The influence of collaborative fuel reduction treatments on cross-boundary wildfires east of the Cascade Range in Washington State, USA

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Abstract

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A warming climate and anthropogenic alterations in fuels has resulted in an increase in the average area burned during wildfire events in the Western US. This has led to an increase of cross-boundary wildfires, fires that burn across multiple landowners. As a result, the past decade has seen several programs implemented to support and fund collaborative restoration across landscapes. When trying to create climate and fire-resilient landscapes, forest managers and collaborative groups need to understand how wildfires move across multi-ownership landscapes and the influence collaborative management may have on fire behavior.

We simulated a series of jurisdictional boundary fuel reduction treatments of various intensities and widths across a landscape east of the Cascade Range near Cle Elum, Washington. Our study area encompassed a historically moist-mixed conifer, mixed-severity fire regime that is highlighted as an area of concern for potentially large and destructive wildfires. Two wildfire

models (Randig and FARSITE) were used to quantify the transmission factor between landowners and the influence of fuel reduction treatments on burn probability, fire size, fire spread, flame length and fireline intensity. Collaborative treatments significantly altered predicted fire size and spread compared to individual landowner treatments but were also influenced by the presence of legislative management restrictions. A clearcut with prescribed burn reduced predicted fireline intensity and flame length to the greatest extent and under extreme weather conditions reduced average flame length to heights at which active suppression could occur. Fuel reduction treatments with canopy cover reductions ranging from 30% - 60% resulted in similar decreases of fire severity metrics relative to each other, supporting findings that intensive management may not result in larger decreases in fire metrics compared to moderate management. Fuel treatments were modeled for widths ranging from 50 meters to 500 meters with reduction in fire metrics stabilizing between 300 meters and 400 meters. Proportional to ignitions, the greatest amount of outgoing fire was found for the Bureau of Land Management and Fish and Wildlife while incoming and self-burning fire tended to be concentrated on the US Forest Service and Teanaway Community Forest. However, dominant wind direction was found to influence fire exchange between the US Forest Service and Teanaway Community Forest with results varying substantially between the different fuel reduction treatments and treatment widths.

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1.1 Introduction

Wildfires are a dominant natural disaster that can cause significant losses to both the human and natural environment across the Pacific Northwest (Hagmann et al. 2021). Size, frequency and severity at which wildfires burn has increased over the past few decades (Parks and Abatzoglou 2020; Westerling 2016), due in part to almost a century of fire suppression and a changing climate (Dale et al. 2001; Flannigan et al. 2006; Reiners 2011). Increased burned area can be associated with climatic changes including warming seasonal temperatures, increased length of the wildfire season, drier summers, and decreased winter precipitation (Hessburg et al. 2021). Anthropogenic influences include a period of active and complete suppression that occurred following European colonization in many western American forests (Ryan et al. 2013). This period of suppression led to decreases in both fire frequency and burned area, of which the consequences now include increased fuel continuity and the accumulation of live and dead fuels (Everett et al. 2000; Peterson et al. 2005). In addition to changing climatic conditions and altered forest structure, an increase in human ignitions resulting from population expansion into the forested environment has contributed to the lengthening of the fire season and increased burned area (Balch et al. 2017). As larger and more severe fires begin to occur at higher rates across the western US, there is a growing need to understand how these fires will interact with our landscapes in a warming world and the potential steps we can take to mitigate risk to our forests and communities (Barbero et al. 2015; Halofsky et al. 2020; Parks and Abatzoglou 2020; Reiners 2011; Taylor et al. 2021; USDA 2022; Westerling 2016).

Fire Behavior

Wildfires are measured by a variety of metrics that are categorized by two general classifications, fire severity and fire intensity. Fire severity quantifies the loss of organic matter during a wildfire and fire intensity relates to the energy released during a wildfire (Keeley 2009). Fire intensity can be described by a variety of fire behavior metrics including flame length, rate of spread, heat per unit area or a combination of the previous two metrics referred to as fireline intensity. Flame length is the distance from midway in the active flaming combustion zone to the average tip of the flames and is influenced by vegetation type and fuel moisture (Byram 1959). Rate of spread, the speed at which a flaming zone burns across a landscape, is influenced by wind, slope, vegetation type and fuel moisture (Byram 1959). Fireline intensity is rate of heat transfer per unit length of the fire line and is a representation of the radiant energy released by the flaming zone of a fire (Byram 1959; Keeley 2009). Fireline intensity is calculated as a function of rate of spread and heat per unit. Fireline intensity and flame length are directly related and can be used to determine how a fire will propagate and what strategies should be used for suppression.

Fire Suppression

During an active wildland fire, suppression operations are used to extinguish a wildfire, modify the movement and direction of a fire, or manage a fire (United States Department of the Interior 2021). To accomplish any of these tasks, firefighters manipulate one of the three sides of the fire triangle, oxygen, heat or fuel. Water or fire retardant removes heat from a fire and is dispersed on the ground through pumps and engines or by air with helicopters and airplanes. Vegetation is removed with hand tools, bulldozers or by back burning, a practice where a fire is deliberately set between an established control line and the active fire. Wildfires can evolve quickly as weather, topography and fuels vary across a landscape. Incident commanders need to react swiftly to these changes and determine the appropriate strategies, equipment, and personnel to use in suppression efforts (United States Department of the Interior 2021). On the ground, firefighters need to understand the interaction of their environment with the wildfire as knowledge regarding fire behavior and the tactics most effective for proper suppression are paramount to the safety of firefighters.

Forest Management and Wildfire

A century of wildfire suppression and varied management goals has led to heterogeneity of landscapes across multiple owners (Agee and Skinner 2005; Barros et al. 2021; Hessburg et al. 2005). Across a landscape, management goals can include timber production, grazing, foraging, recreational use, watershed protection, habitat for wildlife, carbon storage and wildfire risk (Ager et al. 2012; Fischer and Charnley 2012). Paired with legislative restrictions, different management practices can result in variable fuel conditions both within and between landowners (Ager et al. 2014; Duncan and Thompson 2006).

There is considerable diversity in how federal, state, and private landowners manage their landscapes to reduce wildfire losses (Charnley et al. 2017). Historically, the treatment of a landscape in relation to wildfires was heavily dependent upon landowners and their management goals, values, practices, perception of fire risk and decision-making drivers (Barros et al. 2021; Charnley et al. 2017). Public managers, such as those working for national forests, state parks and national parks, must adhere to state and federal legislature when managing around wildfire. Often, these managers work within narrow guidelines that can include conflicting goals such as restoring natural fire regimes while also suppressing most wildfires within their boundaries. Private landowners tend to be mostly interested in protecting property and industrial landowners are primarily focused on protecting their economic investment, while tribal managers often balance multiple objectives including reintroducing fire, protecting timber production, and managing spiritual and cultural values (Ager et al. 2019; Dockry and Hoagland 2017). Industrial landowners practice full fire suppression and view mechanical harvesting for timber production as their main management to reduce wildfire losses. Additional practices included understory thinning, burning slash piles and creation of fuel breaks along borders with federal lands (Charnely et al. 2017). As designated by state legislature, state forests within Washington must produce a sustainable yield of timber to generate income for schools, state institutions, and county services (Washington Department of Natural Resources 2006). To protect these landscapes, state forests practice full suppression of wildfires and manage wildfire risk through burning slash piles, creating fuel breaks along roads and intensive management along federal borders (Reiners 2011). Currently, complete suppression is practiced on federal forests with fire hazard reduction comprised of mechanical treatments, prescribed fire and piling and burning slash. Most preventative fire reduction projects on federal forests are implemented within the Wildland Urban Interface (WUI) (Charnely et al. 2017). Fragmentation of the landscape as a result of varying management practices and nearly a century of fire exclusion has altered natural disturbance regimes throughout the western United States (Hessburg et al. 2015). This deviation has given rise to larger and more severe wildfires and when paired with extreme weather events, these fires can escape coordinated suppression efforts (Hessburg et al. 2015).

Cross-Boundary Fire

Cross-boundary wildfires are fires that burn across multiple landowners. The occurrence of these events has risen due to increases in wildfire size, extreme weather events and fires that escape suppression efforts. From 1995-2012 over 1 million ha of private land burned from wildfires that originated on western US national forests (Ager et al. 2014) and a recent modeling study found that across eleven western states, on average, one-third of predicted burned area was the result of fires starting on different land ownerships (Palaiologou et al. 2019). From a social standpoint, the perception of risk for cross-boundary wildfires is also high. Charnely et al. (2017) found that private and commercial landowners in Oregon state treated their lands that bordered US Forest Service property to a greater extent when trying to reduce their wildfire risk. Common viewpoints among private landowners are that federal forests are overstocked and lack management which in turn, allows for unimpeded fire across the landscape (Charnley et al. 2017). However, fuel treatments on individual land ownerships rarely influence wildfire risk to the same extent as coordinated landscape-scale reduction efforts (Charnley et al. 2020; Hessburg et al. 2015). As large cross-boundary wildfires become more common, there is a growing need to approach wildfire mitigation on a landscape-scale through collaborative restoration.

Several programs have been developed to increase communication and decrease the economic hurdles associated with collaborative forest management (Ager et al. 2014; Schultz et al. 2012). On a national level, these policies include the National Fire Plan, Healthy Forest Restoration Act (HFRA 2003), the Federal Land Assistance, Management and Enhancement Act (FLAME 2010) and goals outlined in the US Federal Wildfire Policy of 2013 (Ager et al. 2014). The National Cohesive Wildland Fire Management Strategy finalized in 2014, brought together Federal, Tribal, State, local governments, and nongovernmental organizations to develop a comprehensive collaborative strategy for wildfire management. The three main goals outlined by this group include: 1) restoring resilient fire-adapted landscapes; 2) building fire-adapted human communities; and 3) responding safely and effectively to wildland fire (USDA Forest Service 2022).

As our understanding of wildfire has increased over the past few decades, there has been a shift in management from insular risk reduction to the recognition of the need for landscape-scale management to decrease the risk of large destructive wildfires (Charnley et al. 2020). Numerous approaches built around collaborative agreements of fuel reduction treatments across multiple landowners have been employed to restore and maintain landscapes (Charnley et al. 2017). Beginning in 2009, the US Forest Service adopted an "all lands approach" to forest restoration that calls for collaboration between ownerships for landscape-scale restoration (Fischer and Charnley 2012). Collaborative groups that have resulted from this ideology include the implementation of the USDA FS 2012 Planning Rule, Prescribed Fire Councils, Fire Learning Networks, Fire Safe Councils, and the Co-Management of Wildfire Risk Transmission Partnership (CoMFRT) (Charnley et al. 2017). Since 2014, the Joint Chief's Landscape Restoration Partnership, also known as the Collaborative Forest Landscape Restoration Program (CFLRP), has facilitated the restoration of landscapes between state, tribal and federal entities (USDA 2018). In 2018, Congress signed the Farm Bill which included the Good Neighbor Authority, legislature that allows the USFS to enter into agreements with state forestry agencies in cross-boundary management (USDA Forest Service 2022).

Within Washington State, nine collaborative areas have been created between landowners in similar geographic regions to support the implementation of landscape-scale forest restoration both within and between owners to promote forest resiliency (Ramsey 2019). While the rationale for each landowner's desire to decrease the possibility of fire on their land might be the result of protecting different investments, the facilitation of landscape-scale treatments is beneficial for everyone in decreasing instances of large, high-severity fire.

A key part in the development of these cross-boundary plans is knowledge regarding how fire behaves on a landscape and the transmission risk between different ownerships. Barros et al. (2021) found that patterns of cross-boundary wildfires generally followed patterns set out by management objectives. They found that lands used for commercial timber production and housing developments tended to burn less than expected given their availability to fire, most likely as the result of aggressive suppression tactics used to protect economic investments and structures. Meanwhile, they found areas categorized as USFS wilderness burned more than expected and hypothesized that this may result from wildfires being allowed to burn to meet resource objectives, a strategy known as living with fire (Barros et al. 2021). Other hypotheses for higher burn rates in wilderness areas include remoteness, inaccessibility to suppression resources, delayed detection, and higher fuel loads (Johnston et al. 2021).

Fuel Reduction Treatments and Fuelbreaks

Forest fuels can be classified into four distinct categories; 1) ground, 2) surface, 3) ladder and 4) crown (Stephens et al. 2012). Ground fuels include the duff layer present on the soil surface, while surface fuels are all dead and down woody material, grasses, litter, short shrubs and herbaceous plants. Ladder fuels include small trees or shrubs, and crown fuels encompass the branches, needles and leaves in a trees canopy (Stephens et al. 2012). Each of these categories influences fire behavior in separate ways. In Western US forests, ground fuels are often not deep enough to contribute to wildfire spread or intensity and unless fire has spread into the canopy, crown fuels also contribute less to fire hazard (Agee and Skinner 2005). Surface and ladder fuels are the largest contributors to fire behavior. Surface fuels heavily influence the rate of spread, flame length and energy release of fires through their species composition, density, and vertical structure, while ladder fuels can carry a fire burning on the surface up into the crown (Agee and Skinner 2005). Fuel reduction treatments are used to remove fuels from a combination of the four categories described above to decrease potential fire intensity and the spread rate (Stephens et al. 2021).

Fuel reduction treatments used to minimize the impacts of future fire include mechanical thinning, managed wildfire, prescribed fire, or a combination of these techniques (Hoffman et al. 2018). The focus of fuel reduction treatments is often on decreasing the probability of crown fire and spread (Stephens et al. 2021). Once a fire burns into the crown, the ability to control or slow down fire spread drastically decreases. Crown fires tend to have greater fireline intensities, faster spread rates, larger ecological impacts, and increased creation of fire brands (Stephens et al. 2021), flaming objects that can be lifted and carried large distances away from a flaming zone and start spot fires (Morvan 2020). Agee and Skinner (2005) determined four ways to alter the fuels complex and decrease the likelihood of crown fire: 1) reduce surface fuels, 2) increase canopy base height, 3) reduce canopy bulk density and 4) maintain large fire-resistant trees. Numerous studies, both in-situ and theoretical, have found that mechanical thinning followed by prescribed burning is effective at reducing surface and ladder fuels and decreasing future fire behavior (Agee and Skinner 2005; Finney et al. 2005; Pollet and Omi 2002; Prichard et al. 2010; Prichard and Kennedy 2014; Schmidt et al. 2008; Stevens et al. 2016). Stephens et al. (2009) note that for treatment designs utilizing both mechanical thinning and prescribed fire, importance needs to be placed on completing the whole treatment as the lack of prescribed fire can result in no change or increased surface fuel loadings and potentially increased fire behavior. Landscape level restoration is often complicated by a mixture of legal and physical constraints such as mechanical access, land use or conservation restrictions (Stephens et al. 2021). Studies over the past few decades have found fire spread and severity can be significantly decreased with strategically located treatments on just 18%-20% of a landscape (Calkin et al. 2011; Finney 2001; Prichard and Kennedy 2014; Tubbesing et al. 2019). The effectiveness of fuel reduction treatments is dependent upon continuous maintenance of the treated area to reduce new growth and create a fire-resilient forest (Loudermilk et al. 2014).

Mixed-Severity Fire Regimes

Wildfire regimes are generally classified into three broad severity categories: low, mixed, and high. These categories are influenced by the vegetation across a landscape, ignitions patterns and mean climate. A low-severity fire regime usually encompasses areas that have frequent fire return intervals (0-35 years) and burn less than 20% of other overstory or basal area within a fire perimeter (Agee 2005). While a high-severity regime is classified as greater than 75% basal area or overstory loss and can occur on a variety of return intervals from high frequency (0-35 years), medium frequency (35-200 years) to low frequency (200+ years) (Agee 2005). Therefore, the last regime, mixed-severity, is somewhat of a “catch-all” to describe any fires that burn between 20-70% of their basal area and at a frequency of 35-200 years (Agee 2005; Lesmeister et al. 2019). Due in part to this broad categorization, mixed-severity fires tend to be the least understood of the three main fire regime classifications (Halofsky et al. 2011; Perry et al. 2011). The patch-work landscape that is often indicative of a mixed-severity fire regime is the result of varying fire return intervals and mixed fire behavior within and between fires (Halofsky et al. 2011). The complex pattern that develops across the landscape is the result of different amounts of surface, torching and crown fire (Agee 2005; Halofsky et al. 2011). Across the landscape, patches of early, mid, and late successional habitats can support a large variety of plant and animal species (Perry et al. 2011) and can range in size from a few square meters to hundreds of hectares. More so than their low and high-severity counterparts, mixed-severity fire regimes are influenced by top-down and bottom-up forces. As the top-down force, regional climate alters patterns of seasonality, temperature, and precipitation which in turn influence both fire frequency and severity (Perry et al. 2011). Bottom-up forces include stand structure and topography, which can create variable burn severity across landscapes that experience the same climate (Perry et al. 2011). A landscape that experiences mixed-severity fire often leads to subsequent mixed-severity fire, as the variability in burn conditions from a previous fire can influence the fuel availability for the next fire and thus the severity at which it burns (Agee 2005). Perry et al. (2011) found that mixed-conifer forest types such as Douglas-fir, white fir, or pine, that occupied cool and mesic environments most likely experienced mixed-severity fire regimes in the past, with these habitats being classified as moist-mixed conifer.

Moist Mixed-Conifer Forests

Moist mixed-conifer forests cover a large area east of the Cascade Range and provide a variety of ecosystem services including carbon sequestration, watershed protection, and terrestrial and aquatic wildlife habitat (Stine et al. 2014). They typically included a mixture of shade-intolerant ponderosa pine (*Pinus Ponderosa)* or western larch (*Larix occidentalis)* and shade tolerant Douglas-fir (*Pseudotsuga menziesii),* white fir (*Abies amabalis)* or grand fir (*Abies grandis)* (Stine et al. 2014). Growing in mid-to-upper montane elevations (1680 m - 3048 m) along northerly aspects or valley bottoms, moist mixed-conifer forests historically burned at mixed-severity resulting in both low- and high severity patches across a landscape (Stine et al.

2014). However, decades of fire exclusion and anthropogenic disturbances including logging and grazing have altered forest composition, structure, and function (Stine et al. 2014). As a result, there has been a shift in moist-mixed conifer forests to higher densities of young shade-tolerant conifers as opposed to a historical composition of large fire-resistant species (Perry et al. 2011). Additional deviations from historical conditions include 1) loss of older trees, 2) dense forest structure containing multiple canopy layers, 3) high continuity of homogeneous stands and 4) increased fuel loads both on the ground and in the canopy (Franklin et al. 2008).

Following EuroAmerican settlement, the forests of the Pacific Northwest experienced a period of rapid change. Clearcuts and selective harvests altered forest structure in historically mixed severity fire regimes (Perry et al. 2011). While patches of varying structural composition could have potentially continued to occur on the landscape due to wildfires, the era of fire suppression accelerated the successional timeline of forest structures and allowed understories to be dominated by young shade tolerant conifers (Perry et al. 2011). For example, on the eastern slopes of the mixed conifer zone of the central Oregon Cascades, 89% of trees older than 150 years were comprised of fire-resistant species such as ponderosa pine, western white pine, or Douglas-fir, whereas 90% of trees younger than 100 years were either grand fir or lodgepole pine (Perry et al. 2011). The introduction of a dense shade-tolerant understory can potentially increase fire risk as understory species act as ladder fuels to carry fire from the surface into the canopy (Perry et al. 2011). However, in some stands this increased density can decrease fire risk as shade produced by denser canopy cover can lead to increased fuel moisture and high densities of trees can block wind (Perry et al. 2011).

Definitions of Fire: Risk, Exposure and Behavior

The analysis and research of wildland fires utilizes a variety of terms that all correspond to different components of fire across temporal and spatial scales (Hardy 2005). Throughout this study I will be discussing the following metrics: wildfire risk, wildfire exposure, transmission risk and fire behavior. Wildfire risk is the expected loss calculated by the likelihood of ignition, expected fire intensity, and effects of fire intensity on the surrounding community, such as vegetation and structures (Ager et al. 2019). However, wildfire exposure only relates to predicted fire occurrence and intensity without further calculation of expected losses (Ager et al. 2019). This study analyzes wildfire exposure as I do not calculate expected losses to the study area due in part to the computational limitations of the selected wildfire models. However, wildfire risk will be mentioned in relation to previous studies. My use of the term transmission risk follows the rationale set forth by Ager et al. (2014), that defines the term as the potential for fire on parcel A given ignition on parcel B without consideration of expected loss. When discussing the influence of implemented fuel reduction treatments, my analysis will revolve around metrics related to fire behavior which is the interaction of fuels, topography, and heat, most often described in terms of flame length, rate of spread and fireline intensity (Hardy 2005).

Overall Goal

The purpose of this study was to analyze the influence of collaborative multi-entity fuel treatments on wildfire behavior in a mixed-severity fire regime forest. Focus on collaborative management specifically in a mixed-severity forest was two-folded:

1) Given their complexity over both spatial and temporal scales, mixed-severity fire regimes are understood less than their high and low severity counterparts and future

climatic conditions are projected to increase the wildfire occurrence within these areas (Halofsky et al. 2011; Hessburg et al. 2016; Perry et al. 2011).

2) The call for collaborative management across different ownerships has increased over the past decade, notably in relation to reducing wildfire behavior. However, decades of conflicts, lawsuits and euro-centric management has led to hesitation among landowners (Hessburg et al. 2015). To overcome past issues, there is a growing need for a scientific foundation to support collaborative management and highlight areas in which collaborative management would be beneficial across a landscape (Charnley et al. 2017).

By simulating a variety of fuel reductions and potential wildfires within these forests, I hope to add to the body of research utilized by landowners when considering future fuel reduction projects and the benefits of collaborative management.

The broad research question for this study was: how do collaborative fuel treatments of varying width (treatment size) and intensity (treatment prescription) influence fire behavior in cross-boundary wildfires?

To better address this question, I addressed the following:

1. How do fuel treatments of varying widths, intensities and placements compare in their ability to influence cross-boundary fire size relative to an untreated landscape?
2. How do fuel treatments of varying widths, intensities and placements influence fire behavior in and around a treated area?
3. How do fuel treatments influence the transmission risk between different landowners across a landscape?
4. Can an extreme weather event be halted by a fuel reduction treatment?

1.2 METHODS

1.2.1 *Study Area Criteria*

To analyze the influence of fuel reduction treatments on cross-boundary wildfire fire behavior, size, and movement between different landowners, I needed to identify a landscape on which to conduct my study. When narrowing down potential landscapes I determined a series of six base parameters.

1. A landscape classified as a mixed-severity fire regime as outlined by the Interagency Fire Regime Condition Class Guidebook and utilized within LANDFIRE.
2. A minimum of two different landowners across the landscape. To properly analyze the influence of collaborative fuel treatments I needed to incorporate more than one ownership.
3. In situ differing management practices on the landscape across the different ownerships that could be easily identifiable with remotely sensed data.
4. A landscape where the dominant fuel model was classified as Timber-Understory according to Scott and Burgan (2005) 40 Fuel Models. This allowed me to remove grass fires and isolate my study in a landscape where fire spread within forested stands was plausible.
5. A landscape that had continuous fire carrying fuels which could feasibly support a Class G large wildfire fire event, as defined as a fire greater than 2023 hectares (National Wildfire Coordinating Group 2021).
6. A landscape where ownership borders resided in areas where fuel treatments were plausible, thus discounting alpine terrain and non-forested landscapes.

1.2.2 *Study Area*

After considering the six parameters outlined above, I narrowed down the study area to a 228,143-hectare region just east of the Cascade Range in Washington, USA (Fig. 1). The Köppen-Geiger climate classifications of the study area include Dsb (Cold, dry summer, hot summer) and Dsc (Cold, dry summer, cold summer) (Beck et al. 2018) depending on elevation. According to annual weather data collected from the Swauk Remote Automated Weather Station (RAWS) from 1899 – 2021, the mean annual temperature is 14.5 °C, ranging from -6.6 °C (January annual average minimum) to 27.6 °C (July annual average maximum). Mean annual precipitation is 576 mm with the majority occurring between October and March (Table 1). Elevation across the study area ranges from 233 meters to 2863 meters and includes various forest types with 68.2% of the study area is classified as either a Timber-Understory or Timber Litter fuel model (Table 2; Fig. 2b) (Scott and Burgan (2005)).

Low elevation forests within the study area are mostly Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*) with a high frequency (<35 years), low and mixed severity fire regime (LANDFIRE 2020; Table 3). Mid-elevation forests are dominated by a mix of Douglas-fir (*Pseudotsuga menziesii*) and grand fir (*Abies grandis*) with a mixed severity fire regime with moderate return intervals (36-100 years). High elevation forests contain mountain hemlock (*Tsuga mertensiana*) and subalpine fir (*Abies lasiocarpa*) that can burn at a variety of severities (low, medium, and high) (Agee 2003). Overall, the study area is mostly characterized by the fire regime code III-A which corresponds to mixed (25-75% severity) to low (0-25%) severity fires that occur on a historic interval of 35-200 years (LANDFIRE 2020).

The Wildfire Hazard Potential (WHP) tool depicts the probability of an area supporting a wildfire that would be difficult for suppression resources to contain (Dillion 2015). The WHP is used to identify areas across the United States where vegetation treatments could be implemented to reduce the intensity of future wildfires and is categorized on a five-level scale of very low, low, moderate, high and very high. When defined by the five levels of the WHP, 37.7% (87,239 ha) of the study is categorized as very high, 21.1% (48,813 ha) as high and 21.2% (48,966 ha) as moderate (Table 25).

Since the 1950s, forests in the area have undergone various anthropogenic disturbances. Selective cutting and partial removal cuts on federal land between the 1950s and early 1980s removed large ponderosa pine, Douglas-fir, and western larch, allowing for growth of a grand fir and Douglas-fir understory (Bommarito 2019). On privately owned forest lands, clear cutting, and selective harvests have resulted in large accumulations of untreated logging slash (Townsley et al. 2004). Decades of fire exclusion paired with these harvest activities has led to a major shift in species composition from pine and larch forests to grand fir and Douglas-fir (Townsley et al. 2004).

1.2.3 *Land Ownership*

Ownership within the study area includes the United States Forest Service (FS), the Washington Department of Natural Resources (DNR), the United States Fish and Wildlife Service (FWS), and The Nature Conservancy (TNC), along with state and private parcels (Fig. 2a).

Historically, timber production was the primary objective of the working forests within the study area. Prescriptions targeted economically viable species such as large Douglas-fir and ponderosa pine (Townsley et al. 2004). Starting in 1994, a large shift in land management objectives and ownership groups began with the Northwest Forest Plan (NWFP). The NWFP almost permanently ended active harvest on federal lands as management goals switched from sustained timber harvest to the conservation of biodiversity and ecological processes (Franklin and Johnson 2009). As the timber industry changed in the region and management goals shifted to more ecologically based conservation (Spies et al. 2018), large amounts of previously private timberlands began to be bought by a variety of public agencies. In the early 2000s, many parcels of private lands within the boundary of the Cle Elum Ranger District were acquired by the Okanogan-Wenatchee National Forest (Townsley et al. 2004). The Teanaway Community Forest was created in 2013 following the purchase of 20,332 ha of land from American Forest Holdings LLC (WA DNR 2015). The acquisition, authorized by the Governor and Legislature, is to protect a segment of the Yakima River Basin watershed and is managed by the Department of Natural Resources with consultation from the Department of Fish and Wildlife (WA DNR 2015). In 2014, The Nature Conservancy purchased 19,393 ha of land from the Plum Creek Timber Company with the goal of restoring long-term forest health (Overview Washington Nature 2022). Active management occurs on a variety of lands within the study area, with objectives and practices based on guidelines outlined in the Northwest Forest Plan and Forest Practices Act (Table 4).

1.2.4 *General Wildfire Modeling*

Wildfires remain one of the more complicated disasters in the world as they are both hard to predict and hard to extinguish (Sayad et al. 2019). Fire behavior can change quickly as wildfires move across a landscape and encounter new fuels, topography, and weather (Holsinger et al. 2016). At certain sizes, a single wildfire, or multiple wildfires in the same area, can begin to produce its own weather, a phenomenon called a firestorm. Instances of firestorms are hard to predict and the weather they produce can lead to drastic changes in fire behavior (Fromm et al.

2010). Given the large amounts of fire we see in the United States, there has long been a goal of trying to understand how wildfires move across a landscape and interact with the environment.

The science of fire modeling has been around since the early 20th century and has evolved from pen-and-paper calculations to advanced physics-based models run on supercomputers (Mell et al. 2010; Stratton 2006). The basis of most fire models used around the world is Rothermel's 1972 spread equation. Building upon previous decades of research and data, Rothermel's "A Mathematical Model for Predicting Fire Spread in Wildland Fuels" detailed the structure and function of a quasi-empirical model for calculating the steady state spread rate and intensity of wildland surface fire (USDA Milestones 2022). Following Rothermel's fire equation, Huygens principle of wave propagation began to be adapted to model fire spread and is currently one of most common methods for modeling fire propagation (Ciarochi 2020). Since the 1990s remote sensing has produced fuel maps of the entire United States, current maps are now available at a 30-meter resolution and updated every two years (Stratton 2009). The availability of fine-scale vegetation layers has since allowed the incorporation of Monte Carlo simulations into fire models for use in risk analysis (Finney et al. 2011). Computational power paired with remote sensing led to the development of complex 2D and 3D based spread models (Bakhshaii and Johnston 2019; Stratton 2006) which in turn have been coupled with atmospheric models through the use of computational fluid dynamics (Bakhshaii and Johnston 2019).

The goal of wildfire modeling is to better understand wildfires both before, during and after they burn across a landscape. Models allow managers and scientists to theoretically burn fires ranging from the stand level to entire regions and test various weather scenarios, fuel treatments or suppression efforts (Loehman et al. 2020). Results from these models allow managers to decide when and where it is safe to prescribe burn, determine the risk analyses of an area, develop fire management plans, and analyze fuel treatments prescriptions and layouts. Understanding how future wildfires will behave in different situations is paramount to developing strategies to live safely with fire.

During an active wildfire, fire models can be used to estimate potential fire behavior and effective suppression efforts. Models can provide firefighters with the probable direction a fire could burn, how quickly it might arrive at various points and the potential intensity of a fire in metrics such as flame length, rate of spread and energy production. Therefore, fire models are important to determine suppression strategies and the safest way to deploy firefighters and plan community evacuations (Ciarochi 2020).

1.2.5 *Methodology Flowchart*

The stepwise flowchart in Fig. 3 identifies each generalized step of the study:

1) Input data is downloaded from LANDFIRE, described in section 1.2.6;
2) Treated areas are identified and manipulated in the Forest Vegetation Simulator (FVS) and RStudio, described in section 1.2.8.;
3) Newly formed .tif files are combined with weather data from FireFamily+, described in section 1.2.7;
4) Input data is run through simulations models FARSITE and Randig, described in sections 1.2.6 and 1.2.9 for the former and sections 1.2.6, 1.2.10 and 1.2.11 for the latter;
5) Outputted metrics are analyzed in RStudio, described in 1.2.12.

1.2.6 *FARSITE, Randig and LANDFIRE*

Developed by Mark Finney at the Missoula Fire Lab, the Fire Area Simulator (FARSITE) is a two-dimensional fire modeling system that links multiple empirical and deterministic sets of mathematical equations (Stratton 2006). FARSITE incorporates surface fire spread (Albini 1976, Rothermel 1972), crown fire spread (Rothermel 1991, Van Wagner 1977, Van Wagner 1993), spotting (Albini 1979), point-source fire acceleration (Forestry Canada Fire Danger Group 1992), and fuel moisture (Nelson 2000) to model fire behavior. FARSITE simulates wildfire growth and behavior for extended periods of time under diverse conditions of terrain, fuels, and weather.

Temporal variations due to weather conditions are modeled in FARSITE in addition to dependent fire behavior calculations. As a result, FARSITE is often used to determine fire movement across a landscape (Stratton 2006). While newer models couple fire to fire or fire-atmospheric interactions (Coen 2018, Kochanski et al. 2013), FARSITE is considered one of the more reliable models for fire suppression management and fire preparedness analysis (Williams et al. 2014).

FARSITE requires a series of spatial files to simulate fire spread and weather inputs including air temperature, wind speeds, wind direction and relative humidity (Finney 1998). Incorporation of a spotting probability factor is based on equations derived from Albini (1979) that utilize particle size distribution, wind velocities and fire intensity (Cochrane et al. 2012). During crown fire events, FARSITE models firebrands that are lofted into the air based on empirical data from different tree species (Cochrane et al. 2013).

The incorporation of firebrands in FARSITE allows for barriers such as roads, rivers, lakes, and fuel treatments to be bypassed and for spot fires to occur multiple kilometers away from the flaming front, altering growth patterns and fire behavior (Finney 1998. Spotting within FARSITE is based on Albini's (1979) equation for firebrand creation from torching trees and only occurs when passive or active crown fire is detected (USGS 2010). At each vertex, dependent upon fire perimeter and distance, pixel resolution and timestep, 16 incrementally sized embers are lofted and simulated downwind. Ember direction and distance are dependent on canopy cover, crown fraction burned, elevation, winds, tree species and tree diameter at breast height (USGS 2010). Embers fall at their terminal velocity, derived from diameter and initial loft time, during each timestep which allows for changes in ground elevation, wind speed and overall flight time and extinguish if they are airborne longer than the average burning duration for an ember of that size (Albini 1979). If the ember lands on a pixel with a burnable surface, a spot fire is ignited (Finney 1998). Users set a spotting probability and ignition delay in FARSITE with recommendations to lower probability overall in FARSITE (USGS 2010). Due to spotting, FARSITE simulations are inherently stochastic and model outputs are unique each time they run, regardless of unchanged input parameters (Cochrane et al. 2012).

Developed as a command-line version of the Minimum Travel Time module (Finney 2006), Randig is a multi-threaded algorithm that allows for Monte Carlo simulations of thousands of randomized ignitions across a landscape (Ager et al. 2010, Gannon et al. 2020). As opposed to FARSITE, which models continuous spread of wildfire over multiple days, Randig was created to simulate discrete burn periods within large fires (Ager et al. 2012). Due to its Monte Carlo capabilities, fire perimeter output and computation of burn probability, a multitude of studies have used Randig to simulate landscape transmission risk in relation to fuel treatments (Ager et al. 2010; Ager et al. 2012; Chiono et al. 2017; Drury et al. 2016; Haas et al. 2015; Oliveria et al. 2016). Environmental variables in Randig are held constant throughout each simulation, a feature that allows for concentrated analysis on the influence of fuels and topography. Within Randing, surface spread is modeled using Rothermel equations and crown fire initiation follows Scott and Reinhart's algorithm (Hass et al. 2014). Due to computational complexity and storage space limitations, Randig only stores fire perimeters and ignition locations for each fire, not pixel-specific values per individual ignitions, such as FARSITE (Ager et al. 2014).

Fire growth in both Randig and FARSITE is based on Huygen's principle (Finney 1998; Finney 2002; Finney 2006) with the expansion of fire as an elliptical wave front in which each vertex can be the source of an independent elliptical expansion (Finney 1998). As a result, fire shape is less distorted and fire spread is more accurately predicted (Ager et al. 2010).

Ignition start locations within Randing can be randomized for each simulation or reused across multiple simulations. To utilize the same series of ignitions across multiple simulations, a fire list that contains the x and y coordinates of each ignition's starting point, in the same coordinate system as the landscape file. Due to the static nature of the simulations, a single set of scenarios describing the constant fuel moisture, wind speed and wind direction are inputted in addition to spot probability and burn duration.

LANDFIRE is a nationwide geospatial database that provides fire, fuel, and vegetation mapping in support of cross-boundary planning and management (Rollins 2009) and is the basis for the majority of fire decision support systems in the United States (National Academies of Science 2017). Data for use in FARSITE and Randig can be obtained from LANDFIRE in the form of a single binary file called an LCP. This file contains the required eight spatial inputs for each application; elevation, slope, aspect, fuel model (Anderson 1982; Scott and Burgan 2005), canopy cover, canopy height, canopy base height and canopy bulk density (Stratton 2009).

LANDFIRE data is provided at a 30 m x 30 m resolution but pixel dimensions for each individual project may differ to match the extent of the project, the type of fire modeling system used, and the outputs desired (Scott et al. 2013). For larger scale projects encompassing whole states, regions, or the countries, LANDFIRE data is often resampled to coarser resolutions between 60 m and 270 m (Ager et al. 2012; Ager et al. 2013; Finney et al. 2011; Kreitler et al. 2020; Scott et al. 2013; Stratton 2006). Resampling to coarser resolutions is often done to achieve practical simulation times for large projects (Chiono et al. 2007; Finney et al. 2011; Kreitler et al. 2020) but has the downside of losing heterogeneity across the landscape; often resulting in an overestimation of fire spread and crown activity through the loss of natural firebreaks (Scott et al. 2013). One-way researchers combat homogenizing through coarse resolution is to use the "nearest-neighbor" method when resampling, which allows riparian corridors and roadways to remain in the landscape (Scott et al. 2013). Risk assessments utilizing 30 m x 30 m LANDFIRE data more often occur at scales of landscapes, project areas or single events (Finney et al. 2011). A strength of this resolution is that the assessments can be used for specific management responses and priorities through scenario analysis while identifying areas of high risk across the landscape at a finer scale (Calkin et al. 2011). Conducting projects at this scale also requires the integration of community priorities and the challenges associated with navigating the intersection of multiple stakeholders, limitations that are diluted for more generalized larger scale assessments (Calkin et al. 2011).

