

Four Forest Restoration Initiative, Rim Country EIS

Socioeconomics Report

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4FRI Rim Country EIS

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Introduction/Project Information

The Four Forest Restoration Initiative, Rim County EIS analyzes the proposal to conduct restoration activities within 1.2 million acres of ponderosa pine ecosystems over approximately 20 years on the Apache-Sitgreaves, Coconino, and Tonto national forests. The project area includes Coconino, Yavapai, Gila, and Navajo counties in Arizona. Apache County is also included due to social and economic ties to the project area. Treatments would occur in the vicinity of Happy Jack, Payson, Young, Heber-Overgaard, Show Low, and Pinetop-Lakeside, Arizona. This report analyzes the social and economic consequences of proposed restoration activities.

The purpose of the Rim Country Project is to reestablish and restore forest structure and pattern, forest health, and vegetation composition and diversity in ponderosa pine ecosystems to conditions within the natural range of variation, thus moving the project area toward the desired conditions. The project responds to a need to support sustainable forest products industries in the region. Appropriately-scaled businesses would play a key role in achieving the goals of 4FRI by harvesting, processing, and selling wood products, thereby reducing treatment costs and providing economic opportunities.

Relevant Law, Regulation, and Policy

Multiple statutes, regulations, and executive orders identify the general requirement for the application of economic and social evaluation in support of Forest Service planning and decision making. These include, but are not limited to, the Multiple-Use Sustained Yield Act of 1960 (74 Stat. 215; 16 USC 528-531), National Environmental Policy Act of 1969 (83 Stat. 852; 42 USC 4321, 4331-4335, 4341-4347), and the Planning Act of 1974.

Federal Law

Multiple-Use Sustained-Yield Act

The Multiple-Use Sustained Yield Act of 1960 (74 Stat. 215; 16 USC 528-531) requires that economic impacts are considered when establishing management plans or decisions that may affect the management of renewable forest and rangeland resources. This report meets the requirements of this law by addressing the economic impacts of the Rim Country project on the local economy.

National Environmental Policy Act

National Environmental Policy Act (NEPA) of 1969 (83 Stat. 852; 42 USC 4321, 4331-4335, 4341-4347) requires that economic and social impacts of federal actions be considered through environmental analysis. This specialist report includes analysis on social and economic issues identified during the scoping process to meet the terms of the NEPA and regulations.

National Forest Management Act

National Forest Management Act (NFMA) of 1976 (16 U.S.C. 1600) and regulations require that the economic impacts of decisions or plans affecting the management of renewable resources are analyzed and that economic stability of communities whose economies are dependent on materials from national forest lands are considered. This analysis meets the requirements of the NFMA by specifically considering the economic impacts of the implementation of the Rim Country project and its impacts on local communities and minority populations.

Civil Rights Act

The Civil Rights Act of 1964 provides for nondiscrimination in voting, public accommodations, public facilities, public education, federally assisted programs, and equal employment opportunity. Title VI of the Act, Nondiscrimination in Federally Assisted Programs, as amended (42 U.S.C. 2000d through 2000d-6) prohibits discrimination based on race, color, or national origin.

Executive Orders

Environmental Justice, EO 12898 of February 11, 1994

Executive Order 12898 directs federal agencies to identify and address any adverse human health and environmental effects of agency programs that disproportionately impact minority and low-income populations.

Land Management Plan Direction

The Apache-Sitgreaves, Coconino, and Tonto National Forest Land Management Plans provide management direction for the social and economic environment. All three plans incorporate desired conditions and objectives related to the social and economic environment. In particular, desired conditions related to air quality, transportation, forest products, wildland fire management, and other resource areas are relevant to the social and economic environment:

“Vegetation provides products—such as wood fiber or forage—to help meet local and regional needs in a manner that is consistent with other desired conditions on a sustainable basis within the capacity of the land” (Apache-Sitgreaves LMP, pg. 29).

“Annually, prepare and offer up to an average of 122,000 CCF from suitable timberlands resulting from sustainable harvest to provide wood products to businesses and individuals” (Apache-Sitgreaves LMP, pg. 95).

“The intent of management is to promote dependent user stability through direct supply of products such as wood and forage and to provide community stability and enjoyment through the direct or indirect supply of products and other opportunities” (Tonto LRMP, pg. 19).

“Actively participate with all interested and potentially affected parties to develop strategic Interface management measures to reduce Wildland Fire threats to life, property and resources, address issues of Forest health, and provide for community partnerships including treatments of vegetation and fuels, and access needs” (Tonto LRMP, pg. 20).

“Human life and property are protected. There is reduced fire hazard, intensity, and severity to human health, safety, infrastructure, communication sites, water supply, astronomical sites, and characteristic ecosystem function” (Coconino LRMP, pg. 75).

“The Coconino NF provides a sustainable supply of forest products consistent with other resource desired conditions and applicable laws and regulations. This supply contributes to the stability and social, economic, and cultural aspects of the communities in central and northern Arizona” (Coconino LRMP, pg. 88).

The Land Management Plans for the Apache-Sitgreaves, Coconino, and Tonto NFs do not specify standards and guidelines specific to the social and economic environment. The three plans do provide standards and guidelines for resources and uses, such as forest products, that contribute to social and economic conditions. Those standards and guidelines are addressed in their respective resource reports.

Affected Environment

Existing Condition

Population Growth

The planning area counties are home to approximately 615,000 people, which is approximately 9 percent of Arizona’s population (U.S. Census Bureau 2020). Table 2 displays population estimates for the planning area counties and the state.

Table 1. Population Estimates, 2010 to 2019

Location	2010	2019	Percent Change 2010-2019
Arizona	6,407,172	7,278,717	13.6%
Apache County	71,829	71,887	0.1%
Coconino County	134,612	143,476	6.6%
Gila County	53,561	54,018	0.9%
Navajo County	107,697	110,924	3.0%
Yavapai County	210,983	235,099	11.4%

Source: U.S. Census Bureau, 2020

Arizona has been among the fastest growing states. Between 2010 and 2019 Arizona grew 13.6 percent (U.S. Census Bureau 2020). The counties in the planning area grew more slowly over this period, ranging from 11.4 percent population growth in Yavapai County to no growth in Apache County (U.S. Census Bureau 2020).

Population growth in the planning area may interact with forest management activities. For example, population growth may increase the size of the wildland-urban interface. Wildland-urban interface growth can affect ecological integrity, wildfire suppression costs, and the number of people exposed to smoke emissions.

Wildland-Urban Interface

The wildland-urban interface is the area where urban development contacts natural or undeveloped land. This wildland-urban interface is especially vulnerable to wildland fire. Figure 1 displays the share of homes in the wildland-urban interface in the planning area. Approximately one-fifth of homes in Coconino, Gila, and Navajo counties are in the wildland-urban interface. Only 6.4 percent of homes in Yavapai County are in the wildland-urban interface. These data reveal that a sizeable share of residents in the planning area have homes in the wildland-urban interface. Homes in the wildland-urban interface are about far more common in the planning area as they are State-wide (13.9 percent compared to 1.9 percent). Nearly half of the homes in the planning area’s wildland-urban interface are second homes, suggesting that many of their owners are part-year residents (Headwaters Economics 2020).

