands and spreading into the wetlands."

		"**Stressors.** Longleaf pin-dominated woodlands, savannas and flatwoods are highly diverse and resilient to the effects of climate change, wildland fire and hurricanes."
Management Area	MA1	"Management Area 1 encompasses ecosystems that include longleaf pine in the maintenance condition class and provides the most benefit to habitats for at-risk species and fire-adapted terrestrial ecosystems…The Forest Service is technically and fiscally capable to manage smoke and public safety associate with prescribed fire in this management area. Therefore natural fie regimes are mimicked, including frequent, low-intensity fire to provide historic fire return intervals across to restore fire-adapted terrestrial ecosystems. "
Management Area	MA2	"most of the ecosystems in Management Area 2 are influenced by adjacent development and human activities; therefore, frequent, low-intensity fire is less likely to be practiced, even though it is desired to restore fire-adapted ecosystems where they have occurred historically…Use of herbicides, mechanical methods and other management tools will be used more often in MA2 to provide habitats for rare plants and animals."
Desired condition	DC-COM-2	"**Fire-Adapted Human Communities.** Risk to human populations and infrastructure from wildfire is low. Through fire regime condition class maintenance and restoration, vegetative conditions are within or near historical range, resulting in reduced risks of wildfire to development, private property and Forest Service infrastructure in the interface and intermix areas. Through education and outreach, communities and public are receptive to, knowledgeable about and accept the role of fire and its short-term impacts… Wildland fire, as an essential ecological process and natural change agent, is incorporated into the planning process and wildfire response. Appropriate management response to wildland fire is based on the ecological, social and legal consequences of the fire."
Objective	OBJ-ECO-2	"**Frequent Prescribed Fire for Ecosystem maintenance or Restoration.** *Prescribed Fire-Base level:* Apply Prescribed fire on at least 30,000 acres per year to maintain or restore fire-adapted ecosystems…"
Objective	OBJ-COM-3	"**Reduce Wildfire Risk.** Assist counties with developing 1 county-wide community wildfire protection plan (CWPP) for Berkeley County and 1 county-wide CWPP for Charleston County within 10 years of plan approval."
Monitoring	MQ28	**Question:** Are the fire regime condition class (FRCC) maintenance and restoration, vegetative conditions within or near historical range, resulting in reduced risks of wildfire to developments, private property and Forest Service infrastructure in interface and intermix areas? **Indicator:** Acres in FRCC 1, 2, and 3."
Monitoring	MQ30	**Question:** What assistance has been provided to counties for developing and implementing mitigation and protection in county-wide community wildfire protection plan (CWPP) for Berkeley County and

		one county-wide CWPP for Charleston County? **Indicator:** Counties providing technical and monetary assistance (i.e. agreements or other instruments). This includes needing to know acres treated and location to infrastructure."

F) Helena – Lewis & Clark National Forest

Ecosystems on the Helena-Lewis & Clark National Forest are fire-driven and have historically been shaped by fire's occurrence. Typically, weather patterns produce thousands of lightning strikes throughout the summer, resulting in natural-ignition wildfires (Helena-Lewis & Clark 2015). These natural wildfire influence forest structure and composition, nutrient cycling, snag creation, and vegetation seeding and sprouting.

Wildfires are considered a key ecological characteristic and the need for integrated fire management has influenced the overall management in the revised forest plan. Across the Forest, fires burn along a spectrum of intensities, severities, and frequencies that maintain ecosystem health and function (Helena-Lewis & Clark 2016). Many of the proposed actions are designed to restore or maintain ecosystems with reference to their natural range of variability and historic integrity. To this aim, the fire management strategies in the revised forest plan seek to balance the need for fire to play its natural role in ecosystems while also protecting resources and at-risk values. As stated in the Proposed Action, the Helena – Lewis & Clark National Forest intends to accomplish this balance by "implementing a coordinated risk management approach to promote landscapes that are resilient to fire-related disturbances and preparing for and executing a safe, effective, and efficient response to fire" (Helena-Lewis & Clark 2016).

The combined influences of climate and human activities, such as grazing, development, and fire suppression, have altered fire regimes from reference conditions (Helena-Lewis & Clark 2015). Relative to historic conditions, the extent of fires has decreased but the size of individual fires is increasing. Areas that historically experienced higher frequency, lower severity fires are now epitomizing moderate/high severity fire regimes. Uncharacteristic large-scale, stand-replacing fires are now more common.

Landscape pattern and heterogeneity have been reduced as fire suppression has reduced the extent of acres burned each season. Plan components include desired conditions to trend the forest towards vegetation characteristics that would support wildland fires similar to historic reference conditions. To restore fire regimes the revised forest plan includes an objective to manage ten percent of natural ignitions for increased resource benefit.

The plan components in the revised forest plan also reflect the need to balance the ecological role of fire and resource value protection. One goal is for the forest to work with adjacent landowners and educate them to adapt to wildfire risks and understand the necessary ecological role of fire. The forest-wide, fire-specific desired conditions show a need to manage fuels to reduce the severity of fires so they can be allowed to burn naturally, providing resource benefits and minimal threats to values. Several plan components also clearly integrate fire and landscape-scale forest planning. One desired condition, for example, recognizes that fires burning within the natural range of variation can support ecosystem functions and contribute to both vegetation and wildlife desired conditions. Another fire-specific objective is directly linked to a vegetation-specific objective. The intent of this linked objective is use either fires or mechanical treatments to annually treat fuels on 5,000 – 15,000 acres.