1.2.7 *Weather*

Weather data for the use in FARSITE and Randig simulations was taken from the Swauk Remote Automated Weather Station (RAWS) (Zachariassen et al. 2003) located northeast of Cle Elum, WA. Data was compiled for use in FireFamily+ (Bradshaw 2022), a software package used to calculate hourly and daily fire weather observations from historically observed data. Within FireFamily+, temperature, precipitation, humidity, wind speed and direction and fuel moisture were summarized for use in both FARSITE and Randig. Two unique weather scenarios were utilized for the simulations, a "real-world" consisting of weather experienced during the Jolly Mountain fire of 2017 and an "Extreme" case where 97th percentile weather was isolated from the Swauk RAWS records.

Weather experienced during the 2017 Jolly Mountain fire near Cle Elum Lake was used to model real-world wildfire conditions. The Jolly Mountain fire burned at low to mixed severity over three months starting in August of 2017. Weather for the 2017 fire season in the region was unique for a variety of reasons. At the time, August 2017 was the warmest month recorded since data collection began in 1950. The three-month period of June, July and August was also the warmest on record for most of the western United States (USDA Forest Service 2017). While higher-than-normal amounts of snowfall and precipitation had been seen in the region during the spring of 2017, a three-month drought from June to August resulted in flash drought conditions (USDA Forest Service 2017). Spring was categorized by a period of higher plant growth due to warmer temperatures and higher precipitation levels. However, the flash drought conditions experienced in the summer months led to rapid shifts in dead fuel moisture, development of drought stress in live fuels and drying of fine fuels (USDA Forest Service 2017). Elevated temperatures paired with the flash drought resulted in increased fire danger during the summer months (USDA Forest Service 2017). While the Jolly Mountain fire burned during this period of higher-than-normal temperatures and lower-than-normal fuel moisture, recorded winds were within the normal range experienced in the region. We chose to utilize the weather experienced during the Jolly Mountain fire because it is a proven case where fire growth was feasible on the landscape.

Conditions for use in the "Extreme" weather scenario were identified using the event locator tool within FireFamily+. Large wildfires tend to occur with above-normal temperatures, below-normal dead fuel moisture and high wind speed events (Abatzoglou et al. 2018). Created by the U.S. National Fire Danger Rating System, the Energy Release Component (ERC), is a measurement of fire danger and seasonal drought (USDA Forest Service 2017) and can be used as a stand-in for the influence that fuel moisture has on fire behavior. Following Finney et al. (2010) we used the ERC as a deterministic metric within FireFamily+ to isolate extreme fire conditions, as higher ERC values tend to correspond with lower fuel moistures (Andrews et al. 2003). Event locator criteria included a period length of four hours, max gusts speeds greater than 24 kph, a dry bulb temperature greater than or equal to 75 degrees and a relative humidity less than or equal to 25%. For the list of periods that met these conditions, maximum values over three consecutive days were extracted. The three days both pre and post maximum values were exported for fuel moisture conditioning in FARSITE (Appendix C).

1.2.8 *Treatment Design*

1.2.8.1 Treatment Width

The effectiveness of fuel reduction treatments has long been debated within the fire management community (Agee et al. 2000). The earliest fuel reduction treatments were known as fuelbreaks and called for treatment widths between 60 – 90 meters in which vegetation was permanently changed to a lower fuel volume for reduced flammability (Green 1977). This often resulted in barren fuelbreaks with very little live vegetation. Retention of forest canopy was introduced with the concept of shaded fuelbreaks (Agee et al. 2000). This concept was expanded upon in the creation of defensible fuel profile zones (DFPZ) which are areas that limit fire behavior, reduce likelihood of canopy fire, and provide safe access for suppression activities (Kennedy et al. 2019; Moghaddas et al. 2010). Defensible fuel profile zones are often treated to widths between 400 – 800 meters with a combination of mechanical thinning from below and prescribed fire (Kennedy et al. 2019). Recent research has found that fuelbreak widths greater than 400 meters may be needed to reduce fire behavior (Kennedy et al. 2019) and while fuelbreaks have been found to reduce severity in past wildfire events (Agee et al. 2000), their effectiveness in fires burning during extreme weather events is less understood (Prichard and Kennedy 2014).

For my study I wanted to analyze the effectiveness of collaborative border treatments. To achieve this, I isolated the treatment zones to the largest administrative boundaries occurring within the study area (Fig. 2a), which resulted in an 82-kilometer treatment boundary. Based on the research discussed above, treatment zones centering around this 82-kilometer boundary ranged in widths from 50 – 1500 meters depending on the weather scenario (Table 5).

1.2.8.2 Treatment Prescriptions

Fuel treatments often focus on reducing the probability of crown fire ignition and spread (Stephens et al. 2009) by altering four components of a stands fuel structure as outlined by Agee and Skinner (2005):

1. Reducing surface fuels;
2. Increasing canopy base height (CBH);
3. Reducing canopy bulk density (CBD);
4. Maintaining large fire-resistant trees.

These reduction practices can influence a variety of fire behavior metrics (Table 6) and are achieved by many treatment types including mechanical thinning, managed wildfire, and prescribed fire (Stephens et al. 2021). Multiple studies have shown that mechanical thinning treatments that are followed by prescribed fire have the highest impact on reducing fire severity (Kalies and Yocom 2016; Prichard and Kennedy 2014; Stephens et al. 2012). It is important to note that this combination of treatments is at its most effective when a prescribed fire occurs shortly after treatment, postponement or an incomplete fire treatment can result in no change or even an increase in surface fuel loads (Stephens et al. 2021). While treatments that include prescribed burning have been found to have the greatest reduction in burn severity, Prichard and Kennedy (2014) found that treatments without surface fuel reduction, such as clearcut and thin treatments, reduced burn severity relative to untreated stands.

Within my treatment zones I implemented five unique prescriptions over varying intensities in addition to an untreated scenario. My treatments can be broadly categorized as either a firebreak or fuelbreak. Firebreaks are areas where all vegetation and organic matter has been removed to bare soil to halt the advancement of a fire, whereas fuelbreaks are areas of modified or reduced fuel loads to decrease a fire's severity (Bennett et al. 2010). When designing the five fuel treatments, I manipulated four out of five stand metric layers that are utilized by FARSITE and Randig. Manipulated layers included canopy cover, canopy base height, canopy bulk density and the Scott and Burgan (2005) fuel model type. Stand height was not manipulated as I wanted to maintain the largest trees within the treatment area as suggested by Agee and Skinner (2005). Fire behavior fuel models are used to represent the fuel loadings of a pixel and quantify the amount of live and dead woody surface fuels of various sizes (Rollins 2009). Originally released as a set of 13 general models described by Anderson (1982) and developed by Albini (1976), fuel models are used to predict potential fire behavior by providing set values that are incorporated into various parts of Rothermel's 1972 spread equation (Scott and Burgan 2005). Expansion of these original 13 models into 40 fuel models by Scott and Burgan (2005) covered a wider variety of fuel types and ecosystems. Development of the new set was based on the Natural Fuels Photo Series and includes the following values for each fuel model: fuel load by size class (0-0.25 in, 0.25-1.0 in, 1.0-3.0 in) and category (live and dead), live woody, live herbaceous, and dead 1-hr SAV (surface-area-to-volume ratio), fuelbed depth, dead fuel extinction moisture content, and the heat content of live and dead fuels (Scott and Burgan 2005). By expanding the list of available fuel models for selection, the new 40 fuel models allowed for modeling prescribed fire and wildland fire use, simulating the effects of fuel treatments on potential fire behavior, and simulating transition to crown fire using crown fire initiation models (Scott and Burgan 2005).

My treatment prescriptions were as follows.

1. Clearcut with Prescribed Burn. All vegetation removed resulting in bare soil or rocks leaving a non-burnable area. The dominant fuel model for this treatment is fuel model 99-bare ground, which does not allow for fire spread.
2. Shadetree with Prescribed Burn. Following vegetation thresholds outlined in variety of literature, our shadetree prescription included
   i) Partial vegetation removal to a Canopy Cover (CC) of 40%
   ii) Stand Height (SH) was maintained to mimic a thin from below prescription (Peterson 2005) and to follow Agee and Skinner's (2005) recommendations in which the largest trees are maintained in a stand.

iii) Canopy Base Height (CBH) was increased to 3.05 meters (Fitzgerald and Bennett 2013).

iv) Canopy Bulk Density (CBD) reduced to at least 0.10 kg/m^3. Peterson et al. (2005) found that 0.10 kg/m^3 was a critical threshold at which a crown fire can transition back to surface fire. As noted above, my study area contains large amounts of *Abies grandis* and *Pseudotsuga menziesii* in the understory. Scott and Reinhardt (2007) found that in cases where under- and middle-stories were composed of such species, there existed a critical canopy layer that exerted a greater influence on CBD across silvicultural treatments. In treatments that consisted of thinning-from-below CBD decreased in even small canopy reductions because of these understory species. For pixels where I increased the CBH, but the starting CBD value was greater than 0.10 kg/m^3, I needed to account for the removal of the landscape's understory layer. As a result, if a pixel had less than 0.10 kg/m^3 to start, the CBD value was reduced by 0.01 kg/m^3.

v) The dominant fuel model for this treatment was changed to Timber-Litter fuel model 181- low load compact conifer litter. This fuel model is used to describe a recently burned forest according to Scott and Burgan (2005). Shrub fuel models were changed to Grass-Shrub fuel model 121-low load, dry climate grass-shrub (dynamic), while grass fuel models remained unchanged.

3) Fuel reduction of 30% (R30). General factorial reduction of 30% for canopy closure (CC) and canopy bulk density (CBD). Canopy base height (CBH) was brought to a minimum of 3.05 meters. For pixels where starting CBH was greater than 3.05 meters, an inverse of the reduction amount was applied, in this case pixel CBH was increased by 30%. Following

Agee and Skinner's (2005) recommendations described above, stand height was unchanged across pixels in an effort to maintain the largest trees within the stand. The dominant fuel model for this treatment was changed to Timber Litter fuel model 181-low load compact conifer litter. This fuel model is used to describe a recently burned forest according to Scott and Burgan (2005). Shrub fuel models were changed to Grass-Shrub fuel model 121, low load, dry climate grass-shrub (dynamic) while grass fuel models remained unchanged. Changing the dominant fuel model to 181 provides a realistic and effective way to reduce fire behavior across the landscape and has been utilized in other studies (Parisien 2007). Fuel model 181 has low flammability and thus a lower rate of spread, fireline intensity and very little to no crown involvement (Scott and Burgan 2005).

4) Fuel reduction of 40% (R40). Following logic outlined above, we reduced canopy closure and canopy bulk density by 40% and increased CBH by 40%. The dominant fuel model for this treatment was changed to 181, low load compact conifer litter. This fuel model is used to describe a recently burned forest according to Scott and Burgan (2005). Shrub fuel models were changed to Grass-shrub fuel model 121, low load, dry climate grass-shrub (dynamic) while grass fuel models remained unchanged.
5) Fuel reduction of 60% (R60). Following logic outlined above, we reduced canopy closure and canopy bulk density by 60% and increased CBH by 60%. The dominant fuel model for this treatment was changed to 181, low load compact conifer litter. This fuel model is used to describe a recently burned forest according to Scott and Burgan (2005). Shrub fuel models were changed to Grass-shrub fuel model 121, low load, dry climate grass-shrub (dynamic) while grass fuel models remained unchanged.

Stand metrics for prescriptions one and two were calculated using the public version of the Forest Vegetation Simulator (FVS) Disturbance Database (FVSDDB). Stands within the FVSDDB that matched initial conditions within the treatment zone were identified. Utilizing the high and low mechanical disturbance simulations, I isolated treatments that matched my desired post stand metrics. Initial post treatment levels were taken from the FVS projection one year after harvest. For more detailed information outlining all five treatments please see Appendix A.

The fire triangle is comprised of the three elements needed for a fire to ignite: oxygen, heat and fuel. While fuel treatments come in a variety of shapes, sizes and placements, a commonality is the focus on removing or decreasing fuels within an area to alter fire behavior (Agee and Skinner 2005). I manipulate the fuel side of the fire triangle through both my treatment width and treatment type. As I increase simulated treatment width, the amount of fuel removed from the landscape in turn increases, whereas more fuel is removed in intensive harvests, such as the clearcut with prescribed burn and 60% variable retention harvest. Fire behavior is dependent on fuel as an energy source (Martinson and Omi 2003). By decreasing the overall amount of fuel across the landscape, the goal is to decrease potential fire behavior.

1.2.8.3 Treatment Placement

One of the main goals of this study was to analyze the influence that collaborative treatments can have on wildfire behavior across a landscape. To allow for complete comparison, I needed to manipulate treatment placement on the landscape to account for cases in which collaboration did not occur. To do so, I placed the treatments on both sides of the 82-kilometer boundary (collaborative) or just one side (single entity). For example, if a treatment was planned as a 100-meter fuelbreak, a full collaboration simulation would have 50-meters of treated forest on either side of the ownership boundary. Conversely, a single sided simulation would only have 50-meters of treated forest on one side of the boundary.

As noted above, two of the reasons this landscape was specifically chosen were because it had 1) multiple landowners and 2) in situ differing management practices. The Forest Service land within the study area has two large restrictions to management, one being a roadless area to the northwest and the second being that a majority of Forest Service land was designated as late-successional reserves (Fig. 3) under the Northwest Forest Plan of 1994 (NWFP). Roadless areas within the National Forest were created under the 2001 Roadless Rule which prohibits road construction, road reconstruction, and timber harvesting on certain lands (Special Areas: Roadless Area Conservation 2001). For areas classified as late-successional reserves (LSRs), limited stand management is permitted and must be reviewed by the Regional Ecosystem Office (USDA Forest Service 1994). To some degree, forest health treatments for reducing the effects of uncharacteristic wildfire are allowed in both LSRs and Roadless areas (Special Areas: Roadless Area Conservation 2001; USDA Forest Service 1994), but implementation is difficult and more often than not treatments are not approved. However, in recent years scientists have begun to take a critical look at the benefits and downfalls of entering A large portion of the land owned by the Department of Natural Resources in the study area is the Teanaway Community Forest (TCF) (Fig. 4) purchased in 2013. Managed jointly by the DNR and WDFS, active timber management can occur within the forest to promote management goals. Before this acquisition, land that is now the TCF was owned by industrial timber companies that conducted extension forestry operations (WA DNR 2015). Due to almost 30 years of differentiating management practices, tree volume levels between these two entities differ across the landscape, with the average basal area of trees with a DBH greater than 7.6 cm within FS lands being 25.5 m^2/ha while the average on the Teanaway Community Forest is 18.1 m^2/ha.

The overall size of each border treatment was influenced by two restrictive measures. Following Washington State Forest Practice Rules, a 50-foot (15.24 meters) no-entry buffer was placed on either side of streams classified as fish bearing for a total buffer width of 100-feet (30.48 meters) (WAC 222-30). Additionally, treatments were not implemented in areas classified as Roadless under the 2001 Roadless Act, a restriction that only influenced lands owned by the US Forest Service (Fig. 3). While restrictions were placed on areas under the Roadless Act, simulated harvests were implemented for areas classified as Late-Successional Reserve (LSRs) under the Northwest Forest Plan (Fig. 3). I did not restrict harvests within LSRs to capture the potential influence that entering areas heavily restricted for ecosystem protection could have on overall wildfire reduction across the landscape. Roadless restrictions largely influenced Forest Service lands available for treatment in the central portion of our landscape (Table 8, Appendix B). On average, only 65% of potential land was treated on Forest Service lands due to restrictions whereas 82% of potential land was treated on the Non- FS Lands, a majority of which belong to the Teanaway Community Forest. Total hectares of treated area for collaborative treatments both with and without can be found in Table 7. Single-entity treatments, both with and without restrictions can be found in Table 8 and a visual representation along a portion of the border can be found in Appendix B.

1.2.9 *FARSITE Parameters*

The single wildfire event was conducted using a command line version of FARSITE for Windows (Finney 1998). As discussed above, each simulation conducted through FARSITE is unique regardless of constant inputs because of randomized spotting probability. To account for this stochastic nature, I ran a single ignition point 20 times for each combination of prescription type, width, placement, and weather scenario.

Wildfires can burn continuously for days to months, but large spread events that are often correlated with extreme weather tend to account for the majority of the area burned (Cochrane et al. 2012). These times of active fire growth, also known as burn periods, tend to be greatest between 10:00 a.m. to sundown when temperatures are the highest, fuel moisture is lowest and afternoon wind gusts can occur. For my simulations, I isolated five burn periods that lasted seven hours each from the RAWS data I analyzed in FireFamily+ (Appendix C).

Crown fire can be calculated in FARSITE via one of two methods, either Finney (1998) or Scott and Reinhardt (2001) (Interagency Fuel Treatment Decision Support System 2022). Both methods are based on the same crown fire behavior models of Van Wagner (1977) and Rothermel (1991), but they differ in equations used for the calculation of active and passive crown fire rates of spread. Additionally, they utilize different fire type distinctions, canopy bulk density inputs, crown fraction burned equations and crowing index calculations (IFTDSS 2021). Calculated crown fraction burned values are lower in Finney's method, and as a result under-predict the likelihood that a fire will transition to the crown (IFTDSS 2022). Due to this underprediction, I chose to calculate crown fire from the Scott and Reinhardt (2001) method. For each ignition simulated with FARSITE, output pixel level metrics included fireline intensity, flame length, crown fire activity and arrival time. No suppression activities were modeled in the FARSITE simulations.

1.2.10 *Randig Parameters*

Large scale landscape simulations were conducted using the command line version of the Minimum Travel Time module, Randig (Finney 2006). To decrease processing time, I ran the Randig simulations at a resolution of 90 m x 90 m, the limitations of increased resolution are discussed below. Following a protocol first outlined by Ager et al. (2012), simulation conditions were derived from historic wildfires that burned within the study area. A spatial database that contains wildfire occurrence data for the United States from 1992-2018 as reported by federal, state, and local fire organizations (Short 2021) was used to isolate all fires that had previously occurred within the study area. Of the 903 fires that were recorded, only seven fires (0.8%) were greater than 2023 ha and classified as a large fire according to the National Wildfire Coordinating Group (Table 9). The isolated fires were the Table Mountain (2012), Peavine (2012), Canyon (2012), Poison (2012), Taylor Bridge (2012), Snag Canyon (2014) and Jolly Mountain (2017). Of these seven, two (Taylor Bridge and Snag Canyon) were discounted because the majority of the fire burned through areas classified as grass and shrub by the Scott and Burgan (2005) fuel models. For the remaining five fires I looked at daily spread data from Incident Status Summary ICS-209 reports (https://famprod.nwcg.gov/) and isolated spread events greater than 1000 ha, the size for severe spread events as defined by Ager et al. (2012). Across the five fires, the average severe spread event was 2710 ha. Using Randig simulations, I experimented with different burn period durations until I was able to generate fire size distributions similar to those seen across the five wildfire's severe spread events.

For each combination of treatment type, width, placement, weather scenario and wind direction 8,000 randomized ignitions were simulated across the landscape for this duration of 1,100 minutes. This allowed for at least 99% of burnable pixels within the landscape to have burned at least once during the simulation and for the generated fire size distributions to match those seen across the five wildfires that burned within the study area. Constant weather variables derived from FireFamily+ included a wind direction with an azimuth of 210° and windspeeds of 9.7 km/hr, moderate fire simulations, and 24 km/hr, extreme fire simulations (Table 10). Outputs for each simulation included the burn probably (BP) for each pixel:

$$BP = \frac{F}{n} \qquad (1)$$

where F is the number of times a pixel burns, and n is the total number of simulated fires (8,000). Note that this calculation represents the likelihood that a pixel will burn given a single ignition in the study area (Chiono et al. 2017). Burn probability is then used to calculate the conditional flame length (CFL):

$$CFL = \sum_{i=1}^{6} \left(\frac{BP_i}{BP}\right)(F_i) \qquad (2)$$

where BP_i is the marginal burn probability for each pixel, which is the probability of fire at the i^{th} 0.6 m flame length category, F_i is the flame length midpoint of the i^{th} category and BP is the burn probability (eq 1). Derived by Scott (2006), conditional flame length is the average flame length within each pixel across all simulated fires (Ager et al. 2010).

1.2.11 *Mirrored Ignitions and Inverted Wind Scenarios*

As discussed above, the two major landowners within the study area (FS and DNR) have different fuel volume levels. To analyze the influence of collaborative treatments on the landscape I wanted to make sure that I simulated fires that originated within each major landowner and then burned through the treatments into the other landowner. I wanted to see how our treatments influenced fires that originated in the higher volume landscape and then burned through the treatments into the lower volume landscape in addition to fires that originated in the lower volume landscape and then burned through treatment into the higher volume landscape.

To accomplish this within the FARSITE simulations I mirrored the single ignition point across the nearest horizontal treatment line. Thus, the ignitions were an equal distance from the treatment boundary in their respective starting ownerships. The wind directions were also inverted by 180° so that the fire progressed back through the treatment zone. For each initial ignition location and mirrored ignition, I ran the simulations through the collaborative treatment and then the two single entity treatments. In the end, six orientations of ignition location and treatment placement were utilized in the simulations (Fig. 4).

Due to the sheer number of ignitions in the Randig simulations and the fact that the data is analyzed across all the fires within the landscape as opposed to single ignitions, I chose to not mirror Randig ignition starting points and instead inverted the wind direction by 180°.

1.2.12 *Statistical Analyses*

All analysis was conducted using R (R Core Team 2022), RStudio (RStudio Team 2020) and the following packages: tidyverse (Wickham et al. 2019), sf (Pebesma 2018), sp (Pebesma and Bivand 2005), terra (Hijmans 2021), raster (Hijmans 2021), ggthemes (Arnold 2021), parallel (R Core Team 2022), doParallel (Daniel et al. 2022), and MASS (Venables and Ripley 2002).

1.2.12.1 Randig Simulations

For my Randig simulations I analyzed fire behavior in relation to average burn probability, conditional flame length, transmission risk, and wildfire likelihood. When analyzing average burn probability and conditional flame length, I constrained our analysis to all pixels within 500-meters of ownership boundary. Since output variables for burn probability and conditional flame length from Randig simulations are computed for the entire population, I did not report statistical significance for my results due to analyzing a subset of the data. As a result, I compared proportions and the change in value between treatments. The 500-meter analysis zone totaled 7,756 hectares across the landscape.

Conditional flame length is the average flame length within each pixel across all simulated fires (Ager et al. 2010) and is calculated using equation 2 (eq 2). An example calculation of CFL can be in Table 26.

I utilized both the extracted CFL values and a reclassified dataset for my analysis. For my reclassified dataset, I cross walked the base conditional flame length to one of the four wildfire suppression categories based on research by Andrews and Rothermel (1982) (Table 11, Fig. 5). After reclassification I created frequency tables for the number of pixels within each suppression category and converted pixels to hectares. The goal of fuel reduction treatments is often to not completely halt fire spread but to decrease fire behavior metrics to a point that active suppression can safely occur (Oliveria et al. 2016). With this idea in mind, I summed wildfire suppression categories 3 and 4 into an overall “Uncontrollable Fire (UC)” category. I then calculated how the number of UC hectares for each combination of treatment width and prescription changed in relation to the untreated scenario.

Andrews and Rothermel (1982) found that fire suppression was most likely ineffective for flame lengths greater than 2.4 meters as torching and crowing is likely to occur within the stand. For flame lengths in which suppression is feasible, less than 2.4-meters, Andrews and Rothermel (1982) found that at 1.2-meters, suppression tactics can be changed from direct attack with heavy equipment to the use of handlines. To analyze the influence of fuel reduction treatments on CFL I plotted the average CFL within the 500-meter analysis zone against this 2.4-meter metric for the extreme weather scenario and 1.2-meters for the Jolly Mountain weather scenario.

To quantify the transmission risk between the different landowners within the study area I followed methods initially outlined in Ager et al. (2014) and subsequently used in a multitude of studies (Ager et al. 2018; Ager et al. 2019; Alscasena et al. 2016; Chiono et al. 2017; Hass et al. 2014; Rodrigues et al. 2022). In this method, the transmission of wildfire across boundaries is quantified using the hectares of incoming (TF-IN), outgoing (TF-OUT) and non-transmitted (NonTF) fire summarized by land designation. By overlaying a fire's perimeter with the land ownership map, I was able to determine how many hectares burned within each ownership across a fire's entire perimeter. Similarly, by overlaying the x and y coordinates for each ignition point, I was able to determine the land designation where each fire started (Fig. 6). By distinguishing ignition source and fire perimeter ownerships, I was then able to calculate the total area burned within each ownership in relation to ignition locations (eq 3). The effect of different total ignitions among ownerships was removed by dividing the area burned by the number of ignitions within the source ownership. Transmission factor (*TF*) is defined as follows:

$$TF_{ij} = AB_j / N_i \qquad (3)$$

where TF_{ij} measures the average area burned in land ownership *j* for ignition *i; and* AB_j is the area burned in land designation *j* and N_i are the number of ignitions that started in designation *i*. TF-IN, TF-OUT and NonTF were calculated as follows:

a. <u>TF-IN:</u> Sum of all burned area in designation *j* that started in ignition source *i;*

b. <u>TF-OUT:</u> Sum of burned area for ignitions that started on *i* but burned into designations *j;*

c. <u>NonTF:</u> Sum of all burned areas when ignitions *i* are equal to designations j.

1.2.12.2 FARSITE Simulations

For the FARSITE simulations I analyzed fire behavior in relation to overall fire size and halted fire. To standardize my analysis, I extracted all pixel-level attributes in a 500-meter analysis zone spanning the ownership boundary.

I compared the median wildfire size with Wilcoxon signed rank tests. I used Wilcoxon tests due to their use as a non-parametric alternative to t-tests, as my data was non-normally distributed. As discussed above, FARISTE simulations are inherently stochastic given the randomized spotting factor. This means that each simulation is unique, even when they are run with the exact same input parameters. Due to this stochasticity, I ran each combination of parameters twenty times. For my Wilcoxon tests I individually compared Teanaway Community Forest treatments to Collaborative treatments and US Forest Service treatments to Collaborative Treatments. Instead of using two-sided Wilcoxon tests which would only tell us if their medians were significantly different from each other, I used the alternative "less" which allowed me to test whether the Collaborative Treatments were significantly less than each of the two single entity treatments.

To determine if a fuel treatment suppressed the dominant spread of a wildfire, I calculated a series of distance matrices based on ignition location in relation to fuel treatment. The steps I took to calculate this metric are as follows:

1. I identified the closest treatment segment to the ignition source based on the simulation's wind azimuth and the direction of main fire spread. The direction a

wildfire burns is described by three general terms, head, flank and back. The head is burning in the same direction as wind and is spreading the fastest, the flanks are on the right and left side of the head and burn perpendicular to the head, backing fire is fire that burns opposite the head and against the dominant wind direction. By identifying the closest treatment segment along the simulation's azimuth, I was able to discount flanking and backing fire.

2. Once I identified this segment, I calculated the distance from the ignition point to both edges of the fuel treatment. The treatment edge with the smaller distance from the ignition point was classified as "Entry", as this when the fire first encountered the treatment. The segment that had the greater distance from the ignition point was classified as "Exit", as the fire would be leaving the treatment once it burned passed this line.
3. I then overlaid each simulation's fireline intensity output and extracted the pixel-level values that crossed both the "Entry" and "Exit" lines.
4. If the "Entry" values were greater than zero, I could verify that the fire had indeed crossed into the fuel treatment. If no value was extracted along the "Exit" line, this meant that the fire was suppressed within the treatment.
5. For each of the twenty simulations for all combinations of treatment width, prescription and placement I determined what percentage of simulations were suppressed by the fuel treatments and didn't burn through the "Exit" line.

1.2.13 *Limitations*

Simulation models provide a very important role in wildfire research. They allow us to theoretically test different treatments across large landscapes and give us insights into the potential behavior of wildfires both historically, currently and under future conditions (Oliveria et al. 2016). While current models have been accepted and widely applied within wildfire research, there are many documented limitations (Alexander and Cruz 2013; Stratton 2006).

One large limitation present in both the FARSITE and Randig simulations is the assumption of uniformity for stand metrics within each pixel. Input data for the simulations was downloaded from LANDFIRE at a resolution of 30 meters by 30 meters. Homogeneity within this resolution size means variations smaller than a 30 m x 30 m scale, such as rock outcroppings, clumped trees and/or canopy gaps, are not recognized (Brakeall 2013; Finney 1998).

Within the FARSITE simulations, I used a simplified weather stream which assumed spatially constant open winds that ran parallel to the terrain, thus not accounting for unique wind behavior in valleys or sudden terrain variations (Finney 2006). Zigner et al. (2020) hypothesize that the two-dimensionality of wind inputs in FARSITE decreases the performance of simulating firebrand spotting relative to real-world events. Their study found that lofted embers landed downslope at a slower rate in simulations which correlated to underestimation in fire perimeters. The simplified weather streams also assume uniform daily precipitation taken from input data. Within the weather stream input file, the elevation at which the weather was collected is required in addition to daily maximum and minimum temperature and humidity. Using these metrics, a sine-curve (Rothermel et al. 1986) interpolates how temperature and humidity varies across the landscape in relation to elevation, using a lapse-rate of 9.8 °C/1 km. As a result, maximum temperature and minimum humidity are assumed to coincide, which may be an inaccurate assumption during frontal passage or thunderstorms (Finney 2006).

Dead fuel moistures are calculated using equations proposed by Rothermel et al. (1986). Daily fine fuel moistures at 1400 hours utilize a different equation than other times of the day which can result in abrupt changes and unless manually changed, live fuel moistures remain constant throughout the simulation (Finney 2006). These simplified inputs from the weather stream result in limited fuel-terrain interactions, such as shadows cast by topography or higher fuel moistures near bodies of water (Finney 2006).

Within FARSITE, fire arrival and spread at any given point on the landscape are dependent upon the behavior and travel time en route, which means that as projection time and distanced travel increases, errors will compound upon each other (Brakeall 2013; Finney 2006,). This has been shown to cause overprediction in spread rates for all fuel models (Finney 2006). This problem may be rectified by using rate of spread adjustment factors, however for my simulations, adjustment factors were not used.

Crown fire ignition is calculated in FARSITE based on fuels less than 7.62 cm in diameter. This can cause an underestimation in crowning or torching potential given that fuels greater than 7.62 cm can also contribute to radiative and convective heating of overstory fuels (Finney 2006).

Neither FARSITE nor Randig account for fire-atmosphere and fire-fuel interactions (Ager et al. 2014) which Cruz and Alexander (2010) determined results in an underestimation of crown fire activity and spread rates. Isolation and comparison of separate model components with data from experimental fire and wildfire observations pointed to one potential explanation for this underestimation being that the functions on which these calculations are built, Rothermel's (1991) and Van Wagner's (1977), have an inherent underprediction bias prior to being coupled in modeling systems (Cruz and Alexander 2010).

To decrease the computation power and storage necessary to run the Randig simulations, I increased the spatial resolution of the landscape from 30 meters to 90 meters. One potential limitation to this increase is that the 50-meter single entity treatments are less than the increased spatial resolution. Depending on the vertex edge in relation to an individual fire's starting location, a fire could potentially spread through the fuel break without being affected by the treatments. Another limitation to this size increase is the loss of natural fuel breaks less than 90 meters.

1.3 RESULTS

1.3.1 *Overview*

Start Designation and Wind Scenario

Results from the single ignition FARSITE simulations are impacted by the ignition start designation and will be referenced in relation to each location. When the simulated fire ignited on the Teanaway Community Forest it was simulated with a NNE wind direction and thus labeled TCF. Ignition on the US Forest Service is labeled USFS and was simulated with an SSW wind direction. For Randig simulations results are labeled based on the dominant wind direction, either NNE or SSW.

Conditional Flame Length

When analyzing Conditional Flame Length (CFL) from Randig simulations Cocohro (2017) found that values for conditional flame length derived in Randig tend to be less than those derived with other modeling software. This is because Randig compiles all flame lengths for a pixel regardless of the stage of fire that is crossing said pixel, i.e. it includes both backing and flanking fire in its calculations. This is in opposition to models like Minimum Travel Time where conditional flame length is just calculated from head fire.

Pixel values for Conditional Flame Length were extracted within a 500-meter analysis zone, 250-meters on either side of the ownership boundary. This distance was chosen as it correlated with the largest treatment width implemented under both the Jolly Mountain and Extreme weather simulations.

I frame the analysis around defined levels of fire behavior and suppression tactics in order to analyze the influence of fuel reduction treatments on CFL (Table 11). Wildfires can be broadly categorized as controllable and uncontrollable from a tactical standpoint in relation to the height of the flaming front. Andrews and Rothermel (1982) found that fire suppression was most likely ineffective for flame lengths greater than 2.4 meters as torching and crowing is likely to occur. For Extreme weather, average CFL within the 500-meter zone was plotted against this 2.4-meter metric (Fig. 15). For the Jolly Mountain weather scenario, average CFL is plotted against a 1.2-meter metric. At 1.2 m Andrews and Rothermel (1982) determined that suppression tactics can be altered from direct attack via heavy equipment, such as dozers, to the use of handlines (Table 11).

1.3.2 *Untreated Landscape*

Fire Size

Across the untreated landscapes, the average fire size under the Jolly Mountain scenario was 6,276 ha for fires ignited on Forest Service property and 6,041 ha for fires ignited on the Teanaway Community Forest (TCF) (Table 13). Under Extreme weather the average fire size was 26,831 ha (USFS) and 26,732 ha (TCF) (Table 12).

Conditional Burn Probability

Under the extreme weather scenario for the untreated landscape, maximum CBP within the 500-meter analysis zone was 0.0256 (NNE winds) and 0.0276 (SSE winds). For Extreme weather simulations with SSW winds, the highest CBPs within the study area were located just north of the Teanaway Ridge on FS property in the central portion of the landscape and along FS Road 9701 heading north towards the North Fork Teanaway River (Fig. 11). For the NNE wind scenario, the highest burn probability was concentrated on the south facing aspect of Cle Elum Ridge, surrounding the towns of Ronald and Roslyn, WA (Fig. 12). A defining feature of all three of these areas is hilly terrain dominated by south-facing aspects with continuous canopy cover, low canopy base heights and high canopy bulk densities. In pre-settlement landscapes, southern facing slopes tended to have lower amounts of vegetation that occurred in sporadic patches and were often regulated by naturally occurring fire (Hagmann et al. 2021). However, numerous decades of fire suppression have altered landscapes and allowed for a higher accumulation of fuels (Hessburg et al. 2013). Higher CBP within these areas may be the result of the higher fuel loads in addition to the fact that southern-facing aspects tend to have the lowest fuel moisture levels and highest average temperatures and that fire burns more aggressively when moving uphill.

Overall, CBP was less in the Jolly Mountain weather scenarios with maximum values within the 500-meter analysis zone for the untreated simulations ranging from 0.0069 (NNE winds) to 0.0071 (SSE winds). Within the study area, the highest CBPs under Jolly Mountain with SSW winds were along the eastern side of Teanaway Ridge and just north of the ownership boundary within USFS Roadless areas (Fig. 13). For NNE winds, areas of highest CBP occurred on the western side of the Teanaway Ridge and on the opposite aspects of the CBP found in the SSW wind scenarios (Fig. 14). This suggests, that under the Jolly Mountain weather scenario, CBP was tied to dominate wind direction as areas of high CBP occurred within the same regions but occurred on aspects windward of the dominant azimuth in which the simulations were run.

Conditional burn probability maps for all treatment type, treatment width, treatment placement and weather scenario can be found in Appendix E.

Conditional Flame Length and Transmission Risk

For the untreated landscape, the extreme weather scenario produced average CFLs of 3.1-meters for SSW winds and 2.7-meters for NNE winds (Table 17). Under the Jolly Mountain scenarios, average CFL was 1.6-meters (SSW winds) and 1.5-meters (NNE winds) (Table 16). Results in this section are restricted to only the fires that burned within 250-meters of the ownership boundary for a total analysis zone of 500-meters.

Across all weather and wind scenarios, the largest amount of outgoing fire and smallest amount of self-burning was seen for the BLM and FWS (Fig. 17 and Fig. 18). These two ownerships have the smallest amount of property within our study area (Table 19) and are located next to large areas of continuous forest (Fig. 2b). The large amount of outgoing fire they produced is not unexpected given that a majority of the fire that begins within their boundaries burns onto other designations during the simulations. These results are comparable to those found by Ager et al. (2018) in which the amount of self-burning was found to decrease as parcel size decreased. Self-burning and incoming fire occurred mostly within DNR and FS ownerships (Fig. 17 and Fig. 18). The DNR and USFS are the largest landowners within the study area (Fig. 2; Table 19) and fires that began within their respective boundaries need to burn across large amounts of land before reaching another ownership thus accounting for the high rates of self-burning fire. Given their large boundaries and numerous shared boundaries, fires that began within other ownerships would enter DNR or FS land at a greater rate than other ownerships within the study area, increasing instances of incoming fire.

1.3.3 *Collaborative vs Single-Entity Treatments*

The FARSITE simulation and Randig simulations indicate that collaborative treatments tended to have a larger influence on overall wildfire size and fuel metrics within the treated zone. In the few cases, where single-entity treatments were similar to Collaborative, I hypothesize this is due to management restrictions within Forest Service property.