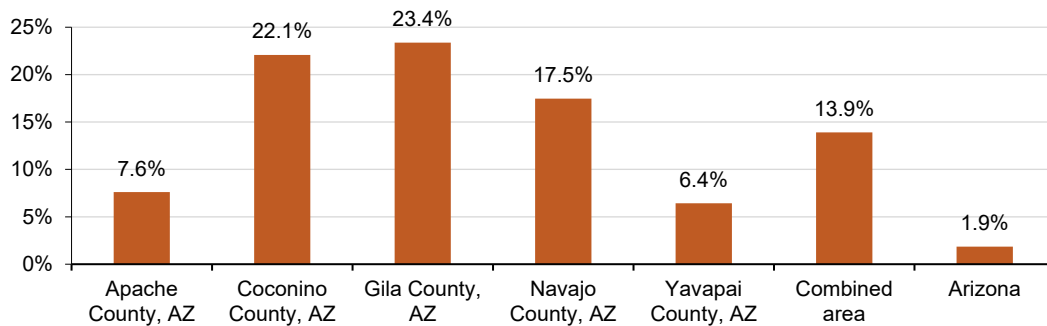


Figure 1. Percent of Total Homes Built in the Wildland-Urban Interface, 2010

Source: Headwaters Economics, 2020

Table 3 below represents the risk of wildfire for lands already developed in the wildland-urban interface. This risk is measured using the 11 westernmost states in the contiguous U.S. and their counties. There are 414 counties, therefore a rank of 1 in 414 indicates that it is considered the most at-risk county for wildland fire, whereas a rank of 414 would indicate very low risk.

Coconino County is the most at-risk county in the planning area, however, all three counties are extremely vulnerable to wildland fires in the wildland-urban interface and rank among the top quartile for all 414 counties. In addition, all three counties rank in the top five for the 15 counties in the state of Arizona.

Table 2. Wildfire Risk to Development, West-wide and State-wide County Rankings, 2010

Location	West-wide Rank by Existing Risk	State-wide Rank by Existing Risk
Apache County	97 of 414	3 of 15
Coconino County	65 of 414	1 of 15
Gila County	101 of 414	5 of 15
Navajo County	99 of 414	4 of 15
Yavapai County	87 of 414	2 of 15

Source: Headwaters Economics, 2020

Wildfire Costs

In 2015 and 2016, federal wildland fire suppression cost approximately \$2 billion annually, \$1.7 billion of which was spent by the USFS (NIFC 2017). That is a nearly 300% increase in cost (inflation adjusted) since 1985 (NIFC 2017). Much of the cost increase has been attributed to the further development of the wildland-urban interface, climate change, and management of forests (suppression, prescribed burns, etc.). Past large wildfires in and around the Rim Country project area have cost tens of millions of dollars to fight. The 2005 Cave Creek Complex fire alone cost the Forest Service approximately \$18 million to fight. In 2016, the Forest Service spent \$12 million on the Juniper and Fulton fires (N. Hale, personal communication, June 7, 2017).

Between 1995 and 2015, the percentage of the Forest Service budget spent on fire expanded from 16 to 52 percent (USFS 2015). Furthermore, suppression costs account for only a fraction of the total cost of wildfires. Wildfires often entail costs associated with rehabilitation, lost property, decreased business revenue, and human health effects. The Western Forestry Leadership Coalition estimates that total

wildfire-related expenses, when accounting for a variety of direct and indirect costs, range from two to thirty times the reported suppression expenditures (WFLC 2010).

The rising cost of federal wildland fire operations has caused a shift of agency expenditures from other mission critical activities (e.g., restoration, research, and recreation) toward firefighting and fire management (USFS 2015). Reduced funding for recreation, vegetation and watershed management, wildlife and fisheries habitat management, and other non-fire activities limits the ability of the Forest Service to contribute to improvements in ecosystem services and quality of life in nearby communities (USFS 2015). For example, between fiscal year 2014 and fiscal year 2015, the agency’s fire suppression expenditures increased by \$115 million while non-fire programs were reduced by the same amount (USFS 2015). Climate change and continued population growth in the wildland-urban interface are expected to contribute to rising fire suppression costs.

Beginning in fiscal year 2020 through fiscal year 2027, the Forest Service fire suppression spending from its regular budget will be capped at just over \$1 billion and fire suppression costs in excess of this amount will be funded through an emergency wildland firefighting account rather than through borrowing from other Forest Service program areas (USDA 2018).

Forest Products Industry

Table 4 shows the number of employees in four forestry-related sectors in the project area. According to the IMPLAN data, the counties in the project area currently have few jobs in forestry-related sectors. Navajo County has the largest numbers of employees in commercial logging, biomass generation, and sawmills. Gila County has the fewest employees in these sectors. The four counties in the project area have approximately 42 percent of commercial logging and sawmill employees and seven percent of wood product manufacturing employees in the state. As of 2017, the only biomass power generation facility in the state was in Navajo County (IMPLAN 2017).

Table 3. Employment in Forestry-Related Sectors, 2017

Location	Commercial Logging	Biomass Power Generation	Sawmills	Wood Product Manufacturing
Apache County	16.05	0	22.52	41.9
Coconino County	18.1	0	17.9	55.8
Gila County	6.5	0	0	136.4
Navajo County	40.5	0.6	80.8	132.8
Yavapai County	11.5	0	23.4	63.3
Arizona	360.8	0.6	192.8	5,746.90

Source: IMPLAN, 2017

In terms of employment, only Navajo County is more specialized in forestry-related sectors than the nation overall (Headwaters Economics 2017). These data indicate where existing capacity – in terms of infrastructure and skilled labor – to implement 4FRI activities may exist in the project area.

The vast majority (97 percent) of timber harvested in Arizona is processed in the state, though very little timber from other states flows into Arizona for processing (Sorenson et al. 2016). In 2012, there were 25 active wood product manufacturers, including sawmills, house log and viga manufacturers, bioenergy facilities, and other plants (Sorenson et al. 2016). These facilities are concentrated near the Rim Country project area. The number of primary wood processing facilities in Arizona increased by approximately 50 percent between 2007 and 2012 (Sorenson et al. 2016). Proximate wood processing facilities are essential

for forest restoration activities, since transportation costs can erode the financial feasibility of removing small diameter and low value forest products.

4FRI Phase One Implementation

Implementation of phase one of 4FRI contributed jobs and labor income to the regional area. This is important because it sets the stage for future implementation activities under the Rim Country 4FRI. This section will demonstrate how the social and economic affected environment has changed since phase one was implemented in FY 2017.