Overall, the organization of the revised forest plan is not geographically focused on fire management. Ten geographic areas were designated to discuss specific management objectives because the public associates with these generalized areas. The geographic areas were not designated based on fire management intent but there are differences between them. In the Elkhorns Geographic Area and Wildlife Management Unit, for example, prescribed fire is only permissible when used to restore wildlife habitat. The Rocky Mountain Range Geographic Area, however, is characterized by natural processes including fire.

The revised forest plan also priorities fuel treatments in and around the WUI. In establishing WUI designations, recommendations in CWPP's can be used or the forest can specify a specific distance from

private land. On the Helena – Lewis & Clark National Forest, three counties worked together to create a Tri-County CWPP that designated areas of low, moderate, high, and very high risk which can be used for fuel treatment prioritization.

The monitoring strategy has not yet been developed. However, several key desired conditions have been described in such a way as to be monitorable. The current objectives could also be used to develop specific monitoring questions and indicators to assess the forest's progress towards desired conditions. Once the monitoring strategy is completed, we would expect to see fire and fire-related indicators as one of the monitoring strategies.

Table 7. Plan components from the Helena – Lewis & Clark National Forest Proposed Action that are important for integrating fire and forest planning.

Helena – Lewis & Clark National Forest		
Plan Component Type	**Plan Component Code**	**Specific Language**
Desired condition	FW-DC-FIRE-01	"Fire plays a supportive role in managing important ecosystem functions. Unplanned and planned ignitions occur periodically to create recently burned forest conditions within the natural range of variability, thereby providing structure and habitat associated with burned forests."
Desired condition	FW-DC-FIRE-04	"Treated fuel management areas (management actions or wildfire) are maintained into the future to allow opportunities for natural fire occurrence and to provide fuel conditions that benefit fire management operations."
Desired condition	FW-DC-FIRE-05	"Fire management strategies promote vegetation conditions where natural fires are self-limiting with resultant fire severities and smoke outputs that are within the natural range of variability."
Goal	FW-GO-FIRE-01	"The FS works with adjacent communities, land-owners, and permittees to educate them about wildfire risk. The need to adapt to wildfire risks, while recognizing that wildland fire is an ecological process, is understood."
Objectives	FW-OBJ-FIRE-01	"Treat fuels on approximately 5,000 to 15,000 acres annually on NFS lands, primarily through planned, mechanical vegetation treatments… and unplanned ignitions."
Objective	FW-OBJ-FIRE-02	"Over the life of the plan, manage natural, unplanned ignitions to meet resource objectives on at least 10 percent of the ignitions."
Standard	FW-STD-FIRE-02	"All human-caused ignitions shall have a suppression response, unless it is determined by fire management that the fire could have resource benefit."

Desired condition	FW-DC-VEGT-01	"Vegetation occurs across the landscape in a diverse pattern of species compositions and structures that are generally within their natural range of variability and resilient or resistant to future climates and disturbances such as fire, insects, disease, invasive species, floods and droughts."

G) Inyo, Sierra, and Sequoia National Forests

In the revised forest plans for all three forests, wildland fire management options range on a continuum from full suppression to managing an unplanned, natural-ignition fire for resource benefit. Full suppression options are chosen to protect values at risk, such as human communities or infrastructure. Managing a fire for resource benefit is a strategic choice to manage a fire for resource objectives when burning conditions are more manageable and pose minimal threat to communities. All three revised forest plans closely integrate fire and forest planning through strategic fire management zones and prioritizing restoration treatments to restore fire-adapted ecosystems.

A large-scale assessment was conducted for the Sierra-Nevada bio-region and was used to inform individual forest assessments and revised plans. The bio-region assessment, while not required under the 2012 Planning Rule, was conducted to provide an understanding of conditions that affect all three national forests but that exceed any one Forest's boundaries. This broader, regional view provided an opportunity to coordinate the forest planning of three adjacent national forests while still allowing for strategic decision for the specific needs of each forest.

Following the completion of the bio-region assessment, the three forests conducted individual assessments and developed individual forest plans. The three revised forest plans have many similarities as the overarching themes from the bio-region assessment helped to coordinate their development and create consistency across each national forest. The overall approach to fire management, including forest-wide desired conditions, plan organizations, and monitoring strategies, are all similar across the three revised forest plans. The plans differ slightly with regards to ecosystems which are unique to a given forest or specific management needs for an individual. Many of the plan components most significant to incorporating fire and planning are phrased verbatim in all three plans.

Plan components in the revised forest plans focus on restoration projects designed to modify vegetation to prevent high severity fires and eventually allow the natural role of fire on the landscape. Priority areas were set following a risk analysis. The Cohesive Strategy goals formed the basis for developing fire management strategies. Desired conditions call for restoration activities, including prescribed fire and mechanical treatments, and will change the amount, configuration and spacing of forest fuels to restore fire-adapted ecosystems. Objectives, specific to each forest, also depict the extent and timing for restoration activities to restore fire regimes.

Prior to successful fire suppression efforts in the bio-region, fires were more widespread and burned with less intensity (Inyo, Sequoia & Sierra 2016). In the last century, the severity of wildland fires has dramatically increased while the acres burned has decreased. Due to 100 years of fire exclusion and changes to fuels, fires now often burn as high intensity canopy fires that move very quickly and have a much higher impact to vegetation and ecosystems. Extensive tree mortality due to insect outbreaks have added to accumulated fuels. Climate change and continued urban development are also expected to magnify fire behavior. The expected trend for fire in the bio-region is that more area will burn with greater severity (Inyo, Sequoia & Sierra 2016). While the extent of burning would not be detrimental if the burned with low intensity, the current vegetation characteristics are likely to cause widespread, high-intensity burns. The frequency and size of high-severity fires is likely to have the greatest impact on ecosystem integrity and is most important for evaluating consequences to ecosystems.