Overall Fire Size

The average fire size for Collaborative treatments compared to single entity treatments was significantly less for a majority of our simulations in relation to fire size (Table 12 and Table 13). The Jolly Mountain weather scenario showed that collaborative treatments began to differ significantly from both single entity treatments starting at the 100-meter width per entity (200-meters for Collaborative) and that this was the case for both ignition start designations. Under

Extreme weather for fires that started on USFS property, average fire size across all treatment prescriptions was significantly less for Collaborative treatments compared to either of the single entity treatments at 200 and 250 meters. For fires starting on the Teanaway Community Forest (TCF), the average fire size of Collaborative treatments was never significantly less than treatments only on the TCF, and only at 250-meters were the majority of Collaborative treatments significantly less compared to treatments only on USFS property.

My hypothesis for why ignitions that started on the TCF tended to have no significant differences between treatment placement is that fire spread in relation to wind direction pushed these fires through an area of restricted management (Fig. 3). The direction of dominant fire spread had these fires burning towards the northwest of the landscape. Across the ownership boundary, this area of FS property has management restrictions due to its classification as a Roadless area under the 2001 Roadless Act (Fig. 3). Treatments within the simulations were not implemented in areas classified as Roadless and as a result, only a small amount of area was treated across the ownership boundary on Forest Service property. Even as the treatment width increased, the amount of area that could be treated within the Roadless boundaries stayed the same. As a result, Collaborative treatments within areas classified as Roadless are similar in size to the single entity TCF treatments. Under extreme weather conditions, this small amount of treated area on the FS property was not enough to significantly alter fire size.

The width of collaborative boundary treatments sufficient to produce a difference in average fire size differed with fire weather. Compared to the untreated landscape, the reduction of average fire size under the Extreme weather scenario fuel treatments did not significantly differ from the untreated landscape until our Collaborative 150-meter treatment width, ranged from an increase of 2.2% to a decrease of 82.4% (Table 12) a. For the milder weather Jolly

Mountain scenario, the reduction in average fire size relative to an untreated landscape ranged from an increase of 1.8% to a decrease of 42.5% (Table 13). Significant differences between the untreated and treated landscape occurred at smaller treatment widths for the Jolly Mountain simulations compared to the Extreme simulations (Appendix D). By the 100-meter collaborative treatment (200-meter total) all treatment prescriptions produced significantly different results from the untreated landscape.

Conditional Flame Length

Under the Extreme weather scenario, the collaborative treatments routinely decreased average CFL to a greater degree than either of the single entity treatments (Table 17). For all treatment prescriptions, average CFL was dropped below the 2.4-meter metric at 100-meters with the Collaborative treatments thus switching the fire from “uncontrollable” to controllable according to the values laid out by Andrews and Rothermel. Across all treatment prescriptions and treatment widths, average CFL under the collaborative treatments was on average 0.32-meters less than USFS only treatments and 0.31-meters less than DNR only treatments under NNE winds and 0.45-meters less than USFS only treatments and 0.31-meters less than DNR only treatments for SSW winds.

For the Jolly Mountain simulations, FS Treatments never decreased CFL to below the 1.2-meter threshold, with lowest lengths occurring at 1.24-meters for NNE winds and 1.31-meters for SSW winds. For DNR Treatments, CFL only dropped below 1.2-meters for the 250-meter Clearcut with Prescribed Burn, averaging 1.9-meters for wind scenarios. When looking at the Collaborative Treatments, starting at 200-meters (400-meters total), all five prescriptions decreased CFL below 1.2-meters. On average, CFL was 0.15-meters less for Collaborative treatments compared to both USFS and DNR only treatments under NNE winds and 0.20-meters less than USFS only treatments and 0.16-meters less than DNR only treatments for SSW winds.

Transmission Risk

Collaborative treatments influenced transmission rates to a greater extent than either of the single entity treatments. This trend was seen in the overall burned area where collaborative treatments ranged 1.1x to 6.6x more effective than either of the single entity treatments for Extreme weather (Table 22) and ranged to 1.2x to 5.8x more effective for Jolly Mountain (Table 23). Collaborative treatments consistently reduce transmission to a greater extent than either of the single entities with the largest differences seen at the 50-meter width per entity. Since collaborative treatments are twice as large as single entity treatments, this result is not surprising as more of the landscape is altered to hinder fire behavior within the collaborative simulations.

1.3.4 *Influence of Treatment Width*

Greater reductions in overall fire size and fire metrics were found as treatment width increased. However, the influence of treatment width appears to stabilize around 300 to 400-meters depending on the metric of choice, suggesting that a wider buffer isn't always necessarily better, a finding supported by Hessburg et al. (2016) that found that increasing treated area improved protection across the landscape but had a tendency for diminishing returns.

Overall Fire Size

For the Jolly Mountain simulations, fuel treatments reduced wildfire size as treatment width increased (Fig. 7 and Fig. 8). The reduction in average fire size relative to an untreated landscape ranged from an increase of 1.8% to a decrease of 42.5% (Table 15). For the 50-meter treatment width, only Clearcut with Prescribed Burn was significantly different from the untreated landscape and only for ignitions starting on USFS property. Starting at 100-meters the average fire size for ignitions starting on USFS property was significantly different across all treatments (Appendix D). For fires starting within the TCF, all treatments were significantly different from the untreated landscape at treatment widths of 150-meters per entity or greater. Continuous reduction in average fire size was seen for the single entity treatments as treatment width increased. For the Collaborative treatments the reduction amount between treatment widths stabilized around 150-meters per entity, 300-meters total. When treatment width increased from 50-meters to 100-meters the average reduction was 892 ha for USFS ignitions and 1,143 ha for TCF ignitions. The average reduction between treatment widths 100-meters and 150-meters was 817 ha (USFS) and 785 ha (TCF). Comparatively, the reduction between 150-meters and 200-meters was 451 ha (USFS) and 177 ha (TCF) and for 200-meters to 250-meters the reduction decreased to 110 ha (USFS) and 46 ha (TCF).

Transmission Risk

When analyzing transmission risk between the two largest landowners within the study area, the US Forest Service and Department of Natural Resources, total burned area, the sum of incoming, outgoing and non-transferrable fire, decreased as treatment width increased (Fig. 19 and 20). The total burned area for the untreated landscape under our extreme weather scenario was 40,942 ha (SSW winds) and 35,627 ha (NNE winds) (Table 22). For the Jolly Mountain weather scenario, the total burned area was either 10,852 ha (SSW winds) or 9,714 ha (NNE winds) (Table 23). Average reduction in total burned area under the Jolly Mountain weather scenario ranged from 2.2% - 21% for NNE winds and 4% - 33% for SSW winds (Table 21). For the extreme weather scenario average reduction ranged from 0.7% - 24% for NNE winds and 2.3% - 36% for SSW winds fuel breaks (Table 20).

1.3.5 *Comparison of Treatment Prescriptions*

The Clearcut with Prescribed Burn prescriptions overwhelming produced larger reductions in fire size and fire metrics. Between the four remaining prescriptions, similar results were found suggesting surface fuel treatments may have a larger influence on fire metrics than overstory within the chosen models.

Conditional Burn Probability

For both the Jolly Mountain and Extreme weather scenarios, Clearcut with Prescribed Burn consistently had CBPs lower than the other four fuel treatments within our 500-meter analysis zone (Fig. 15 and Fig. 16). This result is expected given that the area we treated as a Clearcut with Prescribed Burn was changed to a fuel model classification of 99 which does not support the spread of fire. Low levels of fire spread are supported in the other fuel treatments which had fuel model classification of 181.

Conditional Flame Length

A recurring trend across all widths, placements and wind scenarios was that the Clearcut with Prescribed Burn treatment decreased CFL at a faster rate than the other four treatments. Additionally, the other four treatments reduced CFL at rates that were within 0.01% of each other. The quickest reduction in CFL to below the 2.4-meter threshold was seen within the NNE wind scenario for the 50-meter (100-meters total) Collaborative Clearcut with Prescribed Burn treatment. Average CFL was reduced the least when the landscape was only treated on areas within FS property. For SSW wind scenarios, only 200-meter and 250-meter Clearcut with Prescribed Burn dropped CFL below 2.4-meters and for NNE winds and only treatments implemented at 150-meters or greater saw CFL less than 2.4-meters. When a fuel reduction treatment was implemented across the landscape (excluding Clearcut with Prescribed Burn), the simulations show that a wildfire could be altered from previously “uncontrollable” behavior to control via direct attack (e.g., flame length < 1.2 m) with a Collaborative treatment of 100-meters per entity (200-meters total) for NNE winds and 150-meters per entity (300-meters total) for SSW winds in the event of extreme fire weather.

Clearcut with Prescribed Burn outperformed any of the four fuel reduction treatments in reducing CFL. A general trend among the five treatments was that after 50-meters, the Clearcut with Prescribed Burn decreased CFL to a similar height as a fuel reduction treatment that was one treatment width stage greater than the Clearcut with Prescribed Burn. For example, in Fig. 16 the USFS Treatment for the NNE wind scenario 100-meter Clearcut Prescribed Burn (solid circle), decreased CFL to a value similar to the other four treatments at 150-meters.

1.3.6 *Influence of Wind Direction*

Incoming and outgoing fire were heavily tied to wind scenarios. This result was expected given the relation of fire spread to wind direction. A greater amount of outgoing fire for an entity, and thus a smaller amount of incoming fire, was seen for wind scenarios in which the dominant wind direction pushed wildfires away from a landowner. Dominant fire spread for USFS transmission was seen in the NNE wind scenario while the dominant fire spread for DNR transmission was seen for the SSW scenario. When looking at the amount of outgoing DNR fire in relation to control, we can see that the fuel treatments had a larger impact during SSW winds for both weather scenarios (Fig. 21 and Fig. 22). Reduction in outgoing USFS transmission occurred to a greater extent during NNE winds (Fig. 23 and Fig. 24). Within each wind scenario, a decrease in outgoing transmission for one landowner correlated with a decrease in incoming transmission for the opposite landowner. These results point to fuel reduction treatments blocking fire spread between adjacent landowners.

When considering total burned area, fires under the SSW wind scenarios tended to be larger than those burning under NNE winds (Fig. 17 and Fig. 18). My hypotheses for this trend are two-fold. Fires within the NNE wind scenarios have dominant fire spread in the generally southern direction. The largest southern ownership within the study area is the DNR. As discussed in the introduction and methods, property now owned by the DNR historically belonged to private timber companies. These companies practiced clear cuts, selective harvesting, and shorter rotation ages. As a result, this is a more variable landscape with larger fragmentation between stands and stand structure as opposed to the more continuous forested landscape seen on USFS land north of the ownership boundary (Fig. 2). This patchwork collection of stand ages and structures can lead to a decrease in fire spread as fire moves through varying amounts of vegetation. In addition to decreasing the rate of spread through stand structure, this portion of the landscape has a greater amount of fuel breaks in the form of roads. Land owned by the USFS within our study area is under two heavy restrictions, one being the Roadless area on the eastern side of the landscape and the other being classification under the Northwest Forest Plan as Northern Spotted Owl Habitat (Fig. 3). New road construction has been prohibited in the Roadless Area since 2001 and heavily monitored in areas designated under the NWFP. Meanwhile, across the ownership boundary, the combined effects of historic private timber companies and current use as a community forest means increased road networks and continuous upkeep of roads. Within the simulations, roads that are either paved, gravel or dirt that can support travel of a 2WD vehicle can act as fuel breaks and stop fire spread. Thus, the increased presence of roads that meet the above classifications in the southern portion of the landscape can quickly stop fire spread when the dominant fire direction is in the southern direction, as seen in the NNE wind scenarios.

1.3.7 *Extreme Weather Event*

The single extreme fire event demonstrates that large treatment boundaries (> 600 m) were needed to stop spread between entities with collaborative treatments outperforming single entity (Table 24). This result is not unexpected given that Collaborative treatments by nature are twice as large as either of the single entity treatments. For the simulations that had the wildfire starting on USFS land, 100% of simulations (n=20) were halted across all five treatments for collaborative treatment widths of 700-meters and 750-meters. The majority of simulations were halted for all five treatments at the 600-meter width. In comparison, no simulations were halted when the treatment was only placed on USFS property and for treatments within the TCF only the Clearcut with Prescribed Burn treatment stopped most simulations at widths 600-meters or greater.

Treatments of all widths were less effective at halting fire spread for simulations that started within the TCF compared to fire ignitions on the USFS (Table 24). For these ignitions, treatments placed on the USFS property were unable to stop dominant fire spread for any treatment width. Only the Clearcut with Prescribed Burn treatment on the TCF were able to stop a majority of simulated fires. Within the Collaborative treatments, Clearcut with Prescribed Burn at 600-meters or greater was able to stop a majority of simulated fires, while the other four treatments tended to stop around 30% of simulations.

The goal of fuel reduction treatments is to reduce the intensity and severity of a wildfire, often through the lens of decreasing the amount of high-severity fire that can occur on the landscape (Stephens et al. 2021). And while they may slow down the spread of a fire, they are often not planned with the intention of completely stopping a fire (Oliveria et al. 2016). Extreme fire weather is produced through a combination of low relative humidity, strong surface wind, unstable air, and drought (NWCGA 2022). As these conditions begin to occur more often across western landscapes (Prichard and Kennedy 2014), we wanted to determine if any of the proposed treatment prescriptions could stop a wildfire burning under extreme conditions.

I propose that treatments were more effective for fires burning from the USFS into the TCF relates to the historic management of these lands which has resulted in different stand conditions across the landscape. Similarly, USFS only treatments tended to underperform compared to TCF treatments. In this case, the management restrictions within the USFS boundary in relation to the Northwest Forest Plan and Roadless designation resulted in a smaller amount of the landscape being treated along the eastern portion of the USFS boundary. The amount of area available for treatment was lower due to these restrictions and what could be treated proved to be insufficient in altering fire behavior within the simulations.

1.4 Discussion

As the push for collaborative management increases to treat fire-prone landscapes in a warming world, there is a growing need for information on how fire behavior and severity are altered by the type, amount, spatial placement, and size of said treatments (Cochrane et al. 2012).

For my analysis I simulated a series of jurisdictional boundary fuel reduction treatments of various intensities and sizes across a landscape east of the Cascade crest in Washington State. The study area encompassed a historically moist-mixed conifer, mixed-severity fire regime that due to anthropogenic influences and climate change is now highlighted as an area of concern for potentially large and destructive wildfires. Using two different wildfire models, the goals of this study were to quantify the current fire risk to the area by analyzing burn probability and transmission rates between large landowners and to analyze the influence that preemptive management can have on fire behavior within the region. A large focus of the study was on the use of collaborative treatments in comparison to single ownership treatments. While previous studies have investigated cross-boundary fire transmission on individual national forests (Ager et al. 2014, Ager et al. 2019), the states of Arizona and Colorado (Ager et al. 2018; Haas et al. 2015), and the western United States (Palaiologou et al. 2019) at a fireshed level, a fine scale assessment for this portion of Washington state especially with the incorporation of modeled fuel reduction treatments to influence cross-boundary fires has not been conducted.

Modeling of cross-boundary wildfires can potentially be used for the prioritization of shared stewardship projects as they help identify sources of wildfire risk and dominant transmission pathways (Ager et al. 2019) within a landscape. In their recent framework Ager et al. (2019) noted that the incorporation of modeled fuel treatments when evaluating cross-boundary risk has been missing from recent reviews such as Kalies and Yocom Kent (2016) and Vaillant and Reinhardt (2017). And while there are a multitude of limitations to wildfire modeling (Alexander and Cruz 2013), the insights gained from simulating the interaction of the fire-landscape system allow managers and forest groups to make informed decisions regarding the treatment of their landscapes in the face of increasing fire activity.

1.4.1 *Influence of Different Treatment Types*

While all five fuel reduction treatments reduced potential fire behavior and severity, results varied across treatment type and treatment widths. Amongst the five treatments, clearcut with prescribed burn had the greatest influence on fire size and fire behavior metrics within the treated area. Clearcut with Prescribed Burn resulted in the greatest reductions in average fire size (Fig. 8 – Fig. 11) and consistently influenced average conditional flame length (Fig. 16 and Fig. 17), dropping average CFL to levels in which active suppression can potentially occur at widths 50m – 100m meters less than the other four fuel reduction treatments.

While clearcutting with prescribed burn may have had the largest influence on fire behavior within the treatment zone, there are many economic and ecological downsides to the use of clearcuts. Maintenance of clearcuts as a fire and fuel break is time intensive with return management needing to occur every 2 to 5 years depending on climate and vegetation (Fitzgerald et al. 2019). Frequent maintenance is needed to remove or reduce the growth of shrubs and grasses as these fuel types can increase the size and severity of a wildfire by increasing the rate of spread across the landscape (Stephens et al. 2021). Due to complete vegetation removal, clearcuts also increase chances of soil and water erosion, and habitat fragmentation as well as removing carbon storage and temperature regulating canopy cover (Rice et al. 1972). From an economic perspective, the initial harvest for a clearcut will result in a larger timber sale but lack of replanting removes the land as a continuous source of income unlike other treatment methods whose maintenance could potentially involve economically viable harvests. If the decision is ever made to return a clearcut fuel break to a forested stand, studies have shown that clearcuts have the same impact on seedling regeneration as a high-severity fire (Barker et al. 2014), findings that point to the need for artificial planting, a labor and economically intensive task.

Among the four remaining fuel treatments, shadetree with prescribed burn and reductions of 30%, 40 and 60%, all had comparable influences on fire behavior. When viewing average conditional flame length (Fig. 16 and Fig. 17), treatments on average were within 0.01% of each other. For the simulations, all four of these treatments were given a fuel model classification of 181, low load conifer litter, a fuel model proposed by Scott and Burgan (2005) to mimic forests recently burned by a low-severity fire. While Canopy Base Height, Canopy Bulk Density and Canopy Cover were manipulated to varying levels, fuel model was consistent across the four treatments. The similarity in results for Conditional Flame Length is most likely due to this consistency as flame length is directly related to the structure and composition of fuels within a stand and dependent upon the fuel model selected (Finney 1998). Numerous studies have shown that a mechanical treatment followed up a prescribed burn has the largest influence on wildfire behavior and severity (Cochrane et al. 2013; Kalies and Yocom Kent 2016; Marshall et al. 2020; Prichard et al. 2010; Prichard et al. 2020; Stephens et al. 2012; Tubbesing et al. 2019), however the probability that all four of my retention harvests would have the same fuel loadings post treatment, even following a prescribed fire, is very low.

In future simulations, use of custom fuel models could result in a clearer understanding of the variations in fire behavior resulting from different fuel treatments. The creation of custom fuel models can be achieved in a variety of ways. Existing literature for similar fuel treatments implemented, either in-situ or via simulations, could be consulted to find ranges for fuel loadings following intervention. In-situ studies include those conducted in eastern Washington (Canslet et al. 2022; Prichard et al. 2010; Prichard and Kennedy 2014), Oregon (Ager et al. 2014; Morici et al. 2021; Kane et al. 2009; Youngblood et al. 2007), California (Stafford et al. 2012; Stephens and Moghaddas 2005) as well as general literature reviews and meta-analyses (Martinson and

Omi 2013; Agee and Skinner 2005). Consultation with land managers, local agencies and private landowners could open avenues for ground truthing and plot installation as well as sharing previously collected landscape data. Simulation of forest growth through models such as the Forest Vegetation Simulator (FVS) can be used to model fuel loadings pre/post treatment, as well as over time. If treatments are hypothetical, such as the case in this study, collected field data can be simulated through a variety of treatments with the resulting fuel loading outputs used for the creation of custom fuel models. In the case of this study, where base data was downloaded from LANDFIRE, unique fuel loadings can be acquired through the FVSDDB (mentioned in section 1.2.8.2). Modeling fuel loadings closest to real-world examples would result in a more robust study that captures the variations different fuel treatments can have on fire behavior. The results from this study can only pinpoint large-scale differences between a clearcut treatment and a retention treatment. By varying fuel loadings, I would be able to make more nuanced conclusions about the factors that influence surface fire behavior.

However, similar reductions in conditional flame length amongst all four treatments with FM 181 potentially highlight that, for moderate wildfires in which most of the burning is occurring on the surface, higher intensity canopy reductions influence fire metrics to a similar degree as moderate canopy reductions. This result was previously supported by in situ fire severity during the 1999 Megram Fire in California. During this event, the dominant fire spread burned through fuelbreaks that only had surface and ladder fuels treated with residual canopy cover between 60-70%. When the fire burned through these fuelbreaks, fire severity was significantly reduced, results which support the hypothesis that canopy bulk density reductions may not be needed to impact wildfire severity (Agee and Skinner 2005). Additionally, the extent of ecological degradation of fuel reductions may be lessened through treatments that retain vegetation compared to clearcuts. Depending on the spatial arrangement of tree retention, non-clearcut treatments can maintain habitat connectivity, provide standing boles and snags for wildlife use, and maintain canopy cover levels that preserve surface temperatures (Franklin and Donato 2020).

1.4.2 *Influence of Collaborative vs Single Entity Treatments*

The results of multiple fire metrics including burn probability, conditional flame length and wildfire size found that overall reduction in fire spread, and severity was greater for collaborative treatments compared to either of the single entity treatments. While single entity treatments on land owned by the Department of Natural Resources were comparable to collaborative treatments within the single-event FARSITE runs, I hypothesized that this was due to management restrictions on US Forest Service property that prevented the use of fuel reduction treatments. The fact that collaborative treatments influenced fire metrics to a greater extent was expected since by design, the collaborative treatments were twice as large as the single entity treatments. Having the treatments twice as wide was used as a proxy to simulate the effects of collaborative treatments as it demonstrated that when two entities work together the available area across a landscape that can be treated to influence wildfire is increased.

Our findings that collaborative treatments may be more effective than single entity is supported by previous studies that have found that fuel treatments on individual land ownerships rarely influence wildfire risk at a landscape scale (Charney et al 2020; Hessburg et al. 2015), and that as treatment size decreases, the probability of a wildfire encountering a treatment also decreases (Barnett et al. 2016). While this study quantified collaboration as an increased area for treatment, collaboration also results in sharing of knowledge, skills and economic investments.

Beginning in 2017, the Co-Managing Wildfire Risk Across boundaries (CoMFRT) group of the Rocky Mountain Research Station has worked extensively to study the benefits of collaborative management in relation to cross-boundary wildfires. One CoMFRT site encompasses the northeast portion of my study area, with a larger focus on transmission from the Wenatchee-Okanogan National Forest to surrounding private property. Key results from their findings regarding the benefits of collaborative management include the interdependence of landscapes, i.e., how fire management on one landowner affects a secondary owners ability to manage fire on their property, how the scale on which collaborative management may be implemented across a landscape correlates more with the level at which ecological processes occur, and how the sharing of resources and knowledge increases the chances for effective treatments (Butler et al. 2015). The ability to apply for and secure grants for large-scale treatments has also proven to increase with collaboration, as organizational abilities, data, and knowledge regarding treatment types is shared between landowners of varied sizes and capabilities (Cheng and Dale 2020). For example, a small landowner may not have the capabilities or knowledge to conduct simulations similar to those found in this study. If they were able to work collaboratively with a larger landowner or group that can run similar risk analyses, the small landowner can become more informed about the risk to their property and the greater landscape. Such knowledge may potentially motivate the small landowner to support collaborative treatments, as they have a greater understanding about the interdependence of their land in relation to those around them and awareness of potential wildfire risk.

1.4.3 *Awareness of Risk*

Similar to work done by Hass et al. (2014), simulation results from this study for the untreated landscape can be used by land managers and collaborative management groups for risk mitigation and strategic planning. Knowledge about a landscape's potential to burn allows communities to make more informed decisions regarding suppression and fuel management programs in addition to providing scientific information that can be used to understand wildfire risk to WUIs and structures and develop ignition prevention programs (Ager et al. 2019)

By simulating transmission risk within this landscape, study results have highlighted the land ownerships that have a higher potential for spreading wildfire. The results of Randig simulations and burn probability analysis can pinpoint areas within the landscape that are susceptible to high instances of wildfire under both normal and extreme weather conditions. Single-ignition FARSITE simulations may be helpful in showing the potential direction and intensity at which a large fire could potentially burn across the landscape, highlighting areas in which evacuations would be needed.

Hass et al. (2014) noted that awareness of risk motivates landowners to mitigate their risk. By highlighting the potential for cross-ownership wildfires within the study area, the results of my simulations could potentially motivate landowners to participate and support collaborative landscape reduction efforts. While this study only considered jurisdictional border fuel treatments, the results highlight the need for some form of fuel reduction treatment for mitigation as even small-scale treatments reduced potential risk.

1.4.4 *Limitations*

The goal of this study was to analyze the influence jurisdictional fuel reduction treatments have on cross-boundary wildfires and as a result, treatment design was focused solely on mitigation of wildfire exposure. In real world applications, the implementation of fuel reduction treatments is a complicated combination of economic, ecological, societal, and legislative constraints (McIver et al. 2012; Stephens et al. 2012). By designing the treatment zone to encompass the entire jurisdictional boundary between the two largest landowners within the study area, I did not account for accessibility to sites or slope stability in relation to various harvesting methods. While logging on slopes >50% can occur with cable yarding systems, use of this system for fuel reduction treatments is less common, with most treatments occurring with mechanical equipment on less than 35% slopes (North et al. 2015). The use of fuel reduction treatments within jurisdictional boundaries was more to focus directly on cross-boundary wildfires and less on their strategic placement across the landscape. While linear treatments have been found to increase suppression effectiveness, firefighter safety and anchor indirect control (Oliveria et al. 2016), clumping and layering of treatments or strategic placement parallel to dominant wind direction, along ridge tops or roads has been shown to be more effective in wildfire mitigation (Duncan et al. 2015; Parisien et al. 2007; Stevens et al. 2016). Fuel treatments can also be anchored to other natural and manmade barriers, such as streams, rock outcrops, barren areas or reservoirs (Schmidt et al. 2008). Use of "strategically place area treatments" (SPLATS; Finney 2001) has been found to decrease fire behavior in a variety of studies (Hessburg et al. 2016; Schmidt et al. 2008; Tubbesing et al. 2019; Wilson and Baker 1998). Parisien et al. (2007) directly compared landowner boundary treatments with clustered treatments and found that clustered treatments reduced burn probability to a greater extent than boundary treatments, while also treating a smaller portion of the landscape, an attractive alternative when managers are dealing with finite resources.

Fuel reduction treatments should be tailored to individual landscapes with variations in prescription to account for habitat conservation, watershed protection and topographic formations (Cochrane et al. 2012; Ingalsbee 2005; Stevens et al. 2016). Thus, allowing for different prescriptions within the same landscape for increased effectiveness.

The results of my simulations also represent a discrete moment in time as I did not model future conditions following treatment. Studies have shown that the effectiveness of fuel reduction treatments is time sensitive with most needing return management between 2-15 years (Agee 2005; Barnett et al. 2016; Morici and Bailey 2021; Prichard et al. 2021; Stephens et al. 2021; Vaillant et al. 2013). A critique of fuel treatments is the low probability of a fire burning through a treatment within the treatment’s effective lifespan (Baker and Rhodes 2008), with one study finding only 6.8% of treatments studied encountered a wildfire (Barnett et al. 2016). By only stimulating conditions associated with a wildfire burning through my treatments immediately after their theoretical implementation, my results can skew the interpretation of the overall effectiveness of fuel reduction treatments. Future work would need to model fuel loadings over time within my treated areas and potential fire behavior at intervals 5, 10 or 20 years in the future.

The use of remotely sensed data also introduces sources of error into my analysis both due to the resolution at which the data is available, 30 m x 30 m, and generalization of stand characteristics. Future works should incorporate ground-truthing through data collection within the study area to ensure modeled stand parameters are similar to those seen across the landscape.

1.4.5 *Management Implications*

I acknowledge that a fuel reduction treatment to the extent of my modeled simulation is both impractical across the broader landscape and placement is not spatially optimized for study area. However, I believe that some key points from my simulations can be helpful for managers and community groups working within my study area. Results from this study can potentially help collaborative restoration across the landscapes and starting blocks for the placement and intensity of future fuel reduction treatments.

One aim of this study was to quantify wildfire exposure within our landscape and to analyze how jurisdictional boundary treatments could influence the extent and severity of cross boundary wildfires. The results of Randig simulations highlighted the conditional burn probability and areas of risk across the untreated landscape. By understanding what areas of the landscape are at a greater risk of burning, managers and forest groups can prioritize the planning and implementation of fuel reduction treatments within these areas. Specifically, extreme weather simulations showed enhanced risk just north of the towns of Roslyn and Roland (Fig. 18). Recent studies have shown that human ignitions have increased the fire season and spatial extent of wildfires (Balch et al. 2017) by increasing the number of ignitions around the Wildland Urban Interface (WUIs), roads and recreational areas (Downing et al. 2022; Radeloff et al. 2018). While the randomized ignitions used within the Randig simulations were not distributed to account for the increased potential of human ignitions, I hypothesize that an increase in human ignitions surrounding the towns within this landscape could in turn further increase the burn probability in areas already highlighted for greater risk. To protect both the communities from wildfire and the greater landscape from increased human ignitions, strategically placed fuel reductions on the ridges around Roslyn and Roland could be beneficial to the entire landscape.

Forested land along the Teanaway Ridge in the eastern-central portion of the landscape in addition to areas along the jurisdictional boundary between the USFS and Teanaway Community Forest along Forest Road 9819 were also highlighted as areas of increased burn probability. These two areas highlight on-going discussions within the forest community on how to balance protecting sensitive species and ecological reserves with the need to mitigate wildfire risk. As the area burning at high severity during wildfire events increases (Parks and Abatzoglou 2020), there have been calls for increased implementation of treatments to reduce fire risk across the Western US. Substantial portions of Western US forests are protected under the Northwest Forest Plan (NWFP) and designated as critical habitat. These areas have heavy restrictions on the type and intensity of management that can occur within their boundaries. Within this study area, large portions of the landscape are designated as Roadless Areas or Late-Successional Reserves (Fig. 3), but both allow for management in the context of wildfire risk reduction. Therefore, managers must ask themselves if treating portions of restricted forested areas, such as Northern Spotted Owl (NSO) habitat, to decrease the likelihood for a large potentially high-severity wildfire is worth reducing already existing habitat. Recent studies are split on this issue. Raphael et al. (2013) simulated large scale fuel reduction treatments and NSO populations over 100 years on a large analysis area along the East Cascades that encompasses our study area. They found that while the aggressive fuel reduction treatments initially decreased short-term NSO habitat and population bottlenecks for about 30 years, the end-century populations were similar for the aggressive treatments and the untreated scenario (Raphael et al. 2013). Ganey et al. (2017) noted that the other side of the debate centers on both the effectiveness of fuel treatments at reducing wildfire spread and severity in general and arguments that high-severity fire was historically common in NSO habitat and does not pose immediate threats to populations. After reviewing previous studies, Ganey et al. (2017) argue that uncertainty remains for the response of spotted owls to high-severity wildfire and that the extent of wildfires currently being experienced may have significant impacts on the range of the NSO. One benefit of collaborative landscape scale projects is the ability for managers to implement fuel reduction treatments to potential reduce wildfire risk to restricted areas without having to enter and treat said areas. For example, along the eastern boundary of the US Forest Service and Teanaway Community Forest within the study area, lands within the Forest Service are classified as Late-Successional Reserves (LSRs). One potential avenue for collaboration between the two entities could be the implementation of fuel reduction treatments within the Teanaway Community Forest to reduce potential fire spread and severity of wildfires that ignite within the Teanaway Community Forest and spread into lands owned by the Forest Service. By working collaboratively through the sharing of knowledge, information or economic investments, these two entities could implement treatments that could benefit protected species and the overall landscape.

For the portion of the study that is classified as Roadless, letting wildfires burn but implementing boundary treatments as staging areas for suppression is one-way managers could combat future wildfires. Johnston et al. (2021) found that over the past 30 years, more land has been burned on Roadless areas than Roaded Areas but, because Roadless Areas tend to experience fewer ignitions and often encompass cooler, moister, and higher elevation landscapes, Roadless areas experience decreased fire severity. Therefore, letting fires burn in Roadless areas may increase the resilience of the landscape in relation to climate change. However, they also note that over recent years the largest wildfires that have burned across national forest land began in Roadless Areas (Johnston et al. 2021). Implementation of boundary fuel treatments along Roadless Areas could provide safe corridors for firefighters to suppress wildfires that begin in the Roadless Area from burning into other portions of the forest, WUIs or communities. Managers can utilize the wildfire exposure map derived from this study to highlight areas for future fuel treatments and facilitate discussions with multiple landowners to support the use of collaborative restoration efforts.

The wildfire modeling software used in this study requires eight layers describing site conditions including elevation, slope, aspect, fuel model, canopy cover, canopy height, canopy base height and canopy bulk density. The five layers describing stand conditions (fuel model, canopy cover, canopy height, canopy base height and canopy bulk density) are less applicable to forest managers who tend to create treatment prescriptions based on forestry metrics such as trees per hectare and basal area. To better facilitate the use of wildfire software and treatment software, ArcFuels (Ager et al. 2011) was developed to streamline management planning and wildfire risk assessment with the Forest Vegetation Simulator, ArcMap and FlamMap. This tool allows managers to input delineated stand data with geospatial boundaries into ArcMap, run various proposed treatments through FVS to manipulate the stands and then run FlamMap to derive potential fire behavior metrics. While this application is beneficial when moving from stand data to FlamMap input layers, the reverse process of cross-walking manipulated FlamMap input layers into workable treatment prescriptions is slightly more difficult. To do this, I propose the combined use of keywords, kcp, key and output files within the Forest Vegetation Simulator (FVS) (Crookston and Dixon 2005). Keywords within FVS can be used to thin stands to a variety of metrics such as residual Canopy Cover and can be constrained to a variety of metrics within a kcp file. A string of keywords within a kcp file can simulate a forest thinning to a residual canopy cover percent of 60%, retain only large diameter trees, and remove all small diameter trees. An additional kcp file can be used to output metrics of interest from an FVS simulation such as basal area or trees per hectare. Utilizing their gathered stand data, managers can run kcp files with keywords that match FlamMap layer outputs through FVS and output working prescription metrics such as basal area and trees per hectare. Managers can identify species for retention and various DBH distributions to best fit their landscape while also achieving the overarching fuel profiles that were simulated within FlamMap. An example kcp file and keywords can be found in Appendix F.

As we enter a warming climate, the results from this study may change. The weather variables utilized were derived from a previous wildfire within the region and the 97th percentile weather from a nearby RAWS station. Periods of prolonged drought decreased precipitation and increased summer temperatures could result in weather variables more extreme than those implemented in the study. Decreased relative humidity, resulting from decreased precipitation and increased temperatures, can result in increased rate of spread and fireline intensity. This could result in larger fires that burn at higher severities and can evade the treatment prescriptions proposed above. Evidence from a recent study (Abell et al. 2021) found that future warming could result in the weakening of westerlies and movement poleward of current wind streams. While decreased wind speed can result in less severe wildfire behavior, changing of predominant wind direction can result in fire movement to portions of the landscape that were previously less susceptible to wildfires. Warmer and drier conditions will result in lower fuel moistures and longer fire seasons, potentially increasing the frequency and size of fires when compared with historical averages (Halofsky et al. 2020). Overall, most metrics associated with climate change may increase wildfire behavior and severity across our landscape, allowing wildfires to evade and burn at greater intensity through the treatments proposed in this study.

1.5 Conclusions

As we enter a warming world in which past management decisions are having immense impact on the fire-landscape system and humans continue to expand into forested systems, there is a growing need for scientifically backed ideas to combat the growing wildfire crisis. While the specific treatment prescriptions, widths and spatial arrangements analyzed in this study might not be optimized for the landscape, findings highlight the need for some form of management to mitigate future wildfire risk. Due to numerous landowners within the study area, collaborative management is the best way to reduce wildfire risk to the surrounding forests and communities in terms of both the scale of restoration and ability for larger landowners to support and facilitate treatments that might otherwise be out of reach for smaller landowners.

Within my simulations, complete removal of overstory vegetation resulted in the greatest reduction of overall fire size and reduced conditional flame length to active suppression levels. However, the long-term implications of such an intensive treatment need to be thoroughly considered before such a treatment is implemented on the ground. Simulations of variable retention harvests (30%, 40%, 60%, and Shadetree) all resulted in similar reductions in fire metrics. Underlying model assumptions relating fuel loadings to flame lengths most likely created these similarities but potentially support previous findings that when planning for surface fires, reduction levels for canopy fuels may matter less than surface loadings.

The main goal of this study was to simulate the influence of collaborative vs single-entity treatments with results from the simulations continuously indicating that collaborative treatments outperformed single-entity treatments across multiple fire metrics. Previous studies have noted the benefits of open communication between landowners including awareness of risk and the interdependence of landscapes, sharing of knowledge and the ability to implement strategically placed treatments that fall across multiple landowners. Results from the study highlighted the towns of Roslyn, WA and Roland, WA as areas of concern along with the lands classified as Late-Successional Reserves (LSRs) within the US Forest Service. Understanding areas of greatest concern allows mangers and landowners to conduct further studies that may result in targeted treatments across the landscape to decrease loss of habitat and protect property and structures.