Implementation activities for phase one were assessed using primary employment data gathered via surveys of wood contractors in the area. In FY 2017, the economic activities related to implementation of 4FRI phase one were 12,000 acres mechanically thinned and the removal of about 400,000 green tons of sawlogs and biomass for processing. These activities generated almost 1,000 full and part-time jobs and \$50 million in labor income in FY 2017 in Apache, Coconino, Gila, Greenlee, and Navajo counties in northern Arizona (Hjerpe and Mottek-Lucas 2018).

While these economic contributions from phase one 4FRI activities are substantial, the growth in contributions has been limited and are less than original project objectives (Hjerpe and Mottek-Lucas 2018). Hjerpe and Mottek-Lucas (2018) also found that “the main barrier to ramping up 4FRI mechanical thinning accomplishments is the lack of profitability in thinning and processing small diameter ponderosa pine.” Ways to boost the economic contributions from 4FRI activities include “to increase the scale of acres treated, which would result in greater thinning and wood utilization employment” and “to decrease the amount of contributions leaked from the region” (Hjerpe and Mottek-Lucas 2018). Contributions leave the region when there is inadequate infrastructure to process the harvested wood in the region. Any regional response to these barriers and solutions would affect how wood is processed and how the resulting economic contributions accrue to the region under this current Rim Country 4FRI.

Ecosystem Services

The economic value of Forest Service resources, uses, and management is not entirely captured in market transactions. Much of the value of national forests is “non-market” in nature – meaning that many of the benefits that forests provide to humans do not have a price. The lack of a price, however, should not be conflated with an absence of value. Indeed, non-market values from forests provide economic benefits to adjacent communities and forest visitors.

Ecosystem services are “components of nature, directly enjoyed, consumed, or used to yield human well-being” (Boyd and Banzhaf 2007). Healthy forests provide numerous ecosystem services, including clean water and air, biodiversity, forest products, and many other goods and services.

Wildfire has the potential to reduce ecosystem service values through: (1) destruction of wildlife habitat, (2) water quality and watershed impacts, (3) damage to cultural and archaeological sites, and (4) soil erosion and impacts to water quality (Morton et al. 2003). Furthermore, post-fire effects, such as flooding, can threaten life and property and further degrade ecosystem services.

Socioeconomic Vulnerability

Individuals, households, and communities have different abilities to adapt to changing environmental, social, and economic conditions. The same Forest Service management action may have different effects on individuals within the same community or on communities across the project area. A number of characteristics, such as wealth, education, and age affect households’ ability to adapt to change. Community characteristics, such as social networks, governance, and institutions also contribute to the ability of people to adapt to social, economic, and environmental change (Hand et al., 2018).

A social vulnerability index for all counties in the Southwestern Region of the Forest Service reveals that Apache and Navajo counties have among the lowest adaptive capacity of counties in the region. Households in these counties are likely to have fewer resources available to them. In contrast, Coconino and Yavapai counties have among the highest adaptive capacity of counties in the region. Households in these counties are likely to have many more resources available to them (Hand et al., 2018). Displacement due to wildfire, for instance, may be more difficult for households in Apache and Navajo County than households in Coconino and Yavapai counties. These findings reveal a great deal of socioeconomic diversity across the planning area.

Environmental Justice

In 1994, President Clinton issued Executive Order 12898. This order directs federal agencies to consider the human health and environmental conditions in minority and low-income communities. The purpose of Executive Order 12898 is to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects on minority and low-income populations (Executive Office of the President 1994).

Environmental justice is the fair treatment and meaningful involvement of people of all races, cultures, and incomes, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. The goal of environmental justice is for Federal agency decision-makers to identify impacts that are disproportionately high and adverse with respect to minority and low-income populations and identify alternatives that will avoid or mitigate those impacts. According to USDA DR5600-002 (USDA 1997), environmental justice, minority, minority population, low-income, and human health and environmental effects, are defined as follows:

Environmental Justice means that, to the greatest extent practicable and permitted by law, all populations are provided the opportunity to comment before decisions are rendered on, are allowed to share in the benefits of, are not excluded from, and are not affected in a disproportionately high and adverse manner by, government programs and activities affecting human health or the environment.

Minority means a person who is a member of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic.

Minority Population means any readily identifiable group of minority persons who live in geographic proximity to, and, if circumstances warrant, migrant farm workers and other geographically dispersed/transient persons who will be similarly affected by USDA programs or activities.

Low-Income Population means any readily identifiable group of low-income persons who live in geographic proximity to, and, if circumstances warrant, migrant farm workers and other geographically dispersed/transient persons who will be similarly affected by USDA programs or activities. Low-income populations may be identified using data collected, maintained and analyzed by an agency or from analytical tools such as the annual statistical poverty thresholds from the Bureau of the Census' Current Population Reports, Series P-60 on Income and Poverty.

Human Health and/or Environmental Effects as used in this Departmental Regulation include interrelated social and economic effects.

The emphasis of environmental justice is on health effects and/or the benefits of a healthy environment. The CEQ has interpreted health effects with a broad definition: "Such effects may include ecological, cultural, human health, economic or social impacts on minority communities, low-income communities or Indian Tribes ...when those impacts are interrelated to impacts on the natural or physical environment" (CEQ 1997).

According to U.S. Census Bureau (2021) data reported in Table 5, planning area counties differ substantially in their racial and ethnic composition. The table shows the percentage of residents who self-identify in each of the racial and ethnic categories.

Table 4. Percent of Population by Race and Ethnicity, 2019

Location	White (percent)	Black or African American (percent)	American Indian and Alaska Native (percent)	Asian (percent)	Native Hawaiian and Other Pacific Islander (percent)	Two or More Races (percent)	Hispanic or Latino (percent)
Apache County	22.3	0.6	75.0	0.5	0.1	1.6	6.6
Coconino County	65.7	1.5	27.4	2.1	0.2	3.1	14.3
Gila County	78.2	0.8	18.2	0.9	0.1	1.7	18.9
Navajo County	50.4	1.0	45.7	0.6	0.2	2.2	11.5
Yavapai County	93.3	0.9	2.2	1.3	0.2	2.3	14.7
Arizona	82.6	5.2	5.3	3.7	0.3	2.9	31.7

Source: U.S. Census Bureau, 2021

Note: Hispanic/Latino is an ethnicity, not a race. Individuals who identify as Hispanic/Latino also select a racial category in the survey (e.g., White and Hispanic/Latino or some other race and Hispanic/Latino). Therefore, sums of these rows will exceed 100%.

Apache, Coconino, Gila, and Navajo counties have high concentrations of American Indian residents, due to the large share of tribal lands in these three counties. The majority of land in Navajo County is tribal land. Yavapai County also contains tribal lands, though the areas are quite small.¹ As a result, environmental justice issues are more likely to occur in Coconino, Gila, and Navajo counties than Yavapai County. However, a finding of low racial or ethnic diversity does not eliminate the need to consider potential disproportionate impacts of Forest Service management actions. A county may have a low overall concentration of minority residents, but still have areas with a high concentration of minority residents who could be adversely affected by management actions.