The geographic structuring of the revised forest plans was greatly influenced by wildland fire management. The forests are divided into four zones based on assessed risk of negative impacts from wildland fires. The zones range from current conditions that would be negatively affected by fire to areas where fire can beneficially play is natural role in ecosystems. As restoration activities commence and vegetation conditions are restored, zones where fire is beneficial can be expanded to include these restored parcels. For example, as the accumulated fuels around communities are removed, areas that were

considered at risk of wildland fires might be now adopted into zones that support managing fires for resource benefit.

The strategic fire management zones are described as follows: the community wildfire protection zone identifies areas where hazardous fuel conditions put communities at high risk. Suppression will be the main fire management strategy in this zone. The general wildfire protection zone indicates where conditions currently put some natural resource values at high risk of damage from wildfire. Wildfires that start in this area may also contribute to the risk in the community wildfire protection zone. The wildfire restoration zone identifies where conditions currently put some natural resource values at moderate risk of damage from wildfire. Wildfires that start in this area will have potential benefits under certain fuel, weather, and environmental circumstances. The wildfire maintenance zone includes areas where wildland fire poses a low threat to communities in average fire season conditions. Due to lower risk, opportunities to manage fires for resource benefit are more common.

Overall, the plan components and the geographic structuring of the revised forest plans have realized the opportunities to integrate fire and forest planning found in recent policy changes. The plan components are also structured in such a way as to contribute to the monitoring strategy. The indicators used, such as fire return interval departure, can be used to track the forest's progress towards desired conditions.

Table 8. Plan components from the Inyo, Sequoia, and Sierra National Forests Draft Revised Forest Plans that are important for integrating fire and forest planning.

Inyo, Sequoia, and Sierra National Forests *Unless otherwise noted, plan components are the same for each National Forests		
Plan Component Type	**Plan Component Code**	**Specific Language**
Desired condition	TERR-FW-DC-02	"Fire occurs as a key ecological process in fire-adapted ecosystems where it does not pose an unacceptable risk to life and property. Fire occurs within an ecological appropriate regime of frequency, extent, and severity, and enhances ecosystem heterogeneity and habitat and species diversity."

Desired condition	FIRE-FW-DC-02	"Fire management activities reduce fuel buildup, help maintain and protect habitat for a variety of species, reduce smoke from larger fires, provide added protection for communities, and restore fire on the landscape."
Desired condition	FIRE-FW-DC-03	"Wildland fires burn with a range of intensity, severity and frequency that allows ecosystems to function in a healthy and sustainable manner. Wildland fire is a necessary process, integral to the sustainability of fire-adapted ecosystems."
Desired condition	FIRE-FW-DC-04	"Fire management uses an all lands risk-based approach in planning and decision making, responsive to the latest fire and social sciences, and is adaptable to rapidly changing conditions, including climate change. Wildfire management is coordinated with relevant state agencies and adjacent federal agencies. The net gains to the public are an important component of the decision-making process."
Desired condition	FIRE-FW-DC-05	"The forest contributes to increased awareness and understanding about wildfire risk among community leaders, service providers, homeowners, permitees and tribes who are invested in or adjacent to the forest. This includes an understanding about the need to adapt communities, properties and structure to wildfire while also recognizing that wildland fire is needed ecological process."
Management Area	CWPZ	**Community Wildfire Protection Zone**: "Although some wildfires that burn in this zone can potentially benefit natural resources and help decrease fuels and threats from future wildfires, these potential benefits are less likely under most weather, fuel moisture, and other environmental conditions due to very high risk to community assets during fire season. The long term focus is to create fire-adapted communities that are less reliant on aggressive wildfire protection."
Management Area	GWPZ	**General Wildfire Protection Zone:** "Although some wildfires that burn in this zone can potentially benefit some natural resources, high negative impacts to many natural resources are more likely under most weather, fuel moisture, and other environmental conditions during fire season. Targeted ecological restoration and hazardous fuel reduction are needed in the general wildfire protection zone to safeguard communities and resources."
Management Area	WRZ	**Wildfire Restoration Zone:** "Wildfires that burn in this zone can potentially benefit natural resources, but only under limited environmental conditions. Managing wildfires to meet resource objectives in this one can be constrained due to fuel conditions and moderate risk to natural resources from wildfire. This zone is where some ecological restoration may be needed before using wildland fire under a wider range of weather, fuel moisture, and other environmental conditions."
Management Area	WMZ	**Wildfire maintenance Zone:** "The wildfire maintenance zone poses a low threat to communities in average fire season conditions, and where conditions allow natural resources to benefit from wildland fire…Ecological maintenance can be carried out by the management of wildland fire under a wide range of weather, fuel moisture, and other environmental conditions. Using prescribed fire to meet resource objectives is also appropriate."