The need for collaborative management has grown exponentially in the past few decades and the introduction of programs to facilitate multi-ownership restoration has already resulted in steps towards healthier forests. Since 2011 the landscape analyzed in this study has been a part of the larger Tapash Sustainable Forest Collective, a collective group that includes the Yakama Nation, The Nature Conservancy, USDA Forest Service, Washington Department of Fish and Wildlife, and Washington State Department of Natural Resources. Over the past eleven years this group has worked together to restore habitat and cultural values, increase forest health, and decrease wildfire risk (Adams et al. 2021). Additionally, in 2022 $29.1 million of government funding was awarded to treat over 200,000 acres of high-risk firesheds in central Washington and Oregon as part of a science-backed strategy to target and treat landscapes that will have the greatest and most immediate impact on decreasing wildfire risk (USDA Forest Service). Both groups further support the need for studies like the one conducted above, studies that provide information and awareness to landowners across landscapes and outline potential steps they can take to understand and tackle wildfire risk in an uncertain future.

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FIGURES

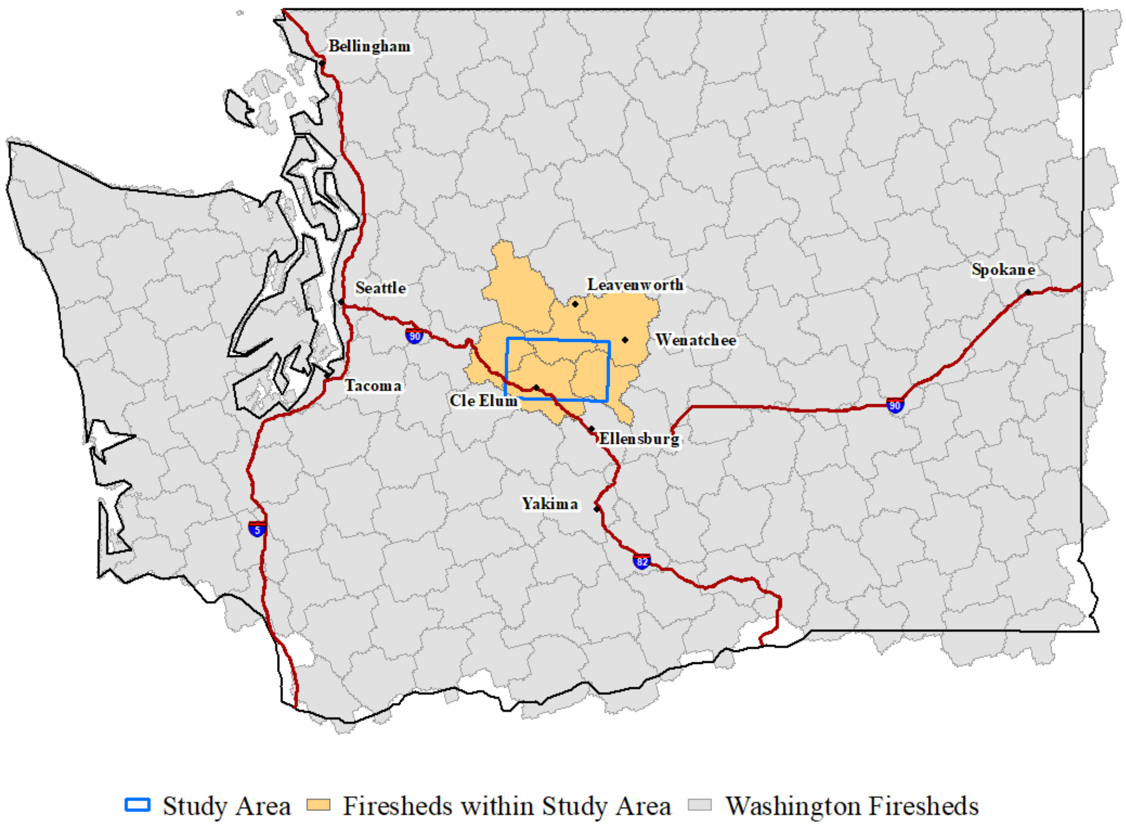


Figure 1: Map of Washington State subdivided by Firesheds (Evers et al. 2020) showing location of case study (blue box).

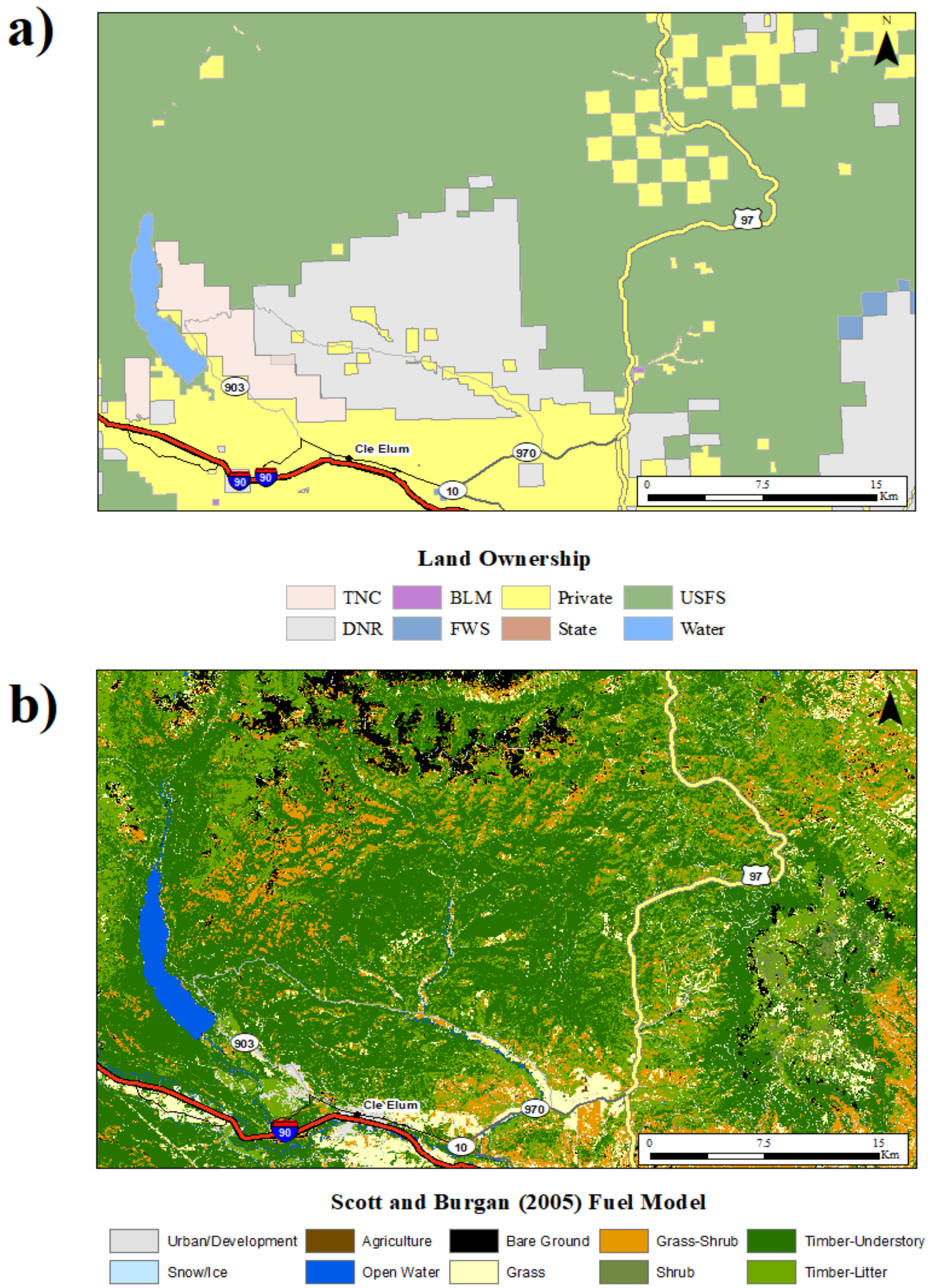


Figure 2: a) Land ownership designations across the study area. TNC: The Nature Conservancy, BLM: Bureau of Land Management, USFS: US Forest Service, DNR: Department of Natural Resources, FWS: Fish and Wildlife Service. b) Fuel Model breakdown of within the study area by Scott and Burgan (2005) classifications.

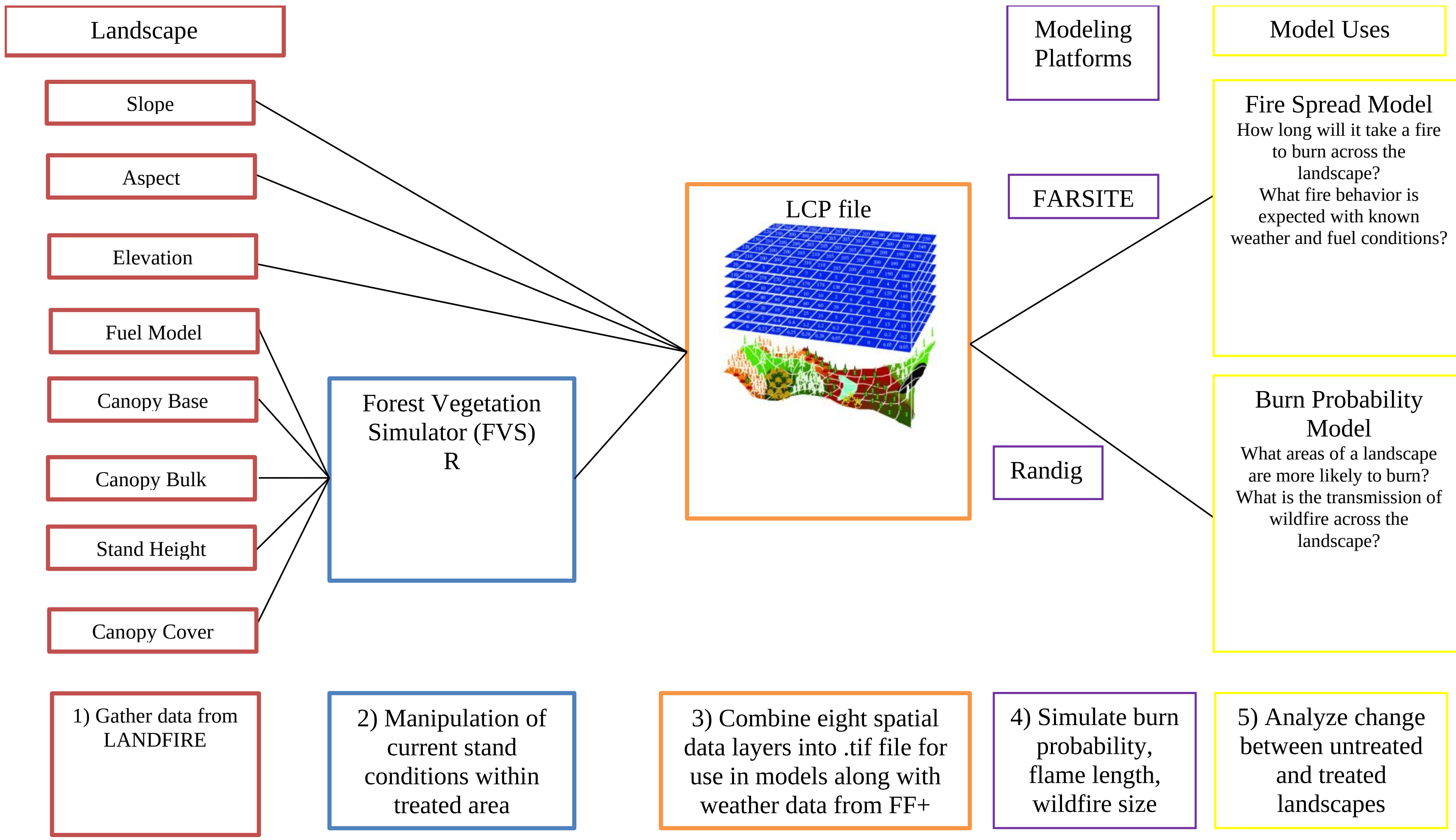
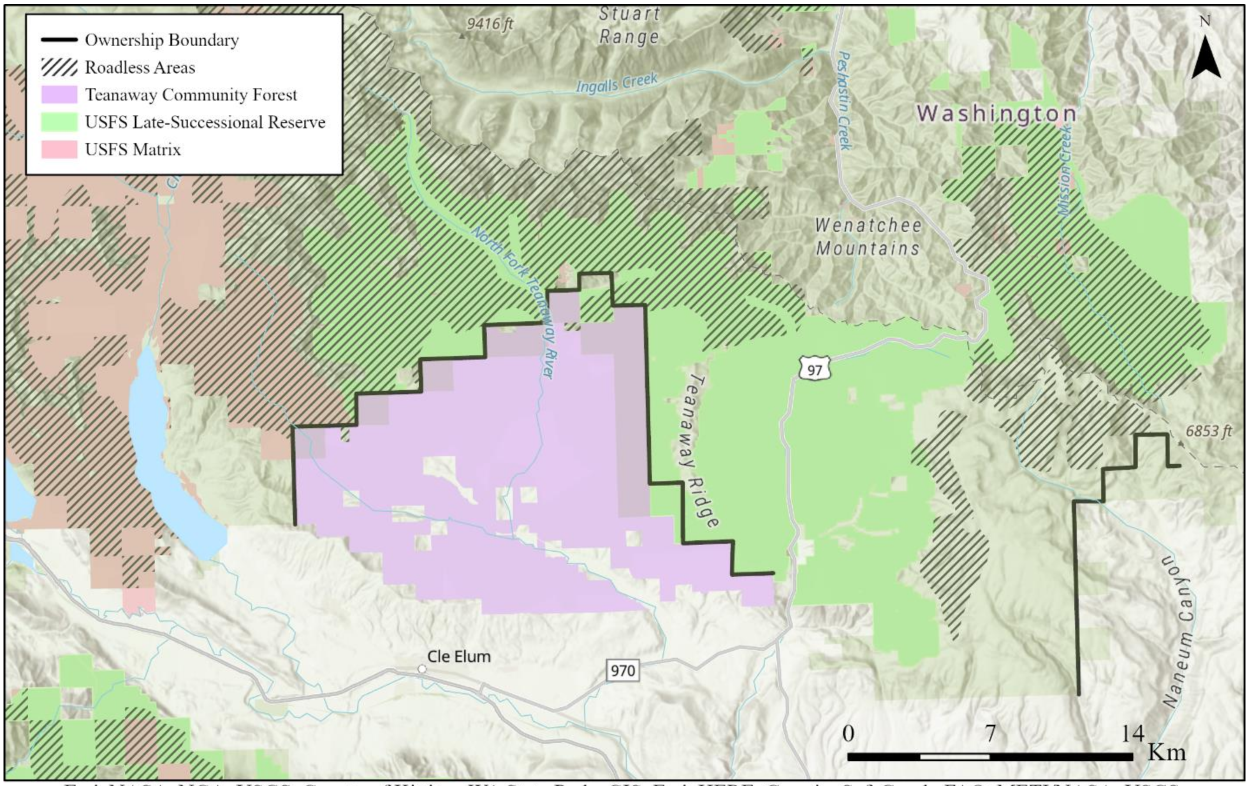


Figure 3: Methodology Flowchart. (1) Gather data, (2) manipulation of data, (3) Combination of .tif and weather files, (4) fire simulation with FARSITE and Randig, (5) Analysis



Esri, NASA, NGA, USGS, County of Kittitas, WA State Parks GIS, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, Bureau of Land Management, EPA, NPS

Figure 4: Late-Successional Reserves and Matrix locations within the USFS land as designated by the Northwest Forest Plan. The Teanaway Community Forest was acquired in 2013. USFS: United States Forest Service.

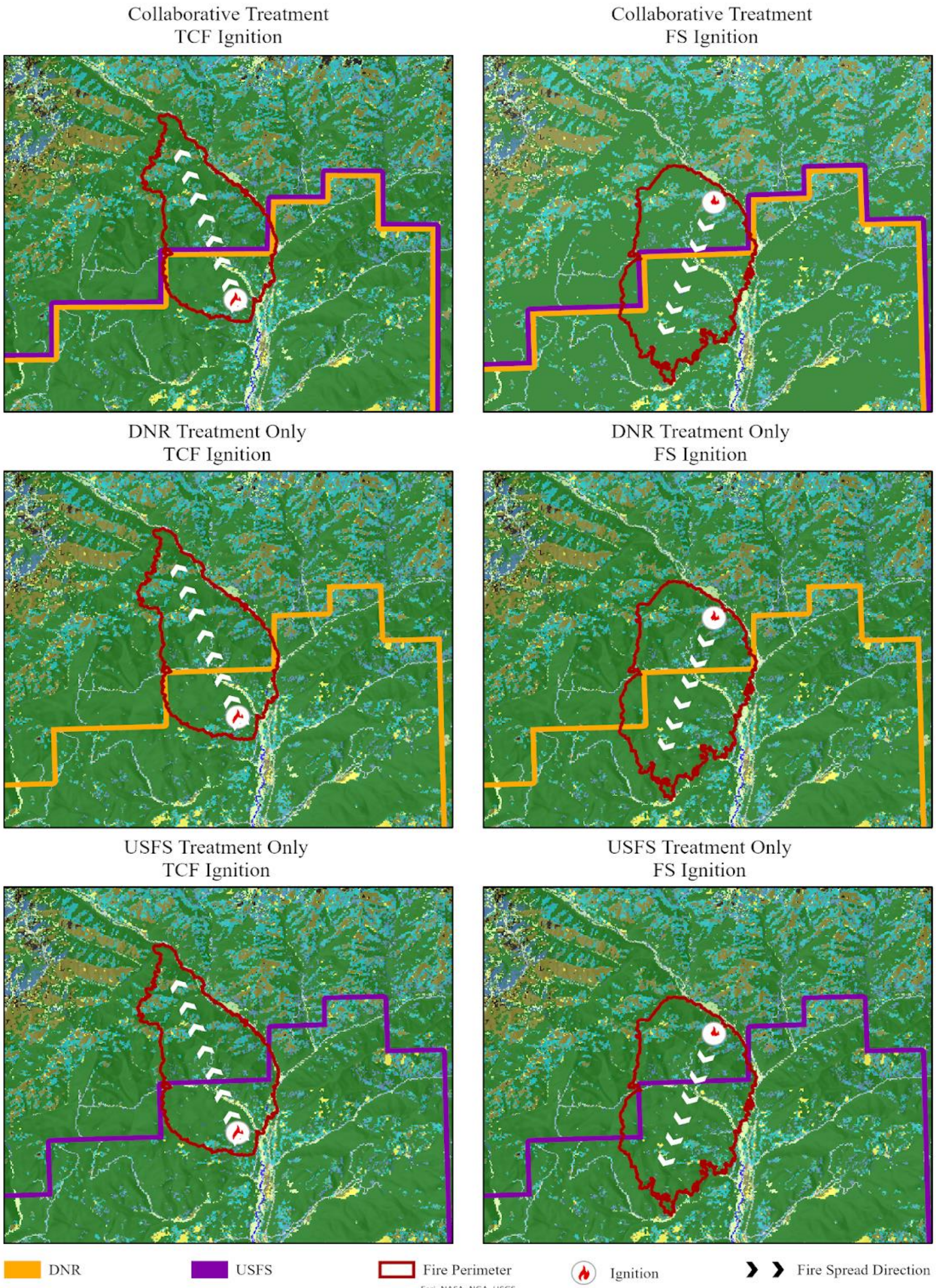


Figure 5: The six unique orientations of ignition starting location and treatment placement. Each orientation was simulated across all combinations of treatment width, treatment type and weather scenario. TCF: Teanaway Community Forest, DNR: Department of Natural.

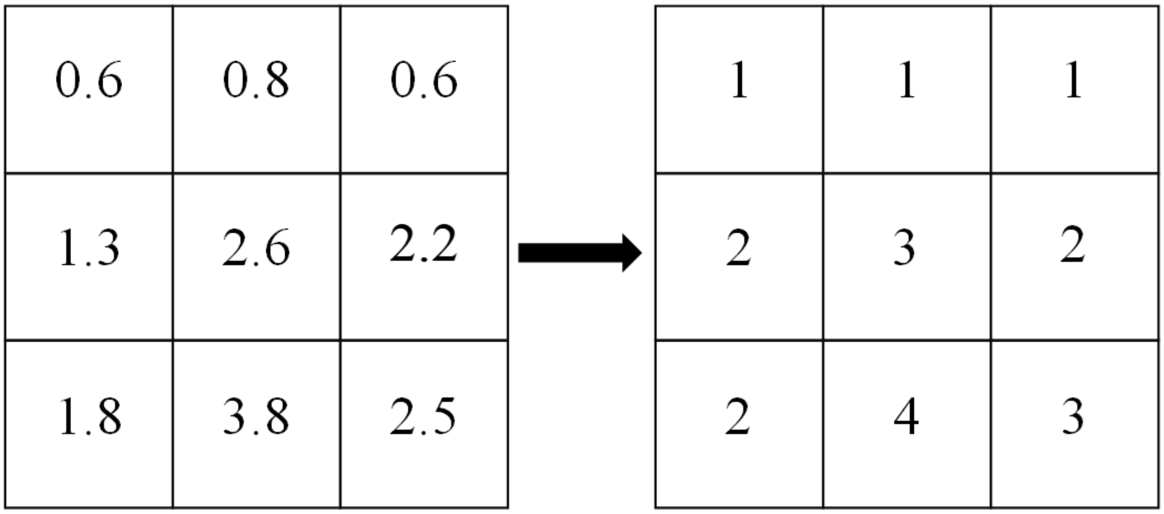


Figure 6: Example of reclassification of flame length base pixel value to suppression tactic classifications as first outlined by Andrews and Rothermel (1982). See Table 11 for Suppression Tactic Categories.

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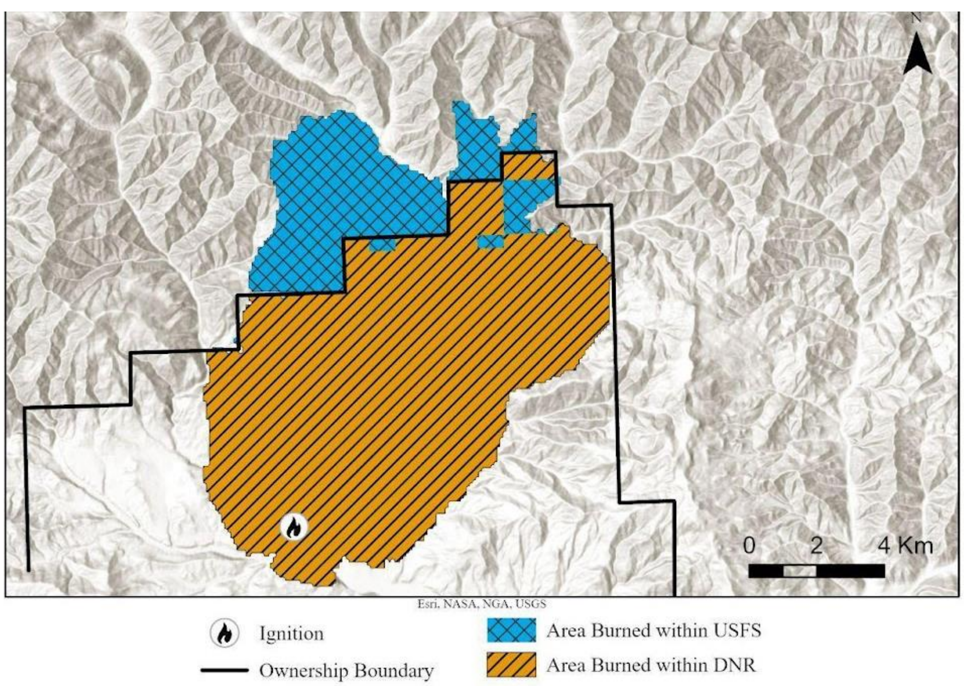


Figure 7: Example of single fire perimeter ownership classification for use in calculation of transmission risk. For this fire, the ignition source designation (fire symbol) is DNR, a majority of the fire burned on DNR lands (orange with cross hatch) until it crossed the ownership boundary and burned into USFS land (blue x hatched). USFS: US Forest Service, DNR: Department of Natural Resources.

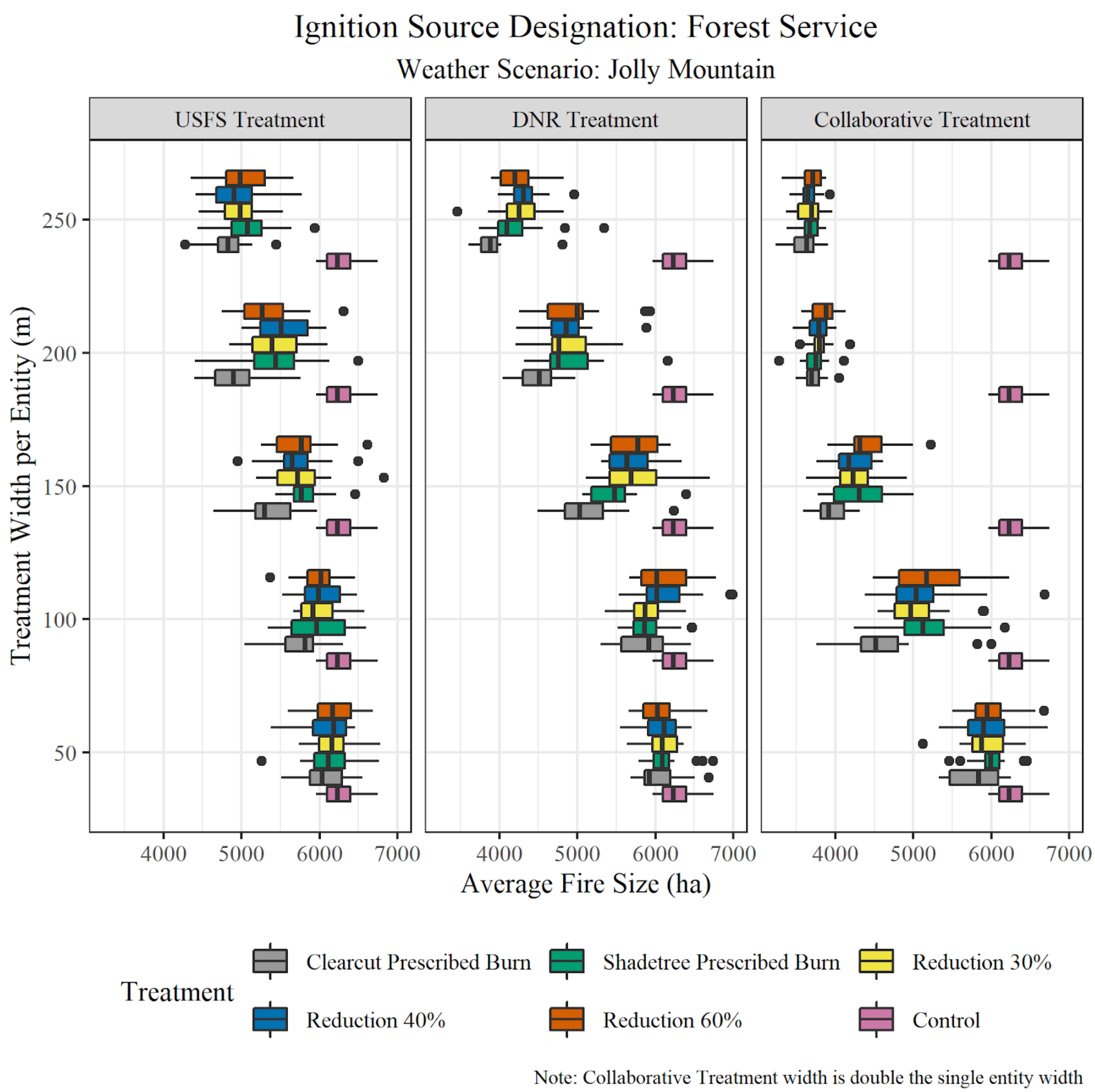


Figure 8: Effects of fuel treatment types, widths and placement on average fire size for single-event FARSITE simulations with ignitions that started on US Forest Service property and burned into the Teanaway Community Forest (DNR) under the Jolly Mountain weather scenario.

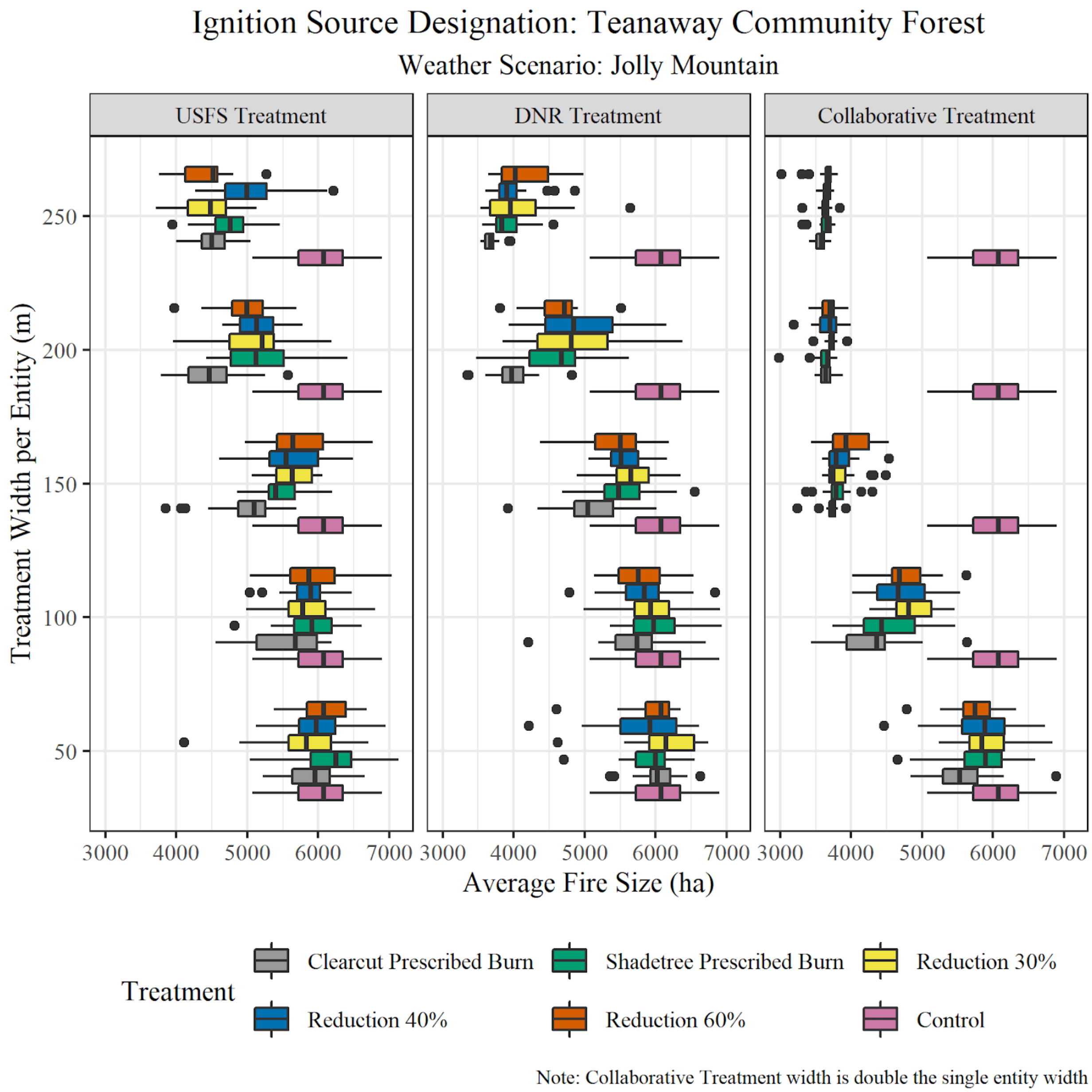


Figure 9: Effects of fuel treatment types, widths and placement on average fire size for single-event FARSITE simulations with ignitions that started on the Teanaway Community Forest (DNR) and burned into US Forest Service property under the Jolly Mountain weather scenario.

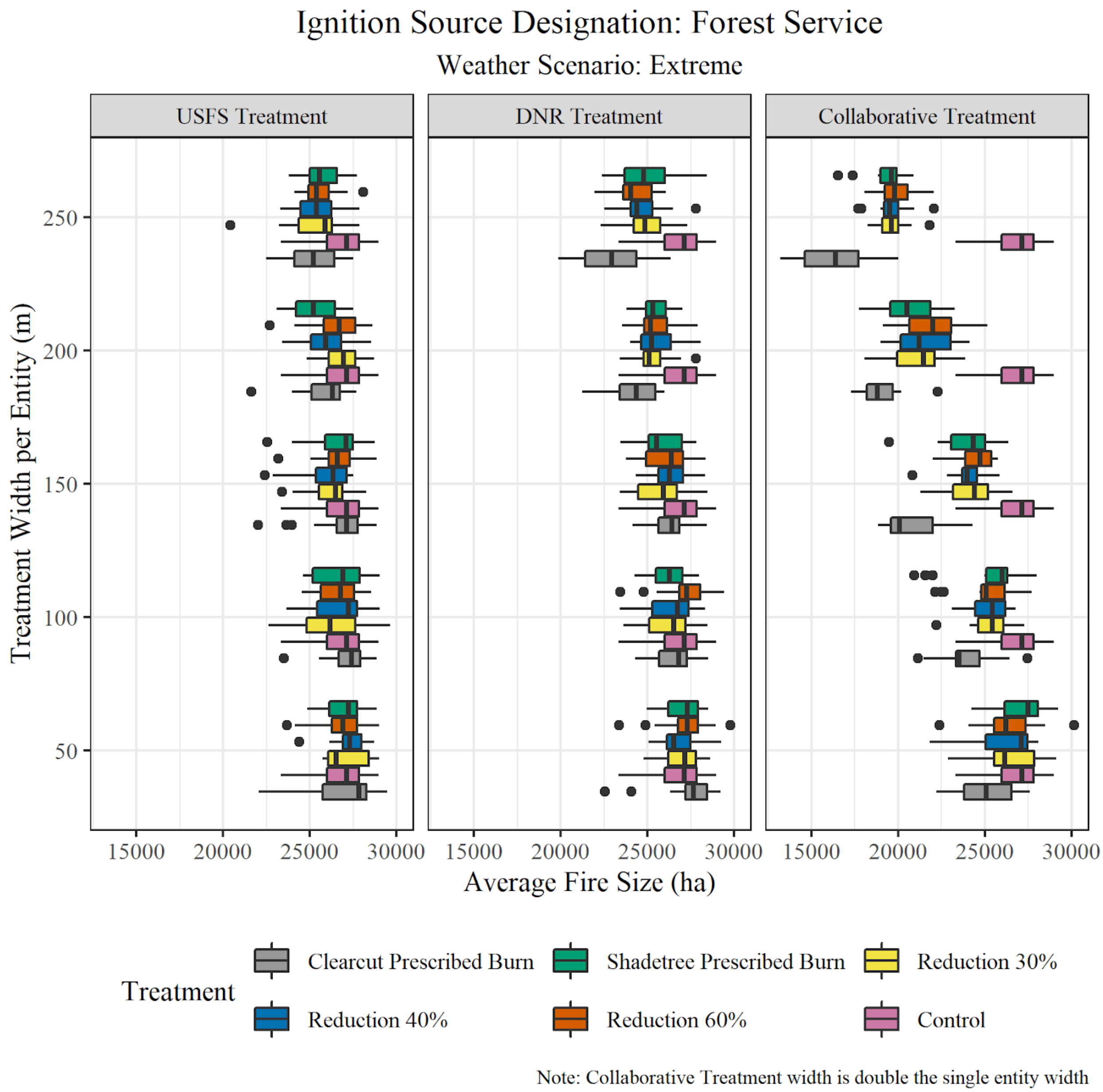


Figure 10: Effects of fuel treatment types, widths and placement on average fire size for single-event FARSITE simulations with ignitions that started on US Forest Service property and burned into the Teanaway Community Forest (DNR) under the Extreme weather scenario.