¹ Coconino County contains all or part of the Navajo Indian Reservation, Hualapai Indian Reservation, Hopi Indian Reservation, Havasupai Indian Reservation, and Kaibab Indian Reservation. Navajo County contains part of the Navajo Indian Reservation, Hopi Indian Reservation, and Fort Apache Indian Reservation. Gila County contains part of the Fort Apache Indian Reservation, the Tonto Apache Reservation, and the San Carlos Indian Reservation. Yavapai County contains all or part of the Yavapai-Prescott Indian Reservation, the Yavapai-Apache Nation Indian Reservation, the Hualapai Indian Reservation, and the Camp Verde Indian Reservation.

Table 6 displays the share of people living in poverty in each Rim Country county. The poverty rate in Arizona is also presented for comparison. Apache, Gila and Navajo counties have meaningfully greater² shares of people living in poverty than the state overall. More than one-fifth of Gila County residents and more than one-quarter of Navajo County residents live in poverty.

Table 5. Percent of People Living in Poverty, 2019

Location	Poverty Rate (%)
Apache County	33.4
Coconino County	15.9
Gila County	21.1
Navajo County	25.2
Yavapai County	12
Arizona	13.5

Source: U.S. Census Bureau, 2021

Based on the minority status and poverty data presented above, Apache, Coconino, Gila, and Navajo counties appear most at risk for environmental justice issues. The largest minority group in these counties – American Indians – also experience a very high poverty rate. Between one-third and one-half of American Indians in the planning area counties live in poverty (U.S. Census Bureau 2016a).

Numerous tribes were invited to consult on the 4FRI project. The process for tribal consultation is outlined in the EIS in Chapter 1 under Public Involvement. In addition, the tribal relations section in chapter 3 of the EIS and tribal relations specialist report provide more information and complete documentation of consultation.

The conditions described in this section underscore the importance of evaluating environmental justice consequences. The economic data suggest that Apache and Navajo counties are both the most underserved county (in terms of economic opportunities) and also reliant on forest-related employment in the study area. Therefore, Apache and Navajo counties may be particularly influenced by economic changes related to 4FRI. The potential for disproportionately high and adverse impacts on minority and low-income individuals due to Forest Service management actions are evaluated in the environmental consequences section of this document.

Issues/Indicators/Analysis Topics

Economics is an issue for the Rim Country project. Stakeholders are concerned that the lack of existing markets and the low value of material generated by proposed treatments may make project implementation economically infeasible. This report analyzes the economic feasibility of proposed activities across a range of alternatives.

Table 1 displays the resource indicators and measures used to evaluate the economic consequences of the Rim Country project.

² In this case, meaningfully greater indicates that the 90% confidence interval of the county's poverty rate does not overlap with the 90% confidence interval of the state's poverty rate.

Table 6. Resource indicators and measures for assessing effects

Resource Element	Resource Indicator	Measure	Used to address: P/N, or key issue?
Economic feasibility	Forest product volume removal	Forest products (ccf) harvested per year	Yes
Economic feasibility	Economic efficiency	Project benefits less project costs	Yes
Economic impact	Employment and labor income	Number of jobs and amount of labor income	Yes
Environmental justice	Effects to low-income and minority populations	Qualitative evaluation of disparate treatment and/or disparate effects	No

Assumptions and Methodology

This analysis addresses the implementation of Rim Country treatments on the Apache-Sitgreaves, Coconino, and Tonto national forests. Unless specifically indicated otherwise, all estimates of economic and social consequences are based on only the implementation of the 4FRI Rim Country Project.

Data are typically reported to the nearest acre, mile, or percentage. Most values have been rounded from their actual decimal values. Totals were calculated before any values were rounded in order to give the most accurate sum. Any apparent inconsistency between the total values reported in a table and a sum resulting from adding up individual values in a table typically accounts for a discrepancy of about 1% in the case of rounding percentages or miles, and <2 acres in the case of acres.

In an attempt to avoid confusion over these kinds of inconsistencies, minor adjustments to the numbers in the EIS document were made to allow for numbers in tables to add up correctly as displayed. As a result, some numbers may not be exactly the same in the EIS document as compared to this report. The numbers in this report are the most accurate and any differences do not alter any determination of effects.

Economic Impact Methodology

Economic impacts were modeled using IMPLAN Professional Version 3.1 with 2017 data. IMPLAN is an input-output model, which estimates the economic impacts of projects, programs, policies, and economic changes on a region. IMPLAN analyzes the direct, indirect, and induced economic impacts. Direct economic impacts are generated by the activity itself, such as forest product harvesting. Indirect employment and labor income contributions occur when a sector purchases supplies and services from other industries in order to produce their product. Induced contributions are the employment and labor income generated as a result of spending new household income generated by direct and indirect employment. The employment estimated is defined as any part-time, seasonal, or full-time job. In the economic impact tables, direct, indirect and induced contributions are included in the estimated impacts. The IMPLAN database describes the economy in 536 sectors using federal data from 2017.

The IMPLAN model area includes the project area of Apache, Coconino, Gila, Navajo, and Yavapai counties. Maricopa County is also included in the economic impact model due to the economic linkages between Maricopa County and the project area. The firms and employees that will support Rim Country activities are located in these counties (both primary and supplier firms).

Data on timber volumes under each alternative are based on modeling collected from the forests' resource specialists. The changes are based on the professional expertise of the forests' resource specialists. Regional economic impacts are estimated based on the assumption of full implementation of each alternative over 20 years. The actual changes in the economy would depend on individuals taking advantage of the resource-related opportunities that would be supported by each alternative. If market conditions or trends in resource use were not conducive to developing some opportunities, the economic impact would be different from what is estimated in this analysis.

Economic Efficiency Methodology

Economic efficiency analysis follows Forest Service and Office of Management and Budget guidance. A 4-percent discount rate is commonly used for evaluations of long-term investments and operations in land and resource management by the Forest Service (FSM 1971.21). This discount rate is used in the calculation of net present value (NPV). Inflation can affect NPV; however, due to the uncertainty of future inflation, OMB Circular A-94 recommends avoiding assumptions about the inflation rate whenever possible. Thus, for the purposes of this analysis, inflation is left at zero. Data on program revenues and program expenditures were provided by the national forests' resource specialists and budget staff.