Objective (Inyo)	TERR-FW-OBJ-02	"Restore low and moderate severity fire mosaics using prescribed fire on 20,000 to 25,000 acres within 10 to 15 years following plan approval."
Objective (Sequoia)	TERR-FW-OBJ-02	"Restore low and moderate severity fire mosaics of beneficial fire using prescribed fire on 5,000 to 15,000 acres within 10 to 15 years following plan approval."
Objective (Sequoia)	TERR-FW-OBJ-03	"Manage wildland fire primarily to meet resource objectives when safe and within resource capability to restore 50 to 90 percent of the area in the kern River drainage, outside of the monument, in the wildfire restoration and wildfire maintenance zones to move toward desired conditions within 10 years following plan approval."
Objective (Sierra)	TERR-FW-OBJ-02	"Restore low and moderate severity fire mosaics of beneficial fire using prescribed fire on 50,000 to 60,000 acres within 10 to 15 years following plan approval."
Goal	FIRE-FW-GOAL-01	"Restore ecosystems to a more fire resilient condition and lessen the threat of wildfire to communities."
Goal	FIRE-FW-GOAL-03	"Help communities become more fire adapted, improving their ability to withstand a fire without loss of life and property."
Goal	FIRE-FW-GOAL-06	"Use wildfires forest-wide to meet multiple resource management objectives, where and when conditions permit and risk is within acceptable limits."
Guideline	FIRE-FW-GDL-01	"When managing wildland fire (i.e., wildfire and prescribed fire), a variety of fire management options and activities should be considered, including hand and aerial ignitions, to achieve a mix of fire effects. When safe and feasible, limit extensive continuous areas of high severity fire effects in old forest habitat and riparian areas."
Monitoring	FIRE-FW-DC-03	**Questions:** "Are wildfires managed for resource objectives meeting the desired range of conditions within forested landscapes?" **Indicator:** "Fire severity; proportion high fire severity classes; fire severity index (FSI); and mean and maximum high severity patch size."
Monitoring	FIRE-FW-DC-03	**Questions:** "Are natural fire regimes within terrestrial ecosystems becoming less departed from the desired conditions and the natural range of variation?" **Indicator:** "Fire return interval departure."
Monitoring	FIRE-FW-DC-03	**Questions:** "Are wildfires becoming larger, more frequent, and more severe with warming climate conditions?" **Indicator:** "Fire return interval departure; fire severity; proportion high fire severity; fire severity index; mean and maximum high severity patch size; and total fire size."

H) **Nez Perce – Clearwater National Forest**

Historically, wildland fires were a primary disturbance process that affected forest composition, structure, and function (Nez Perce-Clearwater 2014a). Most of the forest was characterized by mixed-severity fire regimes. This fire regime included moderate-severity fires with short fire return intervals that

were generally nonlethal to dominant vegetation. Lethal, high-severity fires that were characterized by crown fires were less common. The mix of fire severities and frequencies created a shifting mosaic of vegetation structure and age and highly diverse vegetation communities and habitats.

Vegetation is currently more homogenous than historic conditions due to reduced disturbance (Nez Perce-Clearwater 2014a). Beginning in the 1940s a period of cooler, wetter climate and fire successful fire suppression reduced disturbances across the forest (Nez Perce-Clearwater 2014a). In general, composition has shifted to favor shade-tolerant species, the extent of young stands is reduced, and insect and disease activity is increased. Fuel accumulations and a decade of increased temperature and drought have primed the system for uncharacteristically severe and extensive wildland fires (Nez Perce-Clearwater 2014a). The result is current conditions that are outside the natural range of variation which will necessitate activities, including wildland fire, to restore ecosystem health (Nez Perce-Clearwater 2014b). Increased prescribed fire and/or natural fire is recommended in most ecosystems (Nez Perce-Clearwater 2014a).

Direction for natural ignition fire management is described in forest-wide plan components, generally desired conditions and objectives. Forest-wide desired conditions portray fire as an essential ecological process for maintaining resilient ecosystems. Across the forest, fires range from small to extensive and low severity to high severity. The full range of management options from suppression to managing fires for resource benefit and managing fires for multiple objectives are expected. One important guideline also requires suppression decisions to consider the role of fire in ecosystems and the possible negative, long-term consequences from suppression of fire.

Plan components for forestland vegetation are described by general areas such as breaklands, uplands, and Bitterroot Mountains. Each of these forestlands sections include desired conditions for disturbances and patch size. The desired conditions are described by severity, frequency, and size to paint a picture of how wildland fire should influence each landscape. Objectives for each area prescribe the use

of timber harvest, prescribed fire, or unplanned wildland fire to treat a specified number of acres in each area. These treatment objectives are described as initiating the restoration process to trend the forest towards desired conditions.

Preliminary management areas have been described but are still being determined based on public input. The first proposed management area includes wilderness, recommended wilderness, special management areas, research natural areas, and wild and scenic rivers. Management area 2 includes the backcountry and management area 3 consists of the front country. Wildland fire has been incorporated into both management areas 1 and 2 through desired conditions. Within these areas, fire, as a natural disturbance regime, is expected to continue to affect vegetation with little influence from suppression actions. Wildland fire is the primary force affecting forest composition, structure, and patterns and is an appropriate tool for trending the forest towards other desired conditions.

The monitoring strategy has not been developed yet, but based on the influence that fire has on ecosystems, we would expect monitoring questions and indicators to include fire. A monitoring strategy that includes the currently proposed desired conditions for fire would provide one more opportunity to integrate fire and forest planning. It is not yet clear how the forest will choose to develop the monitoring strategy, but the proposed action has potential for an integrated monitoring program.

Table 9. Plan components from the Nez Perce - Clearwater National Forest Proposed Action that are important for integrating fire and forest planning.

