Taos County Return on Investment Study for the Rio Grande Water Fund

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1. Introduction

The Rio Grande Water Fund ("RGWF" or "Water Fund") is an initiative of the Nature Conservancy ("TNC") and partners to "accelerate ecological restoration of forests throughout the upper Rio Grande watershed for communities, fish and wildlife, wildfire protection, and clean-water security" by proactively addressing the threat of catastrophic fire, and the associated impacts on people and watersheds, through landscape-scale forest restoration treatments.

The RGWF Comprehensive Plan (RGWF 2014) identified four geographic focal areas for the Water Fund, one of which was the west slope of the Sangre de Cristo Mountains. Taos County represents a large portion of this focal area and was identified as the focus area for this study.

The goal of this study was to evaluate the return on investment (ROI) from the RGWF for Taos County and results, therefore, only represent a portion of the benefits associated with all forest restoration treatments planned by RGWF across the larger Rio Grande watershed in northern New Mexico. We chose to focus on estimating the avoided costs of wildfire associated with market goods and services to best target values likely to represent potential motivation for RGWF funding. Avoided financial costs are generally the most germane to planning the public and private financial investments needed to support Water Fund treatments.

This report outlines methods, data collection and analysis before presenting results for two "representative" fire scenarios in Taos County. For each fire, impacts were estimated for both a "with" and "without" RGWF forests treatment scenario. The difference in impacts allows us to gauge the return on investment of the Water Fund's proposed treatments *in the event where the representative fire occurs.* Due to resource constraints, we did not undertake efforts to estimate the likelihood or timing of wildfires needed to calculate and expected value of the benefits from the RGWF. A full treatment and restoration plan for the RGWF is not currently defined, while the overall intention of the RGWF and effectiveness of full treatments in general are both well accepted. Consequently while simulation modeling results for the untreated scenario are relevant and likely accurate, modeling results for the treatment scenario are less so. We rely on a combination of simulation runs, experiences elsewhere, and generally accepted science and practice concerning fuel treatment effectiveness to identify and calculate wildfire effects under treatment scenarios. Accordingly this study relies heavily on the assumption of a carefully designed and implemented treatment and restoration plan.

In addition, we discuss limitations of the study and opportunities for refinement of the study in the future.

2. Methodology

As Taos County was the primary focus of the study, the results primarily summarize benefits accruing to Taos County only. One exception is the inclusion of impacts on downstream surface water supply users. We recognize that impacts are not limited by politically defined boundaries and that many of the impacts considered would have additional effects outside Taos County. Therefore, findings from this study represent only a portion of the total benefits of the RGWF.

2.1. Geographic Focus and Distribution of Benefits

This study's focus is on the return on investment from RGWF activities in Taos County, New Mexico. To gauge the impact of the Water Fund we examine two "representative wildfire" scenarios to understand both the magnitude and distribution of related costs and benefits. The fires scenarios used in the study occur in two different areas in southern Taos County. The area involved in the study is a small portion (perhaps 25% of the total area) of the Water Fund's Western Slope of the Sangre de Cristo Mountains focal area. The RGWF also is planning treatments in three other mountain ranges across northern New Mexico, the Jemez mountains, the southern San Juan Mountains, and the Sandia/Manzano mountains. In sum, *the activities discussed in this study are a small portion of the much larger RGWF effort and do not reflect the aggregated economics of the Water Fund*.

The implications of this geographic focus bear emphasis because many of the RGWF benefits flow downstream in the watershed. For "downstream" stakeholders in Santa Fe, Albuquerque and the Middle Rio Grande Valley, forest treatments in Taos are only part of the larger package of RGWF projects that deliver water security benefits. In fact, Taos County treatments might be expected to deliver less value to downstream users than some of the other RGWF projects (because Taos is relatively distant from the Middle Rio Grande and upstream of Cochiti Reservoir, attenuating water quality impacts from fire, and because Santa Fe and Albuquerque rely more heavily on water sourced from the San Juan – Chama project and Rio Chama basin than they do on native Rio Grande water). This context is provided to emphasize that the relatively modest downstream benefits in this report should not be confused with the value of the entire RGWF to residents of Albuquerque, Santa Fe, and environs.

In contrast, for Taos County residents, the RGWF treatments studied deliver concentrated local benefits. Unsurprisingly, much of the value of protecting forests in Taos County accrues to residents of the county. That said, treatments in the Jemez Mountains or other areas that deliver significant downstream benefit might offer little value to Taos County.

It is important to consider the geographic context and distribution of benefits and to understand that this study addresses only a minor portion of the larger RGWF effort.

2.2. Event-Based "Representative Fire" Approach

This study used an event-based "representative fire" approach to gain insight into the economics of RGWF treatments in Taos County. Under this approach, we used fire-modeling software to develop two different representative fires, each of which was simulated under landscape conditions reflecting current conditions and improved post-RGWF treatment conditions. As expected, fires were substantially less damaging in the "with treatment" scenarios. We then estimated total costs of each fire in each case, and contrasted the "with treatment" and "without treatment" cases to estimate the gain in benefits from the RGWF. Comparing these benefits with costs generated net present value and return on investment of the Water Fund's treatments.

Details about the location, size, and timing of the fire, as well as of the RGWF treatments, of course drive results. In the extreme, a large fire, occurring in an area with high value assets, and assumed to ignite in the near future will have larger economic impacts than a small blaze in an undeveloped area occurring some time from now. There are also assumptions to be made about the extent (and therefore cost) of RGWF treatments. On the one hand, it is unrealistic to associate only treatments that mitigate a specific representative fire with the benefits of preventing that fire, because the location and timing of the fire is unknown. "Cherry picking" the fire-treatment scenario yields little useful information – we all know that if you could buy insurance the day before being robbed the policy would pay off handsomely. At the same time, associating the entire cost of an ambitious treatment effort like RGWF with the benefits of a single fire is overly conservative, because it counts costs of some treatment without acknowledging commensurate benefits over the full effective lifespan of those treatments. This would occur if, for example, the avoided costs of one of our representative fires were compared with costs of RGWF treatments in Taos County, the Jemez Mountains, and the Southern San Juan Mountains; costs would

outweigh benefits, largely because we would have failed to count benefits of fire mitigation in the other areas.

The key to having this analysis deliver value is in ensuring that each fire is in fact realistic, or "representative". Described in greater detail below, two fires were modeled using simulation software under dry conditions with ignition points in the more populated areas of Taos County where RGWF treatment projects are already being planned in conjunction with the Taos Valley Watershed Coalition. The treatment acreage used includes areas both inside and outside of fire perimeters, and was chosen to reflect a realistic program of fuels reduction. Treatment acreage was held constant across both fires, reflecting the reality that the decision to treat is made prior to knowing where the fire will occur. The fires are in size ranges with precedent in Northern New Mexico, and are certainly possible in a future of climate change. Out of conservatism, we assumed that the RGWF treatments were less successful at mitigating fire than the model indicated. The result is two scenarios that are realistic and informative indicators of the cost and benefits of the RGWF activities described, well-suited to informing stakeholder understanding of the Water Fund.

Importantly, this approach is "representative" but does not attempt to provide a probabilistic estimate of its likelihood. Recent years in New Mexico have seen variable fire seasons, with good years of limited activity interspersed with periods where multiple major blazes were burning simultaneously. The fire scenarios and associated return on investment described in this study are not assured. Fires could occur in larger or smaller sizes, in locations more perilous or relatively benign, and in greater or fewer numbers. The economic case for the RGWF will vary accordingly, with our representative fire scenarios one plausible outcome among many.

Modeling the actual effectiveness of the RGWF treatment and restoration efforts is difficult at the time of this writing, both because the full treatment plan is not completely defined, and simulation modeling tools are too coarse to capture the full effectiveness of treatments to protect valuable assets and facilitate more successful protection and suppression efforts in the case of a fire. Where valuable and fire-sensitive assets occur, a treatment plan would provide protections, and produce conditions that reduce the risk while increasing the effectiveness of efforts by fire crews. Given these conditions, we generally assume that treatments would effectively protect or allow protection of valuable assets. We do develop estimates of damages attributable to fire under the treatment scenario, but we emphasize a comparison of the costs of treatment to the costs of untreated fires, rather than the treated vs. untreated fire simulation results.

2.3. Values not Included

This study focused primarily on financial values substantiated in market values for property, goods, and services impacted by RGWF. This approach was chosen for three primary reasons. First, using financial values and impacts is appropriate for stakeholders contemplating investing financially in RGWF alongside other potential uses of capital. Economic values that cannot be monetized are important but have less relevance to institutions managing public funding. Second, this approach is inherently conservative—if RGWF provides an attractive investment based solely on market values, then the broader societal economic case for the Water Fund is only bolstered. Finally, non-market valuation is inherently difficult and controversial, and avoiding questionable assumptions is desirable in gaining acceptance of the analysis.

In most cases, we did not explicitly include financial value estimates for "two-sided" benefits or impacts directly resulting from forest restoration treatments such as recreational enhancements, job creation, and/or revenue from sale of wood products. To do so would require the inclusion of similar type benefits directly resulting from wildfire suppression and rehabilitation efforts and would have unnecessarily complicated the study. For example, while implementing Water Fund treatments would create employment, so would fire suppression, replanting and restoration work, and rebuilding following a major fire. Similarly, the economic costs of carbon emissions are not included, both because the net effect

is difficult to estimate (carbon is emitted both by fire and treatment/fuels reduction and subsequent activities) and because it is not monetized under current policy.

In general, and in Taos County perhaps more than elsewhere, wildfire also would create substantial impacts on a variety of non-market goods and services. These are important benefits and resources, some might argue of immeasurable value, both locally and more broadly. While literature exists on how wildfire might impact these categories (e.g., Bixby et al. 2015; Venn and Calkin 2011) and well-recognized methods, such as replacement cost valuation, are available, attempting to put a monetary value on some of these categories of impacts may not be appropriate.

The following are impact categories for which a monetary value was not calculated either because of insufficient data or because impacts include non-market values. It should be noted, however, that in all cases, the direction of impacts would be negative—meaning inclusion of some or all of these categories in the analysis would only strengthen the overall benefits resulting from the Water Fund.

- Lost infrastructure for campgrounds and cabins on National Forest land and elsewhere: While it well known that numerous campgrounds and rental cabins operate in Taos County, we were not able to determine the exact quantity, quality (e.g., furnished cabin vs. wilderness campsite) and location relative to the representative fires modeled. In addition, we were not able to identify reasonable replacement/rebuilding cost information.
- Multiplier effects: The direct impact on an industry is not the only impact wildfire could have on the economy – as additional multiplier effects may be seen across the broader economy in the form of employment, labor income and value added. When considering the broader effect of changes in economic activity, input-output analysis can be used to model the interrelationships of economic sectors and describe the multiplier effect of changes in one sector across a broader economy. While this methodology is commonly used to estimate the impact of a program or initiative that would result in new money entering an economy, it can also be used to understand how decreases in revenue and/or jobs in one industry sector might affect the larger economy. IMPLAN is perhaps the most commonly recognized input-output model; however, it is proprietary software whose purchase was outside the scope of this study.
- Consumer surplus: Consumer surplus is generally defined as the difference between the total amount a consumer is willing (and able) to pay and the total amount actually paid (i.e., the market price) for a good or service. For example, our study can generally capture the market impacts of an individual canceling their trip to Taos because of wildfire. What it cannot capture is the additional value of that trip to the individual associated with scenery/views unique to Taos, the ability to view culturally and historically significant sites, etc. nor can it capture how much the individual would have been "willing to pay" to ensure the trip was possible. This is a non-market value on which we did not attempt to place a monetary value.
- Cultural aspects: Taos County includes a number of culturally and archaeologically significant sites. Members of the Taos Pueblo use tribal lands and forest for a variety of activities including spiritual/ceremonial purposes, hunting, food gathering (e.g., piñon nuts) and wood harvesting, among others. In addition, Taos Pueblo (right at the edge of the forest) is a UNESCO World Heritage site and significant tourist destination. These are non-market values on which we did not attempt to place a monetary value.
- Ecosystem services: There are numerous ecosystem services generated by forests and watersheds—many of which have the potential to be negatively impacted by wildfire. Examples include the ability to: sustain habitat, purify air and water; mitigate floods, generate and preserve soil quality; cycle nutrients, control pests, sequester carbon and more. In addition to general habitat destruction and loss, there are several key species that would potentially be substantially impacted by a large wildfire including the Rio Grande Silvery Minnow, Rio Grande Cutthroat

trout and Southwestern Willow Flycatcher, among others. The value of these species and others in the study area, as well as the habitat on which they depend, would primarily be considered a non-market value. Aspects of forest and river ecology that could be valued through markets include values associated with fishing, bird watching, hunting, and wildlife viewing, among others. Impacts on these uses are included in the recreation and tourism valuation. Broader impacts likely do exist, but are difficult to estimate with precision, and were therefore not included in the study out of conservatism.

2.4. Treatment Area

For the purposes of this study, the assumed treatment area is the same as the TVWC area planned treatment acreage. Total acreage for this area was estimated to be 101,647 acres of which 4,629 are Wildland Urban Interface ("WUI") acres on private lands. As mentioned previously, treatment acreage was held constant across both fires, reflecting the reality the decision to treat is made prior to knowing where the fire will occur. There is significant overlap between the planned treatment area and the footprint of the two fire scenarios, and we believe that the benefits of avoiding these fires are appropriately aligned with the costs of the treatments.

2.5. Fire Scenario Modeling

Modeled flame length is a measure of fire intensity and has been used to approximate the likely effects of a fire (e.g., Butler et al. 2014; Buckley et al. 2014; Roose et al. 2008). It is also used by Wildfire Incident Managers to understand potential fire behavior and the likely effectiveness of suppression and control efforts (NWCG 2013). In this analysis, values such as vegetation and infrastructure were overlaid with modeled flame lengths to calculate the area (or length) of each value impacted by high intensity fire.

Flame lengths were modeled for all of Taos County with FlamMap5 (Finney 2006). The fire model was run with a climate and fuels scenario representative of conditions during which fires have historically occurred in the region[1]. LANDFIRE v1.3.0 that represents fuel conditions in 2012 was used to generate the landscape file used during modeling (LANDFIRE 2014a).

After fire behavior was modeled, the flame length output was classified into five bins. The flame length classes used in this analysis were modeled on the recent avoided cost study in the Mokelumne watershed in the Sierra Nevada (Buckley et al. 2014). These bins were used to calculate the area impacted by high intensity fire. In addition, certain landscape areas that are valued by the community were overlaid with the modeled flame lengths to identify values that could be impacted by high severity fire.