Assumptions

1. The IMPLAN model assumes a static economy – in other words, the industry composition and trade linkages in the economy today will be the same in the future.
2. The IMPLAN model does not impose supply constraints when estimating employment and labor income effects. It assumes that local industry will be able to harvest and process all of the forest product volume from the Rim Country project. If some of the forest product volume is harvested or processed by firms outside the model area, the employment and labor income effects would be lower than those estimated here.
3. The economic analysis assumes that all project activities are implemented over a 20-year period. If the implementation period is longer, the average annual number of jobs and amount of labor income would be lower than estimated in this report.
4. The economic analysis assumes that firms bid on 4FRI Rim Country contracts and that the activities are fully implemented. Full implementation relies on private sector interest in bidding on contracts. A slower pace and/or lower forest product volume removal would produce less economic activity than estimated in the analysis.
5. The economic analysis uses forest product distribution data from the 4FRI implementation team to classify forest product types in the economic modeling program. The economic analysis assumes the following distribution: 30 percent sawn products, 6 percent poles, 4 percent firewood, and 60 percent other forest products (including biomass). This assumption is used for modeling and does not preclude any future utilization of forest products.
6. The economic analysis assumes that forest products are harvested outside of protected activity centers (PACs) with mean slopes less than 40%.
7. The economic analysis assumes that the cost of prescribed fire treatment is \$175 per acre. Actual costs will vary depending on treatment size and location. Larger and more remote treatment areas may have lower costs, while some landscapes and regions will be more costly. The economic analysis assumes the cost of mechanical treatment is \$400 per acre. This assumes ground-based operations. Actual costs will vary based on the value of the timber removed and special

conditions of the treatment locations. There are limited areas with very high cost treatment work, for example where helicopter logging is necessary. This analysis does not consider different types of contracting. Contracting is not part of the alternatives or decision. The analysis also assumes that treatments are evenly distributed across 20 years.

Information Sources

Demographic and economic data contained in the affected environment section of this report are primarily from federal sources, including the U.S. Census Bureau and the Bureau of Economic Analysis.

Data on national forest resources, uses, and expenditures were obtained from Forest Service personnel and agency databases.

Incomplete and Unavailable Information

Communities in the project area are tied to national, and global, markets. Future economic conditions are unknown. In particular, the following could substantially affect the economic feasibility of the Rim Country project:

1. Global demand for forest products
2. Global supply of forest products
3. Technological change
4. Economic development in the Rim Country region
5. Infrastructure development in the Rim Country region
6. Energy prices
7. Population distribution across the U.S.
8. Federal, state, and local policy changes

The characteristics of the firm(s) that will bid on the Rim Country contracts are unknown. Firm size, location, and other characteristics may affect the number, type, and location of jobs attributable to the Rim Country project. This analysis does not consider different types of contracting. Contracting is not part of the alternatives or decision. The request for proposals is handled through the contracting side forest management and includes contract awards, funding, congressional communication, potential partnerships, and market capacity.

Summary of Alternatives and Resource Protection Measures (Design Features, Best Management Practices, Mitigation and Conservation Measures)

This report evaluates the socioeconomic consequences of three alternatives – a no action alternative, the modified proposed action, and a focused alternative. Details on the Modified Proposed Action are outlined in Chapter 2 of the FEIS.

Alternative 1: As required by 40 CFR 1502.14(c), the no action alternative (alternative 1) has been analyzed to contrast the impacts of the action alternatives with the current condition and expected future condition if the project was not implemented.

Alternative 2: The Apache-Sitgreaves, Coconino, and Tonto National Forests propose mechanical thinning, prescribed fire, and other restoration activities throughout the project area that would make the forest more resilient to natural disturbances such as fire, insect and disease, and climate change. Facilitative operations may be needed in other cover types (such as pinyon juniper) to enable or complete treatments in target cover types, by reducing uncharacteristic fire risk, reducing ground disturbance from fireline construction, or improving operability. Activities would be implemented over 20 years, or until objectives are met.

Alternative 3: Alternative 3 is designed to focus restoration treatments in areas that are the most highly departed from the natural range of variation of ecological conditions, areas that represent Forest priorities, and/or that are currently putting communities at risk from undesirable fire behavior and effects. Restoration activities and treatments included in alternative 3 would maintain or restore forest structure and pattern, desired fire regimes, and watershed and ecosystem health and function in ponderosa pine, ponderosa pine-evergreen oak, frequent fire mixed conifer (dry mixed conifer), aspen, and grassland cover types, moving them toward conditions within the natural range of variation. Alternative 3 restoration activities and treatments are designed to achieve the purpose and need over a period of 20 years or until completed. Alternative 3 responds to the treatments in Mexican spotted owl protected activity centers, treatments in northern goshawk habitat, large tree retention, smoke/air quality, and roads issues.

Environmental Consequences

Alternative 1 – No Action

Forest Products: Under alternative 1, the three national forests would continue to provide forest products and support restoration activities. However, the scale of these activities would be substantially smaller than activities under the Rim Country project. The provision of forest products unrelated to Rim Country treatments would be the same under all alternatives, and therefore, are not described in detail in this report.

Economic Efficiency: Under alternative 1, wildfire suppression costs would, on average, increase due to fuel buildup and the expanding wildland-urban interface. The per-acre administrative burden (cost of time and other resources) of planning, implementing, and monitoring forest restoration activities would be highest under alternative 1. The Rim Country project benefits from economies of scale – a single environmental compliance document addresses more than 1 million acres. Furthermore, the large treatment area reduces cost to government through increased private sector interest in engaging in harvesting and restoration activities on the forests. In contrast, restoration activities under alternative 1 would occur piecemeal – requiring numerous environmental compliance documents and increased administrative costs.

Employment and Labor Income: The three national forests would continue to provide opportunities for forest product harvesting, livestock grazing, recreation, and other activities that support employment and labor income in communities in the project area. The extent of these contributions are not expected to differ from current conditions. Forestry-related sectors would remain a relatively minor part of the project area's economy.

Environmental Justice: The communities that surround the project area, particularly in Apache and Navajo County, have large minority populations, high poverty rates, and individuals vulnerable to smoke. Minority and low income residents may experience differential exposure to wildland fire, changes in employment opportunities, or changes in the provision of ecosystem services. None of the alternatives eliminates smoke – either from wildfire or prescribed burns. Alternative 1 would treat the fewest acres

with prescribed fire; however, it would also do the least to restore fire-adapted forests. As a result, smoke from uncharacteristic wildfire is most likely under alternative 1. Wildfires produce out of control smoke emissions. Smoke emissions from prescribed burning would be lower under alternative 1. Smoke emissions resulting from wildfires and prescribed burns may produce health and quality of life consequences. Smoke is most likely to affect vulnerable populations – children, the elderly, and individuals in poor health. The Air Quality Effects Analysis discusses smoke impacts in greater detail as well as the regulatory framework of the ADEQ in order to protect human health and safety.

Alternative 1 would not affect the potential for wildland fire to threaten human safety and property in the project area. Low income individuals have fewer resources to engage in averting behavior (e.g., leaving town during a wildfire to avoid smoke emissions). However, since approximately half of homes in the wildland-urban interface in the project area are second homes, the individuals with the highest exposure to wildfire risk are expected to be relatively affluent (Headwaters Economics 2017).

Alternative 1 would not affect employment or labor income in the project area. Therefore, no disproportionate or adverse effects related to changes in economic opportunities would occur as a result of this alternative.

The provision of ecosystem services may be affected by alternative 1, however, these effects would not disproportionately affect low income and minority residents.