Nez Perce – Clearwater National Forest		
Plan Component Type	**Plan Component Code**	**Specific Language**
Desired condition	FW-DC-TE-01	"Vegetation management supports native forest composition and structural diversity as described across biophysical settings in the face of changing climate conditions."
Desired condition	FW-DC-FIRE-01	"Wildland fire occurs as an essential process in maintaining healthy, resilient ecosystems, as appropriate for the vegetation type and other resource objectives. Fire disturbance contributes to vegetation diversity across the landscape. Fire disturbances generally range from small spot-fire, to thousands of acres."

Desired condition	FW-DC-FIRE-03	"Fuel characteristics allow for the full range of management response to wildland fire. Fuel levels adjacent to the wildland urban interface, other infrastructure, or historic or cultural resources provide fire managers with safe, feasible opportunities to achieve protection measures."
Desired condition	FW-DC-FIRE-04	"Natural fuels emulate the structure, species mix, spatial pattern, extent and resiliency of the natural fire regime for the particular planning area."
Guideline	FW-GDL-FIRE-01	"Fire suppression strategies should recognize the role of fire in ecosystem function and identify those instances where fire suppression actions could be damaging to long-term ecosystem function."
Desired condition	MA2-DC-02	"Natural ecological processes (e.g., plant succession) and disturbance (e.g., fire, insects, and disease) are the primary forces affecting the composition, structure, and pattern of vegetation."
Desired condition	MA2-DC-03	"The use of fire serves as the primary tool for trending the vegetation towards the desired conditions as well as serving other important ecosystem functions."
Desired condition	MA3-DC-01	"Vegetation management activities have a dominant role in affecting composition, structure, and patter of vegetation. These management activities trend the vegetation toward desired conditions described in the terrestrial ecosystem section. Although natural ecological processes and disturbances are still present, they are influenced more by human activity in this MA than in others."

I) Rio Grande National Forest

Wildland fire is a key characteristic of many ecosystems across the Rio Grande National Forest. Historic fire regimes vary widely across the Forest with some plant communities either fire-adapted or fire-dependent (Rio Grande 2016). However, fire suppression policies, timber management, grazing, invasive species, and rural/urban development have all contributed to altering fire characteristics and decreased ecosystem integrity. Insect outbreaks have also increasing the proportion of standing dead trees across the forest, changing the available fuels for uncharacteristically sever wildfires (Rio Grande 2016) and will likely require appropriate fire management strategies in the future.

The revised forest plan has integrated fire and forest planning to restore and maintain fire-adapted ecosystems. Forest-wide, natural ignition fires can be managed to promote ecological benefits. The role of fire in ecosystem dynamics is recognized and is supported as a management tool to maintain or restore ecosystems (Rio Grande 2016). Full-suppression strategies will only be used on unplanned human-

ignition fires, when fire created unacceptable risk to life or property, and in specific habitat types where fire will likely have detrimental effects (Rio Grande 2016).

Several specific plan components clearly link fire and forest planning. One of the forest-wide desired conditions is that vegetation types differ minimally from historic fire reference conditions. A plan component that could help achieve this desired condition is the objective that 2,000 acres across the forest are treated with either prescribed fire or natural-ignition fire, annually. Another desired condition is that natural ignition fires paly their natural role in ecosystems across the forest. Trending the forest towards this desired condition will require landscape-scale planning that integrates vegetation treatments and fire management. While no standards explicitly manage natural-ignition fires, the revised forest plan explains that standards can at times be too inflexible. When more adaptability is needed, management approaches are used to describe the intent. In the revised forest plan, the Rio Grande included a management approach for fire-adapted ecosystems where natural ignition fires are managed for multiple objectives, when possible.

Some of the management strategies in the revised forest plan are also geographically organized around fire management. Two distinct Wildland Fire Management Zones (WFMZ) overlay the geographic areas across the Forest. The first WFMZ, indicated as the resource restoration zone, applies to the Wilderness and Roadless Geographic Areas. For this WFMZ and these geographic areas, the general fire management strategy is to manage naturally occurring wildland fires for their ecological benefits with minimal influence from suppression. The second WFMZ is the resource protection and benefit zone. This zone applies to the General Forest and Specially Designated Geographic Areas. In general, the fire management strategy for this WFMZ is to manage fires for multiple objectives and to let fire play its natural role in ecosystems when the risk to values and resources is minimal. Suppression will play a much larger role in this WFMZ but fire is still recognized as having potential ecological benefits. The wildfire management zones do not have individual plan components, but some additional, specific direction is

included through the management area plan components. They are designed to support decision-making by pre-assigning areas for fire management strategies based on potential risk and benefits.

Table 10. Plan components from the Rio Grande National Forest Draft Revised Forest Plan that are important for integrating fire and forest planning.