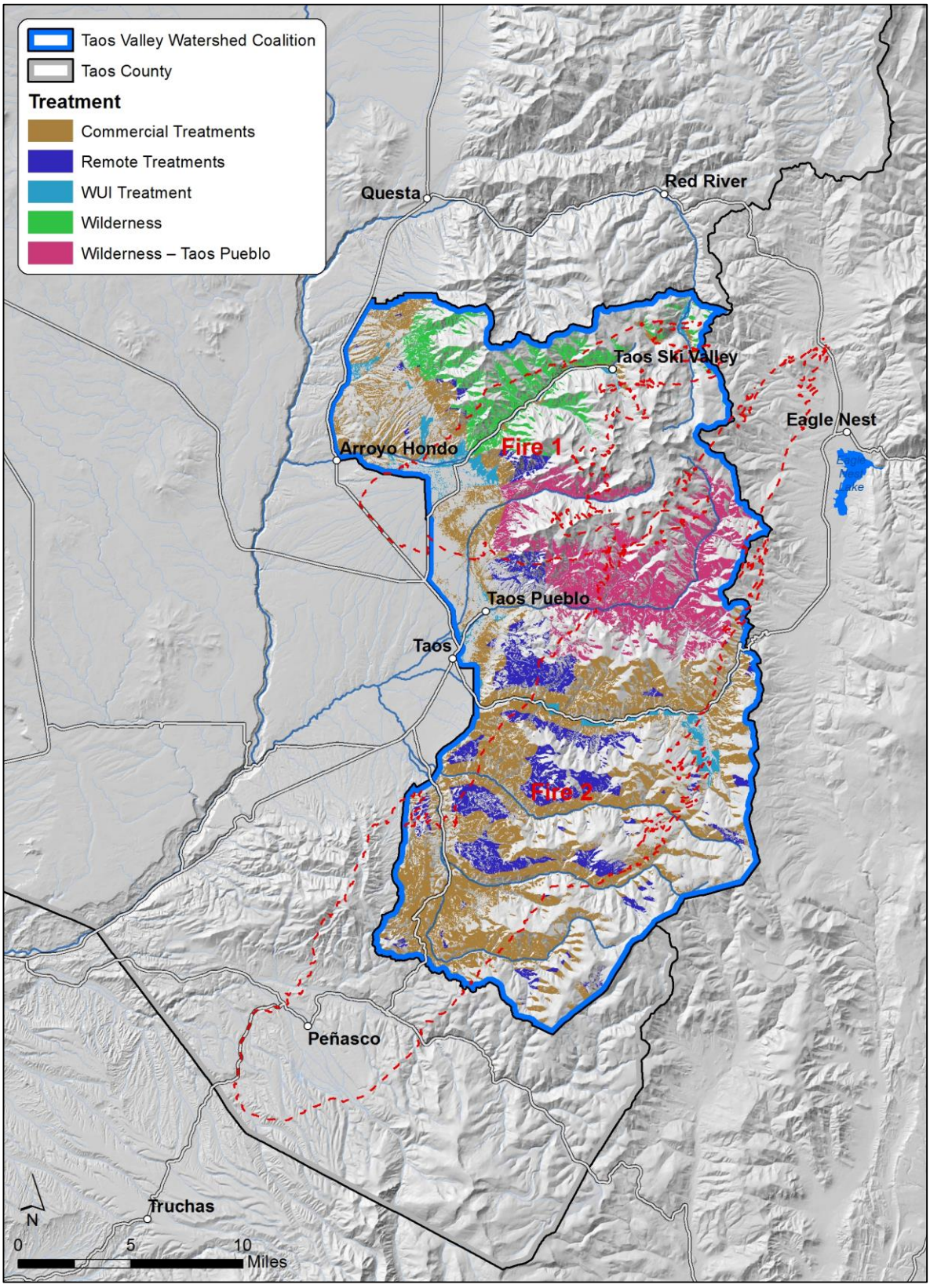
- To evaluate the threat of fire to forestland in Taos County, vegetation types were overlaid with the flame length data. Generalized categories of forest type were derived from LANDFIRE v1.3.0 existing vegetation data (LANDFIRE 2014b).
- The threat of high intensity fire to residential development was also analyzed. Block level housing unit density data derived from 2010 Census data was used to approximate actual housing density. Data was processed to remove areas with no residential development including public land and bodies of water (Helmers 2011).
- Fire intensity was also overlaid with land ownership data to evaluate which land owners would be most affected by high intensity fire (Table 4). Land ownership data was aggregated into broad classes from nationwide data (USGS 2012).
- Road data from the 2013 Tiger line dataset (USBC 2013) were used to overlay road centerlines with classed flame length data in order to estimate road mileage impacted by fire.

[1] Weather and related parameters are based on those during the 2011 Las Conchas Fire that burned 156,000 acres in New Mexico.

- Electrical transmission lines that would be impacted by fire were also estimated using transmission line data derived from a national database (Ventyx 2016).

Two locations for fire ignition and resulting fire spread and intensity were modeled, based on areas with little current fuel treatment and valuable assets at risk. Each fire was simulated with and without fuel treatments. Fuel treatment model runs resulted in very small fires, of 13% of the untreated fire for Fire 1, and less than 1 percent for Fire 2. As a conservative assumption, treated fire perimeters were expanded to the full, untreated fire perimeter and fire intensity calculated as if the fire were to spread to the full perimeter. Then, 15% of the associated damages and costs are used to represent the negative effects of wildfire post-treatment. This assumption is conservative not only because it utilizes a larger area than the simulation runs, but also by applying effects proportionally, it does not fully account for the strategic implementation of treatments to protect the most valuable assets, and likely reduce risk to those assets greater than proportionally.

Figure 1 Preliminary fuel treatment plan for Taos County and perimeters for the two modeled representative fires



2.6. Impact Identification

As a first set of results, we created a matrix to categorize and describe the likely benefits (i.e., avoided costs) of forest restoration treatments (see Appendix A for the full matrix). Categories were: suppression and rehabilitation, surface water supply, property and infrastructure, industry, recreation, cultural/traditional forest uses, public health, river ecology and forest ecology.

For each category and/or sub-category, we included:

- A definition of the benefit
- The beneficiary(s) (e.g., federal/state agencies, ratepayers, private landowners, etc.)
- The location (i.e., upstream, local, downstream)
- The likely order of impact (and a brief justification) (i.e., low, medium, high)
- The likely time frame (i.e., days, weeks, months, years)

The goal of this exercise was a first-cut assessment of the broad range of impacts associated with wildfire in the study area and the importance of each impact from an analytical perspective (not a societal perspective, necessarily). As the study progressed, however, additional information allowed and/or required us to combine/reassign categories of impacts and refined methods. As such, the final set of impact categories included in the results is similar, but not identical, to those included in the original matrix submitted.

2.7. Impact Quantification

Fire model outputs were used to quantify the estimated physical impacts of the fire for each impact category. Direct outputs from the fire model were available only for the suppression and property/infrastructure categories including land, residences, roads and transmission lines. For these categories we directly input the fire model results (i.e., acres or miles impacted at each flame length) into the calculator.

For many of the other categories, impacts could not be linked to or are not as dependent on the relationship between the physical footprint of the fire and a specific location. For example, impacts on tourism are not directly related to a specific acre burning or not burning, but rather, to more general attributes like timing, magnitude and duration of the fire. As such, more generalized estimates based on evidence from past wildfires were used—e.g., number of visitor days lost after a fire, number of person days of smoke exposure. Justification for such choices is included in the data collection section (see Section 4).

2.8. Impact Valuation

The specific method for estimating the monetary value of each impact varied by impact type. Data sources, assumptions and final values selected for each category are included in the data collection section of the report. The methods used for the overall impact valuation followed these general steps:

- Establish a baseline unit and value for each category based on best available data—update all values to constant 2015 dollars.
  - Example 1: The baseline unit for wildfire suppression is an acre. The assumed average suppression cost per acre is $325.
  - Example 2: The baseline unit for residential property is a “home”. The average median home price is Taos County is $208,100 (2015$). The assumed impact on homes in areas with flame length greater than 8ft is 100% (complete loss), while the assumed impact on property values for homes in burn areas with flame length below 8ft is 15%.
  - Example 3: The baseline unit for public health impacts is per individual per day. The assumed cost per individual per day is $10.00.

- Apply cost methodology to the estimated physical impact quantity/count.
  - Example 1: N acres burned multiplied by $325/acre in suppression costs.
  - Example 2: N miles of transmission lines requiring repairs at $10,000/mile.
  - Example 3: 15% impact on tourism for 1 year with a baseline gross income of $71.1 million.
- Distribute the avoided costs and treatments over time in a financial model.
  - We assumed a time frame of 20 years, which is the number of years estimated to complete one round of forest thinning treatments.
  - In all likelihood, forest restoration treatments would be done strategically—focusing on high risk areas first, resulting in diminishing marginal returns across time; however, as detailed information on this was not available we used an even distribution of treatment costs and benefits to represent equal probability of a fire occurring in each of those twenty years.
  - We assumed only one fire would occur in those 20 years for each scenario.
- Calculate and sum the present value of avoided costs – We assumed a discount rate of 3%.
- Compare the total estimate of avoided costs to the cost of treatment.
- Calculate return on investment.

3. Data Collection

Data used to estimate the degree and value of impacts came from a variety of sources—in some cases, data were study-area specific, but in others, more generalized information was used. In this section, we document relevant studies and data sources for each impact area, and select a baseline value. It should be noted, as discussed later, that an additional component of this study was the development of a calculator, which allows the user to modify key parameters, adjust baseline values, and calculate results under differing assumptions.

3.1. Forest Treatment Costs

Treatment costs are affected by a number of variables including treatment type, stand age and species, topography and road access, among others. As such, we relied on New Mexico specific average estimates from existing studies. In their comprehensive plan, the RGWF (2014) estimated average costs of $700/acre for thinning dense forest in the focus area.

As points of comparison, a 2010 report on treatments in the Santa Fe watershed estimated average costs of $920/acre (Stednick and Ice 2010). A more recent article in the Santa Fe New Mexican (Matlock 2015) estimated treatment costs for Santa Fe National Forest at $400-950/acre with an average of $600/acre. As the RGWF estimate falls within the range of estimates from other sources, we chose to use the RGWF average forest thinning treatment cost as the baseline value for our study. Actual costs can vary from site-to-site based on accessibility, slope, mechanical vs. prescribed burn, and salvageable material with value (e.g., timber, firewood, biofuel, etc.). Cost of treatment is the sole investment cost included in the model, and therefore estimated return on investment is substantially impacted by changes in cost assumptions.

For private acres located within the wildland urban interface (WUI), we used a treatment cost estimate from a current pricing agreement for the study area (State of New Mexico 2014), which sets treatment costs at $2,150/acre for WUI acres on private land.

We assumed an average fuel treatment cost of $2,150/acre for WUI acres on private land and $700/acre for all other lands.

3.2. Wildfire Suppression

The costs of wildfire suppression (i.e., firefighting) can be affected by a number of variables including topography, accessibility, land cover, population density, etc., making it more difficult to predict costs for a specific area. As such, we relied on more general data from recent wildfires.

A recent study aimed at estimating the full cost of New Mexico wildfires included a summary of fires in the state over 40,000 acres from 2009-12 (see Table 1) Updating the values included in the study and weighting the costs by the size of the fire, we calculated a weighted average cost per acre of $130 (2015$). As a point of comparison, we also calculated 5- and 10-year means using the National Interagency Fire Center (NIFC) statistics on annual federal firefighting costs. These costs do not include risk of injury and death to fire crews, certainly an issue of high importance.

Table 1 Suppression costs of New Mexico fires (adapted from Impact DataSource 2013; NIFC 2016)

Fire	Year	Density	Acreage	Costs	$/Acre	(2015$)
Whitewater-Baldy	2012	0.5	297,845	$23,000,000	$77	$80
Little Bear	2012	4.2	44,330	$19,400,000	$438	$451
Las Conchas	2011	35.5	156,593	$48,385,000	$309	$325
Miller	2011	7.5	88,835	$18,100,000	$204	$214
Donaldson	2011	4.2	101,563	$5,700,000	$56	$59
Lash Chance	2011	12.9	53,342	$2,062,400	$39	$41
Enterprise	2011	14.7	64,936	$37,000	$1	$1
Cato	2009	10.8	55,080	$460,000	$8	$9
Pasco	2009	1.4	93,029	$450,000	$5	$5
Weighted mean						$130
NIFC 5-year mean						$322
NIFC 10-year mean						$282

We assumed an average wildfire suppression cost of $325/acre—which is similar to both the cost per acre of the Las Conchas fire and the NIFC 5-year mean. The New Mexico weighted mean cost per acre of $130 was not used because it is largely driven by the low cost incurred fighting the Whitewater – Baldy fire, which burned in a much less populated area that is not representative of Taos County. This estimate is assumed to be an "average cost" across all flame lengths.

3.3. Wildfire Cleanup & Recovery

The US Forest Service Burned Area Emergency Rehabilitation (BAER) program supports basic rehabilitation and recovery efforts and could be viewed as emergency stabilization and treatment after a fire. It does not include replanting of commercial forests or grass for forage, replacement of habitat, etc. The BAER program estimates that, on average, rehabilitation costs are 5% of suppression costs (US Forest Service 2016).

The most recent study found with comprehensive rehabilitation cost estimates included six fires from 2000-03. Updating the costs to constant dollars (2015$) and removing a California fire, which was not as similar to the study area as the others, rehabilitation costs ranged from $160-$2,320/acre with a median of $380/acre. (WFLC 2009) $380/acre exceeds our estimate fire suppression cost of $325/acre, which is at significant variance with the general expectation that rehabilitation costs would total 5% of suppression costs. The assumed value in our model is therefore conservative.

We assumed a conservative average cleanup and recovery cost of $35/acre (~10% of assumed suppression costs) across all flame lengths.

3.4. Property & Infrastructure

3.4.1. Land Values

In order to estimate the potential impacts on land values, it was necessary to first identify land ownership, land type (e.g., forest, scrub, irrigated agriculture) and current per acre value by land type and/or ownership in Taos County.

USGS data were used to identify broad classes of land ownership (USGS 2012). More than half of Taos County is under federal government ownership (see Table 2) and only one-third of the land is under private ownership.

Table 2 Land ownership in Taos County

Land Owner	Total Acres	% of Total
Private	461,057	33%
BLM	228,297	16%
BLM Wilderness	15,319	1%
State Land Office	61,808	4%
Other State Land	10,335	1%
Taos Pueblo	116,613	8%
USFS	440,502	31%
USFS Wilderness	76,879	5%
Total:	**1,410,809**	—

GIS data also were used to categorize acres in Taos County by vegetation type (see **Table 3**) (LANDFIRE 2014).

Table 3 Land by type in Taos County

Vegetation Type	Total Acres	% of Total
Spruce-Fir	159,518	11%
Aspen	113,068	8%
Mixed Conifer Wet	160,122	11%
Mixed Conifer Dry	81,939	6%
Ponderosa Pine	66,073	5%
Piñon-Juniper	222,147	16%
Shrubland	497,821	35%
Grassland	47,010	3%
Riparian/Wetland	11,169	1%
Sparsely Vegetated	3,387	0%
Barren	7,722	1%
Water	3,964	0%
Developed Vegetation	14,886	1%
Developed Ag	10,251	1%
Developed Infrastructure	11,746	1%
Total	**1,410,823**	—

With respect to current land values by type, a recent study by Larson (2015) estimated the value of federal, developed and agricultural lands by state. Table 4 includes estimates from the study in constant dollars (2015$) for New Mexico lands. While there is an argument that Federal lands in Taos County would exceed statewide average values, we just the average figures in the study out of conservatism.