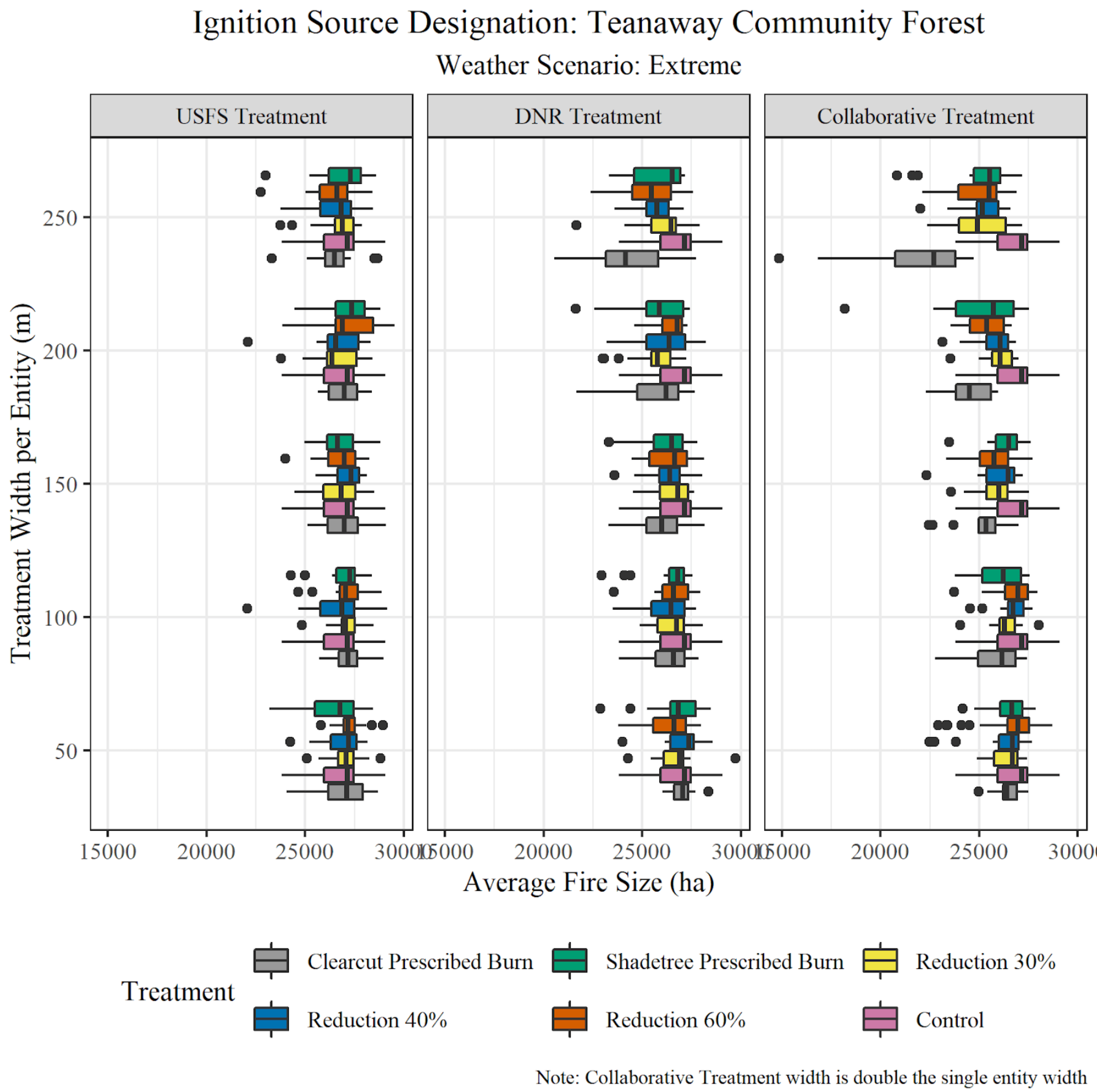


Figure 11: Effects of fuel treatment types, widths and placement on average fire size for single-event FARSITE simulations with ignitions that started on the Teanaway Community Forest (DNR) and burned into US Forest Service property under the Extreme weather scenario.

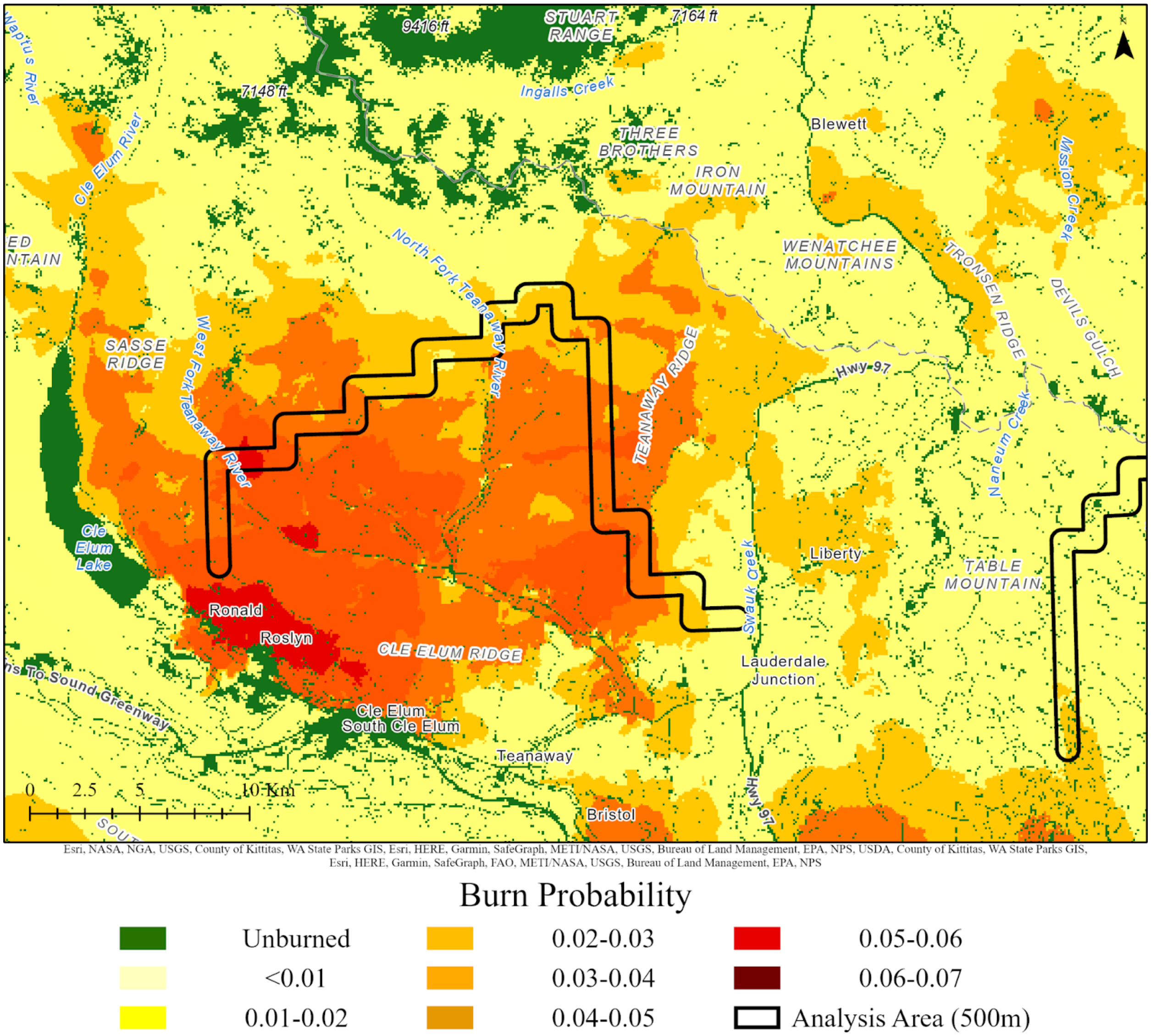


Figure 12: Burn probability map derived from Randig over the course of 8,000 simulated fires under Extreme weather conditions with dominant winds coming from the NNE. The black analysis outlined area encompasses 500 meters on either side of the largest landowner boundary within the study area.

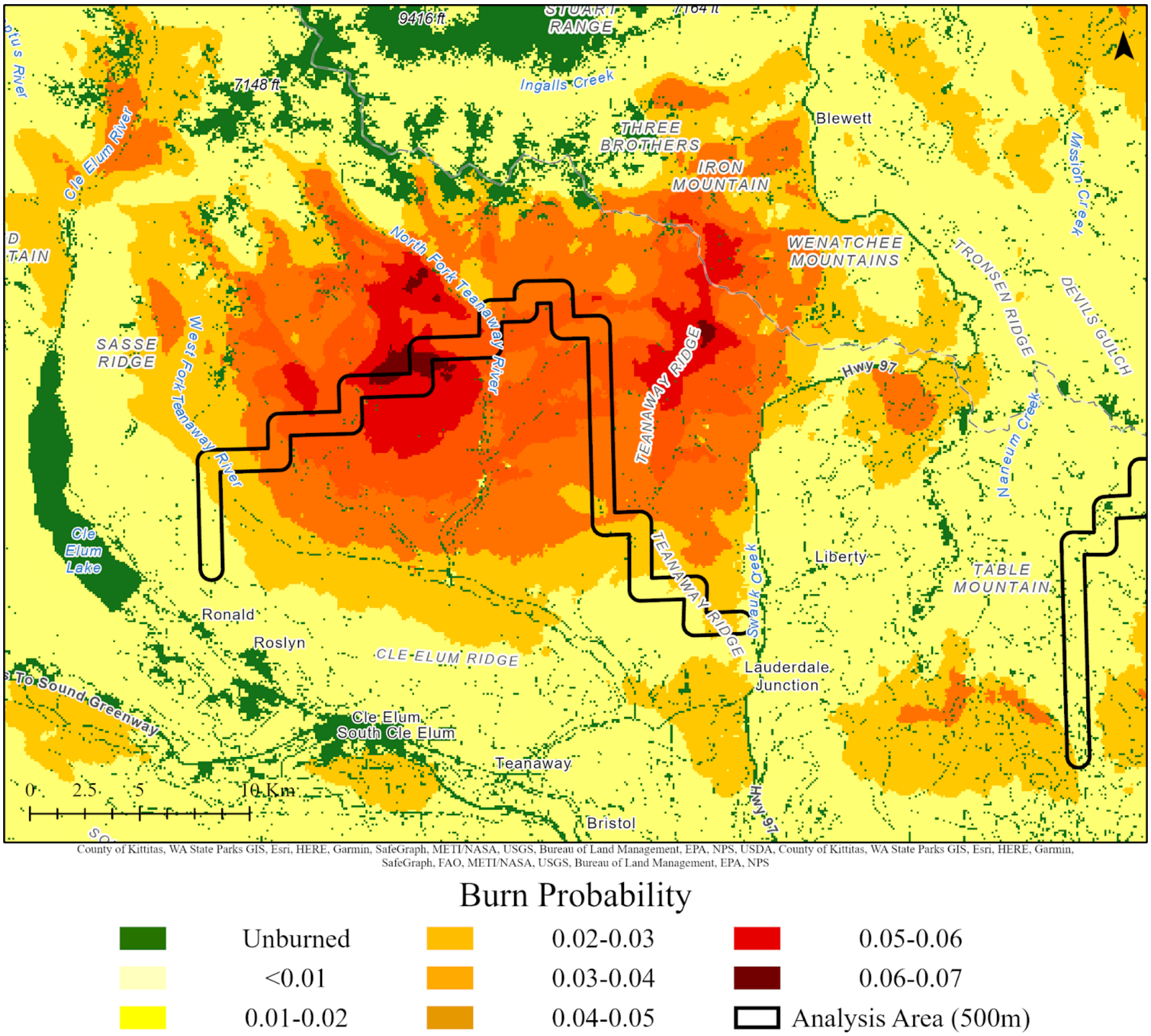


Figure 13: Burn probability map derived from Randig over the course of 8,000 simulated fires under Extreme weather conditions with dominant winds coming from the SSW. The black analysis outlined area encompasses 500 meters on either side of the largest landowner boundary within the study area.

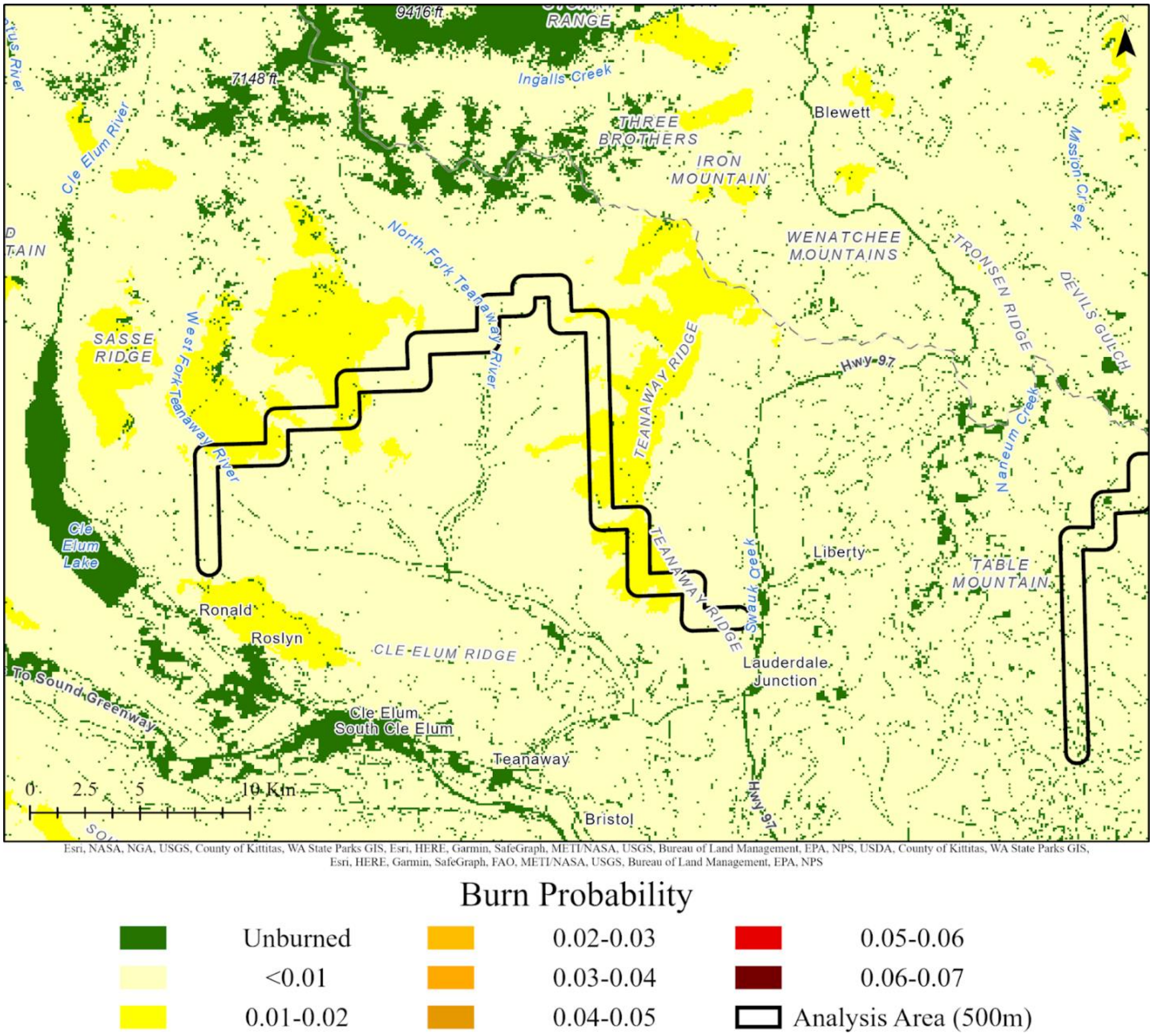


Figure 14: Burn probability map derived from Randig over the course of 8,000 simulated fires under Jolly Mountain weather conditions with dominant winds coming from the NNE. The black analysis outlined area encompasses 500 meters on either side of the largest landowner boundary within the study area.

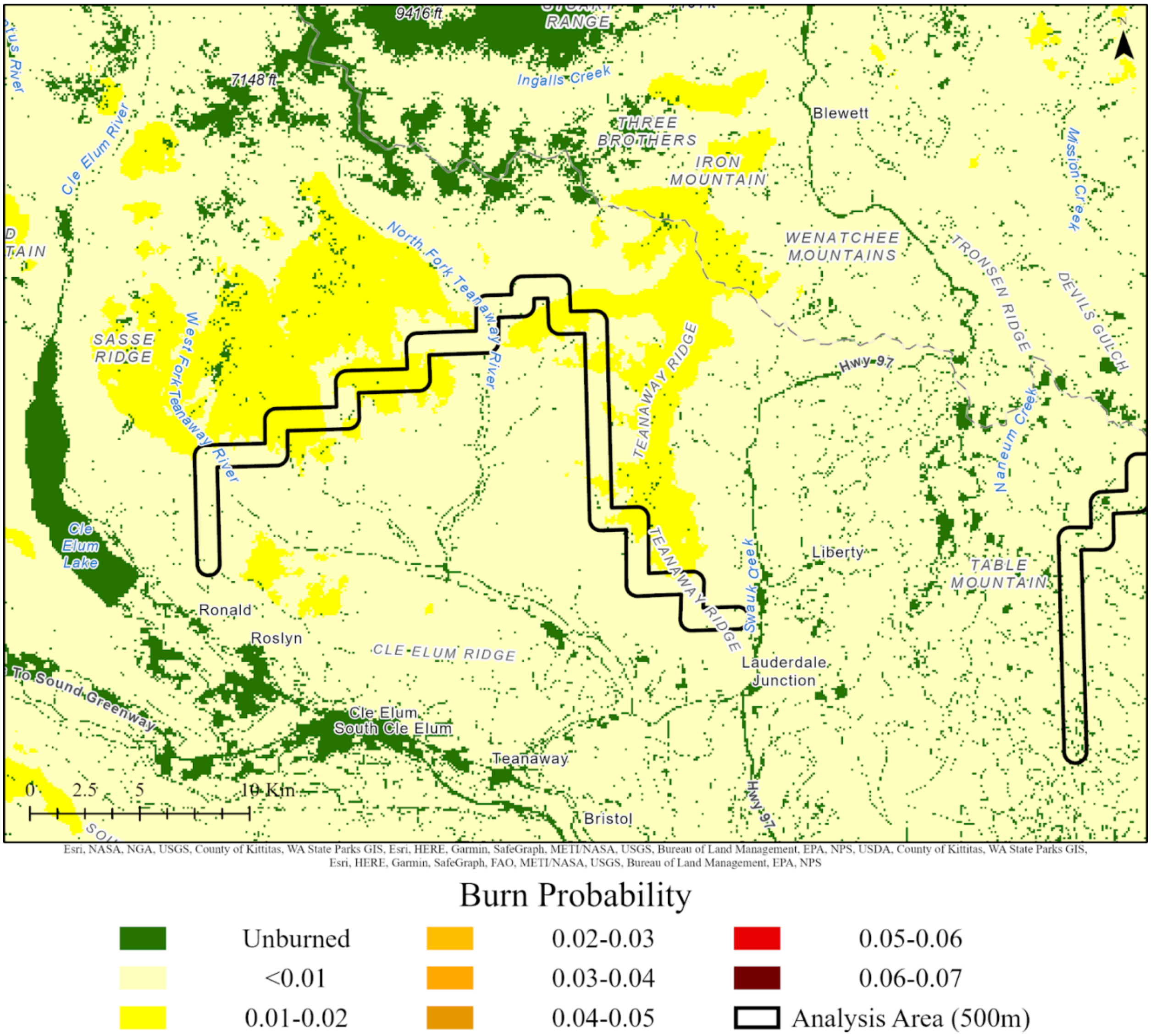


Figure 15: Burn probability map derived from Randig over the course of 8,000 simulated fires under Jolly Mountain weather conditions with dominant winds coming from the SSW. The black analysis outlined area encompasses 500 meters on either side of the largest landowner boundary within the study area.

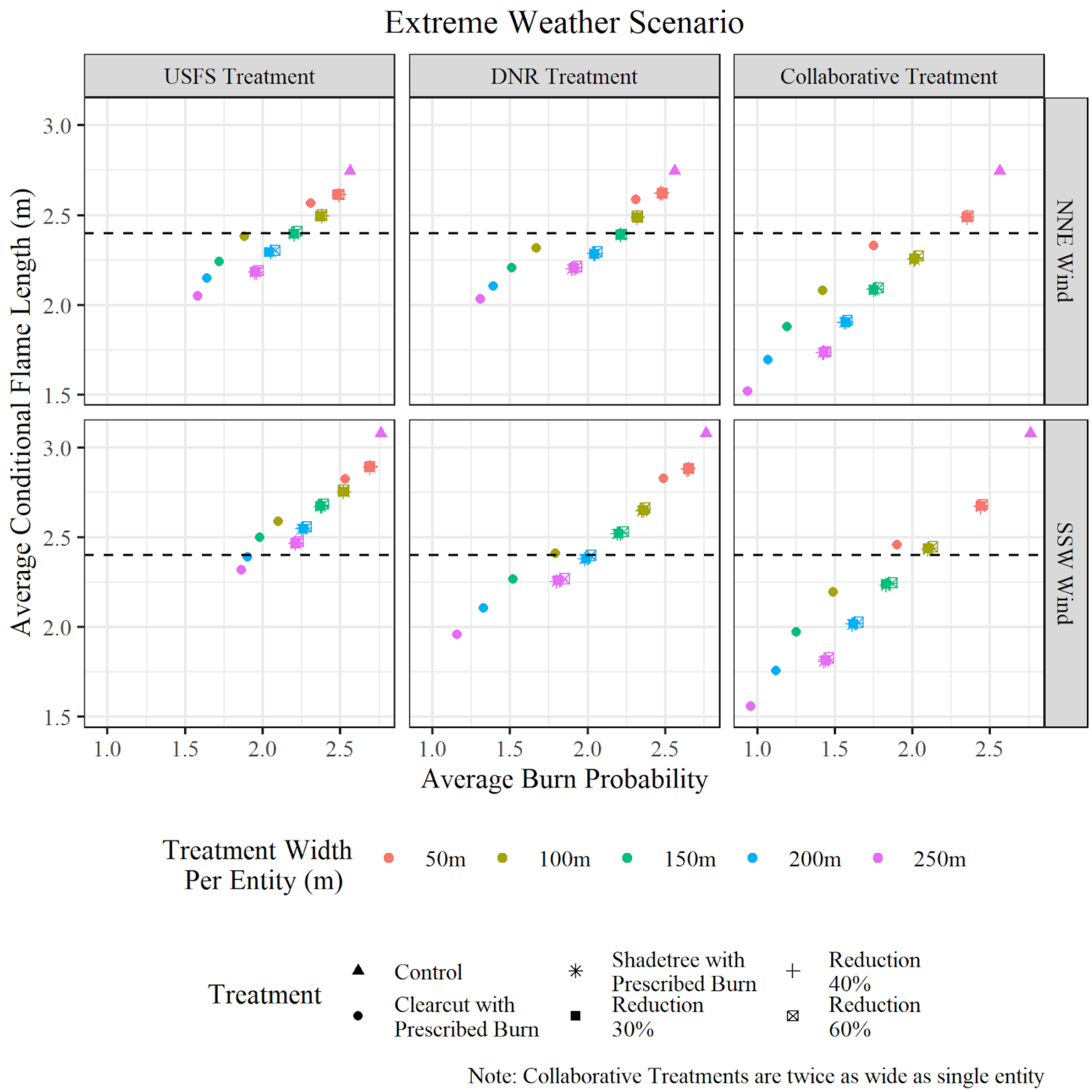


Figure 16: Average Conditional Flame Length (meters) in relation to Average Burn Probability for fires simulated under Extreme weather within a 500-meter analysis zone on either side of the main land ownership boundary within the study area. Results are shown under different treatment widths, treatment types, treatment placements and wind scenarios. Dotted line at 2.4-meters represents the flame length height that Andrews and Rothermel (1982) hypothesized would correlate to uncontrollable fire as suppression efforts would be ineffective in combating torching and spreading within the canopy. USFS: US Forest Service, DNR: Department of Natural Resources

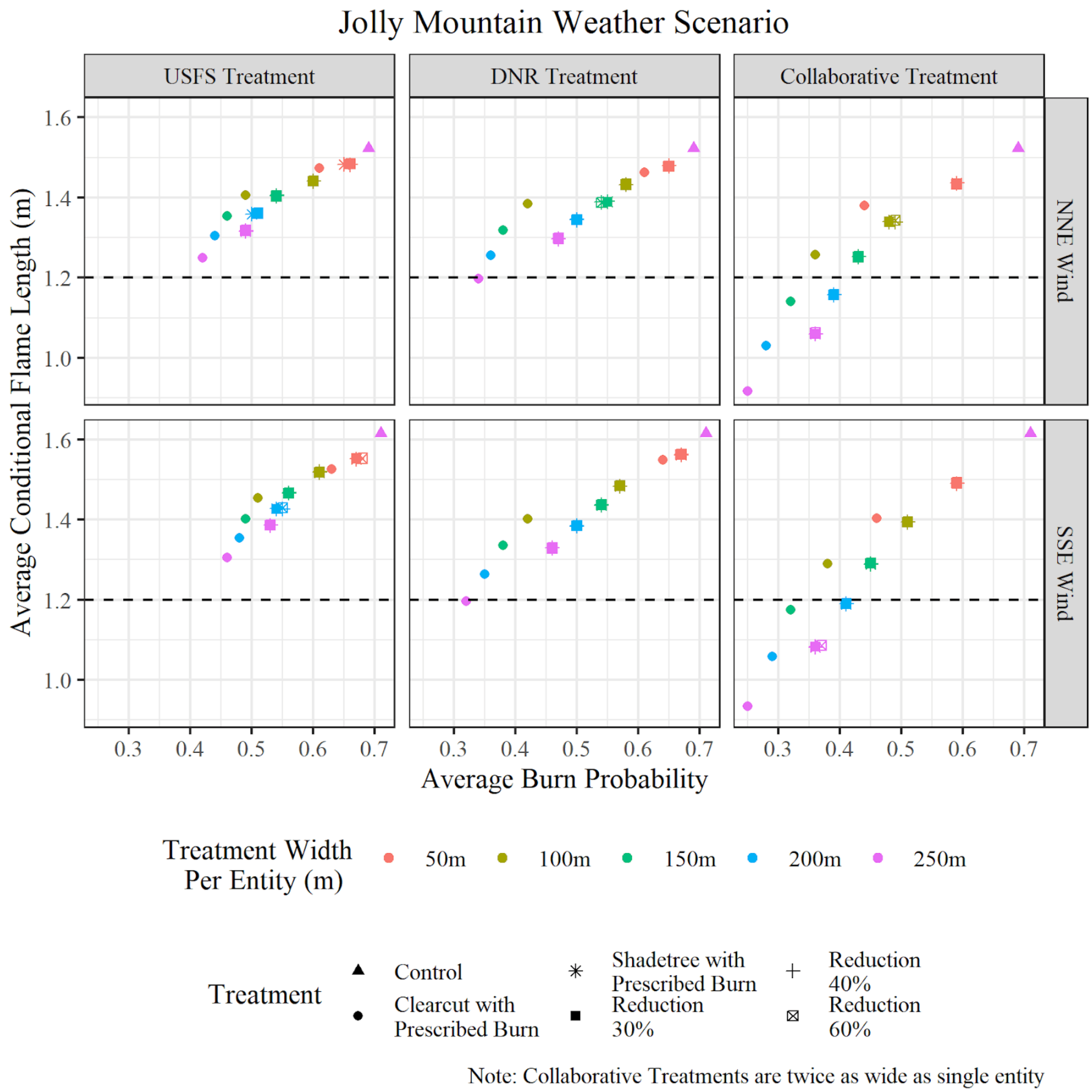


Figure 17: Average Conditional Flame Length (meters) in relation to Average Burn Probability for fires simulated under Jolly Mountain weather within a 500-meter analysis zone on either side of the main land ownership boundary within the study area. Results are shown under different treatment widths, treatment types, treatment placements and wind scenarios. Dotted line at 1.2-meters represents the flame length height that Andrews and Rothermel (1982) hypothesized would correlate with a change in direct attack from handlines to use of heavy equipment for fire suppression operations. USFS: US Forest Service, DNR: Department of Natural Resources.

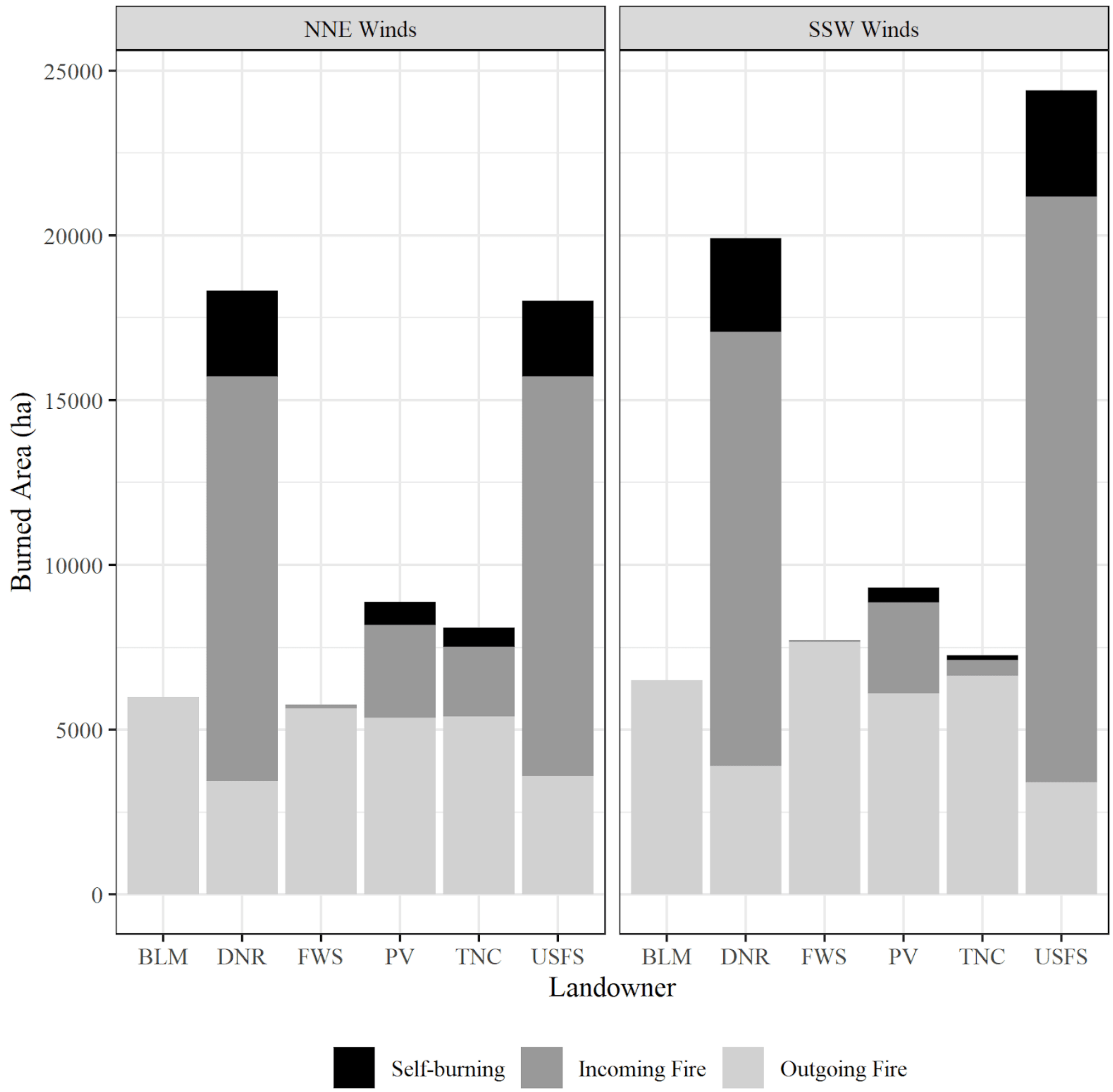


Figure 18: Hectares of self-burning, incoming and outgoing fire in the untreated landscape for each landowner under our Extreme weather scenario. Self-burning represents the total burned area for fires that started in a landowner and only burned within that landowner's boundaries. Incoming fire represents the total burned are transmitted into a landowner from neighboring landowners. Outgoing fire represents the total burned area transmitted into neighboring landowners for ignitions started within that landowner. BLM: Bureau of Land Management, DNR: Department of Natural Resources, FWS: Fish and Wildlife Service, PV: Private, TNC: The Nature Conservancy, USFS: US Forest Service.

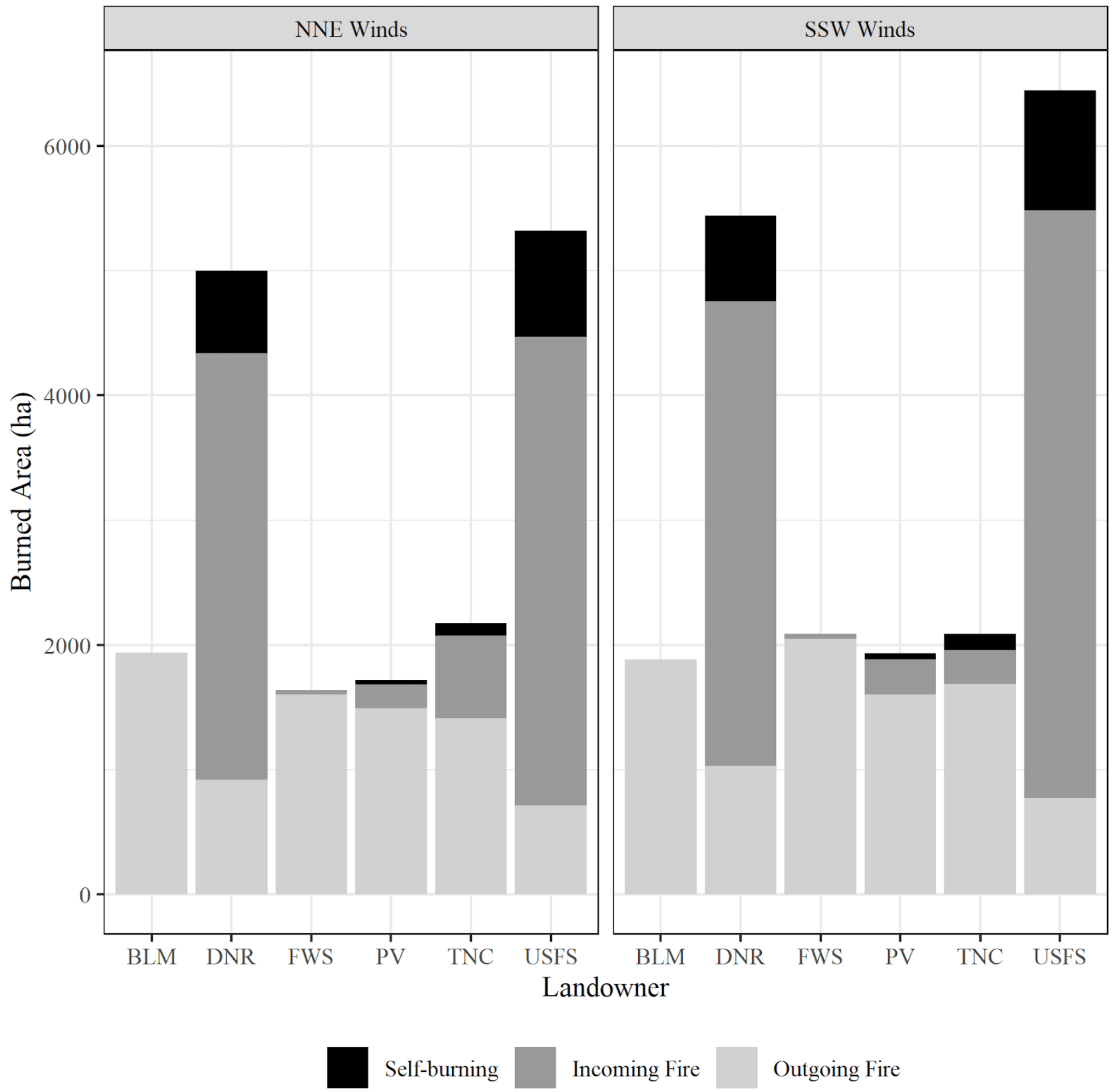


Figure 19: Hectares of self-burning, incoming and outgoing fire in the untreated landscape for each landowner under our Jolly Mountain weather scenario. Self-burning represents the total burned area for fires that started in a landowner and only burned within that landowner's boundaries. Incoming fire represents the total burned area transmitted into a landowner from neighboring landowners. Outgoing fire represents the total burned area transmitted into neighboring landowners for ignitions started with that landowner. BLM: Bureau of Land Management, DNR: Department of Natural Resources, FWS: Fish and Wildlife Service, PV: Private, TNC: The Nature Conservancy, USFS: US Forest Service.