Rio Grande National Forest		
Plan Component Type	**Plan Component Code**	**Specific Language**
Goal	Goal 2	Maintain and restore sustainable, resilient terrestrial ecosystems: "Ecosystems are a barometer of the quality of land management practices. A natural variety of species, genetic composition, and ecological processes are key to providing the diversity needed for resiliency in the face of environmental disturbances and changes."
Desired condition	DC-FIRE-1	"Major vegetation types reflect little or no departure from historic natural range of variation of fire frequency and intensity (e.g., reflects Fire Regime Condition Class 1). (Forestwide)."
Desired condition	DC-FIRE-5	"Unplanned natural ignitions play their natural role in ecosystem dynamics when and where they do not threaten human life and property. (Forestwide)"
Objective	OBJ-FIRE-2	"Over the life of the plan, complete an average of 2,000 acres of fuels reduction and resource enhancement per year using fire managed for resource benefit and/or prescribed fire on Forest Lands. (Forestwide)"
Standard	S-FIRE-1	"All unplanned human-caused ignitions will be suppressed in the safest and most effective manner possible (General Forest Geographic Area, Specially Designated Geographic Area)."
Management Approach	MA-FIRE-5	"Manage unplanned natural ignitions for multiple objectives (including resource benefit) in fire-adapted ecosystems when conditions are favorable to achieve desired resource benefits and protect values at risk. (Forestwide)"
Wildland Fire Management Zone	WFMZ-R	"These areas present a lower risk to resource values from wildfires, and conditions allow natural resources to benefit from wildland fire… All naturally occurring unplanned wildfires in these areas will be managed primarily to restore and maintain the natural role of fire in the ecosystem with a minimal emphasis on suppression." (Applies to the Wilderness and Roadless Geographic Areas)
Wildland Fire Management Zone	WFMZ-PB	"Current conditions may put some natural resource values at varying degrees of risk of damage from wildfire…Wildfires that burn in this zone may benefit natural resources under certain conditions. All lightning-caused wildfires in these areas will be assessed on an individual basis for the most appropriate response based on values at risk and potential benefits to natural resources from wildfire."

5. Key Findings and Recommendations

A) Adaptability of 2012 Planning Rule

The 2012 Planning Rule provides sufficient flexibility for each National Forest to fulfill its requirements while still meeting their unique ecological needs. Each National Forest has used a different approach, or combination of approaches, to integrate fire and forest planning. The only revisions that are similar are from the Inyo, Sequoia, and Sierra National Forests, because they were written collaboratively. Clearly, there is no one-size-fits-all approach for integrating fire and forest planning.

The variety of approaches used demonstrates the adaptability of the 2012 Planning Rule. It shows that methods to fulfill the Planning Rule's requirements can be tailored to meet the distinct needs of each forest. That is, the Planning Rule explicitly requires revised plans to include plan components to restore and maintain ecosystem integrity and consider disturbance regimes and opportunities to restore wildland fire. However, each forest has taken these same requirements and has fulfilled them in unique ways.

The demonstrated flexibility of the Planning Rule is important because each forest is ecologically unique. The Francis Marion National Forest, for example, generally needs frequent fires to maintain ecosystem but land fragmentation complicates their fire management. To address this challenge, two management areas are used to signify where prescribed fire is, or is not, an appropriate management strategy. This system is mostly binary. In contrast, the Flathead National Forest must plan for a much larger range of fire frequencies, intensities, and severities to maintain their ecosystems. The differences in fire ecology are uniquely challenging across forests. These challenges can be addressed because the Planning Rule provides sufficient flexibility to integrate fire and forest planning, regardless of the fire regime or ecosystem.

The flexibility provided by the Planning Rule requirements is why forest plan revisions can successfully integrate fire and forest planning. During interviews, participants unanimously agreed that forest plan revisions are an appropriate platform to integrate them because they can provide guidance

without being inflexible. Forest plan revisions offer an opportunity to provide sideboards and broad landscape-level direction to guide fire management while maintaining some flexibility in incident-level decision-making.

B) Trends in Plan Components

All the revised forest plans are uniquely tailored to suit each forests' fire management needs, however, there are trends in the plan components. For example, standards and guidelines are the plan components least used to address the ecological benefits of fire. Every revised plan includes standards and guidelines to address fire management, but they are largely used to restrict fire suppression tactics, such as the use of fire retardant near water. Only three revised forest plans include standards, and only four include guidelines, that directly address how wildland fire can be used for ecological benefit. This means that fewer than half of the revised forest plans include standards and guidelines which require the consideration of wildland fire and its role in ecosystems.

Standards and guidelines do not compel agency action, rather, they restrict specific actions that would prevent progress towards the desired conditions. Unless they are written to include caveats or exceptions, they provide little room for management adaptation without plan amendment. As a result, planning teams may be hesitant to restrict fire management decision-making with too many standards and guidelines. This may be appropriate as fire management is replete with risk and uncertainties and fire managers must maintain some discretion to safely manage the unique challenges of each individual fire. However, the plan components, when combined, must provide enough direction to guide the forest towards the

Required Plan Components

Desired condition: "description of specific social, economic, and/or ecological characteristics of the plan area, or a portion of the plan area, toward which management of the land and resources should be directed."

O*bjectives:* "Concise, measurable, and time-specific statement of a desired rate of progress toward a desired condition or conditions. Objectives should be based on reasonably foreseeable budgets."

Standards: "Mandatory constraint on project and activity decisionmaking, established to help achieve or maintain the desired conditions or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements."

Guidelines: "Constraint on project and activity decisionmaking that allows for departure from its terms, so long as the purpose of the guideline is met."

desired conditions. If standards and guidelines are minimally used, then the other required plan component, objectives, must provide sufficient direction.

Objectives regarding the ecological benefits of fire are used in five of the revised forest plans. As defined in the Planning Rule (see sidebar), they are less restrictive than standards and guidelines. They do not constrain decisions but dictate a desired rate of progress. When flexibility in decision-making is necessary for safe fire management, I recommend the increased use of objectives. When objectives are developed to be specific and measurable, they can guide decision-making to achieve the desired conditions without tying the hands of fire managers.

Within the forest plan revisions, there is also a trend of vague desired conditions. Desired conditions that describe the ecological benefits of fire are included in all forest plan revisions (except the El Yunque which does not include fire-adapted ecosystems). This is a significant and positive development, especially when we consider how rarely fire was incorporated into the forest plans developed under the 1982 Rule.