Table 4 New Mexico land values

Land Type	(2015$)
Federal	$1,370
Developed	$48,570
Agriculture	$430

In order to further categorize agricultural lands, we consulted the 2012 US Census of Agriculture (2012), which estimated 313,414 acres of farmland (22.2%) in Taos County, of which only 14,458 acres (1.0%) were irrigated. We combined this information with the USDA (2015) estimated land values for New Mexico farmland (see Table 5) included in its 2015 Land Values Summary.

Table 5 Agricultural land in Taos County

Land Type	(2015$)
Cropland Irrigated	$3,920
Cropland Non-Irrigated	$390
Pasture	$340

When considering the impact of wildfire on property values, it is important to note real financial impacts likely would be seen only 1) if a property were sold; or 2) if the property value was reassessed and property taxes adjusted accordingly. In the case of federal, state and tribal lands, the likelihood of land being sold is low.

In the case of agricultural land, an initial drop in value might be seen directly after the fire, but would likely recover as these lands could be reseeded/replanted the following year—resulting in the likelihood of minimal long-term impacts on agricultural land value. Also, note that impacts related to agricultural earnings and impacts directly on irrigation systems were accounted for elsewhere in the study.

The land type most likely to be impacted by wildfire is private developed land—primarily residential properties. Unfortunately, limited literature exists on the impact of wildfire on land values. A 2013 study on the impacts of wildfires on residential properties by Earth Economics cited three studies (i.e., Price-Waterhouse Coopers 2001; Loomis 2004 & Stetler et al. 2010) on the topic. All find that wildfires have a negative impact on residential property values ranging from 3% to 16% across the studies.

Based on this, we assumed that impacts to federal, state, tribal and agricultural lands were low (aside from small short-term impacts that are unlikely to be seen at the market level), while the impacts to private property values were higher.

We assumed the following per acre values and percentage impact on property value:

Land Type	Per Acre Value	% Impact
Federal/State	$1,370	2%
Cropland (Irrigated)	$3,920	1%
Tribal (Non-residential)	$1,370	2%
Private (Developed)	$48,600	15%
Private (Undeveloped/pasture)	$365	1%

3.4.2. Residential Homes

Due to the type and availability of data, impacts on residential home values were evaluated separately from the land, notwithstanding that homes and land are most commonly sold together. Developed land (not including structures) was accounted for in the previous section.

With regards to the number and value of residential homes in Taos County, the US Census estimated that Taos County had 33,084 residents and 20,354 housing units in 2014, of which an estimated 2,340 were in multi-unit structures. The estimated median value, according to the US Census for owner-occupied housing units from 2009-13 was $204,800 or $208,122 in constant dollars (2015$).

The Taos County Association of Realtors reported 2015 sales statistics for the following discrete areas of Taos County: Angel Fire, Red River, Taos and Taos Ski Valley. Mean and median sale estimates were provided for single-family homes and condominiums (see **Table 6**). Lastly, the Taos County Chamber of Commerce (2014) reported the median price of residential property sold in 2013 was $219,507 (or $223,000 in 2015$) based on 458 sales.

Table 6 2015 home sales in Taos County

Location/Type	Mean (2015$)	Median (2015$)
Angel Fire		
Single Family	$303,492	$116,288
Condominium	$115,288	$109,750
Red River		
Single Family	$353,588	$324,000
Condominm	$86,250	$86,000
Taos		
Single Family	$300,498	$276,000
Condominm	$141,852	$139,000
Taos Ski Valley		
Single Family	$339,000	$231,773
Condominm	$390,000	$205,000

Limited literature exists on the impact of wildfire on property values for property not directly damaged. A 2013 study by Earth Economics cited three studies (i.e., Price-Waterhouse Coopers 2001; Loomis 2004 & Stetler et al. 2010) on the topic. All found that wildfires had a negative impact on residential property values, which ranged from 3-16% across the studies.

We reviewed impacts on homes in historical fires both nationally and in New Mexico (see **Table 7** and **Table 8**). Across the US, the median number of acres burned per home destroyed was 2,575 from 2000-12. This number of acres is similar to the Las Conchas fire, where 2,486 acres burned for every home destroyed. In contrast, substantially higher numbers of homes were destroyed per acres burned for both the Cerro Grande and Little Bear fires. We report these numbers here as a point of comparison for the representative fires modeled in this study.

Table 7 Historical homes lost per acre for the US

Year	Homes Lost	Acres Burned	Acres/Home Lost
2000	861	7,393,493	8,587
2001	731	3,570,911	4,885
2002	2,381	7,184,712	3,018
2003	5,781	3,960,842	685
2004	2,400	8,097,389	3,374
2005	2,200	8,669,389	3,941
2006	2,251	9,873,745	4,386
2007	4,900	9,328,045	1,904
2008	2,800	5,292,468	1,890
2009	2,300	5,921,786	2,575
2010	2,002	3,422,724	1,710
2011	5,850	8,711,367	1,489
2012	4,244	9,326,238	2,198
		Mean	**3,126**
		Median	**2,575**

Table 8 Historical homes lost per acre for large New Mexico fires

Fire	Acres Burned	Homes Lost	Acres/Home Lost
Cerro Grande	47,000	280	168
Little Bear	44,000	254	173
Whitewater-Baldy	297,000	12	24,750
Las Conchas	156,593	63	2,486

It is also important to note that post-fire costs for homeowners often exceed the value of the house. In addition to rebuilding, demolition and removal of the destroyed structure may need to occur. In other cases, the insurance value of older homes may be insufficient to cover the costs of building a similar home under current regulations and codes. Out of conservatism, these considerations were not included in this study, and their inclusion would increase the benefit of avoided costs to homeowners over what is presented in the results.

We assumed that flame lengths of less than 8ft resulted in a 15% decrease in property values, while flame lengths greater than 8ft resulted in complete loss (100%).

As a conservative approach, we assumed the lowest possible number of housing units within each housing density bin (i.e., where density was 1-20 homes per acre, we assumed 1 unit, where density was 21-50 homes per acre, we assumed 21 units, and where density was over 50 units per acre, we assumed there were 51 units).

Without additional information, we assumed a structural value of $174,400 per residence, which is based on an assumed average property size of one acre valued at $48,600, and a residential property value of $223,000. ($223,000 - $148,600 = $174,400)

3.4.3. Property Insurance

Any number of variables can affect property insurance rates—as such, we relied on an online site, valuepenguin.com, which collects sample insurance rates for a representative home from major insurance providers. The average homeowners insurance rate for Taos, New Mexico was listed as $1,291 per year (valuepenguin.com 2016) or 0.6% of the median home value in the area.

The New Mexico F.A.I.R. property insurance program provides insurance to qualified homeowners living in high-risk areas who cannot acquire insurance in normal markets. A quote from their website (http://www.nmpropertyinsurance.com) for a median priced home in Taos County with $20,000 worth of contents was $150/month and $199/month for a masonry and a frame house, respectively.

Assuming the average of these two values, $175, the New Mexico F.A.I.R. annual premium would be $2,100—approximately 60% higher than the current average rate.

We assumed an average annual premium of $1,300/home. In the absence of data on the individual home proximity to each fire scenario, we assumed an average increase in homeowners' insurance rates of 25% and 5% for all homes within the county without- and with-RGWF, respectively.

3.4.4. Roads

In order to estimate the impact of wildfire on roads, we first calculated total road mileage in Taos County by road type. **Table 9** includes estimates of road miles in Taos County, which come from the 2013 Tiger line dataset (USBC 2013).

Table 9 Miles of road in Taos County

Road Type	Miles
Secondary road	317
Local/rural road or city street	3,811
Vehicular trail (4WD)	168
Private service road	159
Driveways, etc.	153
Total	**4,608**

With regards to road repair costs, the New Mexico Department of Transportation (2014) estimated per land mile chip and seal costs and annual maintenance costs of $11,500 and $1,100, respectively. As a point of comparison, Coconino County in Arizona recently conducted a review of US Forest Service roads and estimated road maintenance (i.e., repaving using the chip and seal method) cost, on average, $29,000 in 2013 or $29,470 in 2015, per road mile. Assuming this is for two lanes, the costs are similar to those from the New Mexico study.

In a 2015 travel-analysis report on the Olympic National Forest, deferred maintenance and annual maintenance costs for 90,000 miles forest service roads in the Pacific Northwest Region were estimated to be $12,900/mile and $1,330/mile, respectively. Similar information could not be located for the Southwestern Region in which New Mexico is located. Since "deferred maintenance" occurs when annual maintenance is not performed and suggests some level of accumulated disrepair—this could be viewed as a proxy for wildfire impacts.

We assumed flame length greater than eight feet resulted in some level of road repair and average per lane mile repair costs of $15,000 and $10,000 for primary roads and all other road types, respectively.

3.4.5. Electric Transmission Lines

Transmission line data were derived from a national database (Ventyx 2016), with an estimated 162 miles of lines in Taos County.

With regards to the cost to repair and/or replace damaged or destroyed lines after a wildfire, Black and Veatch (2014) prepared a report on capital costs for transmission and substations for the Western Electricity Coordinating Council. **Table 10** summarizes the study's estimates of baseline capital costs for transmission lines by line type. Another recent study estimated repair costs of $150,000-$300,000/mile based on actual post-wildfire repair cost estimates from San Diego Gas and Electric Company (Johnson 2014).

Table 10 Baseline transmission costs (from Black and Veatch 2014)

Line Description	$/Mile ($2015)
230 kV Single Circuit	$959,700
230 kV Double Circuit	$1,536,400
345 kV Single Circuit	$1,343,800
345 kV Double Circuit	$2,150,300
500 kV Single Circuit	$1,919,450
500 kV Double Circuit	$3,071,750
500 kV HVDC Bi-pole	$1,536,400
600 kV HVDC Bi-pole	$1,613,200

We assumed a repair cost of $150,000 per mile for flame lengths greater than eight feet, the low end of the range estimated in the recent SDG&E study.

3.5. Surface Water

This section focuses on uses of surface water downstream from Taos County. The three largest users are Albuquerque Bernalillo County Water Utility Authority ("ABCWUA"); City of Santa Fe Water Division; and irrigators served by the Middle Rio Grande Conservancy District ("MRGCD"). Surface water relates to ABCWUA and the Santa Fe Water Division in two main ways that have bearing on the extent of impacts from upstream wildfire-related sedimentation.

ABCWUA has a surface water diversion on the Rio Grande in Albuquerque that supplies a treatment plant and their distribution system. From a water rights perspective, the water used at the plant is imported from the Colorado River Basin through the Bureau of Reclamation's San Juan Chama ("SJ-C") project and is stored water. ABCWUA has contractual rights to 48,200 acre-feet per year from the project, but has stored reserves from previous years. The SJ-C water is a complement to the Authority's groundwater use, providing 50% or more of production on an annual basis. The water is delivered via the Rio Chama and the Rio Grande, so it could be fouled by sediment from other watersheds even if the SJ-C headwaters and project infrastructure are not impacted. This would be case with a Taos County fire, where the sediment from the Upper Rio Grande would impact the SJ-C water downstream of the Rio Grande's confluence with the Chama. However, because water is stored in Heron and Abiquiu reservoirs in the Upper Chama prior to release downstream, the utility would not lose the water in the event of a fire, instead temporarily being forced to switch sources for the duration of the severe sedimentation. As a result, impacts of a fire in Taos County, in the event that sedimentation resulted would be mostly in terms of when the water is used, as well as any maintenance of diversions that were clogged even if idled. Santa Fe is in a similar situation with their Buckman Direct Diversion.

Both Albuquerque and Santa Fe have other sources of water that allow them to maintain deliveries even without access to surface water from the Rio Grande. ABCWUA has an extensive system of groundwater wells, while Santa Fe has both groundwater sources as well as surface water from the Santa Fe River. As a result, economic impacts are related primarily to the costs of substituting alternative existing sources of water rather than actual lack of water availability. If watersheds were to become so degraded that use of surface water were no longer viable for municipal utilities, then economic impacts could be much greater. However, impacts of this scale would not likely result from Taos county fires alone.

3.5.1. Albuquerque Bernalillo County Water Utility Authority (ABCWUA)

Without information directly linking increased sediment in the water supply to increased operational costs, pumping costs or other costs, we assumed a value of $700/AF in increased costs for water supplied by ABCWUA to consumers over one month (the estimated duration of affected operations). This assumes that a fire in Taos County would result in sedimentation requiring the utility to forego use of its surface water diversion plant entirely for the impacted period, substituting groundwater production. This value is based on personal communication identifying marginal costs of additional water at $500/AF for ABCWUA for aquifer storage, combined with $200/AF for treatment and pumping as an order of magnitude approximation.[2] In reality, ABCWUA reports that destabilization and degradation of its water supply watersheds can affect quality, quantity, storage, and reliability of water supplies in myriad ways. These other costs would accrue over several years, but current data do not support quantification at this time. The perceived risk associated with such long-term effects though is potentially much greater than the increased costs estimated here. A review of ABCWUA's audited financial statements from 2011 and 2012 did not document any specific additional costs associated with impacts from the Las Conchas fire, an event estimated to have impacts greater than those that would occur from a fire in Taos County (owing to that fire's relative proximity to the Albuquerque area).

[2] Yuhas, K. 2015. Personal communication. December.

In a 2013 planning document, the ABCWUA estimated it supplied 102,000AF per year to consumers (ABCWUA 2013). Monthly consumption information was not found; however, another planning document estimated that summer consumption is two to three times winter consumption. Using this information, we calculated a generic estimate of 12,000AF per month for summer months.

We assumed an increase in operation costs of $700/AF and a one-month duration of impact. We conservatively assumed no difference in impact between the two without-treatment scenarios and we assumed only 25% of these impacts would occur under the with-treatment scenario.

3.5.2. City of Santa Fe – Water Division

Without information directly linking increased sediment in the water supply to increased operational costs, pumping costs or other costs, we assumed a value of $700/AF increase in costs for water supplied by the SF Water Division to consumers over one month (the assumed duration of affected operations). This is the assumed cost to the utility of producing water from either the Santa Fe River or groundwater instead of the diverting surface water from the Rio Grande through the Buckman Direct Diversion project. Based on personal communication, marginal costs to supply water for Santa Fe are roughly similar to ABCWUA, and therefore have a similar representative value. Furthermore and again in common with ABCWUA, Santa Fe reports long-term reliability of natural watershed functions as the primary concern for wildfire, as opposed to short-term severe effects. Consequently again these costs can be underestimates due to lack of sufficient data to currently assess such long-term effects.