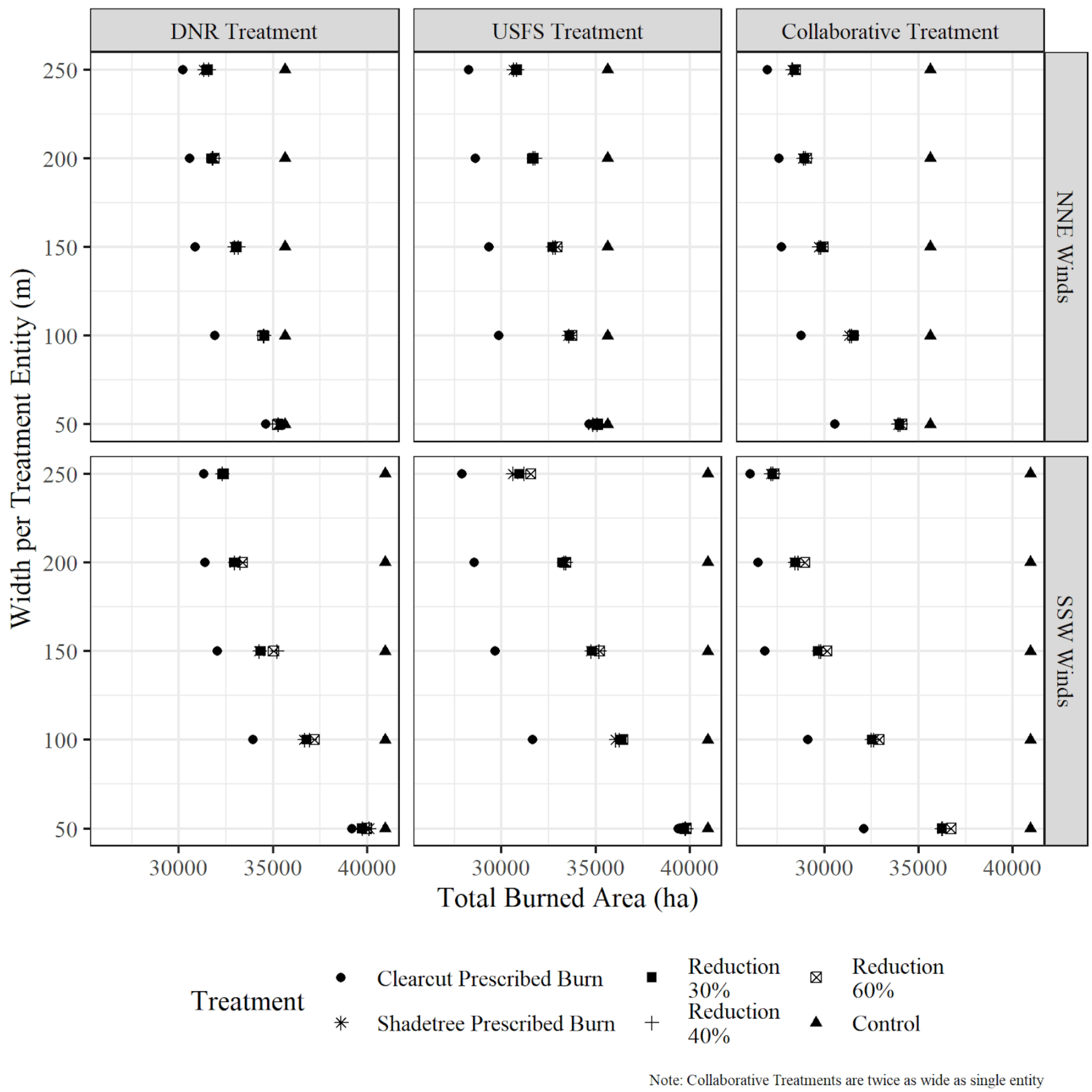
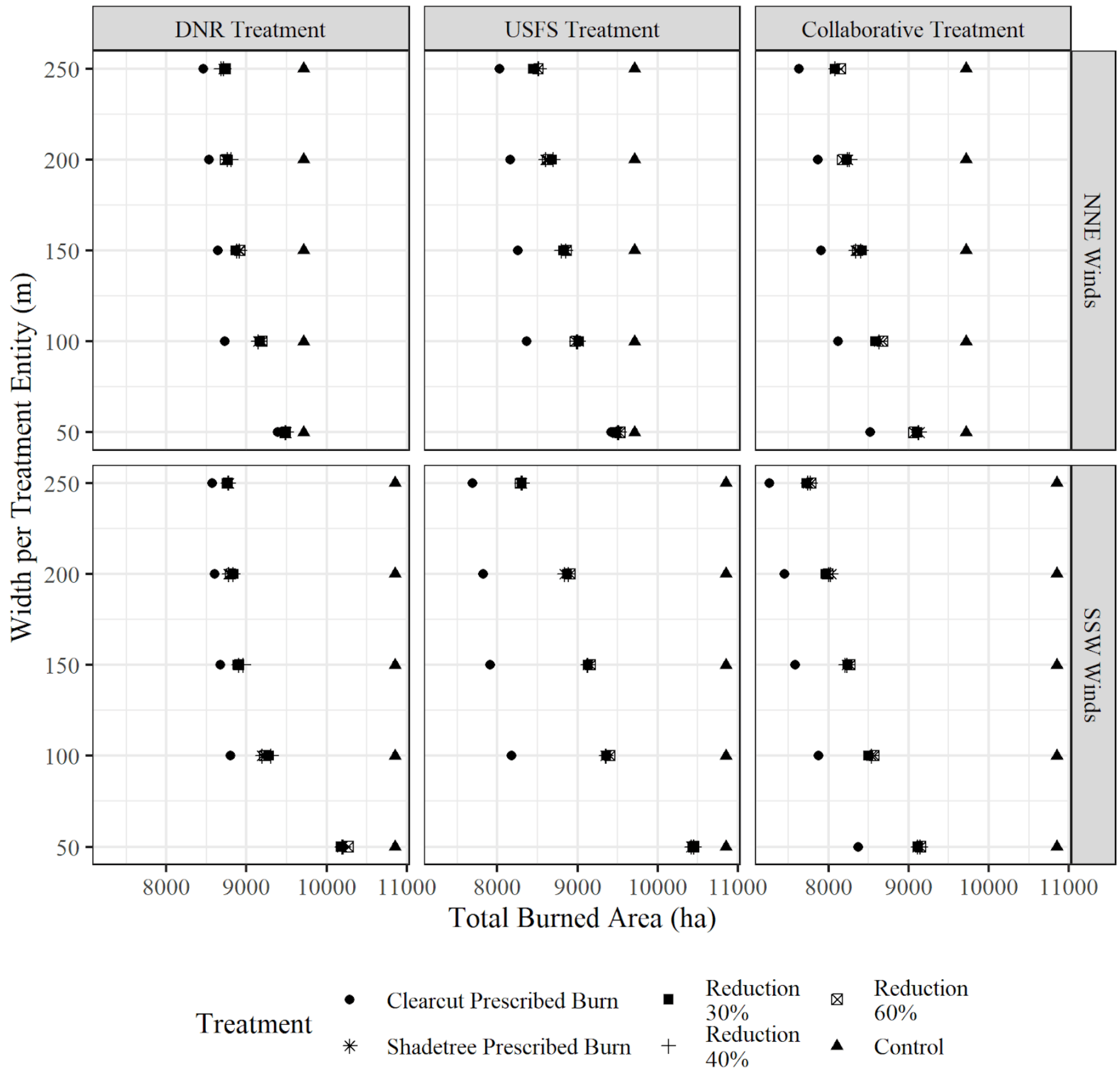


Figure 20: Total Burned Area (sum of self-burning, incoming and outgoing fire) for the two largest landowners, DNR and FS, across treatment widths, types, placements and wind direction under our Extreme weather scenario. All values expressed are in hectares (ha). USFS: US Forest Service, DNR: Department of Natural Resources.



Note: Collaborative Treatments are twice as wide as single entity

Figure 21: Total Burned Area (sum of self-burning, incoming and outgoing fire) for the two largest landowners, DNR and FS, across treatment widths, types, placements and wind direction under our Jolly Mountain weather scenario. All values expressed are in hectare (ha). USFS: US Forest Service, DNR: Department of Natural Resources.

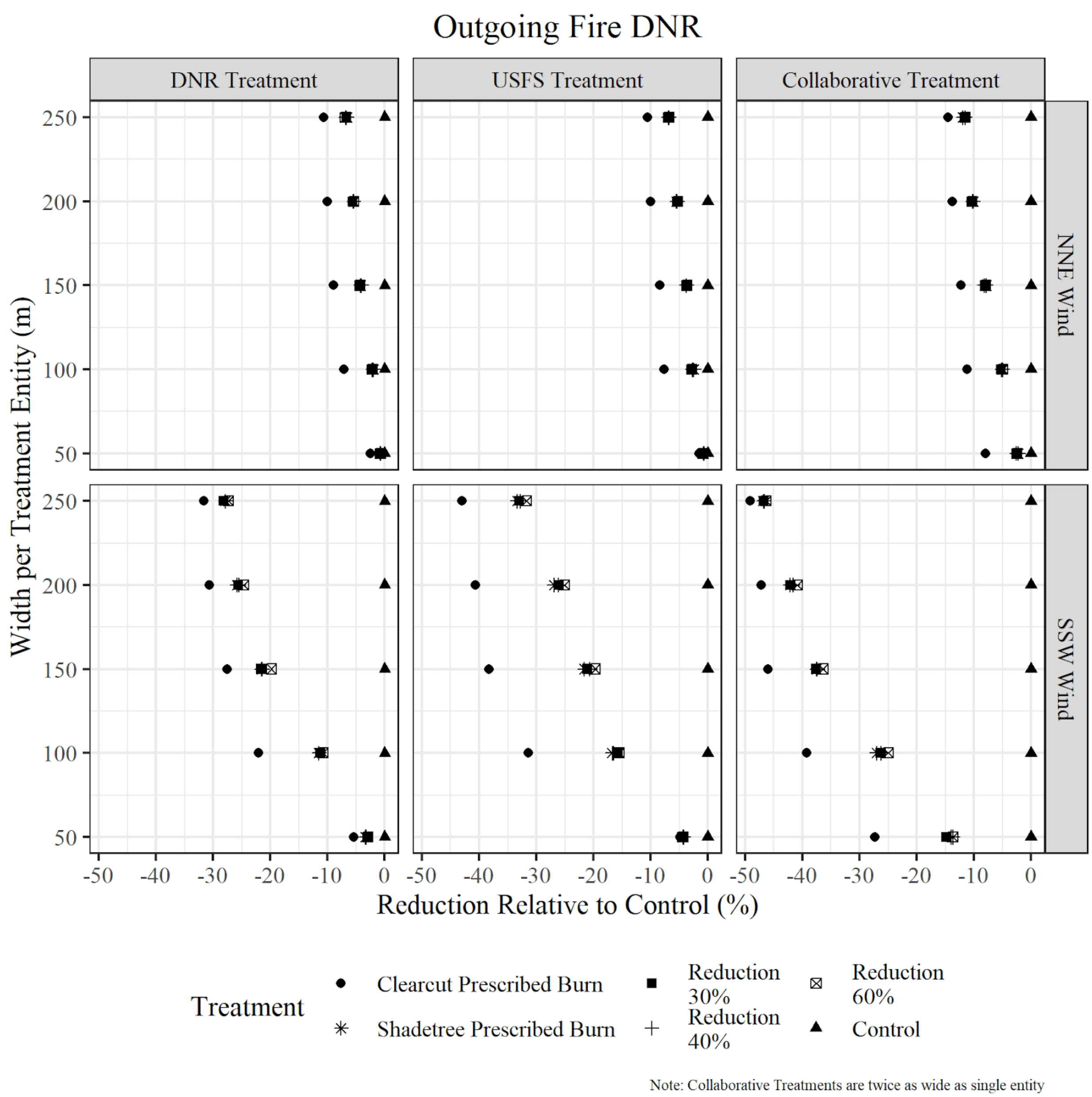


Figure 22: Percent reduction in Outgoing Fire for the Department of Natural Resources (DNR) between a treated landscape and untreated landscape simulated under Extreme weather.

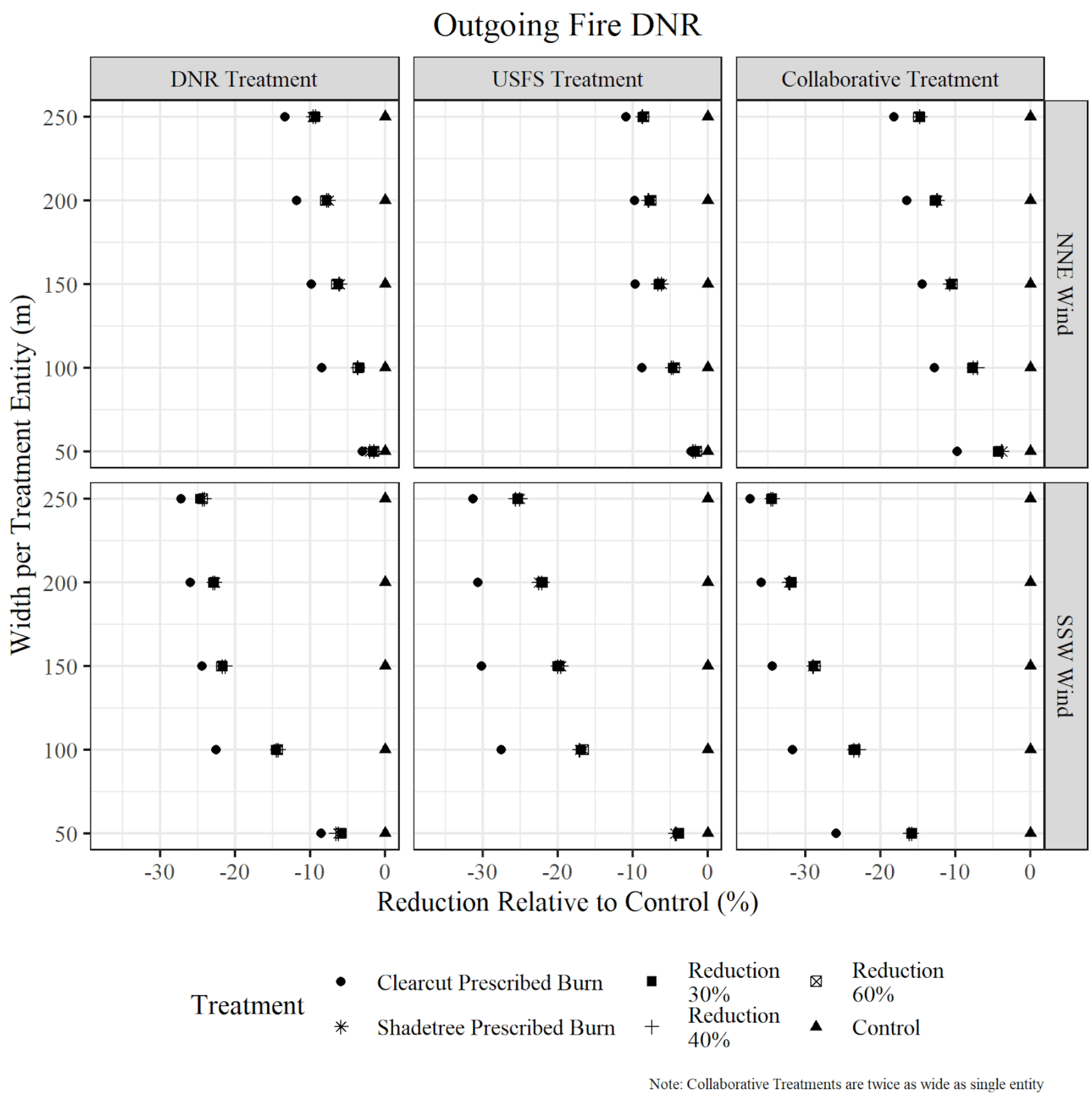


Figure 23: Percent reduction in Outgoing Fire for the Department of Natural Resources (DNR) between a treated landscape and untreated landscape simulated under Jolly Mountain weather.

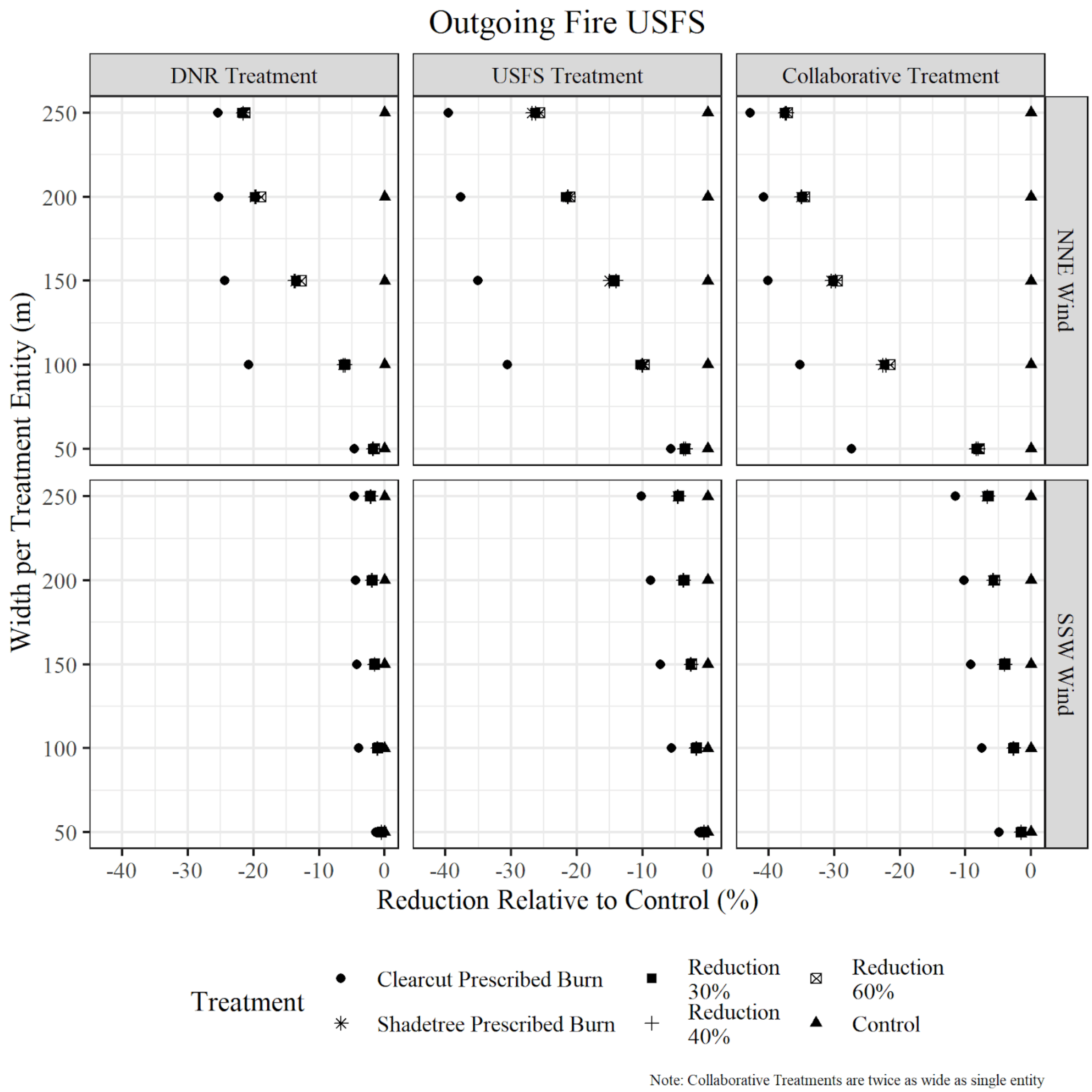


Figure 24: Percent reduction in Outgoing Fire for the United States Forest Service (USFS) between a treated landscape and untreated landscape simulated under Extreme weather.

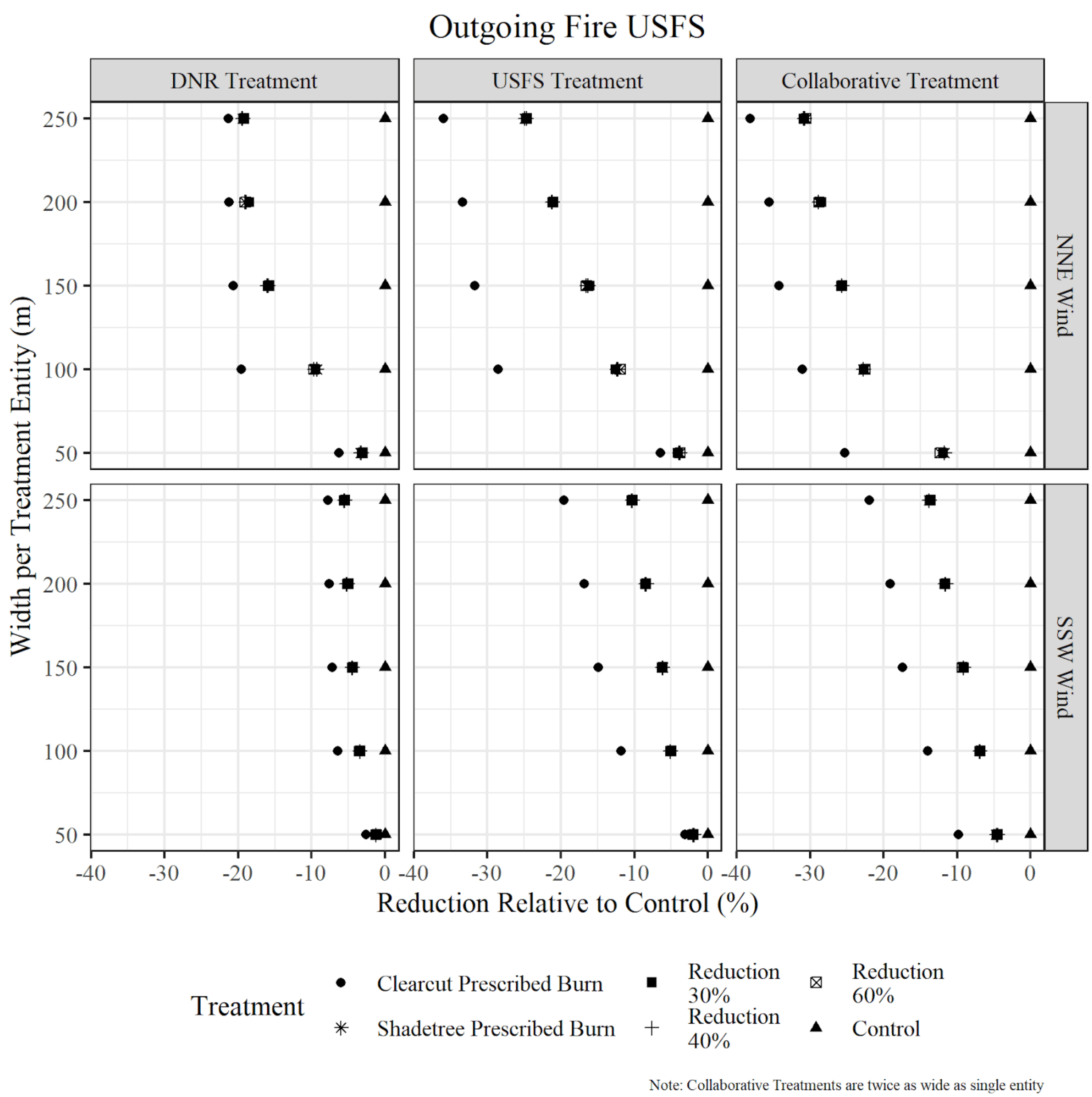


Figure 25: Percent reduction in Outgoing Fire for the United States Forest Service (USFS) between a treated landscape and untreated landscape simulated under Jolly Mountain weather.

TABLES

Table 1: Monthly Climate Summary for Cle Elum, Washington from 1899 - 2021 (WRCC 2021) (Western Regional Climate Center, Cle Elum, Washington, USA).

Latitude	Longitude	Elevation	Mean Average Temperature	Mean Temperature Annual Range	Mean Maximum Temperature	Maximum Temperature Annual Range	Mean Minimum Temperate	Minimum Temperate Annual Range	Mean Annual Total Precipitation	Monthly Precipitation Range
Degrees and Minutes		m	°C	°C	°C	°C	°C	°C	cm	cm
47° 11'	120° 57'	575	7.8	-21.4	14.5	1.6 - 27.6	1.3	-6.6 - 10.2	57.6	0.9 - 4.11

Table 2: Breakdown of hectares and proportion of Scott and Burgan (2005) classified Fuel Models within the study area.

Fuel Model	Hectares	Percent of Study Area
Urban/Developed	6417	3
Snow/Ice	70	0
Agricultural	27	0
Open Water	2926	1
Bare Ground	10681	5
Grass	17173	8
Grass-Shrub	33001	14
Shrub	2263	1
Timber-Understory	101223	44
Timber-Litter	54362	24
Total	228143	100

Table 3: Breakdown of hectares and proportion of fire regime classification according to fire frequency and fire severity levels within the study area.

Fire Regime	Frequency (years)	Severity	Hectares	Percent of Study Area
I-B	6 - 15	Low	9651.15	4.3
I-C	16 - 35	Low	51427.71	22.5
II-C	16 - 35	Mixed	29.97	0.0
III-A	36 - 100	Mixed	101367.45	44.4
III-B	101 - 200	Low	9346.59	4.1
IV-A	36 - 100	High	17187.39	7.5
IV-B	101 - 200	Mixed	12.96	0.0
V-A	200+	Any	11.34	0.0
V-B	500+	Any	27124.47	11.9
NA	NA	NA	11984.22	5.3
Total			228143	100

Table 4: Objectives and management types of the various landowners within the study area along with the governing act that the landowner must work within. [a]DNR (2015). [b]DNR (2020). [c]USFS (1994). [d]Central Cascades Forest (2022).

<table>
<tr><th>Ownership Type</th><th>Governing Act</th><th>Ownership Objectives</th><th>Management Types</th></tr>
<tr><td>Department of Natural Resources - Teanaway Community Forest (DNR)</td><td>Forest Practices Act / State Environmental Policy Act</td><td rowspan="2">-Provide diverse habitats across the landscape through active management[a]
-Increase the quality and quantity of habitat across the landscape[a]
-Enhance the snowpack retention capacity of the forest[a]
-Reduce the rate of runoff from rain-on-snow events[a]
-Manage the forest to reduce the risk and severity of fire near infrastructure and sensitive fish and wildlife areas[a]
-Work with neighboring landowners and partners to address forest health and habitat issues across ownership boundaries[a]

[a]Exempt from usual requirement that land must generate income to fund operations[a]</td><td rowspan="2">Active Harvests including[a]
-Thinning
-Gap creation
-Fuels reduction</td></tr>
<tr><td>U.S. Fish and Wildlife Service (FWS)</td><td>Forest Practices Act / State Environmental Policy Act</td></tr>
<tr><td>State</td><td>Forest Practices Act / State Environmental Policy Act</td><td>-Increase forest and watershed resilience[b]
-Reduce risk of uncharacteristic wildfire and other disturbances[b]
-Enhance economic development[b]
-Implement coordinated landscape-scale forest restoration via collaborative[b] cross-boundary management</td><td>Active Harvests including[b]
-Thinning
-Prescribed Burns</td></tr>
</table>

Table 4 (continued).

US Forest Service (FS)	Northwest Forest Plan	-Maintenance of late-successional and old growth species habitat and ecosystems[b] -Native biological diversity[b] -Sustainable-yield timber production[b] -Prevention of large-scale disturbances by fire, wind, insects and diseases[b]	Active Harvests including[c] -Thinning -Underplanting -Reforestation -Prescribed fire
The Nature Conservancy (TNC)	Forest Practices Act / State Environmental Policy Act	-Restore Forests of the Central Cascades to be more resilient to fire, disease and changing climate[b]	Active Harvests following ecological forestry principles developed by Jerry Franklin including[d] -Thinning -Gap Creation -Prescribed fire -Surface treatments -Reforestation

Table 5: Treatment widths for each unique weather scenario. Note that the treatment width is for single entity treatments. For collaborative treatments, width is double the listed width.

Treatment Widths	Jolly Mountain Weather	Extreme Weather
50 m	X	X
100 m	X	X
150 m	X	X
200 m	X	X
250 m	X	X
1200 m		X
1400 m		X
1500 m		X

Table 6: Influence of fuel treatment reductions on fire behavior, modified from Stephens et al. 2020.

Treatment	Outcome
Reduce Surface Fuels	Decrease surface fireline intensity and increase fire suppression effectiveness
Increase Canopy Base Height	Decrease risk of crown fire initiation and increase fire suppression effectiveness
Reduce Canopy Bulk Density	Decrease potential for active crown fire spread
Maintain large fire-resistant trees	Increase tree survivability

Table 7: Total area (ha) available for collaborative treatments with and without restrictions. [a]Width run under Jolly Mountain weather. [b]Width run under Extreme weather. [1]Restrictions include 30.48-meter buffer on fish bearing streams and no entry into areas classified as Roadless under the 2001 Roadless Rule.

	Area of Treated Boundary Zone (ha)	
Collaborative Treatment Width (m)	Without Restrictions	With Restrictions[1]
100[ab]	701.17	596.95
200[ab]	1402.66	1192.37
300[ab]	2104.49	1778.4
400[ab]	2806.65	2366.98
500[ab]	3509.14	2953.21
1200[b]	8435.81	6966.4
1400[b]	9846.46	8061.33
1500[b]	10552.34	8603.6

Table 8: Total area (ha) available for each single entity treatment (US Forest Service and Non-FS Lands) with and without restrictions. [a]Width run under Jolly Mountain weather. [b]Width run under Extreme weather. [1]Restrictions include 30.48-meter buffer on fish bearing streams and no entry into areas classified as Roadless under the 2001 Roadless Rule. [2]Restrictions include 30.48-meter buffer on fish bearing streams.

Area of Treated Boundary Zone (ha)				
	US Forest Service		Non-FS Lands	
Collaborative Treatment Width (m)	Without Restrictions	With Restrictions[1]	Without Restrictions	With Restrictions[2]
100[ab]	409.18	274.42	408.74	323.18
200[ab]	817.35	539.59	815.57	656.82
300[ab]	1224.51	796.17	1220.51	991.21
400[ab]	1630.65	1059.95	1623.54	1324.64
500[ab]	2035.79	1321.8	2024.67	1659.31
1200[b]	4843.4	3145.62	4779.38	3985.03
1400[b]	5636.47	3644.9	5549.33	4639.05
1500[b]	6031.49	3892.97	5931.46	4966.18

Table 9: Wildfire occurrence in study area from 1992-2018 (Short 2021) as defined by the National Wildfire Coordinating Group's fire size classes.

Size Class of Fire	Size (ha)	Number of Fires in Study	Proportion of Overall Fires
A	x < 0.6	587	65
B	0.6 > x < 4	258	28.6
C	4 > x < 40	31	3.4
D	40 > x <121	6	0.7
E	121 > x < 405	10	1.1
F	405 > x < 2023	4	0.4
G	> 2023	7	0.8
	Total	903	100

Table 10:Weather variables for use in Randing, the command-line version of FlamMap (Finney 2006).

Weather Scenario	Wind Speed km/hr	Wind Direction	Fuel Moisture 1-hr	10-hr	100-hr	Live herbaceous	Live woody
Jolly Mountain	9.65	210	4	4	8	45	68
Jolly Mountain - Inverted	9.65	30	4	4	8	45	68
Extreme	24.1	210	3	3	8	25	60
Extreme - Inverted	24.1	30	3	3	8	25	60

Table 11: Fire suppression interpretations of flame length and fireline intensity, modified from Andrews and Rothermel 1982.

Flame Length (m)	Fireline Intensity (kw/m/s)	Fire Suppression Tactic
<1.2	<1,100	Direct Attack with handtools - handline should hold
1.2 - 2.4	1,100 - 5,500	Heavy Equipment - handline cannot be relied on to hold fire
2.4 - 3.3	5,500 - 11,000	Control efforts most likely ineffective - potential for torching, crowning and spotting
>3.3	>11,000	Control efforts ineffective - torching, crowning and spotting probable

Table 12: Average simulated wildfire size for single event FARSITE runs under Extreme weather, fire size in hectares. Significant differences in average fire size of the single entity treatments (USFS/TNC) compared to Collaborative treatment. Wilcoxon t-test; [a], P<0.05, [b], P<0.01, [c], P<0.001, [d], P < 0.0001

Treatment Type	Treatment Width (m)	Ignition Start Designation and Treatment Placement					
		US Forest Service			Teanaway Community Forest		
		USFS	TCF	Collaborative	USFS	TCF	Collaborative
Untreated	50		26831			26732	
Clearcut with Prescribed Burn	50	26976	27428 [b]	25112	26919	27000	26444
Reduction of 30%	50	27064	27005	26435	27086	26683	26407
Reduction of 40%	50	27265	26802	26139	26861	27055	26167
Reduction of 60%	50	26689	27124	26277	27274	26474	26606
Shadetree with Prescribed Burn	50	27003	27140	27163	26398	26722	26558
Untreated	100		26831			26732	
Clearcut with Prescribed Burn	100	27133 [d]	26514 [c]	23848	27263 [a]	26317	25815
Reduction of 30%	100	26165	26272	25289	26998	26466	26355
Reduction of 40%	100	26668	26293	25270	26582	26212	26693
Reduction of 60%	100	26562	27197	25212	27094	26571	26702
Shadetree with Prescribed Burn	100	26668	26252 [a]	25405	26972	26412	26075

Table 12 (continued)

Treatment Type	Treatment Width (m)	Ignition Start Designation and Treatment Placement					
		US Forest Service			Teanaway Community Forest		
		USFS	TCF	Collaborative	USFS	TCF	Collaborative
Untreated	150		26831			26732	
Clearcut with Prescribed Burn		26678 [d]	26161 [d]	20628	26997 [b]	25850	25166
Reduction of 30%		26218 [b]	25697	24140	26776	26580	25844
Reduction of 40%		25935 [b]	26334 [d]	24071	27063	26290	26013
Reduction of 60%		26534 [c]	25998	24494	26742	26395	25665
Shadetree with Prescribed Burn		26589 [c]	25749	24022	26821	26150	26304
Untreated	200		26831			26732	
Clearcut with Prescribed Burn		25833 [d]	24232 [d]	18914	26924 [d]	25593	24604
Reduction of 30%		26821 [d]	25339 [d]	21007	26586	25638	26007
Reduction of 40%		25982 [d]	25523 [d]	21445	26645	26214	25710
Reduction of 60%		26454 [d]	25551 [d]	22006	27152 [a]	26435	25274
Shadetree with Prescribed Burn		25284 [d]	25419 [d]	20750	27123	25851	25130

Table 12 (continued)

Treatment Type	Treatment Width (m)	Ignition Start Designation and Treatment Placement					
		US Forest Service			Teanaway Community Forest		
		USFS	TCF	Collaborative	USFS	TCF	Collaborative
Untreated			26831			26732	
Clearcut with Prescribed Burn	250	25135 [d]	22943 [d]	16369	26473 [d]	24444	21759
Reduction of 30%		25316 [d]	24987 [d]	19672	26691 [a]	25984	25135
Reduction of 40%		25400 [d]	24591 [d]	19647	26594 [a]	25724	25107
Reduction of 60%		25571 [d]	24226 [d]	19876	26400	25417	24975
Shadetree with Prescribed Burn		25695 [d]	25056 [d]	19285	26935	25907	25105

Table 13: Average simulated wildfire size for single event FARSITE runs under Jolly Mountain weather, fire size in hectares. Significant differences in average fire size of the single entity treatments (USFS/DNR) compared to Collaborative treatment. Wilcoxon t-test; [a], $P<0.05$, [b], $P<0.01$, [c], $P<0.001$, [d], $P < 0.0001$.

Treatment Type	Treatment Width (m)	Ignition Start Designation and Treatment Placement					
		US Forest Service			Teanaway Community Forest		
		USFS	TCF	Collaborative	USFS	TCF	Collaborative
Untreated	50		6276			6041	
Clearcut with Prescribed Burn	50	6087	6047	5796	5893	6031 [a]	5587
Reduction of 30%	50	6171	6096	5929	5806	6116	5898
Reduction of 40%	50	6111	6094	5940	5978	5818	5819
Reduction of 60%	50	6198	6045	6000	6075	5952	5749
Shadetree with Prescribed Burn	50	6125	6116	6001	6148	5928	5813
Untreated	100		6276			6041	
Clearcut with Prescribed Burn	100	5721 [c]	5878 [d]	4625	5584 [d]	5675 [d]	4273
Reduction of 30%	100	5985 [c]	5892 [d]	5048	5815 [d]	5968 [d]	4864
Reduction of 40%	100	5995 [c]	6135 [d]	5136	5851 [d]	5826 [c]	4762
Reduction of 60%	100	5976 [b]	6106 [c]	5240	5890 [d]	5765 [d]	4760
Shadetree with Prescribed Burn	100	6004 [c]	5893 [c]	5156	5874 [d]	6000 [d]	4493

Table 13 (continued)

Treatment Type	Treatment Width (m)	Ignition Start Designation and Treatment Placement					
		US Forest Service			Teanaway Community Forest		
		USFS	TCF	Collaborative	USFS	TCF	Collaborative
Untreated	150		6276			6041	
Clearcut with Prescribed Burn		5376 [d]	3926 [d]	3926	4997 [d]	3707 [d]	3707
Reduction of 30%		5738 [d]	4248 [d]	4248	5621 [d]	3854 [d]	3854
Reduction of 40%		5682 [d]	4217 [d]	4217	5652 [d]	3852 [d]	3852
Reduction of 60%		5727 [d]	4426 [d]	4426	5711 [d]	4009 [d]	4009
Shadetree with Prescribed Burn		5810 [d]	4304 [d]	4304	5483 [d]	3807 [d]	3807
Untreated	200		6276			6041	
Clearcut with Prescribed Burn		4948 [d]	4485 [d]	3717	4512 [d]	3960 [a]	3652
Reduction of 30%		5456 [d]	4871 [d]	3797	5090 [d]	4826 [d]	3721
Reduction of 40%		5527 [d]	4854 [d]	3768	5141 [d]	4914 [d]	3685
Reduction of 60%		5322 [d]	4942 [d]	3857	4966 [d]	4636 [d]	3680
Shadetree with Prescribed Burn		5411 [d]	4862 [d]	3725	5161 [d]	4595 [d]	3605

Table 13 (continued)

Treatment Type	Treatment Width (m)	Ignition Start Designation and Treatment Placement					
		US Forest Service			Teanaway Community Forest		
		USFS	TCF	Collaborative	USFS	TCF	Collaborative
Untreated			6276			6041	
Clearcut with Prescribed Burn	250	4822 [d]	3899 [c]	3607	4506 [d]	3684	3570
Reduction of 30%		4981 [d]	4258 [d]	3665	4454 [d]	4078 [a]	3627
Reduction of 40%		4909 [d]	4330 [d]	3656	5021 [d]	3983 [b]	3653
Reduction of 60%		5016 [d]	4225 [d]	3700	4424 [d]	4151 [c]	3628
Shadetree with Prescribed Burn		5083 [d]	4208 [d]	3685	4726 [d]	3931 [c]	3634

Table 14: Percent change in average fire size across all treatment types, ignition start designations, treatment placement and treatment width relative to an untread landscape for single event FARSITE simulations under Extreme weather.