The 2012 Planning Rule requires that "desired conditions must be described in terms that are specific enough to allow progress toward their achievement to be determined" (36 C.F.R. §219 2012). This requirement applies to every desired condition, and yet, vague desired conditions statements were found throughout the revised forest plans. Developing desired conditions for wildland fire that include specific direction is clearly a challenge. According to the interview participants, the public's negative connotations with fire, perceptions of risk, budgets, and even climate change, all complicate the development of ideal desired conditions.

Suitability of lands: "Specific lands within a plan area will be identified as suitable for various multiple uses or activities based on the desired conditions applicable to those lands. The plan will also identify lands within the plan area as not suitable that are not compatible with desired conditions for those lands."

Optional Plan Component

Goals: "Broad statements of intent, other than desired conditions, usually related to process or interaction with the public."

Optional Plan Content

"A plan may include additional content, such as potential management approaches or strategies and partnership opportunities or coordination activities"

The challenge of developing specific, measurable desired conditions can be addressed by adding goals and management approaches. Goals and/or management approaches are used in five of the revised forest plans. They are not required plan components, but goals and management approaches can be used to provide specifics and additional guidance and to help set priorities. I recommend that goals and management approaches be used to supplement vague desired conditions.

Developing a monitoring strategy for wildland fire is another challenge that requires careful consideration when developing plan components. Six out of the eight National Forests that have developed a monitoring strategy, explicitly include wildland fire in monitoring questions and use some characteristic of fire as an indicator. The Planning Rule does not require every plan component to be included in the monitoring strategy, but it does require them all to be specific and measurable. Eight of the plan revisions include at least one plan component that is specific and measurable within the lifetime of the plan. However, many of the plan components, particularly desired conditions, are broad, generalized statements that lack specificity or may not be measurable in a fifteen-year planning cycle.

When developing plan components, National Forests must consider how they will translate into a monitoring strategy. That is, plan components must be specific enough to be monitorable. Particularly in complex systems or systems with long fire return intervals, monitoring challenges should be considered early in the planning process. To monitor the effectiveness of plan components, National Forests must be realistic about the data that can be collected, and the trends that can be detected, during the fifteen-year lifetime of a forest plan.

C) Fire-Specific Area Designations

Five of the eleven revised forest plans have used fire-specific area designations. These area designations geographically represent where certain plan components do and do not apply. Each revised forest plan discusses different areas of the forest that are likely to be appropriate for natural ignition fire management, but the methods used to designate these areas vary. Suitability determinations are largely

unused to specify areas appropriate for different fire management options. Several forests have relied on the usual area designations, including management and geographic areas, to spatially depict fire management approaches. Several other forests have geographically structured their plan around fire and different fire management strategies.

The spatial design of several revised forest plans was not influenced by fire. Forests that took this approach included the Flathead, Chugach, and Helena – Lewis & Clark National Forests. In general, these plans designated management or geographic areas based on other resources or location. Almost by default, however, fire strategies often differ between these areas. For example, a common management area designation is for backcountry areas. The management approaches for these areas often discussed minimizing roads and increasing recreation opportunities. Because these areas also tended to be farther from communities or infrastructure, they also generally supported the use of natural ignition fires for resource benefit. Using this approach, fire management strategies were depicted through forest-wide direction or plan components that applied in specific circumstances. Rather than mapping specific areas and assigning a fire management strategy, these forests described the conditions (such as topography, weather, and season) that would be necessary to manage fires for resource benefit.

Another approach used by several forests was to spatially structure fire management strategies through physical delineation of forest areas. This approach has so far been used by the Francis Marion, Inyo, Sequoia, Sierra, and Rio Grande National Forest. In each of these forest plans, physical boundaries describe the range of fire management approaches appropriate in each area. However, the specifics of how the designations were determined and how they relate to other plan components varies among the forests.

The Inyo, Sequoia, and Sierra National Forests developed their forests plans as a joint effort and as such used the same method. These plans delineated strategic fire management zones. These zones each have their own plan components including desired conditions, guidelines, goals, and occasionally,

standards and management approaches. The fire zones overlay the other management area designations made in the plans. In contrast, the Francis Marion revised plan did not create overlying zones; rather, it used two management areas to divide the forest based on areas that either permit or prohibit and discourage the use of prescribed fire. Both management areas provide detailed plan components directing distinct fire management strategies. The Rio Grande National Forest used yet another variation. They established two distinct wildland fire management zones that overlay the geographic areas. Unlike the other plans, these zones do not have their own plan components but suggest management strategies for both areas based on risk.

The forests that have fully developed plans, even if they are still in draft form, are already being used as templates for other plans still in development. Interview respondents expressed that they looked at other forests for ideas on how best to geographically define fire management strategies. The Francis Marion, Flathead, Inyo, Sequoia, and Sierra revised forest plans are being studied by the other forests for guidance. These forests all have very fire-focused plans, but the approaches they used for designating areas are significantly different. Additional guidance on why these different approaches were chosen and how they developed would likely be useful for other forests. Specifically, interviewees explained that there is still a great deal of confusion regarding designating fire management zones. This will likely be an approach used by other forests but there is not yet any official direction for how these zones fit within the management or geographic areas required by the Planning Rule.