Water management in Santa Fe is part of the public utilities division of the city of Santa Fe government. In a 2015 planning document, estimated 2014 supply for summer months was approximately 1,075AF per month (City of Santa Fe 2015).

We assumed an increase in operation costs of $700/AF and a one-month duration of impact. We conservatively assumed no difference in impact between the two without-treatment scenarios and we assumed only 25% of these impacts would occur under the with-treatment scenario.

3.5.3. Irrigation Districts

Potential impacts on downstream irrigation districts include increased O&M costs, additional dredging costs, and decreases in crop revenues.

Without specific information on increased district operational or dredging costs associated with wildfire impacts on water quality or increased pumping costs resulting from switching water sources, we used several simplifying assumptions in estimating the impact of a representative fire in Taos County on downstream irrigation districts.

First, we reviewed audited financial statements for the Middle Rio Grande Conservancy District (MRGCD) before, during and after the Las Conchas fire in an effort to identify any anomalies in expenditures that could be attributed to costs associated with the fire; however, there were no significantly noticeable differences across those years nor was the fire mentioned in the statement narrative. This implies that there may not have been incremental operating costs related to the fire.

Personal conversations with irrigators and managers in the District suggest that systems could be turned off if necessary and that most irrigators would be able to go several weeks either with no irrigation or with water from groundwater sources. While not ideal, it suggests that crops would likely survive, perhaps with a slight decrease in yield, and that the District itself would avoid material direct cost impacts.

Based on this, and lacking additional information, we used an assumed a decrease in annual crop yield, and associated value of agricultural production for the four counties served by the MRGCD (i.e., Sandoval, Bernalillo, Valencia, and Socorro, see **Table 11**) as a measure of the impact of wildfire-related sedimentation on downstream agriculture. We assumed minor impacts due to (i) lack of evidence of direct cost from similar events, (ii) large distance from Taos county to MRGCD and the presence of Cochiti Reservoir to mitigate sedimentation, (iii) likelihood that the timing of a sedimentation event would correspond with a period of monsoonal precipitation, lessening the impact of foregone irrigation, and (iv) ability of many farmers to substitute groundwater use in the event of surface water curtailment.

Table 11 Crop sales for downstream counties

County	Crop Sales (2015$m)	% of market Sales for 2012
Sandoval	$6	53%
Bernalillo	$8	42%
Valencia	$14	24%
Socorro	$12	15%
Total	**$39**	—

We assumed total crop sales would be reduced by 2% and 0% under without- and with-treatment scenarios, respectively.

3.6. Industry

There are multiple ways the value of industry could be ranked and assessed—total gross income, total net income, number of employees, contribution to the community, etc. For the purposes of this study, we focus primarily on gross income and, more specifically, the potential impact of wildfire on county level gross income and the associated impact on county government tax revenue. In the following sections we provide a brief overview of Taos County as a whole and then, as possible, discuss the industries most likely to be affected by wildfire: commercial timber, agriculture, tourism, and government (in the form of tax revenues).

3.6.1. Gross Income

The Taos County Chamber of Commerce produces economic indicators and statistics on a quarterly basis; however, the most recent annual report available online was for 2013. Total gross receipts for 2013 were estimated at $842.5 million and the median for 2009-13 was $863.1 million in constant dollars (2015$). The NAICS industry sectors with the highest gross income were retail, construction, and accommodations & food services (see **Table 12**).

Table 12 2013 gross receipts for Taos County (2015$m)

NAICS Industry Sector	2015$m	% of Total
Retail Trade	$323.07	38.3%
Construction	$100.66	11.9%
Accommodations & Food Serv	$91.03	10.8%
Other Services (Except Public Admin)	$56.70	6.7%
Health Care & Social Assisstance	$46.80	5.6%
Utilities	$44.57	5.3%
Information & Cultural Industries	$37.94	4.5%
Profession, Scientific & Tech Services	$29.32	3.5%
Wholesale Trade	$25.36	3.0%
Manufacturing	$22.02	2.6%
Real Estate & Rental/Leasing	$21.92	2.6%
Admin & Supt Waste Mgmt & Remed	$10.09	1.2%
Arts, Entertainment & Recreation	$6.03	0.7%
Finance & Insurance	$4.95	0.6%
Transportation & Warehousing	$3.05	0.4%
Education Services	$2.06	0.2%
Unclassified	$1.69	0.2%
Agriculture, Forestry & Hunting	*	*
Mining & Oil Gas Extraction	*	*
Management of Co & Enterprises	*	*
Public Admin	*	*
Total	$842.50	

Table 13 shows gross receipts for key categories most likely to be affected by wildfire. Note that the tourism index is a sum of four categories—amusements, gambling & recreation; accommodation; full service restaurants; and drinking establishments—as defined by the Taos County Chamber of Commerce.

Table 13 Summary of gross income for key industry sectors (2015$m)

Year	Ag, Forestry & Hunting	Art Dealers	Real Estate	Tourism Index
2009	$1.36	$1.93	$17.79	$78.43
2010	$1.82	$2.19	$17.83	$79.00
2011	$4.20	$2.19	$16.96	$71.07
2012	$1.25	$1.90	$18.37	$69.07
2013	$0.00	$2.65	$22.28	$71.12
Mean	$2.16	$2.17	$18.64	$73.74
Median	$1.36	$2.19	$17.83	$71.12

As mentioned previously, impacts on these industries are not directly related to a specific acre in the county burning or not burning, but rather, to more general attributes like timing, magnitude and duration of the fire.

The availability of substitute areas within the county for the activities on which the agriculture/forestry/ hunting and tourism industries, in particular, are dependent should also be considered. For example, the two representative fires modeled in this study were approximately 50,000 acres and 150,000 acres in size. Total acreage for the county is over 1.4 million acres, meaning these two fires covered only 4% and 11% of total acreage in Taos County, respectively. While smoke and general concern over fire proximity could motivate temporary behavior changes in visitors and recreationalists, it is possible that the high level of substitutability within the county for many key recreational and tourism activities would mitigate longer-

term effects on related industry. That being said, a larger fire and/or a fire in a different location could substantially change the level of impact.

We assumed the following baseline annual gross income and percentage impact by industry:

Industry Sector – Taos County	Income ($2015m)	% Impact w/o RGFW	% Impact w/RGFW
Ag, forestry, hunting	$1.36	10%	5.0%
Art dealers	$2.19	5%	2.5%
Real estate	$17.83	15%	5.0%
Tourism	$71.12	15%	5.0%

We also assumed a 4% impact (i.e., loss of 10 business days) for the following industries: retail trade, construction, information & cultural, wholesale trade, and transportation/warehousing. The time frame of impacts for all industries is assumed to be one fiscal year. We conservatively assumed the same percentage impact for both fire scenarios.

3.6.2. Government Tax Revenues

Like most local governments, Taos County and the Town of Taos rely on a combination of state and local taxes to support their activities. The following sections describe the current tax rates as well as their contribution to local government revenues.

Property tax varies based on location within the county, amenities provided to that location, etc. Based on a review of 2015 tax rates, a rate of 2% of assessed property value appears to be a reasonable average across the county.

The state of New Mexico's 2015 gross receipts tax rate schedule for parts of Taos County as follows:

- Taos Ski Valley: 8.6875%
- Taos/Taos Pueblo: 8.1875%
- Red River: 8.4375%
- Remainder of the county: 7.1250%

Additional taxes within the county include a lodger's tax (5%), a state-shared auto and gasoline tax and a franchise tax; however, information necessary to include these taxes in the analysis was not available. The impact of that exclusion is minor; based on the 2014 Taos County Annual Financial Report, these three taxes account for only 3% of annual tax revenue, while property and gross income taxes accounted for 61% and 36%, respectively.

We assumed tax rates of 2.0% and 8.1875% for property and gross income, respectively.

3.7. Recreation

In addition to the impacts of lost tourism on the local economy, recreationalists would lose access to recreational opportunities in the area—some short-term (e.g., ballooning) and some potentially long-term (e.g., mountain biking).

While real and important to consider, non-market values associated with recreating in the study area are outside the scope of this study; however, costs associated with repairing/rebuilding recreational amenities are included.

Carson National Forest has over 330 miles of trails, the majority of which are located in Taos County. These trails are used for a variety of activities including hiking, mountain biking, horseback riding and winter sports, among others.

Trails Unlimited (2016), a trail building operation associated with the US Forest Service, estimated a cost of $2,500-$12,000 for building new trail and $2,500-$6,000 for providing maintenance (the higher costs being associated with heavy maintenance such as retaining walls and drainage structures).

Consumer surplus, or net benefit after all costs, to recreation participants is a common measure for benefit. In this case, it is difficult to estimate the total difference between the treated and untreated scenarios in terms of participation rates. The most recent data available for Carson National Forest estimate 945,000 visits for recreation purposes in FY 2013 (USFS 2015). Consumer surplus values per user-day as recommended by the USFS in 2015 dollars ranges from $28 to $225 for New Mexico per user per day, suggesting tens of millions of dollars of value in net benefit to recreation participants at stake annually in Taos County (Loomis 2005).

Without additional information, we assumed one mile of trail would need repaired for every 2,500 acres burned. We assumed per mile repair costs of $6,000 and $3,000 for without- and with-RGFW scenarios, respectively.

3.8. Cultural/Traditional/Personal Uses

As mentioned previously, there are a variety of uses and values wildfire would impact that do not directly relate to market activities. In some cases, wildfire would impact individuals' abilities to grow, gather and/or harvest goods for personal use and/or for barter/trade. In other cases, wildfire could impact an area or prevent an activity with cultural, archeological and/or spiritual significance.

With regards to the impacts on goods for personal use and/or barter/trade, a replacement cost method could be used provide a monetary estimate of value. For example, many acequia users rely on the water supplied by the acequias to grow gardens that provide food for them and their families. In this case, the replacement cost method could be used to estimate the cost of purchasing similar food at a local grocery store to replace food lost—such a value would not include values associated with personal enjoyment of gardening, the cultural value of acequias, the income (or lack thereof of the individual) or the "healthiness" of homegrown foods relative to those bought in the store; however, it would provide low-bound estimate of impact.

3.8.1. Acequias

Post-fire erosion, sediment flows and flooding can have substantial impacts on acequias—resulting in limited capacity or rendering them completely ineffective. Many acequia members are small farmers/ranchers who, in addition to small sales, rely on their agricultural production for personal use and barter/trade.

In reviewing the New Mexico acequia irrigation trends for 2013, fire and/or post-fire silting resulted in water scarcity for a number of areas. Actions taken as a result of this scarcity included herd reductions

(some as high as 80%), reduced plantings, no plantings, early plantings, and prioritization of gardens above other water uses. Similar actions would likely be taken in the event of a fire in Taos County.

The Taos Valley Acequia Association states there are approximately 7,000 water right holders for 12,000 acres.

With regards to estimate the replacement costs of goods produced using acequia water, the USDA (2014) estimated the per month cost of food for individuals and families at four levels (i.e., thrifty, low, moderate, and liberal) by gender and age range. We averaged the "moderate" estimates for both genders across all age ranges, which resulted in an estimated cost of $275/month per individual, or $3,300/year.

Acequias in Taos County play crucial cultural roles in subsistence activities and support community activities including barter and gift economic activity. These culturally-significant roles for acequias are not monetized here, but personal communication suggests the high value to right-holders for any loss of this capacity through degradation of water quality or acequia infrastructure. State policy protecting acequia water use also reflects the cultural value of traditional irrigation practices.

Without additional information, we assumed 10% and 20% of water right holders in the Taos County Acequia Association lost one season of crops/gardens/ranching under the small and large fire scenarios, respectively. We then assumed that only 25% of these individuals would be impacted under the with-treatment scenario.

With respect to consumption, we assumed that each individual relied on the acequia water for 25% of his/her food consumption. We assumed the average individual would spend $3,300 per year on food, resulting in a baseline value of $825 per individual.

3.8.2. Personal Use - National Forest

A variety of non-recreational forest uses also occur on National Forest lands within the study area including wood harvesting, hunting and food gathering for personal consumption and grazing.

In 2014, the Camino Real and Questa Ranger Districts sold 1,716 and 288 dead-and-down permits, respectively—resulting in a total of approximately 10,500 cords of fuelwood harvested (at a permit cost of $4.00/cord). In addition, these two districts sold a combined total of 6,532 linear feet in vigas (i.e., a timber/rafter for an adobe building) and 3,000 latillas (i.e., a limb or stick used for ceiling material).

Reviewing Santa Fe craigslist advertisements, cords of firewood currently from around $100-$200. Using simple math, a cord of wood harvest from Carson National Forest would cost $4.00—estimate $5.00 with material costs. Assuming a cost of $100/cord purchased at market prices, this results in a difference of $95/cord.

Information was not available on hunting/food gathering.

In addition, it should be noted that approximately 200,000 acres of National Forest in Taos County is permitted out annually for grazing; however, this land value was accounted for in the federal per acre land values and the impact on ranchers is accounted for as part of the Taos County industry.

Without additional information, we assumed a relatively small impact on personal use given the size of the fires modeled and the availability of substitute locations for these activities within the county and outside the burn area. More specifically, we assumed a $95.00 replacement cost for a cord of firewood and a 1% impact for every 10,000 acres burned. In addition we assumed 100% and 50% of this impact under the without- and with-RGFW scenarios, respectively.

3.8.3. Tribal Use

The 2014 American Community Survey estimated approximately 1,000 individuals residing in the census-designated place (CDP) of Taos Pueblo. The 2010 US Census estimated Taos Pueblo had 484 housing units of which 418 were occupied.

We recognize that Pueblo residents use their lands to harvest and gather goods for barter, trade, or sale, however we were unable to obtain data quantifying the extent of this activity. We also do not attempt to place an economic value on the cultural, spiritual, and ceremonial uses of the Pueblo lands – such valuation is both inappropriate and methodologically difficult. Given this, it is important to underscore that the estimates in this section represent a low-bound value for potential Pueblo impacts and does not attempt to place any value the cultural and traditional aspects of the sites/areas potentially affected by wildfire.

Without additional information, we assumed a relatively small impact on Pueblo residents given the location of the two fire scenarios considered in this study; however, were a fire to occur closer to or on Pueblo lands, the impacts would be substantially greater.

We assumed 10% and 20% of Pueblo residents lost one season of crops/gardens/gathering under the small and large fire scenarios, respectively. Furthermore, we assumed that 100% of this impact would occur in the without-treatment scenario, and would decrease to 25% under the with-treatment scenario.

We assumed, on average, each individual uses one cord of wood per year at a replacement value of $100. We also assumed that the average individual relies on tribal lands and forests for 25% of their food for personal consumption, with an average replacement cost of $825.

3.9. Public Health

The primary impact of wildfires on public health is disease burden due to smoke-inhalation and poor air quality. A study by Richardson et al. (2012) estimated an average (private, not social) medical cost of $9.50 per exposed person per day for wildfire smoke. The same study also calculated willingness-to-pay (WTP) to avoid "a reduction in one wildfire smoke induced symptom day" of $84.42 per exposed person per day (Richardson et al. 2012).