Table 7. Resource indicators and measures for alternative 1

Resource Element	Resource Indicator	Measure	Alternative 1
Economic feasibility	Forest product volume removal	Forest products (ccf) harvested	Forest products would continue to be harvested from all three national forests, consistent with current conditions
Economic feasibility	Economic efficiency	Project benefits less project costs	No direct project benefits or costs; no economies of scale in forest restoration activities
Economic impact	Employment and labor income	Number of jobs and amount of labor income	Three national forests would continue to support local employment and labor income associated with harvesting, grazing, and recreation at levels similar to current conditions
Environmental justice	Effects to low-income and minority populations	Qualitative evaluation	Smoke emissions from wildfire are most likely to adversely affect vulnerable populations, including children, the elderly, and individuals in poor health

Effects Common to All Action Alternatives

Environmental Justice: The employment and labor income associated with the Rim Country project are expected to have a small, but positive, effect on employment and labor income in minority and low income communities.

None of the alternatives eliminates smoke – either from wildfire or prescribed burns. Smoke emissions from both prescribed fire and wildfire can have health effects, particularly on the young, elderly, and individuals with existing health issues. Smoke emissions from prescribed burning would be higher under

the action alternatives. Tribal elders may be more likely to experience acute health effects. Technological and cultural constraints to effective communication would make smoke effects more pronounced, as averting behavior is limited. Smoke emissions from prescribed burns have the advantage over wildfires of being controlled and regulated by the ADEQ in order to protect human health. Burn plans written for implementation of the proposed prescribed fires would include modeling to determine the most appropriate conditions under which to burn in order to minimize smoke impacts. Burn plans also specify mitigation measures, such as notification strategies to contact people known to be sensitive to air pollution prior to the ignition of the prescribed fire. The action alternatives, through increased treatment acres would do more to restore fire-adapted forests. As a result, smoke from uncharacteristic wildfire is less likely under the action alternatives. The Air Quality section discusses smoke and fire in more detail.

Effects Unique to Each Action Alternative and Differences Among Them

Forest Products: Alternative 2 would produce approximately 5.4 million ccf of forest products over the life of the project. The economic analysis assumes that volume is harvested evenly over a 20-year period. Approximately 269,280 ccf would be harvested annually.

Alternative 3 would produce approximately 3.6 million ccf of forest products over the life of the project. The economic analysis assumes that volume is harvested evenly over a 20-year period. Approximately 181,120 ccf would be harvested annually.

Economic Efficiency: Under alternative 2 and alternative 3, the per-acre administrative burden (cost of time and other resources) of planning, implementation, and monitoring forest restoration activities would be lower than alternative 1. The Rim Country project benefits from economies of scale – a single environmental compliance document addresses hundreds of thousands of acres across three forests. Alternative 2 would mechanically treat up to 816,912 acres of vegetation and treat up to 850,241 acres with prescribed fire. Alternative 3 would mechanically treat up to 424,801 acres of vegetation and treat up to 426,481 acres with prescribed fire.

The present net cost to taxpayers to conduct restoration treatments equivalent with those proposed under alternative 2 would be approximately \$340 million and approximately \$170 million under alternative 3 over 20 years. As stated in the assumptions, these costs are an approximation. Per acre treatment costs can vary significantly depending on a number of factors including treatment size, location, and existing road condition. Actual costs will also vary based on the value of the timber removed.

Infrastructure costs, including roads, will be highly variable depending on the existing condition of roads and the implementation of the treatments or timber removal. For example, for all merchantable timber removal, the cost associated with improving Forest Service system roads, and conducting road maintenance would be paid for by the purchaser of the contract. In other cases, road costs may be shared under cooperative road maintenance agreements. Although additional traffic would occur over county or other government agency roads, the anticipated traffic from this project would not affect routine maintenance schedules due to being a small percentage of total traffic volume on those roads.

The Rim Country project would provide a stable supply of forest products to encourage private sector engagement in forest restoration activities, which would reduce the cost to taxpayers. Furthermore, the treatments will reduce the risk and hazard of uncharacteristic wildfire. The costs of a single large fire routinely cost millions of dollars in direct suppression expenditures alone. The Forest Service, for instance, spent approximately \$14.4 million responding to the 2010 Schultz Fire (Combrink et al. 2013). Furthermore, the total cost of the Schultz Fire and subsequent flooding – including decreased property values, loss of life, cleanup, evacuation, and habitat destruction – is estimated to be between \$133 million and \$147 million (Combrink et al. 2013). For the 2002 Rodeo-Chedeski Fire, estimated suppression costs

ranged between \$43 and 50 million. Other direct costs, including the loss of homes and property, totaled \$122.5 million. Rehabilitation costs were projected over a three year period for a total cost of \$139 million (WFLC 2010).

Compared to alternative 2, alternative 3 would treat fewer acres more intensively. More concentrated treatments may lower the operating costs associated with treatments. Fixed costs associated with site preparation would be lower, site infrastructure needs (e.g., processing, roads) would be reduced, and costs associated with transporting forest products would be lower than under Alternative 2. Given the relatively low market value of most of the wood products to be removed from the project area, keeping operating costs low is critical to the financial feasibility of forest treatments.

Employment and Labor Income: The direct, indirect, and induced economic effects of forest product removal under alternative 2 are estimated to support approximately 2,020 jobs and \$86 million in labor income, or approximately \$43,000 per job, on an average annual basis over the life of the Rim Country project.

Alternative 3 would produce somewhat lower wood product volume than alternative 2. Therefore, alternative 3 would support fewer jobs and less labor income than alternative 2. The direct, indirect, and induced economic effects of forest product removal under alternative 3 are estimated to support approximately 1,360 jobs and \$58 million in labor income, or approximately \$43,000 per job, on an average annual basis over the life of the Rim Country project.

Both alternative 2 and alternative 3 may temporarily displace other forest users (e.g., recreation visitors) due to treatment activities. Alternative 2 would lead to more displacement of forest visitors than alternative 3 due to the larger number of acres to be treated under alternative 2. Displaced recreationists are expected to visit another site on one of the three forests to participate in another activity in the local area. Therefore, recreation visitor expenditures are not expected to change.

Likewise, forest restoration activities may affect ranchers who graze livestock in the project area. The brief duration and advance notice of disturbances due to Rim Country treatments will make it easier for ranchers to adapt to changes. As a result, no reductions in grazing-related employment are expected. However, minor reductions in rancher income are possible if ranchers purchase more expensive private forage or reduce their stocking levels. However, post-treatment soil and forage quality is expected to increase. Therefore, over the long-term, ranchers would benefit from Rim Country activities.