I recommend that all forest plan revisions contain some spatial components to fire management planning. Whether it be management areas, geographic areas, zones, or suitability designations[1],

[1] Land suitability determinations were rarely used to address fire management in forest plan revisions and provided little to no additional guidance beyond the other plan components. The USFS Directives indicate that suitability determinations should be used for forest uses (such as harvesting timber or motorized recreation) and not the management tool used to achieve desired conditions (such as chemical treatments or prescribed burning) (USDA 2017). However, suitability determinations could still be useful for spatially structuring fire management. Much like delineating where timber harvests are appropriate, designating certain lands as suitable for resource benefit fires could facilitate project-level decision-making. Considering USFS spatial fire planning requirements, suitability determinations could be integrated into WFDSS, especially when other spatial structuring approaches are not used in plan revisions.

landscape-scale spatial fire planning will help facilitate incident-level decision-making. The USFS already has spatial fire planning requirements through WFDSS and fire-specific area designations should work well with this process. Communication with the public could also be facilitated with area-specific designations. A physical, geographic representation of what plan components apply where can help explain the forest plan intent and make communication with the public more straight-forward.

When using fire-specific area designations, forests must provide clear direction on the relationship between these areas and the rest of the forest plan. Describing this relationship, however, is one of the greatest challenges expressed by interview participants. The USFS is in the process of developing a technical guide for integrating fire into land management planning (Barrett *et al.* 2017). This guide will be a useful resource during the forest plan revision process and when determining the most appropriate approaches for spatial representation of fire management. The technical guide describes how fire can be incorporated in management, geographic, and designated areas and zones. However, it provides minimal guidance on why the different approaches should be used or how best to accomplish specific land management goals. Additional concerns reflect the potential requirement for a plan amendment if fire management zone boundaries are changed. More than any other aspect of the revision process, I see this challenge as warranting additional guidance by the USFS.

D) Influence of the Cohesive Strategy

The Cohesive Strategy is influencing forest plan revisions, although it is rarely referenced directly. The Francis Marion, Inyo, Sequoia, and Sierra National Forests, discuss the Cohesive Strategy in their assessments and environmental impact statements. They describe the Cohesive Strategy as a platform for working with stakeholders and as an information source for risk assessment and risk mitigation. The Cohesive Strategy is not directly referenced in any of the plan components developed so far. However, it is important to note that many of the plan components do fulfill the three goals of the Cohesive Strategy – resilient landscapes, fire-adapted communities, and safe and effective response to wildfire.

Despite the lack of direct reference in plan components, interview participants explained that the Cohesive Strategy is being used during decision-making. They described that it is very broad in scope which makes it unwieldy and challenging to integrate during the revision process. However, these same participants explained that the Cohesive Strategy is helpful for beginning the decision-making process. Many of the interviewees recommended the Cohesive Strategy as a supporting document and an appropriate starting place when revising forest plans.

It is appropriate and beneficial that the Cohesive Strategy is influencing decision-making, but the lack of reference in plan components is a missed opportunity. Referencing the Cohesive Strategy directly in plan components is a missed opportunity because it could be used to address the larger social issues that challenge wildland fire management. All the forest plan assessments or need for change documents discuss the influence that the public and stakeholders can have over fire management decisions. Six of the revised forest plans also include desired conditions for neighboring communities to be more knowledgeable and accepting towards the natural role of fire on the landscape. The Cohesive Strategy is an interagency agreement that provides national direction and regional priorities. This high-level view should be used to leverage partnership opportunities for cross-jurisdictional fire management.

6. Conclusion

As evidenced in the forest plan revisions, the USFS has made important, initial steps towards integrating fire and forest planning. Forest planning is a three-tiered process and the 2012 Planning Rule and forest plans represent the first two tiers. Both now allow, or even encourage, the management of natural-ignition fires for resource benefit. As such, forest plan revisions are now a viable vehicle for changing fire management paradigms. However, they are not action compelling with regards to fire management and change will depend on the final tier of the planning process, incident-level decision-making. Going forward, incident-level decision-making will provide the needed growth and change in fire management in the USFS. The cumulative impact of these decisions will determine if the USFS fire management programs will fulfill the intent of the 2012 Planning Rule and Cohesive Strategy.

These first early adopter National Forests have made important strides in incorporating fire into forest planning and have set the stage for change. The approaches used by these National Forests provide examples of how to begin integrating fire management with forest planning across USFS lands. However, an adaptive, iterative process of planning, implementing, monitoring, and amending will be needed to achieve the desired conditions of these forest plans. Landscape-scale fire planning will require adaptive management which should be a continual learning process where incident-level decisions are cumulatively monitored for trends, triggering changes in management strategies and forest plan amendments. As the second tier of forest planning, these forest plan revisions are a large achievement that provide a foundation for moving forward. The ongoing revision processes across the national forests can benefit greatly from the efforts of these pilot forests.

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Appendix A: Interview Questions

1. The 2012 Planning Rule calls for restoring or maintaining ecological integrity by considering opportunities to restore fire to the landscape and developing plan components that take into account system drivers, stressors, and disturbance regimes such as wildfires. Is this part of the Rule relevant to your forest? Please explain.

2. Are you familiar with the Cohesive Strategy? If so, was it applicable to and help inform the plan revision process? Please explain.

3. Generally speaking, can you tell me your sense of the support or aversion to the use of natural ignition fires or fires for resource benefit on your national forest? (inside the agency, from NIFC, and from the public).

4. Do you believe that forest plans are the right platform to be making decisions or priorities regarding natural ignition fire management?

5. What are some of the incentives and disincentives to planning for resource benefit fires rather than suppression? (Differences in funding, agency culture, public acceptance, perceptions of risk, availability of resources).

6. During the forest plan revision process, what were some of the challenges or impediments you experienced when incorporating wildland fire planning into the land management planning process? If none, can you explain why?

7. Do you have anything you'd like to add or any lessons learned to share with Forests that will be going through the process next?