These figures are subject to caveat. Private costs associated with seeking medical help, while based on market transactions, likely underestimate societal costs of smoke exposure (because some will experience disease but not seek medical attention). WTP, which is based on a hypothetical market, may or may not represent true costs.

The prevailing wind direction in Taos County is westerly in April, May and June and northerly all other months of the year. Taos County has approximately 33,000 residents, while the two counties to the east of Taos, Colfax and Mora, have approximately 20,000 residents combined. Our estimates of smoke exposure are based on the population of these three counties.

Without RGFW, we assumed 50,000 individuals are exposed for 14 days each. With RGFW, we assume 33,000 individuals are exposed for 3 days each. We assumed a conservative public health cost of $10.00 per exposed person per day.

4. Calculator

As mentioned previously, a core component of this study was the development of a calculator. The objectives of the calculator were as follows:

- Comprehensive, yet straightforward in application
- Based on generally available and reliable information
- Allow the user to include quickly update or modify data inputs

Information required to run the calculator includes:

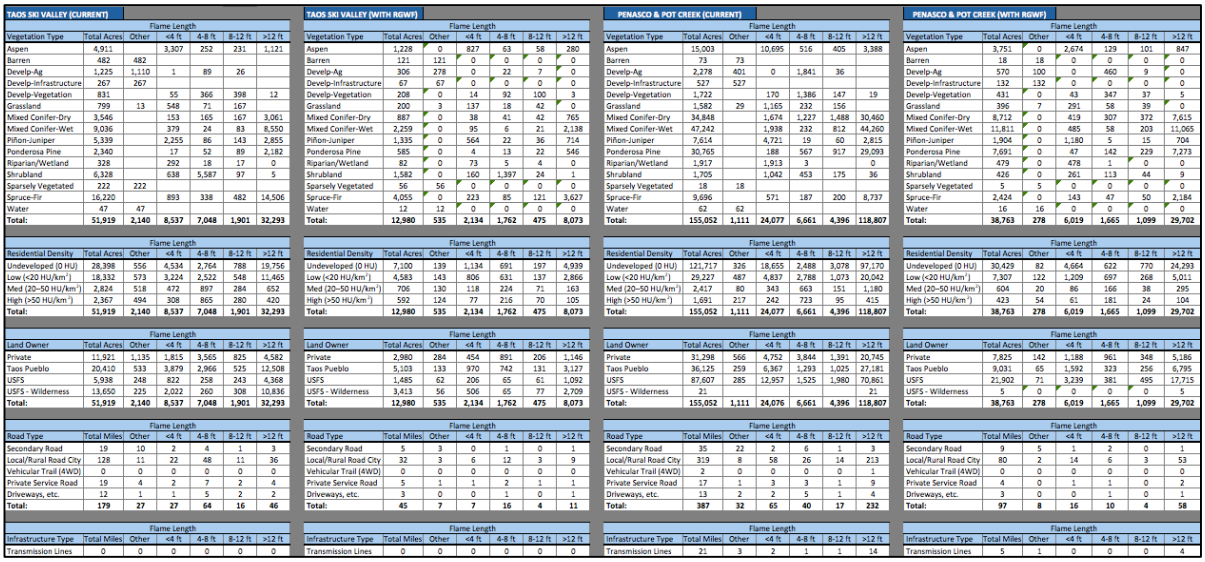
- Imported analysis from FlamMap5 including vegetation type, residential density, land owner, road type and infrastructure type
- Unit of impact by category and estimates of monetary per unit value (e.g., $/acre)
- Percentage impact by category type of wildfire with and without the RGFW treatments (e.g. Impacts on Taos County annual gross income from tourism of 15% and 5% for the without- and with-treatment scenarios, respectively)—for some categories this may not be needed.
- For impact categories not included in the FlamMap5 analysis, estimated number of units (e.g., either baseline or impacted as required by the category)

The flexibility of the calculator allows for sensitivity testing of key parameters and/or a presentation of a range of results for a specific category of impacts.

The calculator contains four tabs:

1. Fire Inputs – the values in the tables on this tab should be copied directly from the FlamMap analysis results. For the purposes of this study, the tab currently includes with- and without-treatment scenarios for two fires—Taos Ski Valley and Peñasco/Pot Creek (see Figure 2).

Figure 2 Screenshot of Fire Input tab (for illustrative purposes only)



TAOS SKI VALLEY (CURRENT)

			Flame Length			
Vegetation Type	Total Acres	Other	<4 ft	4-8 ft	8-12 ft	>12 ft
Aspen	4,911		3,307	252	231	1,121
Barren	482	482				
Develp-Ag	1,225	1,110	1	89	26	
Develp-Infrastructure	267	267				
Develp-Vegetation	831		55	366	398	12
Grassland	799	13	548	71	167	
Mixed Conifer-Dry	3,546		153	165	167	3,061
Mixed Conifer-Wet	9,036		379	24	83	8,550
Pinon-Juniper	5,339		2,255	86	143	2,855
Ponderosa Pine	2,340		17	52	89	2,182
Riparian/Wetland	328		292	18	17	0
Shrubland	6,328		638	5,587	97	5
Sparsely Vegetated	222	222				
Spruce-Fir	16,220		893	338	482	14,506
Water	47	47				
Total:	**51,919**	**2,140**	**8,537**	**7,048**	**1,901**	**32,293**

			Flame Length			
Residential Density	Total Acres	Other	<4 ft	4-8 ft	8-12 ft	>12 ft
Undeveloped (0 HU)	28,398	556	4,534	2,764	788	19,756
Low (<20 HU/km²)	18,332	573	3,224	2,522	548	11,465
Med (20–50 HU/km²)	2,824	518	472	897	284	652
High (>50 HU/km²)	2,367	494	308	865	280	420
Total:	**51,919**	**2,140**	**8,537**	**7,048**	**1,901**	**32,293**

			Flame Length			
Land Owner	Total Acres	Other	<4 ft	4-8 ft	8-12 ft	>12 ft
Private	11,921	1,135	1,815	3,565	825	4,582
Taos Pueblo	20,410	533	3,879	2,966	525	12,508
USFS	5,938	248	822	258	243	4,368
USFS - Wilderness	13,650	225	2,022	260	308	10,836
Total:	**51,919**	**2,140**	**8,537**	**7,048**	**1,901**	**32,293**

			Flame Length			
Road Type	Total Miles	Other	<4 ft	4-8 ft	8-12 ft	>12 ft
Secondary Road	19	10	2	4	1	3
Local/Rural Road City	128	11	22	48	11	36
Vehicular Trail (4WD)	0	0	0	0	0	0
Private Service Road	19	4	2	7	2	4
Driveways, etc.	12	1	1	5	2	2
Total:	**179**	**27**	**27**	**64**	**16**	**46**

			Flame Length			
Infrastructure Type	Total Miles	Other	<4 ft	4-8 ft	8-12 ft	>12 ft
Transmission Lines	0	0	0	0	0	0

TAOS SKI VALLEY (WITH RGWF)

			Flame Length			
Vegetation Type	Total Acres	Other	<4 ft	4-8 ft	8-12 ft	>12 ft
Aspen	1,228	0	827	63	58	280
Barren	121	121	0	0	0	0
Develp-Ag	306	278	0	22	7	0
Develp-Infrastructure	67	67	0	0	0	0
Develp-Vegetation	208	0	14	92	100	3
Grassland	200	3	137	18	42	0
Mixed Conifer-Dry	887	0	38	41	42	765
Mixed Conifer-Wet	2,259	0	95	6	21	2,138
Pinon-Juniper	1,335	0	564	22	36	714
Ponderosa Pine	585	0	4	13	22	546
Riparian/Wetland	82	0	73	5	4	0
Shrubland	1,582	0	160	1,397	24	1
Sparsely Vegetated	56	56	0	0	0	0
Spruce-Fir	4,055	0	223	85	121	3,627
Water	12	12	0	0	0	0
Total:	**12,980**	**535**	**2,134**	**1,762**	**475**	**8,073**

			Flame Length			
Residential Density	Total Acres	Other	<4 ft	4-8 ft	8-12 ft	>12 ft
Undeveloped (0 HU)	7,100	139	1,134	691	197	4,939
Low (<20 HU/km²)	4,583	143	806	631	137	2,866
Med (20–50 HU/km²)	706	130	118	224	71	163
High (>50 HU/km²)	592	124	77	216	70	105
Total:	**12,980**	**535**	**2,134**	**1,762**	**475**	**8,073**

			Flame Length			
Land Owner	Total Acres	Other	<4 ft	4-8 ft	8-12 ft	>12 ft
Private	2,980	284	454	891	206	1,146
Taos Pueblo	5,103	133	970	742	131	3,127
USFS	1,485	62	206	65	61	1,092
USFS - Wilderness	3,413	56	506	65	77	2,709
Total:	**12,980**	**535**	**2,134**	**1,762**	**475**	**8,073**

			Flame Length			
Road Type	Total Miles	Other	<4 ft	4-8 ft	8-12 ft	>12 ft
Secondary Road	5	3	0	1	0	1
Local/Rural Road City	32	3	6	12	3	9
Vehicular Trail (4WD)	0	0	0	0	0	0
Private Service Road	5	1	1	2	1	1
Driveways, etc.	3	0	0	1	0	1
Total:	**45**	**7**	**7**	**16**	**4**	**11**

			Flame Length			
Infrastructure Type	Total Miles	Other	<4 ft	4-8 ft	8-12 ft	>12 ft
Transmission Lines	0	0	0	0	0	0

PENASCO & POT CREEK (CURRENT)

			Flame Length			
Vegetation Type	Total Acres	Other	<4 ft	4-8 ft	8-12 ft	>12 ft
Aspen	15,003		10,695	516	405	3,388
Barren	73	73				
Develp-Ag	2,278	401	0	1,841	36	
Develp-Infrastructure	527	527				
Develp-Vegetation	1,722		170	1,386	147	19
Grassland	1,582	29	1,165	232	156	
Mixed Conifer-Dry	34,848		1,674	1,227	1,488	30,460
Mixed Conifer-Wet	47,242		1,938	232	812	44,260
Pinon-Juniper	7,614		4,721	19	60	2,815
Ponderosa Pine	30,765		188	567	917	29,093
Riparian/Wetland	1,917		1,913	3		0
Shrubland	1,705		1,042	453	175	36
Sparsely Vegetated	18	18				
Spruce-Fir	9,696		571	187	200	8,737
Water	62	62				
Total:	**155,052**	**1,111**	**24,077**	**6,661**	**4,396**	**118,807**

			Flame Length			
Residential Density	Total Acres	Other	<4 ft	4-8 ft	8-12 ft	>12 ft
Undeveloped (0 HU)	121,717	326	18,655	2,488	3,078	97,170
Low (<20 HU/km²)	29,227	487	4,837	2,788	1,073	20,042
Med (20–50 HU/km²)	2,417	80	343	663	151	1,180
High (>50 HU/km²)	1,691	217	242	723	95	415
Total:	**155,052**	**1,111**	**24,077**	**6,661**	**4,396**	**118,807**

			Flame Length			
Land Owner	Total Acres	Other	<4 ft	4-8 ft	8-12 ft	>12 ft
Private	31,298	566	4,752	3,844	1,391	20,745
Taos Pueblo	36,125	259	6,367	1,293	1,025	27,181
USFS	87,607	285	12,957	1,525	1,980	70,861
USFS - Wilderness	21					21
Total:	**155,052**	**1,111**	**24,076**	**6,661**	**4,396**	**118,807**

			Flame Length			
Road Type	Total Miles	Other	<4 ft	4-8 ft	8-12 ft	>12 ft
Secondary Road	35	22	2	6	1	3
Local/Rural Road City	319	8	58	26	14	213
Vehicular Trail (4WD)	2	0	0	0	0	1
Private Service Road	17	1	3	3	1	9
Driveways, etc.	13	2	2	5	1	4
Total:	**387**	**32**	**65**	**40**	**17**	**232**

			Flame Length			
Infrastructure Type	Total Miles	Other	<4 ft	4-8 ft	8-12 ft	>12 ft
Transmission Lines	21	3	2	1	1	14

PENASCO & POT CREEK (WITH RGWF)

			Flame Length			
Vegetation Type	Total Acres	Other	<4 ft	4-8 ft	8-12 ft	>12 ft
Aspen	3,751	0	2,674	129	101	847
Barren	18	18	0	0	0	0
Develp-Ag	570	100	0	460	9	0
Develp-Infrastructure	132	132	0	0	0	0
Develp-Vegetation	431	0	43	347	37	5
Grassland	396	7	291	58	39	0
Mixed Conifer-Dry	8,712	0	419	307	372	7,615
Mixed Conifer-Wet	11,811	0	485	58	203	11,065
Pinon-Juniper	1,904	0	1,180	5	15	704
Ponderosa Pine	7,691	0	47	142	229	7,273
Riparian/Wetland	479	0	478	1	0	0
Shrubland	426	0	261	113	44	9
Sparsely Vegetated	5	5	0	0	0	0
Spruce-Fir	2,424	0	143	47	50	2,184
Water	16	16	0	0	0	0
Total:	**38,763**	**278**	**6,019**	**1,665**	**1,099**	**29,702**

			Flame Length			
Residential Density	Total Acres	Other	<4 ft	4-8 ft	8-12 ft	>12 ft
Undeveloped (0 HU)	30,429	82	4,664	622	770	24,293
Low (<20 HU/km²)	7,307	122	1,209	697	268	5,011
Med (20–50 HU/km²)	604	20	86	166	38	295
High (>50 HU/km²)	423	54	61	181	24	104
Total:	**38,763**	**278**	**6,019**	**1,665**	**1,099**	**29,702**

			Flame Length			
Land Owner	Total Acres	Other	<4 ft	4-8 ft	8-12 ft	>12 ft
Private	7,825	142	1,188	961	348	5,186
Taos Pueblo	9,031	65	1,592	323	256	6,795
USFS	21,902	71	3,239	381	495	17,715
USFS - Wilderness	5	0	0	0	0	5
Total:	**38,763**	**278**	**6,019**	**1,665**	**1,099**	**29,702**

			Flame Length			
Road Type	Total Miles	Other	<4 ft	4-8 ft	8-12 ft	>12 ft
Secondary Road	9	5	1	2	0	1
Local/Rural Road City	80	2	14	6	3	53
Vehicular Trail (4WD)	0	0	0	0	0	0
Private Service Road	4	0	1	1	0	2
Driveways, etc.	3	0	0	1	0	1
Total:	**97**	**8**	**16**	**10**	**4**	**58**

			Flame Length			
Infrastructure Type	Total Miles	Other	<4 ft	4-8 ft	8-12 ft	>12 ft
Transmission Lines	5	1	0	0	0	4

2. Impacts – this tab contains the unit, per unit value and percentage impact assumptions used to estimate avoided costs under each scenario. Shaded cells contain formulas and should not be written over or deleted. The upper tables show results by impact category while the lower tables summarize these impacts into more general categories for reporting purposes (see Figure 3).