Table 8. Resource indicators and measures alternative comparison

Resource Element	Resource Indicator	Measure	Alternative 2	Alternative 3
Economic feasibility	Forest product volume removal	Forest products (ccf) harvested	Volume from trees <5" = 284,520 CCF	Volume from trees <5" = 194,370 CCF
			Volume from trees 5" – 12" = 2,385,770 CCF	Volume from trees 5" – 12" = 1,507,420 CCF
			Volume from trees >12' = 2,715,220 CCF	Volume from trees >12" = 1,920,690 CCF

Resource Element	Resource Indicator	Measure	Alternative 2	Alternative 3
Economic feasibility	Economic efficiency	Project benefits less project costs	\$340 million present net cost; Avoided costs from forest restoration and reduced risk of high intensity wildfire	\$170 million present net cost; Avoided costs from forest restoration and reduced risk of high intensity wildfire; more concentrated treatments (compared to alternative 2) would lower operating costs
Economic impact	Employment and labor income	Number of jobs and amount of labor income	2,020 jobs and \$86 million in labor income	1,360 jobs and \$58 million in labor income
Environmental justice	Effects to low-income and minority populations	Qualitative evaluation	Employment and labor income may have a small, but positive, effect on economic opportunities in low-income and minority communities; smoke emissions may have a disproportionate effect on low-income and minority communities	Same as alternative 2

Effects from Rock Pit Use and Expansion

The Rim Country project would authorize the use and expansion of rock pits to supply material for road construction and improvement. Rock pits on the national forests provide a low cost source of material for road work. In particular, rock pits avoid the need to purchase and haul roadbed material from more distant sites. The 2016 Rock Pits Environmental Assessment for the Coconino and Kaibab national forests found that haul costs were approximately four-times higher for material purchased off-site than for on-forest rock pits. Rock pit use and expansion would increase the financial feasibility of road work needed to support Rim Country project activities.

Effects from Use of In-woods Processing and Storage Sites

A key barrier to the financial feasibility of forest restoration is that the costs of hauling raw material from the harvest site to mill locations may exceed the value of the timber harvested in the project area (Aguilar and Garrett, 2009; Conrad 2018; Pan et al., 2002; Riquelme et al. 2020).

Processing sites may serve many purposes. Reducing the moisture content of timber can reduce haul costs because drier trees are lighter in weight. A review of transpirational drying case studies of various tree species around the country demonstrate different weight reductions after various drying schedules (Requelme et al. 2020). One study in the project area showed that moisture content in ponderosa pine bunches decreased from 45 percent to 38 percent and 36 percent within two and four weeks of cutting, respectively (Riquelme 2019). A reduction in weight by volume can allow trucks to carry more volume while remaining under weight thresholds, resulting in fewer truck trips and reducing total haul costs.

Processing sites may allow for storage and sorting. The value of wood removed can be enhanced if the trees are evaluated and sorted for quality and value to allow for better utilization and a diversity of

products (Dramm et al. 2002; Han et al. 2011). Some processing may also occur at the sites, such as chipping, as desired by the materials and markets.

To address this challenge, the Rim Country project would authorize 13 in-woods sites (in addition to the eight sites analyzed in the Cragin Watershed Protection Project) for processing, sorting, storing, and the refinement of raw material. In-woods processing and storage sites would offset haul costs by increasing the value of material either by hauling dried material or secondary products. In-woods processing and storage site selection criteria – including at least ¼ mile from hiking trails, campgrounds, group recreation sites, and private property – would reduce the potential for effects on forest visitors and nearby residents.

Effects from Land Management Plan Amendment

Alternatives 2 and 3 propose an amendment to the 1985 Tonto National Land Management Plan. The proposed Land Management Plan amendment addresses vegetation management, Mexican spotted owl habitat, and cultural resources. Economic activity would not be affected by the proposed amendment, therefore, the implementation (or not) would not lead to differences in local employment or economic efficiency. Social conditions would not be affected by the proposed amendment. Since no social or economic effects would result from the implementation of the proposed amendment, low income and minority populations would not be disproportionately affected.

Cumulative Effects Analysis for all Alternatives

Past management activities, including mechanical vegetation treatments, fuels treatments, and prescribed fire, have affected economic activity in the communities in and around the project area. The socioeconomic consequences of these actions are captured in the baseline data presented in the affected environment section of this report. Therefore, these activities are not included in the cumulative effects analysis.

The temporal boundary is 20 years of implementation activities and the spatial boundary is the economic analysis project area (Apache, Coconino, Gila, Navajo, and Yavapai Counties).

Restoration activities would continue to occur in the region regardless of the Rim Country decision. Current and foreseeable activities include approximately 470,000 acres of mechanical vegetation treatments and approximately 650,000 acres of fuels treatments. The acreages of mechanical vegetation management and fuels treatments are not all mutually exclusive. There are many acres on which proposed fuels treatments (mechanical and prescribed fire) overlap with proposed mechanical vegetation management treatments. Reasonably foreseeable actions on private, state, and other federally-managed lands will include mechanical treatments, fuels treatments, and prescribed fire. These actions will occur regardless of the selected Rim Country alternative.

The effect of past, present, and reasonably foreseeable treatment activities in the project area would improve forest health relative to existing conditions even without the implementation of the Rim Country project.

Forest Products: Forest products available for harvesting under the Rim Country project will contribute to an increased supply of forest products available from national forests in the region. When harvest volumes are low, harvesting and processing industries are unlikely to locate in the region. However, the cumulative effect of both alternative 2 and alternative 3 would be to improve the financial viability of locating forest product industries - including logging firms, sawmills, and biomass facilities – in the project area. The no action alternative would have the least cumulative effects to forest products industries since no forest products would be harvested.

Economic Efficiency: Present net costs are greatest under alternative 2, so the cumulative effects (costs) of the Rim Country project, in addition to other projects, would be the greatest. The no action alternative does not have any costs of treatment for Rim Country, so cumulative costs would be the least.

Observational evidence and fire modeling indicates that large-scale fuel treatments are necessary to meaningfully reduce the risk of high intensity wildfire and produce fire suppression cost savings (Thompson et al. 2017). The proposed Rim Country treatments, in combination with the current and foreseeable mechanical and prescribed fire treatments, will conduct fuel treatments across a large landscape. The cumulative effects of alternative 2 are most likely to reduce wildfire suppression costs in the project area.

Employment and Labor Income: The increase in jobs and labor income during implementation of the Rim Country project would be greater under alternative 2 than alternative 3 and the no action alternative, which would be additive to job contributions from other current and foreseeable projects in the area. Therefore, the cumulative economic impacts would be greatest under alternative 2.

The increased forest product supply from Rim Country and other current and foreseeable projects would contribute to the development of a local forest products industry. Cumulatively, the development of a local industry, as a result of Rim Country and other projects, would have several economic effects, including (1) lower costs of transporting wood products for secondary processing thereby increasing the financial viability of treatments, (2) increase the probability that employment and labor income associated with forest restoration activities would occur in the local area, and (3) contribute to the growth of supporting industries (e.g., construction and retail trade).

As described in the Affected Environment section above, there has been limited growth of jobs and income from 4FRI phase one implementation activities. With more acres treated from the Rim Country 4FRI project, this will add to the wood utilization employment. Cumulative effects of increasing wood volume could increase the amount of economic contributions that stay in the region if the activity boosts the infrastructure and capacity to process the harvested wood in the region. For example, if the wood produced from both phases of 4FRI implementation creates enough demand (or the funding mechanism is collaboratively resolved) for a company to install a biomass facility, the jobs and income from restoration activities are more likely to stay in the region.