Treatment Type	Ignition Start Designation	Treatment Placement	Treatment Width per Entity (m)				
			50	100	150	200	250
Clearcut with Prescribed Burn	FS	USFS	-0.5%	-1.1%	0.6%	3.7%	6.3%
	FS	DNR	-2.2%	1.2%	2.5%	9.7%	14.5%
	FS	Collaborative	6.4%	11.1%	23.1%	29.5%	39.0%
Reduction of 30%	FS	USFS	-0.9%	2.5%	2.3%	0.0%	5.7%
	FS	DNR	-0.7%	2.1%	4.2%	5.6%	6.9%
	FS	Collaborative	1.5%	5.8%	10.0%	21.7%	26.7%
Reduction of 40%	FS	USFS	-1.6%	0.6%	3.3%	3.2%	5.3%
	FS	DNR	0.1%	2.0%	1.8%	4.9%	8.3%
	FS	Collaborative	2.6%	5.8%	10.3%	20.1%	26.8%
Reduction of 60%	FS	USFS	0.5%	1.0%	1.1%	1.4%	4.7%
	FS	DNR	-1.1%	-1.4%	3.1%	4.8%	9.7%
	FS	Collaborative	2.1%	6.0%	8.7%	18.0%	25.9%
Shadetree with Prescribed Burn	FS	USFS	-0.6%	0.6%	0.9%	5.8%	4.2%
	FS	DNR	-1.2%	2.2%	4.0%	5.3%	6.6%
	FS	Collaborative	-1.2%	5.3%	10.5%	22.7%	28.1%
Clearcut with Prescribed Burn	TCF	USFS	-0.7%	-2.0%	-1.0%	-0.7%	1.0%
	TCF	DNR	-1.0%	1.6%	3.3%	4.3%	9.0%
	TCF	Collaborative	1.1%	3.4%	5.9%	8.0%	18.6%
Reduction of 30%	TCF	USFS	-1.3%	-1.0%	-0.2%	0.5%	0.2%
	TCF	DNR	0.2%	1.0%	0.6%	4.1%	2.8%
	TCF	Collaborative	1.2%	1.4%	3.3%	2.7%	6.0%
Reduction of 40%	TCF	USFS	-0.5%	0.6%	-1.2%	0.3%	0.5%
	TCF	DNR	-1.2%	1.9%	1.7%	1.9%	3.8%
	TCF	Collaborative	2.1%	0.2%	2.7%	3.8%	6.1%
Reduction of 60%	TCF	USFS	-2.0%	-1.3%	0.0%	-1.6%	1.2%
	TCF	DNR	1.0%	0.6%	1.3%	1.1%	4.9%
	TCF	Collaborative	-0.3%	0.1%	4.0%	5.5%	6.6%
Shadetree with Prescribed Burn	TCF	USFS	1.3%	-0.9%	-0.3%	-1.5%	-0.8%
	TCF	DNR	0.0%	1.2%	2.2%	3.3%	3.1%
	TCF	Collaborative	0.7%	2.5%	1.6%	6.0%	6.1%

Table 15: Percent change in average fire size across all treatment types, ignition start designations, treatment placement and treatment width relative to an untread landscape for single event FARSITE simulations under Jolly Mountain weather.

Treatment Type	Ignition Start Designation	Treatment Placement	Treatment Width per Entity (m)				
			50	100	150	200	250
Clearcut with Prescribed Burn	FS	USFS	3.00%	8.80%	14.40%	21.20%	23.20%
	FS	DNR	3.70%	6.30%	18.70%	28.50%	37.90%
	FS	Collaborative	7.70%	26.30%	37.40%	40.80%	42.50%
Reduction of 30%	FS	USFS	1.70%	4.60%	8.60%	13.10%	20.60%
	FS	DNR	2.90%	6.10%	8.60%	22.40%	32.20%
	FS	Collaborative	5.50%	19.60%	32.30%	39.50%	41.60%
Reduction of 40%	FS	USFS	2.60%	4.50%	9.50%	11.90%	21.80%
	FS	DNR	2.90%	2.20%	9.20%	22.70%	31.00%
	FS	Collaborative	5.40%	18.20%	32.80%	40.00%	41.80%
Reduction of 60%	FS	USFS	1.20%	4.80%	8.80%	15.20%	20.10%
	FS	DNR	3.70%	2.70%	8.70%	21.30%	32.70%
	FS	Collaborative	4.40%	16.50%	29.50%	38.60%	41.10%
Shadetree with Prescribed Burn	FS	USFS	2.40%	4.30%	7.40%	13.80%	19.00%
	FS	DNR	2.60%	6.10%	13.00%	22.50%	33.00%
	FS	Collaborative	4.40%	17.80%	31.40%	40.60%	41.30%
Clearcut with Prescribed Burn	TCF	USFS	2.50%	7.60%	17.30%	25.30%	25.40%
	TCF	DNR	0.20%	6.10%	15.60%	34.40%	39.00%
	TCF	Collaborative	7.50%	29.30%	38.60%	39.50%	40.90%
Reduction of 30%	TCF	USFS	3.90%	3.70%	7.00%	15.70%	26.30%
	TCF	DNR	-1.20%	1.20%	5.80%	20.10%	32.50%
	TCF	Collaborative	2.40%	19.50%	36.20%	38.40%	40.00%
Reduction of 40%	TCF	USFS	1.00%	3.10%	6.40%	14.90%	16.90%
	TCF	DNR	3.70%	3.60%	7.80%	18.70%	34.10%
	TCF	Collaborative	3.70%	21.20%	36.20%	39.00%	39.50%
Reduction of 60%	TCF	USFS	-0.60%	2.50%	5.50%	17.80%	26.80%
	TCF	DNR	1.50%	4.60%	10.70%	23.30%	31.30%
	TCF	Collaborative	4.80%	21.20%	33.60%	39.10%	39.90%
Shadetree with Prescribed Burn	TCF	USFS	-1.80%	2.80%	9.20%	14.60%	21.80%
	TCF	DNR	1.90%	0.70%	8.50%	23.90%	34.90%
	TCF	Collaborative	3.80%	25.60%	37.00%	40.30%	39.80%

Table 16: Mean Conditional Flame Length and Conditional Burn Probability (CBP) across all wind scenarios, treatment type, treatment placement and treatment width for Jolly Mountain weather.

			Treatment Width Per Entity (m)									
			50		100		150		200		250	
Wind Scenario	Treatment	Treatment Placement	Avg CFL (m)	Avg CPB	Avg CFL (m)	Avg CPB	Avg CFL (m)	Avg CPB	Avg CFL (m)	Avg CPB	Avg CFL (m)	Avg CPB
NNE	Untreated		1.52	0.0069	1.52	0.0069	1.52	0.0069	1.52	0.0069	1.52	0.0069
	Clearcut with Prescribed Burn	USFS	1.47	0.0061	1.41	0.0049	1.35	0.0046	1.3	0.0044	1.25	0.0042
		DNR	1.46	0.0061	1.39	0.0042	1.32	0.0038	1.26	0.0036	1.2	0.0034
		Collaborative	1.38	0.0044	1.26	0.0036	1.14	0.0032	1.03	0.0028	0.92	0.0025
	Shadetree with Prescribed Burn	USFS	1.48	0.0065	1.44	0.006	1.41	0.0054	1.36	0.005	1.32	0.0049
		DNR	1.48	0.0065	1.43	0.0058	1.39	0.0055	1.35	0.005	1.3	0.0047
		Collaborative	1.44	0.0059	1.34	0.0048	1.25	0.0043	1.16	0.0039	1.06	0.0036
	Reduction of 30%	USFS	1.48	0.0066	1.44	0.006	1.4	0.0054	1.36	0.0051	1.32	0.0049
		DNR	1.48	0.0065	1.43	0.0058	1.39	0.0055	1.34	0.005	1.3	0.0047
		Collaborative	1.43	0.0059	1.34	0.0048	1.25	0.0043	1.16	0.0039	1.06	0.0036
	Reduction of 40%	USFS	1.48	0.0066	1.44	0.006	1.4	0.0054	1.36	0.005	1.32	0.0049
		DNR	1.48	0.0065	1.43	0.0058	1.39	0.0054	1.34	0.005	1.3	0.0047
		Collaborative	1.44	0.0059	1.34	0.0049	1.25	0.0043	1.16	0.0039	1.06	0.0036
	Reduction of 60%	USFS	1.48	0.0066	1.44	0.006	1.4	0.0054	1.36	0.0051	1.32	0.0049
		DNR	1.48	0.0065	1.43	0.0058	1.39	0.0054	1.35	0.005	1.3	0.0047
		Collaborative	1.43	0.0059	1.34	0.0049	1.25	0.0043	1.16	0.0039	1.06	0.0036

Table 16 (continued)

Wind Scenario	Treatment	Treatment Placement	50 Avg CFL (m)	50 Avg CPB	100 Avg CFL (m)	100 Avg CPB	150 Avg CFL (m)	150 Avg CPB	200 Avg CFL (m)	200 Avg CPB	250 Avg CFL (m)	250 Avg CPB
			Treatment Width Per Entity (m)									
SSW	Untreated		1.62	0.0071	1.62	0.0071	1.62	0.0071	1.62	0.0071	1.62	0.0071
	Clearcut with Prescribed Burn	USFS	1.53	0.0063	1.45	0.0051	1.4	0.0049	1.35	0.0048	1.31	0.0046
		DNR	1.55	0.0064	1.4	0.0042	1.34	0.0038	1.26	0.0035	1.2	0.0032
		Collaborative	1.4	0.0046	1.29	0.0038	1.17	0.0032	1.06	0.0029	0.93	0.0025
	Shadetree with Prescribed Burn	USFS	1.55	0.0067	1.52	0.0061	1.47	0.0056	1.43	0.0054	1.39	0.0053
		DNR	1.56	0.0067	1.48	0.0057	1.44	0.0054	1.39	0.005	1.33	0.0046
		Collaborative	1.49	0.0059	1.39	0.0051	1.29	0.0045	1.19	0.0041	1.08	0.0036
	Reduction of 30%	USFS	1.55	0.0067	1.52	0.0061	1.47	0.0056	1.43	0.0054	1.39	0.0053
		DNR	1.56	0.0067	1.48	0.0057	1.44	0.0054	1.38	0.005	1.33	0.0046
		Collaborative	1.49	0.0059	1.39	0.0051	1.29	0.0045	1.19	0.0041	1.08	0.0036
	Reduction of 40%	USFS	1.55	0.0067	1.52	0.0061	1.47	0.0056	1.43	0.0055	1.39	0.0053
		DNR	1.56	0.0067	1.48	0.0057	1.44	0.0054	1.38	0.005	1.33	0.0046
		Collaborative	1.49	0.0059	1.39	0.0051	1.29	0.0045	1.19	0.0041	1.08	0.0036
	Reduction of 60%	USFS	1.55	0.0068	1.52	0.0061	1.47	0.0056	1.43	0.0055	1.39	0.0053
		DNR	1.56	0.0067	1.48	0.0057	1.44	0.0054	1.39	0.005	1.33	0.0046
		Collaborative	1.49	0.0059	1.39	0.0051	1.29	0.0045	1.19	0.0041	1.09	0.0037

Table 17: Mean Conditional Flame Length and Conditional Burn Probability (CBP) across all wind scenarios, treatment type, treatment placement and treatment width for Extreme weather.

			Treatment Width Per Entity (m)									
			50		100		150		200		250	
Wind Scenario	Treatment	Treatment Placement	Avg CFL (m)	Avg CPB	Avg CFL (m)	Avg CPB	Avg CFL (m)	Avg CPB	Avg CFL (m)	Avg CPB	Avg CFL (m)	Avg CPB
NNE	Untreated		2.75	0.0256	2.75	0.0256	2.75	0.0256	2.75	0.0256	2.75	0.0256
	Clearcut with Prescribed Burn	USFS	2.57	0.0231	2.38	0.0188	2.24	0.0172	2.15	0.0164	2.05	0.0158
		DNR	2.59	0.0231	2.32	0.0167	2.21	0.0151	2.1	0.0139	2.03	0.0131
		Collaborative	2.33	0.0175	2.08	0.0142	1.88	0.0119	1.69	0.0107	1.52	0.0094
	Shadetree with Prescribed Burn	USFS	2.61	0.0249	2.5	0.0238	2.4	0.022	2.3	0.0205	2.18	0.0195
		DNR	2.62	0.0248	2.49	0.0232	2.39	0.0221	2.29	0.0204	2.2	0.019
		Collaborative	2.49	0.0235	2.25	0.0201	2.09	0.0175	1.9	0.0156	1.74	0.0142
	Reduction of 30%	USFS	2.61	0.0248	2.49	0.0237	2.4	0.022	2.29	0.0204	2.18	0.0195
		DNR	2.62	0.0248	2.49	0.0232	2.39	0.0221	2.28	0.0204	2.21	0.0191
		Collaborative	2.49	0.0235	2.26	0.0201	2.08	0.0175	1.9	0.0157	1.74	0.0143
	Reduction of 40%	USFS	2.61	0.0249	2.5	0.0238	2.4	0.022	2.3	0.0205	2.18	0.0196
		DNR	2.62	0.0247	2.49	0.0232	2.39	0.0221	2.29	0.0205	2.21	0.0192
		Collaborative	2.49	0.0235	2.26	0.0202	2.09	0.0176	1.9	0.0157	1.74	0.0143
	Reduction of 60%	USFS	2.62	0.0249	2.5	0.0238	2.41	0.0222	2.3	0.0208	2.19	0.0197
		DNR	2.62	0.0248	2.5	0.0232	2.39	0.0222	2.29	0.0206	2.21	0.0193
		Collaborative	2.49	0.0236	2.27	0.0204	2.09	0.0178	1.91	0.0158	1.74	0.0144

Table 17 (continued)

Wind Scenario	Treatment	Treatment Placement	Treatment Width Per Entity (m)									
			50		100		150		200		250	
			Avg CFL (m)	Avg CPB	Avg CFL (m)	Avg CPB	Avg CFL (m)	Avg CPB	Avg CFL (m)	Avg CPB	Avg CFL (m)	Avg CPB
SSW	Untreated		3.08	0.0276	3.08	0.0276	3.08	0.0276	3.08	0.0276	3.08	0.0276
	Clearcut with Prescribed Burn	USFS	2.83	0.0253	2.59	0.021	2.5	0.0198	2.39	0.019	2.32	0.0186
		DNR	2.83	0.0249	2.41	0.0179	2.27	0.0152	2.11	0.0133	1.96	0.0116
		Collaborative	2.46	0.019	2.2	0.0149	1.97	0.0125	1.76	0.0112	1.56	0.0096
	Shadetree with Prescribed Burn	USFS	2.89	0.0269	2.75	0.0252	2.67	0.0237	2.55	0.0225	2.47	0.0221
		DNR	2.88	0.0265	2.65	0.0235	2.52	0.0219	2.38	0.0198	2.25	0.018
		Collaborative	2.67	0.0244	2.43	0.021	2.23	0.0183	2.02	0.0161	1.81	0.0143
	Reduction of 30%	USFS	2.89	0.0269	2.75	0.0252	2.67	0.0237	2.55	0.0226	2.47	0.0221
		DNR	2.88	0.0265	2.65	0.0236	2.52	0.022	2.38	0.0199	2.26	0.0181
		Collaborative	2.67	0.0244	2.44	0.021	2.24	0.0183	2.02	0.0162	1.82	0.0144
	Reduction of 40%	USFS	2.89	0.0269	2.75	0.0252	2.68	0.0238	2.55	0.0226	2.47	0.0221
		DNR	2.88	0.0264	2.65	0.0236	2.52	0.0221	2.38	0.02	2.26	0.0182
		Collaborative	2.67	0.0244	2.44	0.0211	2.24	0.0185	2.02	0.0163	1.82	0.0144
	Reduction of 60%	USFS	2.89	0.0269	2.76	0.0252	2.69	0.0239	2.56	0.0228	2.48	0.0223
		DNR	2.88	0.0265	2.66	0.0237	2.53	0.0223	2.4	0.0202	2.27	0.0185
		Collaborative	2.68	0.0245	2.45	0.0213	2.25	0.0187	2.03	0.0165	1.83	0.0146

Table 18: Ignition point starting ownership across weather and wind scenarios for fires that burned within 250-meters of the boundary line during Randing simulations. BLM = Bureau of Land Management, DNR = Department of Natural Resources, FWS = Fish and Wildfire Services, PV = Private, TNC = The Nature Conservancy, USFS = United States Forest Service.

Weather Scenario	Wind Scenario	Landowner						
		BLM	DNR	FWS	PV	TNC	USFS	Total
Jolly Mountain	SSW	5	185	4	283	30	638	1145
Jolly Mountain	NNE	4	195	6	305	27	684	1221
Extreme	SSW	7	344	7	478	51	1134	2021
Extreme	NNE	7	367	9	545	50	1220	2198

Table 19: Breakdown of land ownership within the study area by total hectares and proportion.

Property Owner	Hectares	Percent of Study Area
Bureau of Land Management (BLM)	470.9	0.21
US Fish and Wildlife Services (FWS)	993.87	0.44
Private (PV)	52252.56	22.9
State	76.34	0.03
US Forest Service (USFS)	129737.25	56.87
Department of Natural Resources (DNR)	36174.05	15.86
The Nature Conservancy (TNC)	6586.66	2.89
Water	1851.62	0.81
Total	228143	100

Table 20: Average reduction in total burned area (sum of self-burning, incoming and outgoing fire) presented as a percent reduction compared to the untreated landscape. Total burned area is for the two largest landowners, Department of Natural Resources and the US Forest Service and for fires that crossed within 250-meters on either side of the jurisdictional boundary. Percent reductions are listed across treatment widths, treatment types, treatment placement and wind direction under our Extreme weather scenario.

Wind Scenario	Treatment	Treatment Placement	Treatment Width per Entity (m)				
			50	100	150	200	250
NNE	Clearcut with Prescribed Burn	USFS	2.9	10.4	13.3	14.2	15.1
		DNR	2.7	16.2	17.7	19.6	20.7
		Collaborative	14.2	19.3	22.2	22.6	24.3
	Reduction of 30%	USFS	1	3.1	7.5	10.8	12
		DNR	2.2	5.8	8.2	11	14
		Collaborative	4.8	12	16.6	18.9	20.5
	Reduction of 40%	USFS	0.7	3.1	7.2	10.9	11.6
		DNR	1.5	5.7	8.2	11.2	13.6
		Collaborative	4.6	11.4	16.2	18.8	20.3
	Reduction of 60%	USFS	1	3.2	7	10.7	11.3
		DNR	1.6	5.8	7.8	10.8	13.5
		Collaborative	4.5	11.7	16.3	18.6	20.6
	Shadetree with Prescribed Burn	USFS	1.1	3.3	7.2	10.5	11.6
		DNR	1.5	5.4	7.6	11.1	13.5
		Collaborative	4.3	11.6	16	18.4	20.1
SSW	Clearcut with Prescribed Burn	USFS	4.3	17.1	21.7	23.3	23.5
		DNR	3.8	22.7	27.6	30.3	31.9
		Collaborative	21.6	28.8	34.4	35.3	36.4
	Reduction of 30%	USFS	2.1	10.5	16.3	19.5	21.1
		DNR	3	11.9	15.1	18.7	25.3
		Collaborative	11.4	20.4	27.5	30.6	33.6
	Reduction of 40%	USFS	3	10.2	16.1	19.5	21.1
		DNR	3.1	11.2	15	18.8	24.4
		Collaborative	11.5	20.6	27.6	30.5	33.4
	Reduction of 60%	USFS	3	9.8	14	18.7	21.1
		DNR	2.9	11.5	14.1	18.4	23.8
		Collaborative	11.5	20.6	27.2	30.2	33.4
	Shadetree with Prescribed Burn	USFS	2.4	9.2	14.4	18.5	21
		DNR	2.8	11	14	18.4	22.9
		Collaborative	10.3	19.6	26.4	29.3	33.3

Table 21: Average reduction in total burned area (sum of self-burning, incoming and outgoing fire) presented as a percent reduction compared to the untreated landscape. Total burned area is for the two largest landowners, Department of Natural Resources and the US Forest Service and for fires that crossed within 250-meters on either side of the jurisdictional boundary. Percent reductions are listed across treatment widths, treatment types, treatment placement and wind direction under our Jolly Mountain weather scenario.

Wind Scenario	Treatment	Treatment Placement	Treatment Width per Entity (m)				
			50	100	150	200	250
NNE	Clearcut with Prescribed Burn	USFS	3.3	10.1	11	12.2	12.8
		DNR	3	13.9	15	16	17.4
		Collaborative	12.3	16.4	18.5	19	21.4
	Reduction of 30%	USFS	2.3	5.8	8.2	9.8	10.3
		DNR	2.2	7.3	8.9	11.5	12.4
		Collaborative	6	11.2	14.1	15.2	16.8
	Reduction of 40%	USFS	2.4	5.6	8.8	9.7	10.2
		DNR	2.4	7.2	9.1	10.6	13
		Collaborative	6.2	11.6	13.3	15.2	16.8
	Reduction of 60%	USFS	2.3	5.8	8.5	9.3	10.6
		DNR	2	7.5	9.5	10.5	12.3
		Collaborative	6.1	11.1	13.5	14.9	16.8
	Shadetree with Prescribed Burn	USFS	2.4	5.4	8.2	10	10.1
		DNR	1.9	7.6	8.8	11.2	12.4
		Collaborative	6.7	10.7	13.9	15.8	16.1
SSW	Clearcut with Prescribed Burn	USFS	6	18.9	20	20.7	21
		DNR	3.9	24.6	27.1	27.9	29.1
		Collaborative	22.8	27.4	30.1	31.3	33.1
	Reduction of 30%	USFS	6.1	15.2	18	19.1	19.2
		DNR	4	13.8	15.9	18.6	23.5
		Collaborative	16	21.3	24.2	26	28.7
	Reduction of 40%	USFS	6.2	14.5	18.1	18.5	19.4
		DNR	3.8	13.8	15.9	18.2	23.5
		Collaborative	16	21.7	24.1	26.6	28.8
	Reduction of 60%	USFS	5.9	14.3	17.4	18.6	19.2
		DNR	3.7	13.8	15.9	18.2	23.4
		Collaborative	15.7	21.3	24.3	26.2	28.4
	Shadetree with Prescribed Burn	USFS	5.3	15	17.9	18.9	19.3
		DNR	3.7	13.3	15.6	17.9	23.6
		Collaborative	15.7	21	23.8	26.4	28.3

Table 22: Average total burned area (sum of self-burning, incoming and outgoing fire) in hectares for the two largest landowners, Department of Natural Resources and the US Forest Service for fires that crossed within 250-meters on either side of the jurisdictional boundary. Listed across treatment widths, treatment types, treatment placement and wind direction under our Extreme weather scenario.

Treatment Type	Treatment Width (m)	Wind Scenario and Treatment Placement					
		NNE			SSW		
		USFS	TCF	Collaborative	USFS	TCF	Collaborative
Untreated	50		35627			40942	
Clearcut with Prescribed Burn	50	34610	34652	30576	39194	39376	32085
Reduction of 30%	50	35394	35085	33997	39723	39684	36246
Reduction of 40%	50	35282	35061	34021	39729	39768	36226
Reduction of 60%	50	35242	35084	34104	39978	39806	36714
Shadetree with Prescribed Burn	50	35268	34849	33919	40085	39717	36276
Untreated	100		35627			40942	
Clearcut with Prescribed Burn	100	31908	29857	28768	33952	31656	29137
Reduction of 30%	100	34536	33600	31566	36779	36362	32528
Reduction of 40%	100	34482	33575	31445	36934	36241	32494
Reduction of 60%	100	34454	33715	31509	37195	36444	32910
Shadetree with Prescribed Burn	100	34515	33559	31335	36663	36057	32604

Table 22 (continued)

Treatment Type	Treatment Width (m)	Ignition Start Designation and Treatment Placement					
		US Forest Service			Teanaway Community Forest		
		USFS	TCF	Collaborative	USFS	TCF	Collaborative
Untreated	150		35627			40942	
Clearcut with Prescribed Burn		30875	29326	27721	32058	29661	26854
Reduction of 30%		33073	32697	29856	34346	34791	29649
Reduction of 40%		33146	32854	29822	35196	35180	29825
Reduction of 60%		33055	32932	29937	35033	35210	30144
Shadetree with Prescribed Burn		32953	32720	29712	34269	34760	29702
Untreated	200		35627			40942	
Clearcut with Prescribed Burn		30583	28630	27593	31391	28553	26492
Reduction of 30%		31737	31654	28943	32945	33225	28461
Reduction of 40%		31824	31770	29005	33267	33404	28593
Reduction of 60%		31875	31662	29074	33385	33402	28964
Shadetree with Prescribed Burn		31786	31691	28887	32968	33301	28431

Table 22 (continued)

Treatment Type	Treatment Width (m)	Ignition Start Designation and Treatment Placement					
		US Forest Service			Teanaway Community Forest		
		USFS	TCF	Collaborative	USFS	TCF	Collaborative
Untreated			35627			26732	
Clearcut with Prescribed Burn	250	30231	28245	26979	31318	27885	26052
Reduction of 30%		31480	30788	28405	32320	30938	27249
Reduction of 40%		31586	30814	28290	32294	31187	27275
Reduction of 60%		31508	30803	28480	32355	31550	27323
Shadetree with Prescribed Burn		31343	30629	28329	32304	30596	27174

Table 23: Average total burned area (sum of self-burning, incoming and outgoing fire) in hectares for the two largest landowners, Department of Natural Resources and the US Forest Service for fires that crossed within 250-meters on either side of the jurisdictional boundary. Listed across treatment widths, treatment types, treatment placement and wind direction under our Jolly Mountain weather scenario.

Treatment Type	Treatment Width (m)	Wind Scenario and Treatment Placement					
		NNE			SSW		
		USFS	TCF	Collaborative	USFS	TCF	Collaborative
Untreated	50		9713			10852	
Clearcut with Prescribed Burn		9393	9420	8519	10196	10433	8374
Reduction of 30%		9479	9483	9107	10180	10438	9115
Reduction of 40%		9488	9516	9199	10212	10450	9146
Reduction of 60%		9483	9530	9062	10273	10450	9152
Shadetree with Prescribed Burn		9494	9497	9131	10193	10419	9113
Untreated	100		9713			40942	
Clearcut with Prescribed Burn		8728	8365	8122	8797	8178	7880
Reduction of 30%		9166	9015	8589	9276	9359	8498
Reduction of 40%		9146	8985	8636	9304	353	8540
Reduction of 60%		9192	8971	8674	9229	9404	8572
Shadetree with Prescribed Burn		9151	9006	8630	9197	9354	8536

Table 22 (continued)

Treatment Type	Treatment Width (m)	Ignition Start Designation and Treatment Placement					
		US Forest Service			Teanaway Community Forest		
		USFS	TCF	Collaborative	USFS	TCF	Collaborative
Untreated	150		9713			10852	
Clearcut with Prescribed Burn		8643	8255	7912	8679	1912	7589
Reduction of 30%		8863	8828	8420	8887	9131	8240
Reduction of 40%		8883	8795	8407	8959	9124	8210
Reduction of 60%		8919	8860	8364	8904	9160	8268
Shadetree with Prescribed Burn		8913	8853	8340	8902	9127	8228
Untreated	200		9713			10852	
Clearcut with Prescribed Burn		8532	8163	7872	8603	7827	7453
Reduction of 30%		8771	8681	8233	8840	8872	7967
Reduction of 40%		8808	8695	8266	8829	8882	8005
Reduction of 60%		9739	8629	8181	8803	8905	7991
Shadetree with Prescribed Burn		8759	8601	8239	8780	8836	8030

Table 22 (continued)

Treatment Type	Treatment Width (m)	Ignition Start Designation and Treatment Placement					
		US Forest Service			Teanaway Community Forest		
		USFS	TCF	Collaborative	USFS	TCF	Collaborative
Untreated			9713			10852	
Clearcut with Prescribed Burn	250	8466	8026	7631	8570	7691	7261
Reduction of 30%		8725	8450	8081	8751	8032	7730
Reduction of 40%		8682	8520	8084	8766	8310	7771
Reduction of 60%		8735	8509	8151	8760	8292	7785
Shadetree with Prescribed Burn		8715	8506	8083	8774	8299	7741

Table 24: Proportion of simulated fires (n=20) that were halted within the treatment zone across ignition start designation, treatment placement, treatment width, and treatment type. USFS = United States Forest Service, TCF = Teanaway Community Forest, DNR = Department of Natural Resources

			Treatment				
Ignition Start Designation	Treatment Placement	Treatment Width per Entity	Clearcut with Prescribed Burn	Shadetree with Prescribed Burn	Reduction of 30%	Reduction of 40%	Reduction of 60%
USFS	USFS Only	250	0%	0%	0%	0%	0%
		600	0%	0%	0%	0%	0%
		700	0%	0%	0%	0%	0%
		750	0%	0%	0%	0%	0%
	DNR Only	250	0%	0%	0%	0%	0%
		600	79%	26%	21%	16%	16%
		700	95%	37%	37%	32%	37%
		750	95%	32%	68%	58%	47%
	Collaborative (2x Width)	250	37%	0%	0%	0%	0%
		600	100%	95%	100%	100%	89%
		700	100%	100%	100%	100%	100%
		750	100%	100%	100%	100%	100%

Table 24 (continued)

Ignition Start Designation	Treatment Placement	Treatment Width per Entity	Treatment					
			Clearcut with Prescribed Burn	Shadetree with Prescribed Burn	Reduction of 30%	Reduction of 40%	Reduction of 60%
TCF	USFS Only	250	0%	0%	0%	0%	0%
		600	0%	0%	0%	0%	0%
		700	0%	0%	0%	0%	0%
		750	0%	0%	0%	0%	0%
	DNR Only	250	0%	0%	0%	0%	0%
		600	79%	0%	5%	0%	0%
		700	81%	5%	11%	0%	0%
		750	84%	16%	11%	11%	11%
	Collaborative (2x Width)	250	11%	0%	0%	0%	0%
		600	95%	32%	21%	21%	21%
		700	100%	32%	37%	47%	42%
		750	0%	0%	0%	0%	0%

Table 25: Breakdown of study area by hectares and percentage according to classifications outlined in the Wildfire Hazard Potential tool (Dillion 2015).

Wildfire Hazard Potential Classification	Number of Pixels (270 m x 270 m)	Area (hectares)	% of Study Area
Very Low	638	4651.02	2
Low	2832	20645.28	8.9
Moderate	6717	48966.93	21.2
High	6696	48813.84	21.1
Very High	11967	87239.43	37.7
Non-burnable	2516	18341.64	7.9
Water	375	2733.75	1.2

Table 26: Example calculation of Conditional Flame Length from Ager et al. (2010).

Flame Length Range (m) i	Mid-point Flame Length (m) $\frac{BP_i}{BP}$	Proportion of Flame Length F_i	$\frac{BP_i}{BP} \times F_i$
0 - 0.61 m	0.3 m	0.006	0.002
0.61 - 1.22 m	0.91 m	0.000	0.000
1.22 - 1.83 m	1.52 m	0.113	0.173
1.83 - 2.44 m	2.13 m	0.491	1.047
2.44 - 3.66 m	3.04 m	0.39	1.189
> 3.66 m	7.62 m	0.000	0.000
	Conditional Flame Length	$\sum_{1}^{6} \frac{BP_i}{BP} \times F_i$	2.41 m

APPENDIX A

Detailed description of layer manipulation for each of the five treatments. X= values that remained unchanged.