Figure 3 Screenshot of Impacts tab (for illustrative purposes only)

					TAOS SKI VALLEY AREA FIRE					PENASCO & POT CREEK AREA FIRE				
					Without RGWF		With RGWF		Difference	Without RGWF		With RGWF		Difference
Category (Unit)	Unit	% Impact w/o	% Impact w/	$/Unit	Units	$m 2015	Units	$m 2015	$m 2015	Units	$m 2015	Units	$m 2015	$m 2015
RGFW treatment	Acre	0%	100%	$700	0	$ -	50,000	$ 35.00	-$ 35.00	0	$ -	50,000	$ 35.00	-$ 35.00
Wildfire - Suppression	Acre	100%	100%	$325	49,779	$ 16.18	12,445	$ 4.04	$ 12.13	153,941	$ 50.03	38,485	$ 12.51	$ 37.52
Wildfire - Cleanup & recovery	Acre	100%	100%	$35	49,779	$ 1.74	12,445	$ 0.44	$ 1.31	153,941	$ 5.39	38,485	$ 1.35	$ 4.04
Land - Federal/State	Acre	2%	2%	$1,370	19,117	$ 0.52	4,779	$ 0.13	$ 0.39	87,344	$ 2.39	21,836	$ 0.60	$ 1.79
Land - Cropland (Irrigated)	Acre	1%	1%	$3,920	116	$ 0.00	29	$ 0.00	$ 0.00	1,877	$ 0.07	469	$ 0.02	$ 0.06
Land - Tribal (Non-residential)	Acre	2%	2%	$1,370	19,878	$ 0.54	4,970	$ 0.14	$ 0.41	35,866	$ 0.98	8,967	$ 0.25	$ 0.74
Land - Private (Developed)	Acre	15%	15%	$48,600	831	$ 6.06	208	$ 1.51	$ 4.54	1,722	$ 12.55	431	$ 3.14	$ 9.42
Land - Private (Undeveloped/pasture)	Acre	1%	1%	$365	9,840	$ 0.04	2,460	$ 0.01	$ 0.03	27,133	$ 0.10	6,783	$ 0.02	$ 0.07
Residences - Destroyed	Home	100%	100%	$174,400	269	$ 46.91	67	$ 11.73	$ 35.18	299	$ 52.07	75	$ 13.02	$ 39.05
Residences - Property value	Home	15%	15%	$174,400	376	$ 9.84	94	$ 2.46	$ 7.38	312	$ 8.15	78	$ 2.04	$ 6.11
Residences - Homeowner insurance	Home	25%	5%	$1,300	20,500	$ 6.66	20,500	$ 1.33	$ 5.33	20,500	$ 6.66	20,500	$ 1.33	$ 5.33
Roads - Primary	Mile	100%	100%	$15,000	95	$ 1.42	24	$ 0.36	$ 1.07	253	$ 3.80	63	$ 0.95	$ 2.85
Roads - Secondary	Mile	100%	100%	$10,000	30	$ 0.30	8	$ 0.08	$ 0.23	36	$ 0.36	9	$ 0.09	$ 0.27
Transmission lines	Mile	100%	100%	$150,000	0	$ -	0	$ -	$ -	16	$ 2.44	4	$ 0.61	$ 1.83
Surface water - Albuquerque	Day	100%	100%	$700	12,000	$ 8.40	12,000	$ 8.40	$ -	12,000	$ 8.40	12,000	$ 8.40	$ -
Surface water - Santa Fe	Day	100%	50%	$700	1,075	$ 0.75	1,075	$ 0.38	$ 0.38	1,075	$ 0.75	1,075	$ 0.38	$ 0.38
Surface water - Downstream irrigation	Day	2%	0%	$39,000,000	1	$ 0.78	1.00	$ -	$ 0.78	1	$ 0.78	1.00	$ -	$ 0.78
Reservoir storage/Flood control	Day	100%	100%	$0	0	$ -	0	$ -	$ -	0	$ -	0	$ -	$ -
Taos County - Ag, forestry, hunting	Year	10%	5%	$1,360,000	1	$ 0.14	1	$ 0.07	$ 0.07	1	$ 0.14	1	$ 0.07	$ 0.07
Taos County - Art dealers	Year	5%	3%	$2,190,000	1	$ 0.11	1	$ 0.05	$ 0.05	1	$ 0.11	1	$ 0.05	$ 0.05
Taos County - Real estate	Year	15%	5%	$17,830,000	1	$ 2.67	1	$ 0.89	$ 1.78	1	$ 2.67	1	$ 0.89	$ 1.78
Taos County - Tourism	Year	15%	5%	$71,120,000	1	$ 10.67	1	$ 3.56	$ 7.11	1	$ 10.67	1	$ 3.56	$ 7.11
Taos County - Other industries	Year	4%	0%	$490,100,000	1	$ 19.60	1	$ -	$ 19.60	1	$ 19.60	1	$ -	$ 19.60
Taos County - Tax revenues	Year	100%	100%	n/a	1	$ 2.84	1	$ 0.37	$ 2.47	1	$ 2.72	1	$ 0.37	$ 2.34
Tourism - trails, etc.	Mile	100%	50%	$6,000	20	$ 0.12	20	$ 0.06	$ 0.06	62	$ 0.37	62	$ 0.19	$ 0.19
Personal use - Forest	Person year	100%	25%	$95	525	$ 0.05	525	$ 0.01	$ 0.04	1,575	$ 0.15	1,575	$ 0.04	$ 0.11
Personal use - Acequias	Person year	100%	25%	$825	700	$ 0.58	700	$ 0.14	$ 0.43	1,400	$ 1.16	1,400	$ 0.29	$ 0.87
Personal use - Tribal	Person year	100%	25%	$925	100	$ 0.09	100	$ 0.02	$ 0.07	200	$ 0.19	200	$ 0.05	$ 0.14
Smoke exposure	Person day	100%	100%	$10	700,000	$ 7.00	99,000	$ 0.99	$ 6.01	700,000	$ 7.00	99,000	$ 0.99	$ 6.01
					–	$ 144.0	–	$ 72.17	$ 71.86	–	$ 199.71	–	$ 86.19	$ 113.52

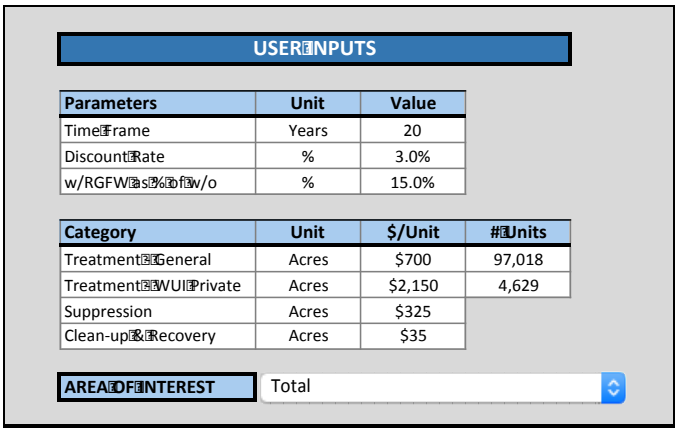
Results – The results tab contains an area for user inputs—values included in this component of the calculator are those preliminary runs showed to be key drivers of the results (see Figure 4). The inclusion of this option enables key parameters to be updated as needed without having to make changes throughout the entire model. Adjustment of a parameter on this tab will result updates of all calculations including that parameter. For example, if the time horizon is changed from 20 years to 10 years, all associated present value calculations will adjust to use 10 years instead of 20 years. The sensitivity of the model to changes in these parameters can also be evaluated quickly through model runs using different parameters.

Parameters included in the user input section include:

- Time frame – the number of years across which the analysis is modelled
- Discount rate – the rate at which future values are
- Size of fire under treated scenario as a percentage of untreated scenario

Additional adjustments could be made to the cost per unit for treatment, suppression and clean-up/recovery as well as the total number of acres treated across the time frame considered.

Figure 4 User inputs



USER INPUTS

Parameters	Unit	Value
Time Frame	Years	20
Discount Rate	%	3.0%
w/RGFW as % of w/o	%	15.0%

Category	Unit	$/Unit	# Units
Treatment - General	Acres	$700	97,018
Treatment - WUI Private	Acres	$2,150	4,629
Suppression	Acres	$325	
Clean-up & Recovery	Acres	$35	

AREA OF INTEREST: Total

With respect to results, the user must first select the "area of interest". Options include met benefits for Treatment, Taos County, Downstream, Suppression/Recovery and Total (which includes all of the previous categories). Once an area of interest is selected, both tables to the right of the user inputs as well as the figure below these tables will update to show results by category for that area of interest only (see Figure 5). The left-most figure summarizes estimated total benefits for all areas of interest.

Figure 5 Screenshot of Results tab (for illustrative purposes only)

USER INPUTS

Parameters	Unit	Value
Time Frame	Years	20
Discount Rate	%	3.0%
w/RGFW as % of w/o	%	15.0%

Category	Unit	$/Unit	# Units
Treatment	Acres	$700	77,000
Suppression	Acres	$325	
Clean-up & Recovery	Acres	$35	

AREA OF INTEREST: Total

RESULTS - TAOS SKI VALLEY (SMALLER FIRE)

Category	Present Value ($m 2015) w/o RGWF	w/ RGWF	Benefit
Treatment	$0	$40.1	-$40.1
Suppression & recovery	$13.3	$2.0	$11.3
Property	$52.5	$8.1	$44.4
Infrastructure	$0.6	$0.1	$0.5
Surface water	$7.4	$1.7	$5.7
Industry	$27.6	$3.8	$23.8
Personal Use	$0.5	$0.1	$0.4
Heath	$5.2	$0.7	$4.5
Other	$0.1	$0.0	$0.0
TOTAL	$107.3	$56.7	$50.6

ROI

RESULTS - PENASCO & POT CREEK AREA (LARGER FIRE)

Category	Present Value ($m 2015) w/o RGWF	w/ RGWF	Benefit
Treatment	$0	$40.1	-$40.1
Suppression & recovery	$41.2	$6.2	$35.0
Property	$61.7	$9.5	$52.2
Infrastructure	$4.4	$0.7	$3.7
Surface water	$7.4	$1.7	$5.7
Industry	$27.8	$3.8	$24.0
Personal Use	$1.1	$0.3	$0.8
Heath	$5.2	$0.7	$4.5
Other	$0.3	$0.1	$0.1
TOTAL	$149.1	$63.1	$86.0

ROI

3. List Content – This is a locked tab that includes parameters and formulas necessary to run certain aspects of the calculator including Consumer Price Index data used for updating values from nominal to constant dollars and developer formulas that allow the user to select area of interest.

5. Results

The two simulated fires resulted in 51,919 acres for Fire 1 (Taos Ski Valley area) and 155,052 acres for Fire 2 (Peñasco Pot Creek) under a "without treatment" (i.e., no RGWF) scenario. Figure 4 and Figure 5 shows the fire severity within each perimeter without treatment and with treatment, respectively. As described earlier, simulations of these two fires under the "with treatment" (i.e., post-RGWF implementation) resulted in minor fires. While this result reflects the fire mitigation objective of RGWF, we developed a higher impact assumption out of conservatism to avoid overestimating benefit of the treatments. To do this, the perimeter under treatment scenarios was extended to the same perimeter as the untreated fire, fire intensity was calculated (generally less than under the untreated scenario due to reduce fuels), and losses calculated at 15% of the full perimeter for the treatment scenarios.

These results focus on the quantifiable and monetizable effects that can be attributed to the untreated scenario for these two fires, in consideration of the costs of treatments. They also include cost estimates of fire effects under the treatment scenario, but as described earlier, emphasize the likely expected results of effective treatment programs rather than specific simulation results, due to modelling limitations. The values in these tables highlight the magnitude of value associated with benefits of treatments in Taos County for these representative fires. These values do not represent all assets at risk of wildfire over the lifespan of fuel treatments, but rather two representative fires in high value areas of the county.

Implementing treatments will take several years, and eventually maintenance treatments will be necessary to maintain treatment effectiveness in perpetuity. Treatment costs here represent the initial treatment costs for all areas to be treated in Taos County, spread over 20 years and discounted to present value at a rate of three percent. Similarly, benefit timing is uncertain, so benefits are similarly distributed uniformly across a 20-year timeframe, discounted to present value at three percent.

These calculations only address the monetized benefits identified in the prior section of this report. Other unquantified benefits, such as recreation participation or existence value, increase the value of treatments.