Environmental Justice: Ongoing and reasonably foreseeable prescribed fire treatments will contribute to smoke emissions, which may affect the health and quality of life of individuals who live near or visit the forests. Since the no action alternative would not prescribe additional treatments, it would not cause cumulative effects related to smoke emissions from prescribed fire. However, the risk of uncharacteristic wildfire and associated smoke emissions in the project area would be highest under this alternative.

The proposed treatments under alternatives 2 and 3 combined with other ongoing and foreseeable treatments could increase exposure to smoke emissions, which could cause cumulative effects to health and quality of life for individuals who are sensitive to smoke. However, the cumulative effect of these treatments would be to decrease the risk of uncharacteristic wildfire, which would decrease the probability of smoke emissions associated with these events. The no action alternative would have lower additive effects to smoke exposure but in the longer term would contribute to a greater risk of wildfire.

Irreversible and Irretrievable Commitments of Resources

Once a contract is awarded and treatment activities are conducted, expenditures associated with those activities are irretrievable. However, contracts are not irreversible. Contracts may be wholly or partially cancelled when conditions warrant (e.g., due to breach or environmental damage).

Unavoidable Adverse Effects

Short-term, temporary displacement of forest visitors due to forest restoration treatments is unavoidable under the action alternatives. Long-term, there are no unavoidable adverse effects related to the social and economic environment.

Short-term Uses and Long-term Productivity

The Apache-Sitgreaves, Coconino, and Tonto national forests are used for both personal and commercial benefit. Individuals recreate, collect firewood, and engage in traditional cultural practices on the forests. Firms use the forests for forest product harvesting, rights-of-way, grazing, and mineral extraction. Short-term management actions, particularly forest treatments, may temporarily limit access for the use and enjoyment of these forest resources. Conducting prescribed burns and mechanical treatments have the potential to restore the landscape and reduce the potential for permanent adverse effects from high intensity, high severity fires. In the long-term, forest resilience will secure opportunities for enjoyment of the multiple uses of the Apache-Sitgreaves, Coconino, and Tonto national forests that contribute to economic and social well-being.

Land Management Plan Consistency

As described at the beginning of this report, the Apache-Sitgreaves, Coconino, and Tonto Land Management Plans aim to provide a sustainable supply of wood products and to reduce wildfire threats in the wildland-urban interface. Alternatives 2 and 3 would contribute to the achievement of these desired conditions. Both alternatives would increase the supply of wood products available to support economic activity in the project area. The proposed forest restoration treatments would reduce the likelihood of high intensity, high severity fire that could threaten homes, infrastructure, and public safety.

Land Management Plan Amendment

Amending the Land Management Plan is not expected to have any additional effects to social or economic resources, other than what is already analyzed. The harvest volumes and treatment acres (and associated costs) are not expected to differ than what is proposed and analyzed under alternative 2 and alternative 3. Costs of treatment may be higher on steeper slopes (due to exception 3. Mechanical treatments on steep slopes), however, this is uncertain and the best cost estimates are used in the analysis.

Discussion of Literature

Economically sound decisions are those where the benefits of the action exceed the cost. A central challenge of an economic evaluation of forest restoration activities is uncertainty regarding the relationship between treated acres and avoided fire suppression costs.

Taylor and others evaluate the economic costs and benefits of ecological restoration and hazardous fuel reduction treatments in ponderosa pine forests (Taylor et al. 2015). Their evaluation considers only the financial costs and benefits (i.e., treatment costs, wildfire suppression cost savings, and revenue from biomass removal). They do not incorporate indirect costs and benefits (e.g., avoided costs from damage to infrastructure and housing) or non-market costs and benefits (e.g., avoided damage to water quality). They find that wildfire suppression cost savings do not offset the treatment costs of either ecological restoration or hazardous fuel reduction. Even when they include revenue associated with biomass removal from ecological restoration treatments, the net present value of treatments only approaches zero under scenarios with biomass prices substantially higher than current market prices (Taylor et al. 2015).

Thompson and others also address the question of whether fuel treatments can pay for themselves via reduced fire suppression costs (Thompson et al. 2017). They find that large-scale fuel treatments are

necessary to meaningfully affect wildfire risk and hazard. They note that “due to the relative rarity of fire and corresponding rarity of fire-treatment interactions, median annual savings in avoided suppression costs will be zero” (Thompson et al. 2017, pg. 7). However, their modeling suggests that over time fuel treatments can pay for themselves through reduced suppression spending, but that uncertainty related to location, intensity, and other characteristics of fire events complicate the analysis of return on investment. Strategic selection of treatment sites in areas with higher burn probabilities increase the potential of net financial benefits from treatments, however, evidence suggests that treatment locations are not routinely aligned with burn probabilities (Thompson et al. 2017).

Some studies have attempted to incorporate additional costs and benefits, including firefighter safety, housing and infrastructure, and ecosystem services into their analyses of the economic justifiability of ecological restoration and hazardous fuel reduction treatments. Gonzalez-Caban and others find that fuel treatments, particularly prescribed fire, reduce property damage from wildfire (Gonzalez-Caban et al. 2017).

Wu et al. (2011) and Wu and Kim (2013) argues that lack of fully accounting for nonmarket and ecosystem services of both restoration activities and the resulting healthy ecosystems has resulted in the undersupply of restoration and resulted in fire-prone landscape. They conclude that if properly accounted for, the benefits of restoration outweigh the potential costs of high severity fire.

One significant factor in the cost of restoration, suppression is the wildland urban interface (Gebert et al., 2007; Calkin and Gebert, 2006). As mentioned above, wildfires often entail costs associated with rehabilitation, lost property, decreased business revenue, and human health effects. The Western Forestry Leadership Coalition estimates that total wildfire-related expenses, when accounting for a variety of direct and indirect costs, range from two to thirty times the reported suppression expenditures (WFLC 2010).

Significant literature addresses the wildland urban interface from various directions. For example, Radeloff et al., 2005 provide a wildland urban interface assessment to help address wildfire needs at a landscape level. Gude et al. 2008 look at the potential for wildland urban interface development and the future implications for wildland fires. Hjerpe et al., 2016 find homebuyer preferences do not fully account for wildfire risk and therefore homeowners might not engage in the appropriate level of fire risk reduction.

Acronyms

CCF: Hundred cubic feet

CEQ: Council on Environmental Quality

d.b.h.: Diameter at breast height

Glossary

Economic Efficiency Analysis: The net present value of the stream of benefits less the stream of costs over the life of a project.

Economic Impact Analysis: Changes in employment, labor income, and/or output in an economy due to a policy, program, or project.

Ecosystem Services: Components of nature, directly enjoyed, consumed, or used to yield human well-being.

Environmental Justice: The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.

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