Figure 4. Fire severity for simulated fires, no treatment

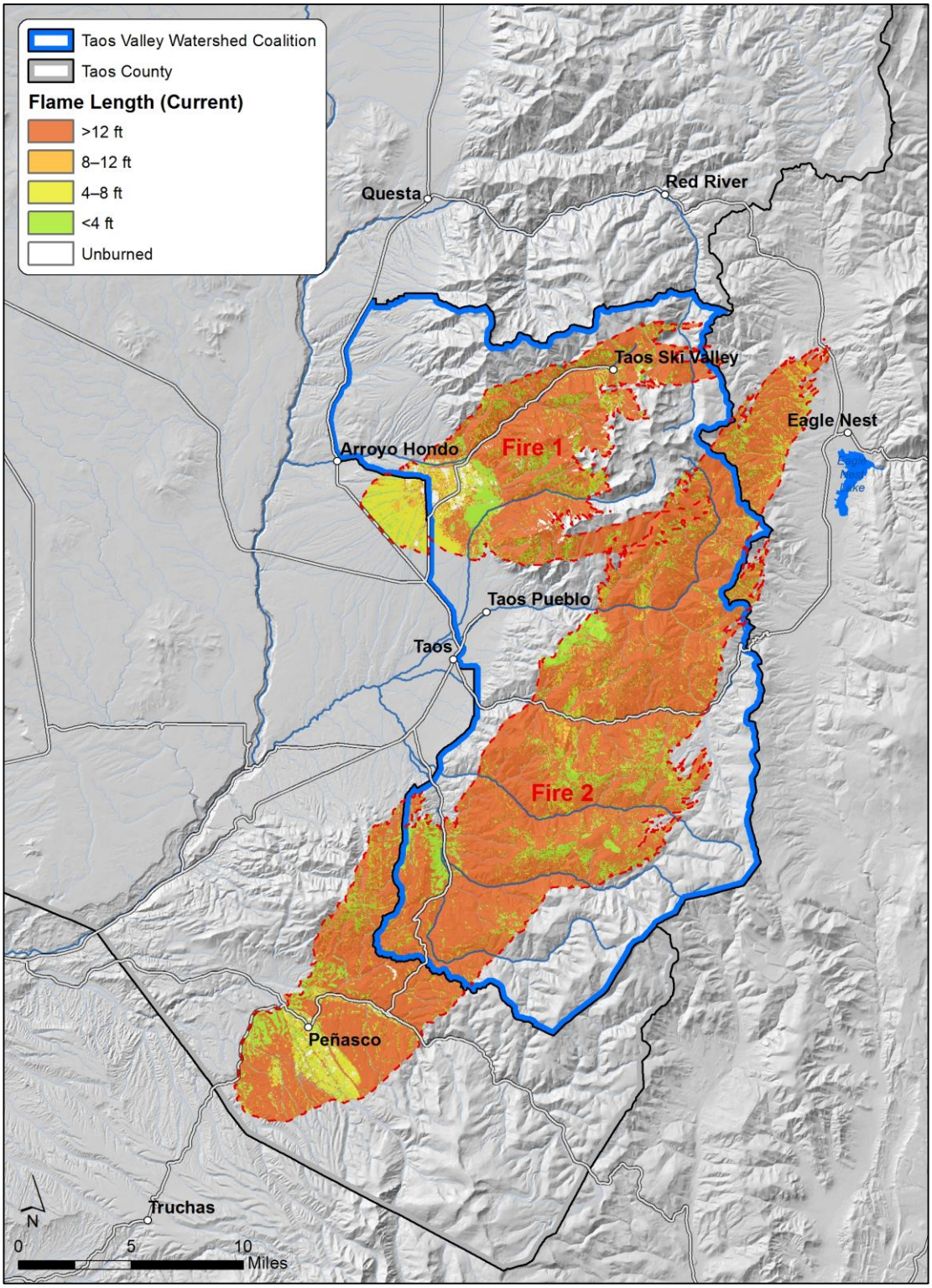
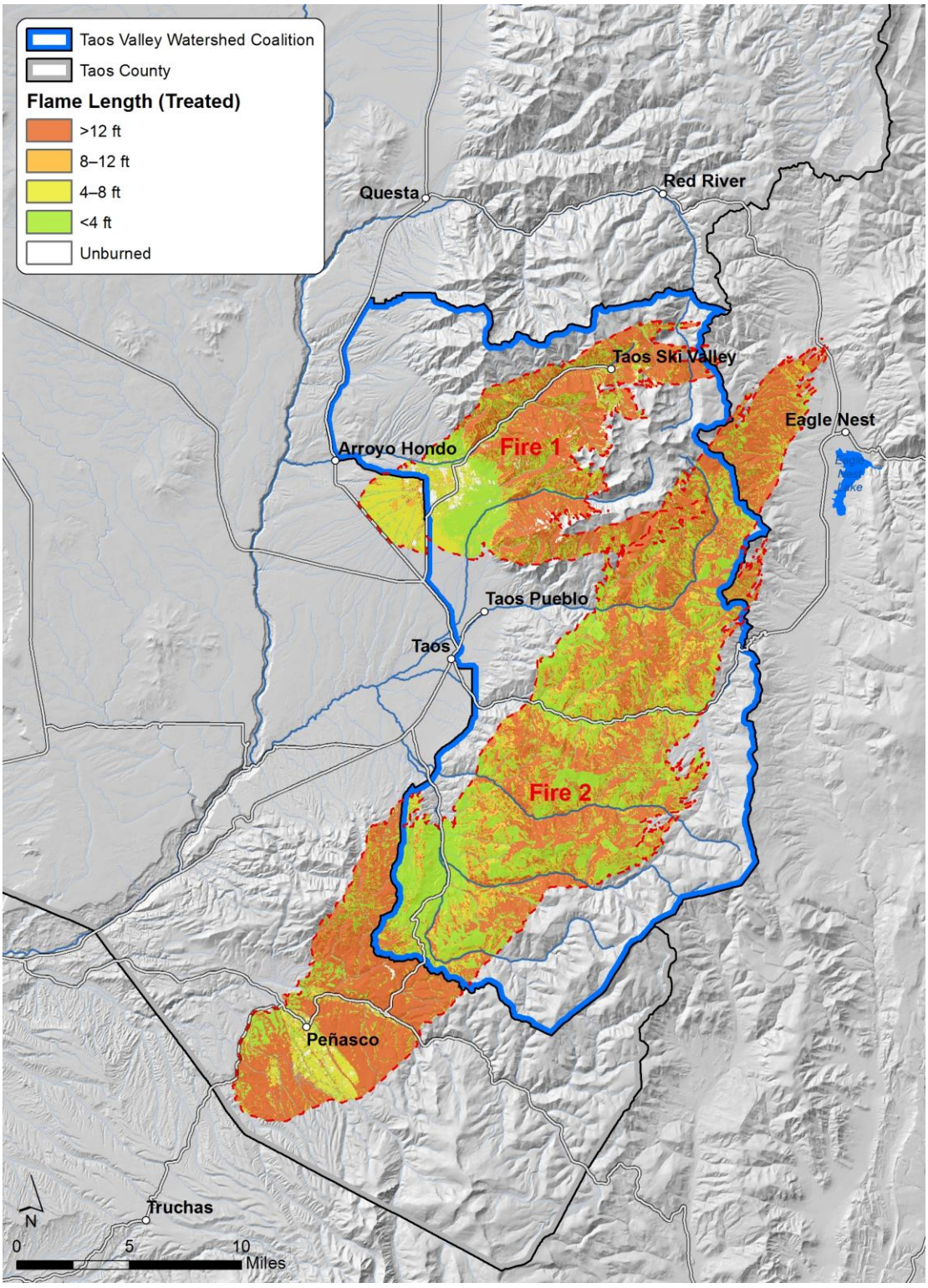


Figure 5. Fire severity for simulated fires, with treatment[3]



[3] Figure 5 depicts the modeled fire severity under treatment assuming that the fire perimeter remains constant – that the same area burns but with less intensity. In practice model simulations show that under treatment any fires are likely to me much smaller – that most of the areas in the "without treatment" perimeter would not burn at all under the treatment case.

5.1. Fire 1 – Taos Ski Valley

Fire 1 is the smaller of the two representative fires modeled—with approximately 52,000 acres inside the fire perimeter. Quantifiable damages from this fire represent $107 million (See **Table 14**). Based on methods described in this report, the estimated damages with fuel treatments (i.e., in the RGWF scenario) are approximately $16 million. When combined with the estimated $58 million in costs for currently planned RGWF treatments in the TVWC planning area, the benefits still outweigh the costs by almost $33 million.

Table 14 Scenario 1 results: Taos Ski Valley Fire

	Present Value (2015$m)		
Category	w/o RGWF	w/ RGWF	Benefit
Treatment	$0	$57.9	-$57.9
Suppression & Recovery	$13.3	$2.0	$11.3
Property	$52.5	$8.1	$44.4
Infrastructure	$0.6	$0.1	$0.5
Surface Water	$7.4	$1.7	$5.7
Industry	$27.6	$3.8	$23.8
Personal Use	$0.5	$0.1	$0.4
Heath	$5.2	$0.7	$4.5
Other	$0.1	$0.0	$0.0
TOTAL	**$107.3**	**$74.6**	**$32.8**

5.2. Fire 2 – Penasco & Pot Creek

Fire 2 is the larger of the two representative fires modelled—with approximately 155,000 acres inside the fire perimeter. Quantifiable damages from this fire represent $149 million (See **Table 15**). Based on methods described in this report, the estimated damages with fuel treatments are approximately $23 million. When combined with the estimated $58 million in costs for currently planned RGWF treatments in the TVWC planning area, the benefits still outweigh the costs by $68 million.

Table 15 Scenario 2 results

	Present Value (2015$m)		
Category	w/o RGWF	w/ RGWF	Benefit
Treatment	$0	$57.9	-$57.9
Suppression & Recovery	$41.2	$6.2	$35.0
Property	$61.7	$9.5	$52.2
Infrastructure	$4.4	$0.7	$3.7
Surface Water	$7.4	$1.7	$5.7
Industry	$27.8	$3.8	$24.0
Personal Use	$1.1	$0.3	$0.8
Heath	$5.2	$0.7	$4.5
Other	$0.3	$0.1	$0.1
TOTAL	**$149.1**	**$81.0**	**$68.2**

These results are based on our "representative fire" methodology grounded in the specific event where one of the two fires occurs. The actual realized value of RGWF implementation in Taos County would depend on the number and distribution of future fires, which is, of course, unknown. Results can be scaled to provide some insight into the range of outcomes. For example, if both Fire 1 and Fire 2 were assumed to occur, then an estimated $216 million in combined damages would be avoided. This reduction would occur at the same RGWF treatment cost of $58 million, implying net benefits of $158 million (because

RGWF implementation must only be funded once). If an even greater number of fires were to occur, benefits would only increase further. These fires and the storm events generating major erosion events would likely occur over time, and with discounting, the magnitude of these benefits would decline. Additionally, there would eventually be maintenance treatments necessary to continue effectiveness of initial treatments lower cost than initial treatment per acre.

These specific benefits are not certain to accrue if fuel treatments are implemented. Fires might be more intense but for treatments, and if treatments are effective, benefits could be greater than these estimates. If fires would not have occurred during the treatment effectiveness timeframe, a highly unlikely scenario, other benefits from risk reduction would still accrue. For example, reducing risk of wildfire can allow public and private investments, such as structures, roads, and water supply infrastructure, which might not make sense if wildfire threats are likely. Furthermore, treatments can have important ecological benefits regardless of whether or not fire would occur.

5.3. Comparative Analysis and Discussion

In addition to the aggregate costs and benefits of RGWF investments in Taos County, our approach also allows us to discuss the distribution of those costs and benefits by category and stakeholder. This analysis yields several insights:

- Benefits accrue to Taos County much more so than to downstream stakeholders (see Figure 6). This is because the RGWF treatments avoid $44-52 million in costs related to local property destruction. Unsurprisingly, avoiding destruction of home and infrastructure is a major source of local benefit.
- Downstream benefits are limited to those related to surface water impacts and are estimated at $5.7 million in both fire cases. The modest impact is driven by the significant distance between Taos County and population centers in the Middle Rio Grande Valley, as well as the fact that both utilities diverting surface water for municipal use have access to alternative water supplies, permitting them to "manage around" temporary declines in water quality.
- Fire suppression and rehabilitation costs are another significant cost of fire, estimated at $13 and $41 million for the two representative fires (see Figure 7). Much of these costs could likely be avoided through RGWF investments, and avoiding these costs is a major benefit of the treatments.
- Treatment costs have not been allocated to specific stakeholders. This can be done as a financing approach is developed, enabling calculation of stakeholder-specific ROI analyses. With currently available information, we are only able to estimate the distribution of benefits by stakeholder group rather than the actual ROI.

Figure 6 Estimated benefits by area of interest

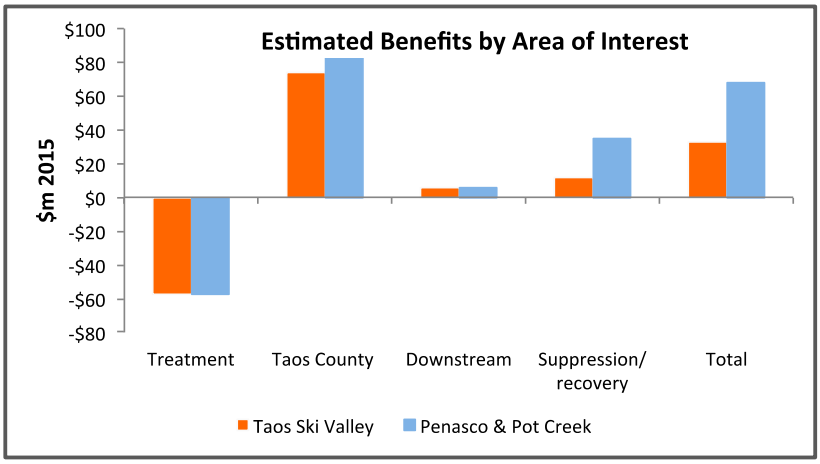
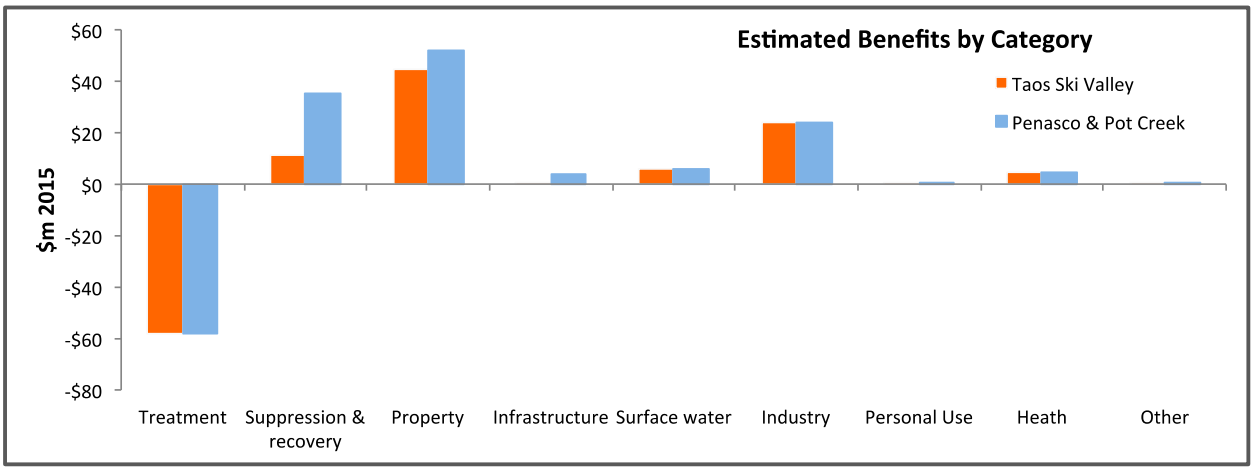


Figure 7 Estimated benefits by category



Return on investment (ROI) is calculated as $\frac{Gain\ from\ investment - Cost\ of\ investment}{Cost\ of\ investment}$. In this case, the gains from investment are calculated as the difference in avoided costs between the with- and without-treatment scenarios. The estimated return on investment for the two representative fire scenarios modeled in this study were 57% and 118% for the smaller and larger fire scenarios, respectively. The difference between the two ROIs is due largely to the assumption that 101,647 acres were treated in each scenario; that is, the costs were constant across the fires, with the benefits (i.e. avoided costs) larger for the larger fire in scenario 2.

It should be noted that these specific benefits are not certain to accrue if fuel treatments are implemented. Fires might be more intense but for treatments, and if treatments are effective, benefits could be greater than these estimates. If fires had occurred during the treatment effectiveness timeframe, a highly unlikely scenario, other benefits from risk reduction would still accrue. For example, reducing risk of wildfire can allow public and private investments, such as structures, roads, and water supply infrastructure, which might not make sense if wildfire threats are likely. Furthermore, treatments can have important ecological benefits regardless of whether or not fire would occur.

The goal of this project was conduct a case study on one focal area, Taos County, within the broader RGFW effort to evaluate the return on investment (ROI) from the RGWF. At the same time, we were restricted by the context and timing of the analysis to the use of currently available data. As a result, we were able to derive quantitative estimates of some impacts (e.g., property values, tourism) and only qualitative approximations of the direction of impact for others (e.g., river ecology, cultural values).

The refinement of current input values and the inclusion of values associated with impacts currently described only qualitatively would increase the robustness of the results. With respect to the latter, their inclusion would only bolster the benefits of the Water Fund. Another complicating factor of the analysis is the uncertainty associated with when, where and how often fires are assumed to occur across the time frame of the analysis.

That being said, the use of conservative estimates for impact categories included in the analysis and the known (negative) direction of omitted categories suggest that the Water Fund would provide robust benefits both locally and downstream with very high certainty. Additional research in other key focal areas within the watershed would improve understanding of the likely watershed-scale benefits of the

RGWF effort, as well as the benefits that each stakeholder would expect to see at full scale implementation.

5.4. Conclusion

This study analyzes two representative fire scenarios in Taos County to gauge the return on investment of proactively addressing the threat of catastrophic fire, and the associated impacts on people and watersheds, through landscape-scale forest restoration treatments. Fire 1, the smaller event, occurs in the Taos Ski Valley area and results in 51,919 burned acres in the "without treatment" case. Fire 2 occurs in the Peñasco/Pot Creek area and is substantially larger at 155,052 acres burned under current conditions. Our economic analysis clearly demonstrates that investment in RGWF fuel treatments dramatically reduces the potential financial impacts from severe wildfire, and that the value of this reduction outweighs the cost of program implementation by $32.8 to $68.2 million for fires 1 and 2 respectively. This study focused primarily on conservative estimation of financial benefits substantiated in market values for property, goods, and services with the potential to be impacted by wildfire in the study area. Using financial values is appropriate for stakeholders contemplating investing financially in RGWF alongside other potential uses of capital. This approach is inherently conservative—if RGWF provides an attractive investment based solely on market values, then the broader societal economic case for protecting and restoring other environmental, cultural, and other resources only bolsters value of the Water Fund. Even under our conservative approach, RGWF implementation in Taos County is expected to yield benefits that vastly outweigh implementation cost.

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Appendix A: Matrix of Impacts

CATEGORY	DESCRIPTION OF AVOIDED COST	BENEFICIARY	LOCATION OF IMPACT	LIKELY ORDER OF IMPACT	BRIEF JUSTIFICATION	LIKELY TIME FRAME	VALUATION METRIC
Suppression & Rehabilitation – Taos County							
Wildfire Suppression	Costs of suppression (equipment, man-hours, etc.)	Federal/state agencies, taxpayers	Local	High	Mega fire would require substantial suppression effort	Weeks Months	Monetary
Wildfire Cleanup & Recovery	Costs of clean-up/recovery costs (equipment, materials, man-hours, etc.)	Similar to suppression	Local	High	Mega fire would require substantial recovery effort	Months Years	Monetary
Property & Infrastructure – Taos County							
Buildings	Costs of replacing buildings/homes damaged/lost	Private owners, agencies, insurance	Local	High	Some homes/buildings would be damanged and/or destroyed	Months Years	Monetary
Land	Costs of lost property amenities & associated decrease in property value – broken out by land type (ag, commercial, residential, timber, gov't, etc.)	Private owners, agencies, insurance	Local	High	Both burned lands & neighboring (unburned) lands will likely decrease in property value – will vary by land type	Years	Monetary
Roads	Costs of replacing/rebuilding roads damaged	Fed agency (e.g., USFS), state,	Local	High	Some roads would be damanged and/or destroyed	Months Years	Monetary
Electrical	Costs of replacing/reparing electrical lines damaged	Utilities	Local	High	Some lines, etc. would be damanged and/or destroyed	Weeks Months	Monetary
Insurance	Cost of increased property insurance due to fire risk	Property owners	Local	High	Property insurance rates would likely increase after fire	Years	Monetary

CATEGORY	DESCRIPTION OF AVOIDED COST	BENEFICIARY	LOCATION OF IMPACT	LIKELY ORDER OF IMPACT	BRIEF JUSTIFICATION	LIKELY TIME FRAME	VALUATION METRIC
Surface Water Supply							
Water Utility – ABCWUA	Increased O&M costs due to sediment/debris; Costs of disruption of operations; Costs of investment in preventative technology	ABCWUA, ratepayers	Downstream	Low	Distance downstream from fire & reservoirs, etc. between locations should decrease order of impact; Possibility of ceasing water diversions if water quality becomes too poor (given groundwater availability)	Weeks	Monetary
Water Utility – Santa Fe Water Utility		City of SF, ratepayers	Downstream	Low	Possibility of ceasing water diversions if water quality becomes too poor given alternative sources (SF River surface water and groundwater)	Weeks	Monetary
Water Utility – San Juan-Chama Project	Increased O&M costs due to sediment/debris; Cost of disruption of operations (really this is lines 12,13 – see note)	Members (municipalities & irrigation districts),	Downstream	Medium	Increased O&M costs from removal of accumulated sediment and debris at diversions and tunnel infrastructure	Months	Monetary
Irrigation – MRGCD	Repair costs due to damages from sediment/debris; Costs from interruption in operations and/or costs associated with groundwater withdrawal/pumping. Costs associated with any loss of operations and/or crops	MRGCD, other irrigation	Downstream	Low	Irrigators could shut off systems and crops likely would be okay for duration of shut-off or groundwater could be used by some; Sedimentation would likely occur during monsoon season, when rains can make up shortfalls	Weeks	Monetary
Reservoir Storage/Flood Control	Costs associated with reduced volume and/or dredging	Storage right holders, reservoir owners (agencies), ISC	Downstream		Sediment loading		Monetary

CATEGORY	DESCRIPTION OF AVOIDED COST	BENEFICIARY	LOCATION OF IMPACT	LIKELY ORDER OF IMPACT	BRIEF JUSTIFICATION	LIKELY TIME FRAME	VALUATION METRIC
Industry in Taos County							
Commercial Timber	Loss of commercially viable forests & associated revenues	NF, land grant holders (e.g. Boy Scouts), Pueblo	Local	Low	Availability of other "substitute" areas to harvest for commercial companies; In 2013, ag, forestry, fishing & hunting represented 0.5% of Taos economy & there was no local employent in industry.	Years	Monetary
Ag (Irrigated) Acequias	Repair costs due to damages from sediment/debris; Costs from interruption in operations and/or costs associated with groundwater withdrawal/pumping; Temporary loss of farmland, crops, associated revenues/consumption	Water right holders, immediate community members; landowners, ag labor	Local	High	In 2013, ag, forestry, fishing & hunting represented 0.5% of Taos economy, but almost 700 individuals employed in ag; Farmers would likely lose crop/rangeland for that season likely no alternative option; Ranchers would likely have to sell stock or purchase hay, etc.; Farming for non-market trade/barter would be impacted	1 season	Monetary & Count
Ag (Grazing/Ranching)	Loss of grazing/ranching land & associated lost revenues	Landowners, grazing lease holders, NF	Local	High		1 season	Monetary
Government Tax Revenues	Avoided loss of property tax revenues	Taos County & State	Local	High	Fires have been shown to decrease property values, which in turn affect government tax revenues	Years	Monetary

CATEGORY	DESCRIPTION OF AVOIDED COST	BENEFICIARY	LOCATION OF IMPACT	LIKELY ORDER OF IMPACT	BRIEF JUSTIFICATION	LIKELY TIME FRAME	VALUATION METRIC
Tourism	Loss of revenue/jobs generated by tourism industries	Local businesess, TSV	Local	High	Evidence from other communities, literature where fire has occurred		Monetary
Ballooning	Short-term loss of access & associated revenues; Longer-term loss of aesthetics	Local residents, in & out of state visitors, businesses & employees, local gov't, NF	Local	High	Decreased user days likely short-term until fire is controlled/out	Weeks	Monetary
Biking	Loss of access & associated revenues; Possible damage/loss of trails; Longer-term loss of aesthetics		Local	High	Decreased user days; Trail repair or complete trail reconstruction	Months	Monetary
Camping/ Cabins	Loss of access & associated revenues; Costs of damage/loss of campgrounds; Longer-term loss of aesthetics		Local	High	Decreased user days; Campground/cabin damage/loss repair/rebuild	Months Years	Monetary
Fishing	Loss of access & associated revenues; Possible long-term or permanent loss of fishing sites		Local	High	Decreased user days & associated impacts on guides/shop; Need to assess availability of substitute sites as this may decrease impact	Months Years	Monetary
Hiking	Loss of access & associated revenues; Possible damange/loss of trails; Longer-term loss of aesthetics		Local	High	Decreased user days & associated impacts on revenues; Damage/loss of trails	Months Years	Monetary
Horseback Riding	Loss of access & associated revenues; Possible damange/loss of trails; Longer-term loss of aesthetics		Local	High	Decreased user days & associated impacts on guides/shops; Damage/loss of trails	Months	Monetary
Hunting	Loss of popular hunting areas due to loss of habitat & associated revenues		Local	High	Decreased user days & associated impacts on guides/shops	Months Years	Monetary
Motorized Recreation	Loss of access & associated revenues; Possible damange/loss of trails; Longer-term loss of aesthetics		Local	High	Decreased user days & associated impacts on shops. Damage/loss of trails	Months Years	Monetary
Rafting	Temporary loss of access due to fire		Local/Downstream	High	Decreased user days & associated impacts on guides/shops	Weeks	Monetary
Ski Resorts	Loss of access to resort & associated revenues/jobs		Local	High	Reduced user-days, open acreage, trail conditions, deadfall hazards	1 season	Monetary

CATEGORY	DESCRIPTION OF AVOIDED COST	BENEFICIARY	LOCATION OF IMPACT	LIKELY ORDER OF IMPACT	BRIEF JUSTIFICATION	LIKELY TIME FRAME	VALUATION METRIC
Tourism Continued							
Taos Pueblo	Loss of access/operations to resort/casino & associated revenue/jobs		Local	High	Reduced visitor days	Weeks Months	Monetary
Tourism (Non-Sport)	Loss of access/operations to tourism related shops/businesses (e.g., galleries) & associated revenue/jobs		Local	High	Reduced visitor days	Weeks Months	Monetary
Winter Sports (Other than Ski Valley)	Loss of access to ski areas & associated revenues		Local	High	Decreased user days & associated impacts on revenues; Damage/loss of trails	1 season	Monetary
Wildlife/ Landscape Viewing	Loss of access & associated revenues; Longer-term loss of aesthetics		Local	High	Decreased user days & associated impacts on revenues	Years	Monetary
Other Uses	Loss of access & loss of intended use (e.g., mushroom foraging)		Local	High	Decreased user days & associated impacts on revenues	Years	Monetary & Qualitative
Cultural/Traditional							
Sites	Loss of irreplaceable sites of cultural, spiritual, & archeological significance from fire & erosion	Descendants, Pueblo, long-standing residents, world heritage	Local	High	Taos Pueblo	Permanent?	Qualitative
Forest Uses	Loss of traditional forest uses for firewood, fenceposts, etc.	Subsistence users, their communities (e.g., elderly given materials or food).	Local	High	Locals rely on local forests for personal use	Years	Monetary & Qualitative
Public Health							
Smoke Exposure	Costs of health problems (& treatment) related to smoke/decreased air quality	Downwind population	Local	High	Existing studies have estimated health effects of smoke on nearby populations	Days	Monetary & Count
Carbon Emissions	Costs of release of large amounts of carbon	Global, federal social cost of carbon (taxpayers)	Global	High	Estimate difference in carbon emissions from treatment vs mega fire	Permanent	Monetary & Quantity

CATEGORY	DESCRIPTION OF AVOIDED COST	BENEFICIARY	LOCATION OF IMPACT	LIKELY ORDER OF IMPACT	BRIEF JUSTIFICATION	LIKELY TIME FRAME	VALUATION METRIC
River Ecology							
Riparian Vegetation/ Wildlife	Impacts to instream species (e.g., Silver minnow, bull trout, etc.)	Legally responsible, those with a WTP	Local/Downstream	High	Instream condition degradation & associated impact on health and size of dependent species populations	Months Years	
Streamflow	Costs of altered hydrology & timing of flows from watershed runoff	Those with only RoR/short-term storage rights (MRGCD, ABQ, SF, etc.)	Local/Downstream	High	Debris flows	Months Years	Qualitative
Channel Conveyance	Cost of dredging, channel/levee maintenance, blockages and/or morphological effects in-stream	ISC, USACE, ABQ, Reclamation	Downstream		Peralta Plug, ISC/BoR/USACE spending for dredging	Months Years	Monetary
Forest Ecology							
Vegetation/Widlife	Costs of temporary/permanent habitat loss & any associated habitat restoration; Potential impacts to threatened species	State & federal agencies, Pueblo, others with WTP	Local	High	Existing studies have shown both short & long-term effects of fire on forest ecology	Years	Monetary & Qualitative

Appendix B: Categories of Impacts

Category (Unit)	Unit	% Impact w/o	% Impact w/	$/Unit
RGFW treatment - General	Acre	0%	100%	$700
RGFW treatment - WUI private	Acre	0%	100%	$2,150
Wildfire - Suppression	Acre	100%	100%	$325
Wildfire - Cleanup & recovery	Acre	100%	100%	$35
Land - Federal/State	Acre	2%	2%	$1,370
Land - Cropland (Irrigated)	Acre	1%	1%	$3,920
Land - Tribal (Non-residential)	Acre	2%	2%	$1,370
Land - Private (Developed)	Acre	15%	15%	$48,600
Land - Private (Undeveloped/pasture)	Acre	1%	1%	$365
Residences - Destroyed	Home	100%	100%	$174,400
Residences - Property value	Home	15%	15%	$174,400
Residences - Homeowner insurance	Home	25%	5%	$1,300
Roads - Primary	Mile	100%	100%	$15,000
Roads - Secondary	Mile	100%	100%	$10,000
Transmission lines	Mile	100%	100%	$150,000
Surface water - Albuquerque	Day	100%	25%	$700
Surface water - Santa Fe	Day	100%	25%	$700
Surface water - Downstream irrigation	Day	2%	0%	$39,000,000
Reservoir storage & flood control	Day	100%	100%	$0
Taos County - Ag, forestry, hunting	Year	10%	5%	$1,360,000
Taos County - Art dealers	Year	5%	3%	$2,190,000
Taos County - Real estate	Year	15%	5%	$17,830,000
Taos County - Tourism	Year	15%	5%	$71,120,000
Taos County - Other industries	Year	4%	0%	$490,100,000
Taos County - Tax revenues	Year	100%	100%	n/a
Taos County - Tourism - trails, etc.	Mile	100%	50%	$6,000
Taos County - Personal use - Forest	Person-year	100%	25%	$95
Taos County - Personal use - Acequias	Person-year	100%	25%	$825
Taos County - Personal use - Tribal	Person-year	100%	25%	$925
Smoke exposure	Person-day	100%	100%	$10