	Clearcut with Prescribed Burn	Shadetree with Prescribed Burn	30% Fuel Reduction	40% Fuel Reduction	60% Fuel Reduction
Canopy Cover %	0	40%	Multiply value by 0.7	Multiply value by 0.6	Multiply value by 0.3
Stand Height (m)	0	X	X	X	X
Canopy Base Height (m)	0	3.05 meters	Minimum 3.05 meters. If greater than 3.05 meters than multiply value by 30%.	Minimum 3.05 meters. If greater than 3.05 meters than multiply value by 40%.	Minimum 3.05 meters. If greater than 3.05 meters than multiply value by 60%.
Canopy Bulk Density (kg/m^3)	0.001	Minimum of 0.1 kg/m^3. If starts greater than 0.1 kg/m^3 reduce by 0.01 kg/m^3	Minimum of 0.1 kg/m^3. If starts greater than 0.1 kg/m^3 reduce by 0.01 kg/m^3	Minimum of 0.1 kg/m^3. If starts greater than 0.1 kg/m^3 reduce by 0.01 kg/m^3	Minimum of 0.1 kg/m^3. If starts greater than 0.1 kg/m^3 reduce by 0.01 kg/m^3
Fuel Model --> Changed to					
Nonburnable (NB)					
NB1 (91) Urban/Develop	X	X	X	X	X

NB2 (92) Snow/Ice	X	X	X	X	X
NB3 (93) Agriculture	X	X	X	X	X
NB8 (98) Open Water	X	X	X	X	X
NB9 (99) Bare Ground	X	X	X	X	X
Grass (GR)					
GR1 (101) Short, Sparse Dry Climate Grass (Dynamic	NB9 (99) Bare Ground	X	X	X	X
GR2 (102) Low Load, Dry Climate Grass (Dynamic)	NB9 (99) Bare Ground	X	X	X	X
GR3 (103) Low Load, Very Coarse, Humid Climate Grass (Dynamic	NB9 (99) Bare Ground	X	X	X	X
GR4 (104) Moderate Load, Dry Climate Grass (Dynamic)	NB9 (99) Bare Ground	X	X	X	X
GR5 (105) Low Load, Humid Climate Grass (Dynamic)	NB9 (99) Bare Ground	X	X	X	X

GR6 (106) Moderate Load, Humid Climate Grass (Dynamic)	NB9 (99) Bare Ground	X	X	X	X
GR7 (107) High Load, Dry Climate Grass (Dynamic)	NB9 (99) Bare Ground	X	X	X	X
GR8 (108) High Load, Very Coarse, Humid Climate Grass (Dynamic)	NB9 (99) Bare Ground	X	X	X	X
GR9 (109) Very High Load, Humid Climate Grass (Dynamic)	NB9 (99) Bare Ground	X	X	X	X
Grass-Shrub (GS)					
GS1 (121) Low Load, Dry Climate Grass-Shrub (Dynamic)	NB9 (99) Bare Ground	X	X	X	X
GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	NB9 (99) Bare Ground	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)
GS3 (123) Moderate Load, Humid Climate Grass-Shrub (Dynamic)	NB9 (99) Bare Ground	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)

GS4 (124) High Load, Humid Climate Grass-Shrub (Dynamic)	NB9 (99) Bare Ground	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)
Shrub (SH)					
SH1 (141) Low Load Dry Climate Shrub (Dynamic)	NB9 (99) Bare Ground	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)
SH2 (142) Moderate Load Dry Climate Shrub	NB9 (99) Bare Ground	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)
SH3 (143) Moderate Load, Humid Climate Shrub	NB9 (99) Bare Ground	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)
SH4 (144) Low Load, Humid Climate Timber-Shrub	NB9 (99) Bare Ground	GS2 (122) Moderate Load, Dry Climate Grass-Shrub	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)

		(Dynamic)			
SH5 (145) High Load, Dry Climate Shrub	NB9 (99) Bare Ground	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)
SH6 (146) Low Load, Humid Climate Shrub	NB9 (99) Bare Ground	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)
SH7 (147) Very High Load, Dry Climate Shrub	NB9 (99) Bare Ground	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)
SH8 (148) High Load, Humid Climate Shrub	NB9 (99) Bare Ground	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)
SH9 (149) Very High Load, Humid Climate Shrub (Dynamic)	NB9 (99) Bare Ground	GS2 (122) Moderate Load, Dry Climate	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2 (122) Moderate Load, Dry Climate Grass-Shrub (Dynamic)

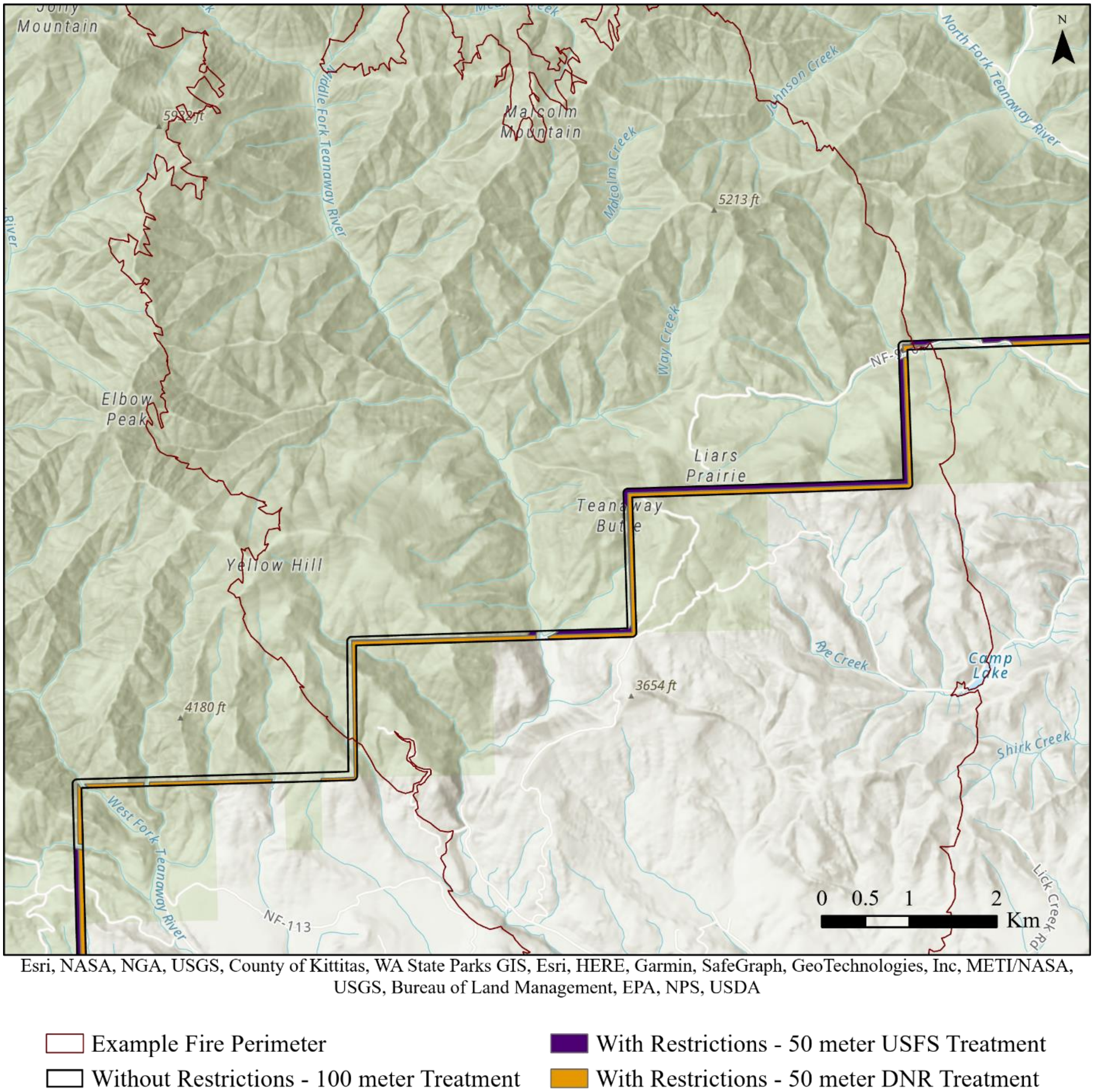
		Grass-Shrub (Dynamic)			
Timber-Understory (TU)					
TU1 (161) Low Load Dry Climate Timber-Grass-Shrub (Dynamic)	NB9 (99) Bare Ground	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter
TU2 (162) Moderate Load, Humid Climate Timber-Shrub	NB9 (99) Bare Ground	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter
TU3 (163) Moderate Load, Humid Climate Timber-Grass-Shrub (Dynamic)	NB9 (99) Bare Ground	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter
TU4 (164) Dwarf Conifer With Understory	NB9 (99) Bare Ground	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter
TU5 (165) Very High Load, Dry Climate Timber-Shrub	NB9 (99) Bare Ground	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter
Timber Litter (TL)					
TL1 (181) Low Load Compact Conifer Litter	NB9 (99) Bare Ground	X	X	X	X

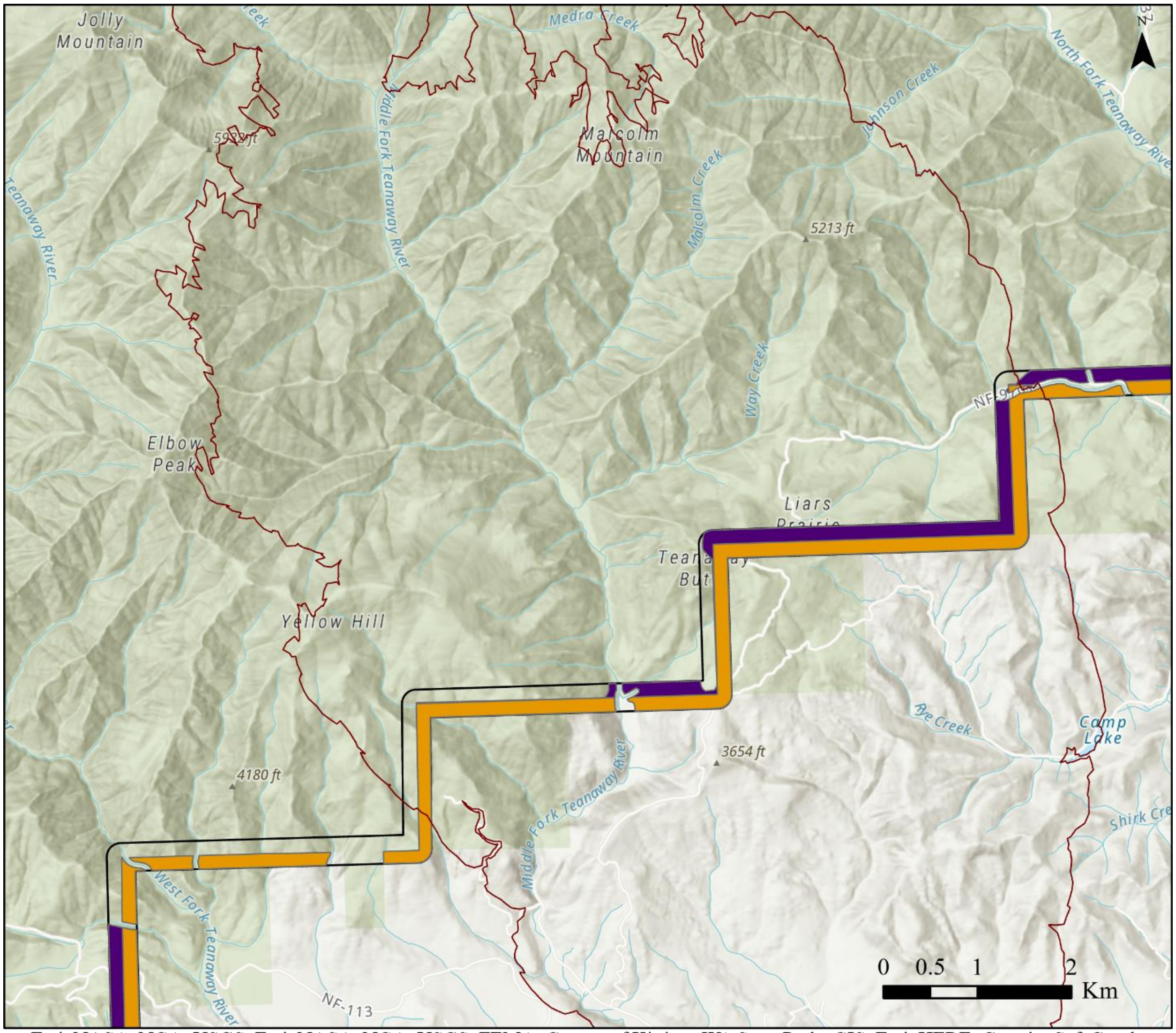
TL2 (182) Low Load Broadleaf Litter	NB9 (99) Bare Ground	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter
TL3 (183) Moderate Load Conifer Litter	NB9 (99) Bare Ground	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter
TL4 (184) Small downed logs	NB9 (99) Bare Ground	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter
TL5 (185) High Load Conifer Litter	NB9 (99) Bare Ground	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter
TL6 (186) Moderate Load Broadleaf Litter	NB9 (99) Bare Ground	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter
TL7 (187) Large Downed Logs	NB9 (99) Bare Ground	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter
TL8 (188) Long-Needle Litter	NB9 (99) Bare Ground	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter

TL9 (189) Very High Load Broadleaf Litter	NB9 (99) Bare Ground	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter
Slash-Blowdown					
SB1 (201) Low Load Activity Fuel	NB9 (99) Bare Ground	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter
SB2 (202) Moderate Load Activity Fuel or Low Load Blowdown	NB9 (99) Bare Ground	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter
SB3 (203) High Load Activity Fuel or Moderate Load Blowdown	NB9 (99) Bare Ground	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter
SB4 (204) High Load Blowdown	NB9 (99) Bare Ground	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter	TL1 (181) Low Load Compact Conifer Litter

APPENDIX B

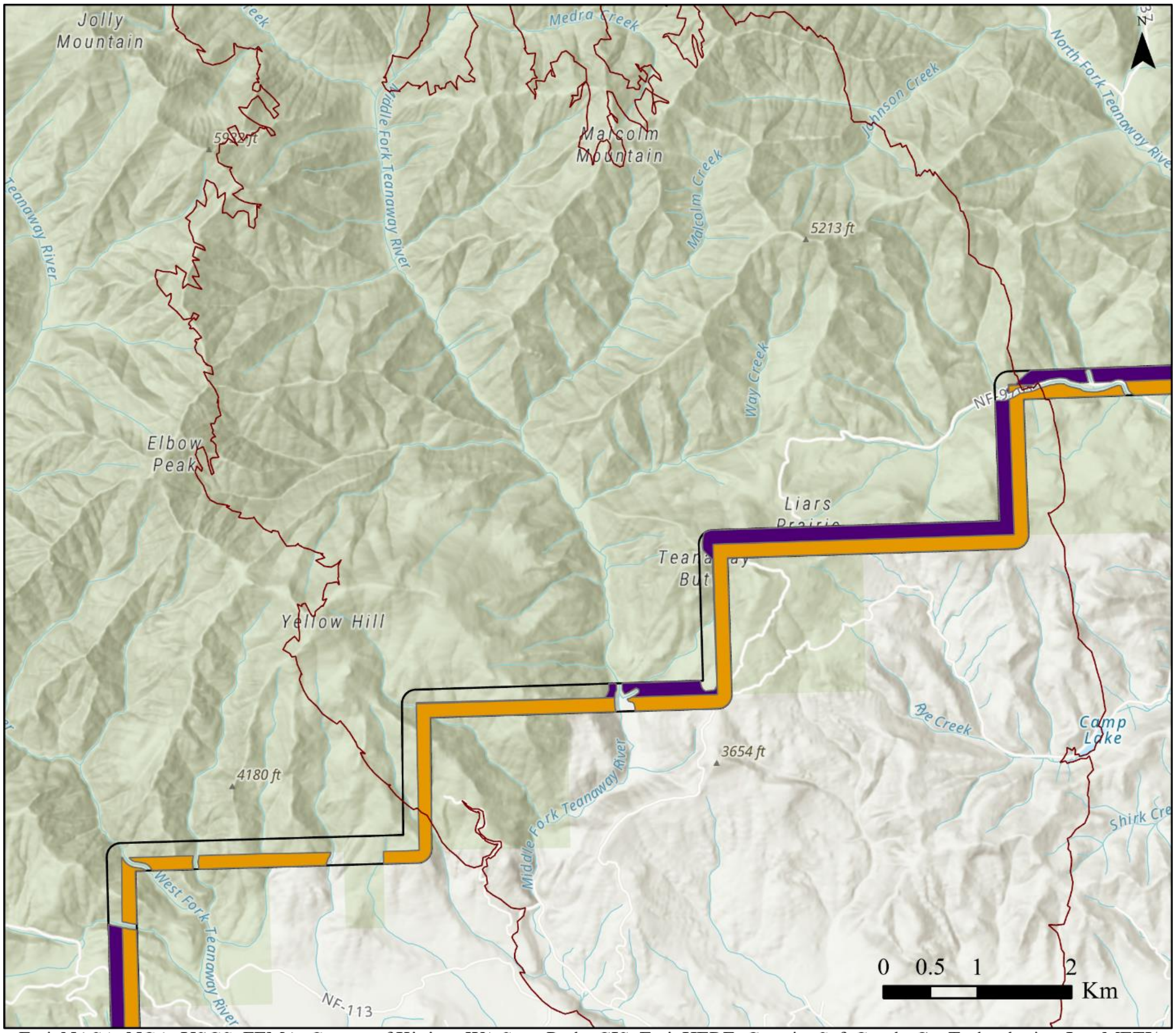
Graphics of available area to be treated for each treatment width with and without management restrictions. Land area available if no restrictions are in place is outlined in black. Actual area treated while accounting for restrictions is purple for the US Forest Service and orange for the Department of Natural Resources.


Mountain
5923 ft
Middle Fork Teanaway River
Malcolm Mountain
Malcolm Creek
Johnson Creek
North Fork Teanaway River
5213 ft
Way Creek
Elbow Peak
Liars Prairie
Teanaway Butte
Yellow Hill
Rye Creek
Camp Lake
3654 ft
4180 ft
Shirk Creek
West Fork Teanaway River
NF-113
Lick Creek Rd
N
0 0.5 1 2
Km
Esri, NASA, NGA, USGS, County of Kittitas, WA State Parks GIS, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA
Example Fire Perimeter
Without Restrictions - 100 meter Treatment
With Restrictions - 50 meter USFS Treatment
With Restrictions - 50 meter DNR Treatment



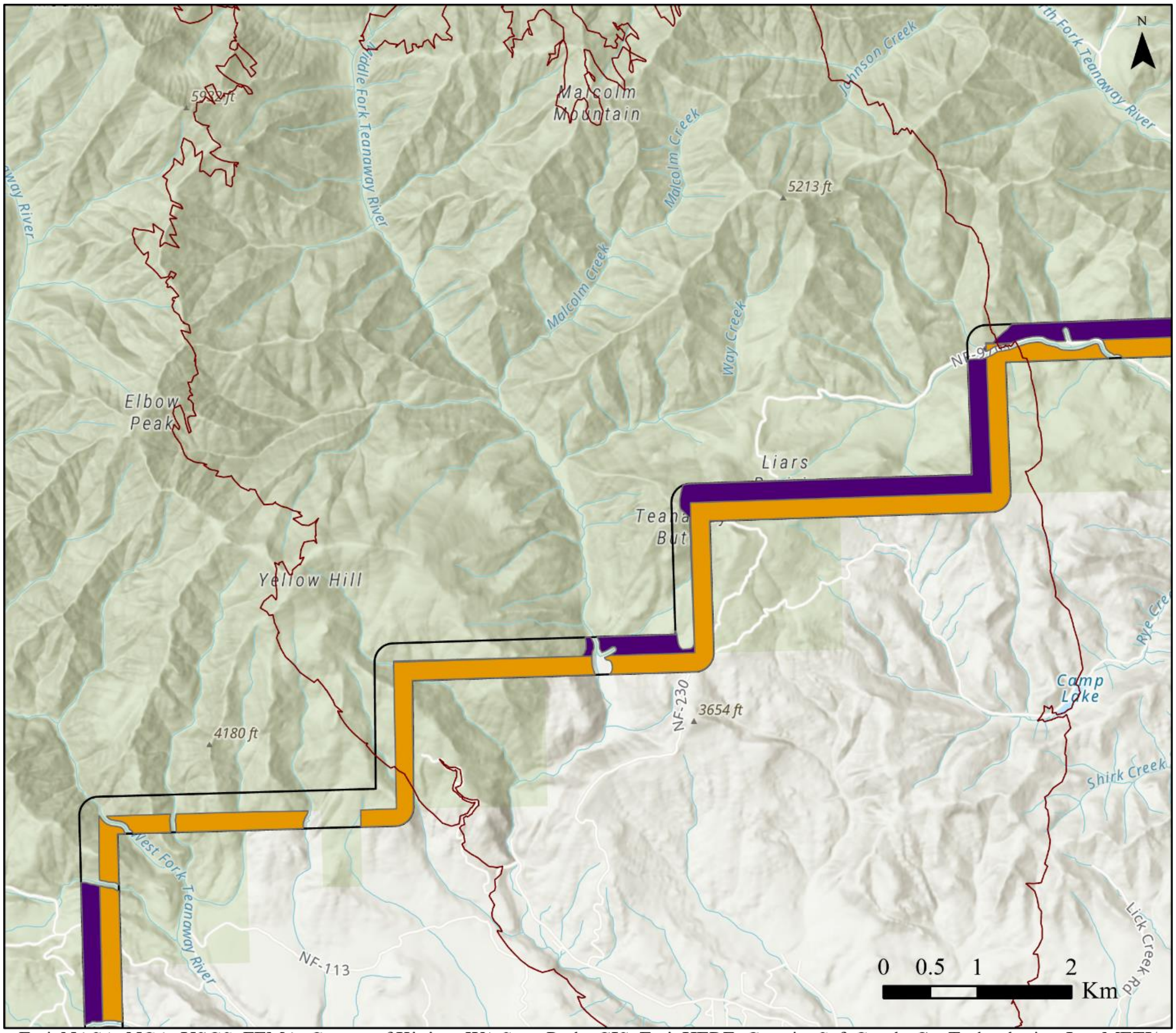
Esri, NASA, NGA, USGS, Esri, NASA, NGA, USGS, FEMA, County of Kittitas, WA State Parks GIS, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA

Example Fire Perimeter
Without Restrictions - 200 meter Treatment
With Restrictions - 100 meter DNR Treatment
With Restrictions - 100 meter USFS Treatment



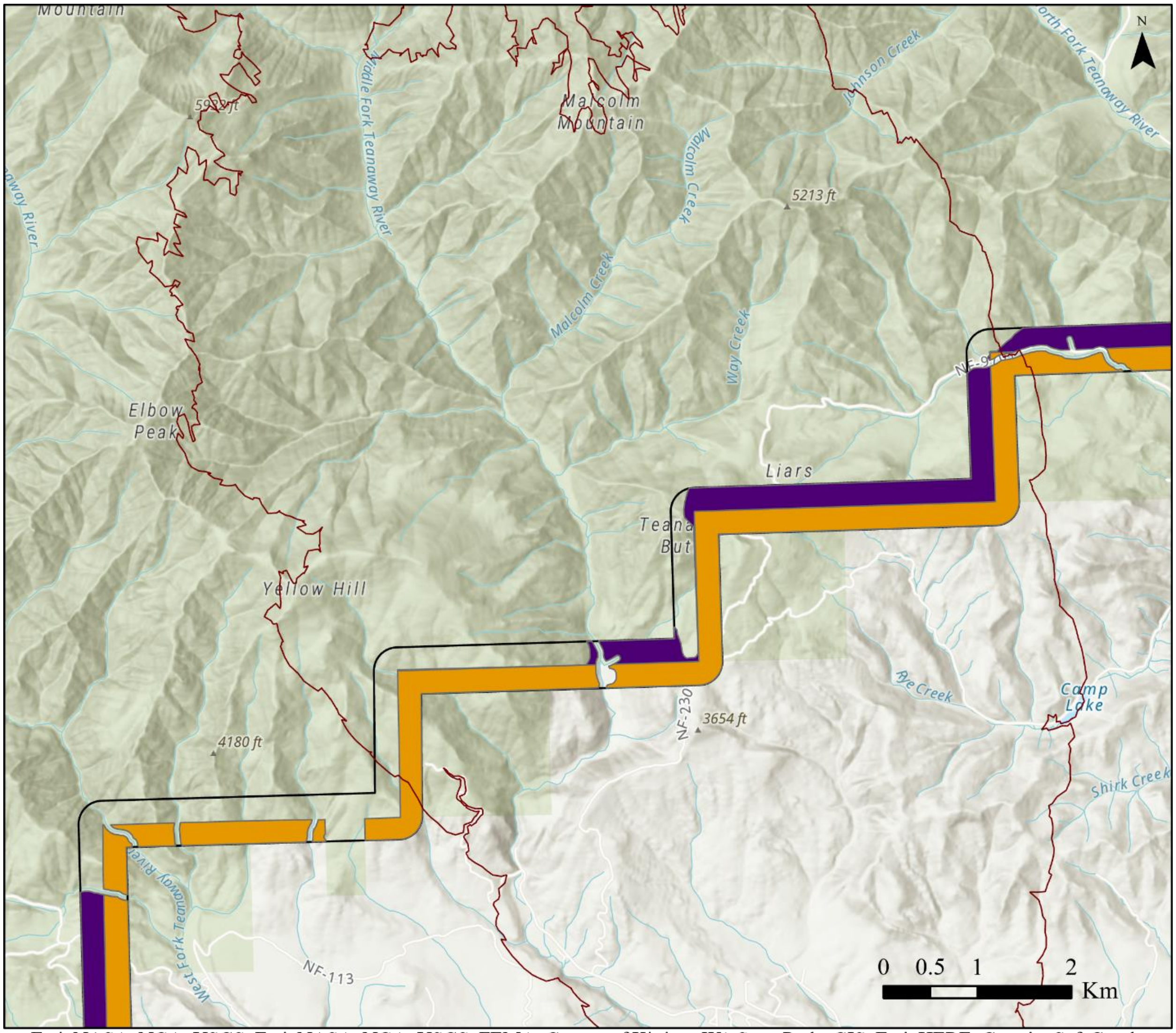
Esri, NASA, NGA, USGS, FEMA, County of Kittitas, WA State Parks GIS, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA

Example Fire Perimeter
Without Restrictions - 300 meter Treatment
With Restrictions - 150 meter DNR Treatment
With Restrictions - 150 meter USFS Treatment



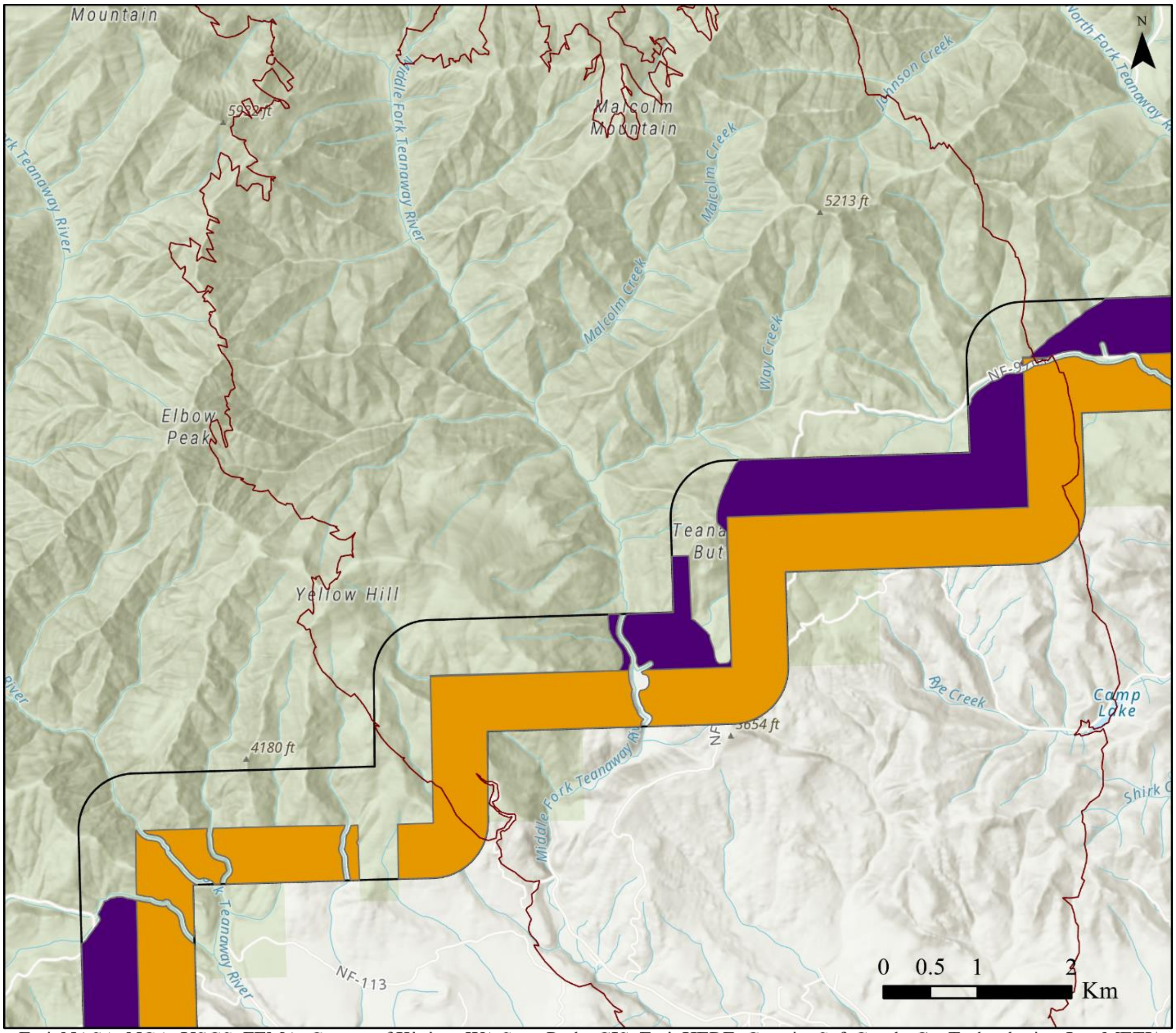
Esri, NASA, NGA, USGS, FEMA, County of Kittitas, WA State Parks GIS, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA

Example Fire Perimeter
Without Restrictions - 400 meter Treatment
With Restrictions - 200 meter DNR Treatment
With Restrictions - 200 meter USFS Treatment



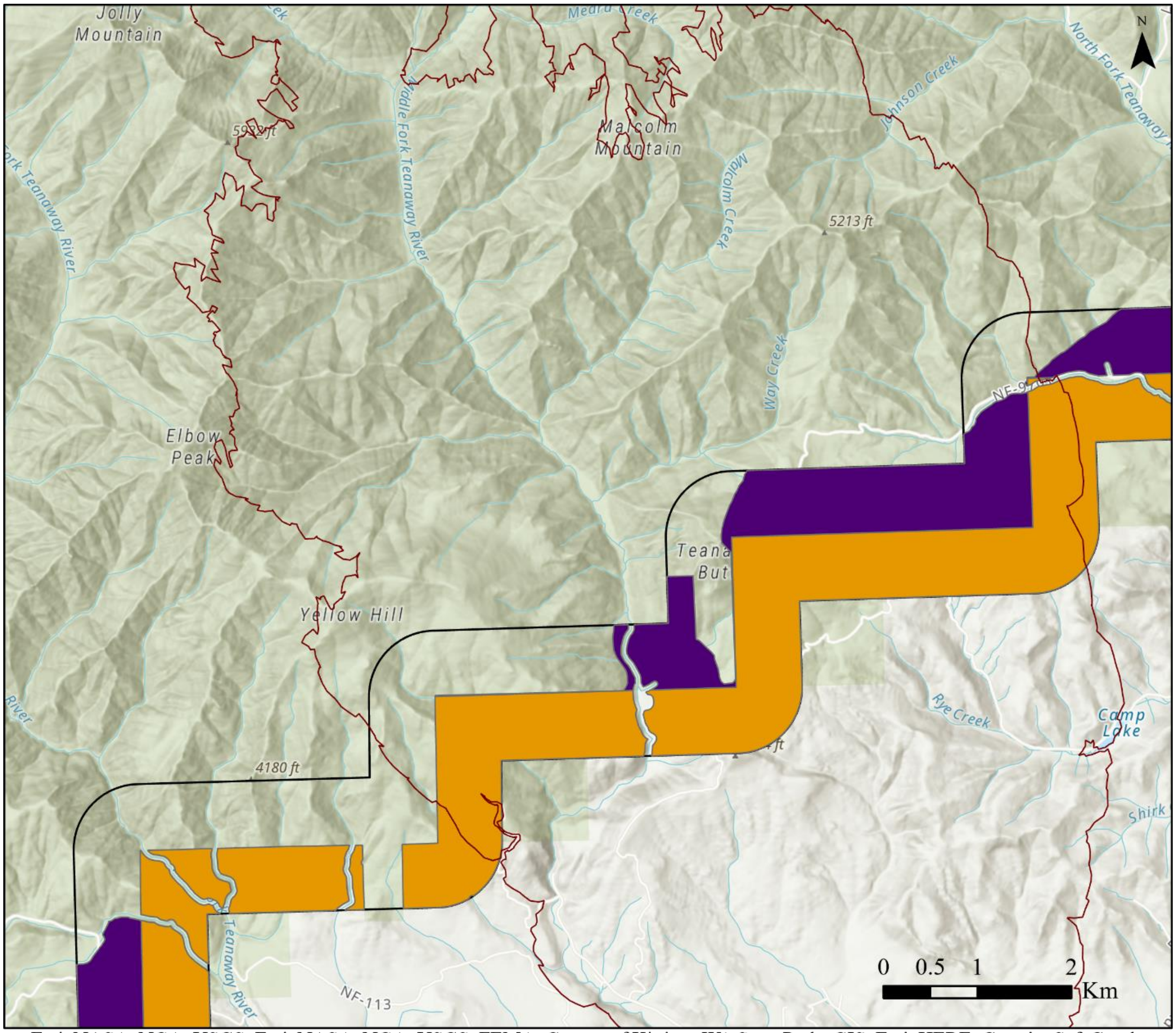
Esri, NASA, NGA, USGS, Esri, NASA, NGA, USGS, FEMA, County of Kittitas, WA State Parks GIS, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA

Example Fire Perimeter
Without Restrictions - 500 meter Treatment
With Restrictions - 250 meter DNR Treatment
With Restrictions - 250 meter USFS Treatment



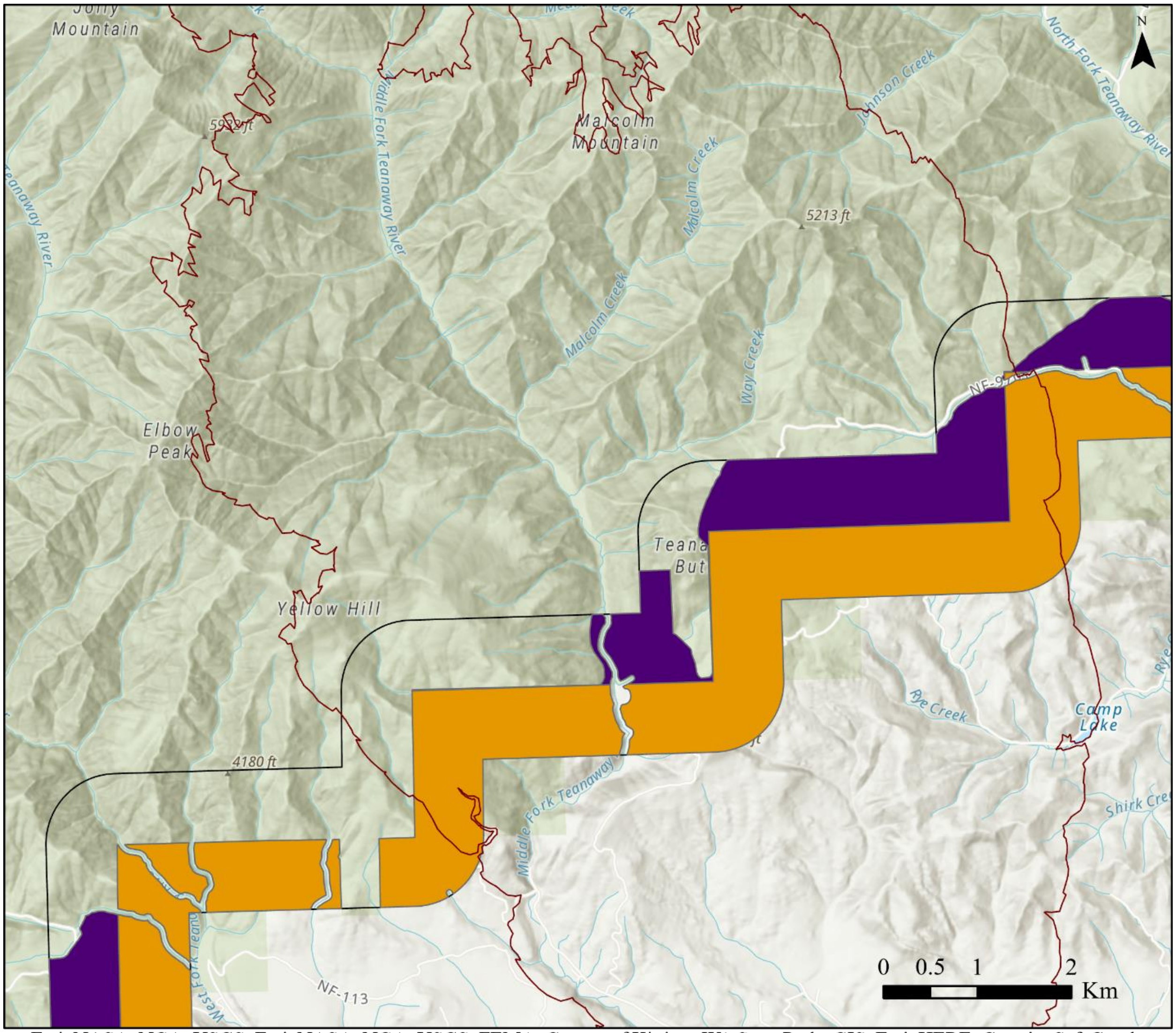
Esri, NASA, NGA, USGS, FEMA, County of Kittitas, WA State Parks GIS, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA

Example Fire Perimeter
Without Restrictions - 1200 meter Treatment
With Restrictions - 600 meter DNR Treatment
With Restrictions - 600 meter USFS Treatment



Esri, NASA, NGA, USGS, Esri, NASA, NGA, USGS, FEMA, County of Kittitas, WA State Parks GIS, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA

Example Fire Perimeter
Without Restrictions - 1400 meter Treatment
With Restrictions - 700 meter DNR Treatment
With Restrictions - 700 meter USFS Treatment



Esri, NASA, NGA, USGS, Esri, NASA, NGA, USGS, FEMA, County of Kittitas, WA State Parks GIS, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA

Example Fire Perimeter
Without Restrictions - 1500 meter Treatment
With Restrictions - 750 meter DNR Treatment
With Restrictions - 750 meter USFS Treatment

APPENDIX C

FARSITE Weather Inputs
Jolly Mountain Weather – Ignition Start Designation: Department of Natural Resources/Teanaway Community Forest

FARSITE INPUTS FILE VERSION 1.0
FARSITE_START_TIME: 08 11 1000
FARSITE_END_TIME: 08 15 1700
FARSITE_TIMESTEP: 60
FARSITE_DISTANCE_RES: 60.0
FARSITE_PERIMETER_RES: 60.0
FARSITE_MIN_IGNITION_VERTEX_DISTANCE: 15.0
FARSITE_SPOT_GRID_RESOLUTION: 30.0
FARSITE_SPOT_PROBABILITY: 0.05
FARSITE_SPOT_IGNITION_DELAY: 15
FARSITE_MINIMUM_SPOT_DISTANCE: 60
FARSITE_ACCELERATION_ON: 1
FARSITE_BURN_PERIODS: 5
08 11 1000 1700
08 12 1000 1700
08 13 1000 1700
08 14 1000 1700
08 15 1000 1700

FUEL_MOISTURES_DATA: 1
0 4 4 8 45 68

RAWS: 599
2017 8 8 0000 69 36 0.00 0 13 0
2017 8 8 0100 68 36 0.00 0 326 0
2017 8 8 0200 68 38 0.00 0 352 0
2017 8 8 0300 67 38 0.00 0 347 0
2017 8 8 0400 67 38 0.00 0 21 0
2017 8 8 0500 67 37 0.00 0 23 0
2017 8 8 0600 68 38 0.00 0 23 0
2017 8 8 0700 71 38 0.00 0 155 36
2017 8 8 0800 77 33 0.00 1 165 6
2017 8 8 0900 81 25 0.00 3 169 3
2017 8 8 1000 86 20 0.00 3 227 1
2017 8 8 1100 88 18 0.00 5 186 0
2017 8 8 1200 90 18 0.00 6 187 0
2017 8 8 1300 92 17 0.00 8 154 0
2017 8 8 1400 92 15 0.00 5 148 0
2017 8 8 1500 93 15 0.00 7 173 0
2017 8 8 1600 91 15 0.00 6 168 0
2017 8 8 1700 90 16 0.00 4 184 0
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2017 9 1 0400 59 39 0.00 0 336 0
2017 9 1 0500 59 35 0.00 0 310 0
2017 9 1 0600 60 33 0.00 1 4 0
2017 9 1 0700 68 23 0.00 0 94 0
2017 9 1 0800 73 19 0.00 2 165 0
2017 9 1 0900 76 16 0.00 2 195 0
2017 9 1 1000 79 16 0.00 4 174 0
2017 9 1 1100 82 15 0.00 5 196 0
2017 9 1 1200 84 11 0.00 6 195 0
2017 9 1 1300 87 12 0.00 6 181 0
2017 9 1 1400 87 14 0.00 6 198 0
2017 9 1 1500 87 15 0.00 4 187 0
2017 9 1 1600 85 17 0.00 4 198 0
2017 9 1 1700 82 19 0.00 3 202 0
2017 9 1 1800 78 23 0.00 2 204 0
2017 9 1 1900 75 29 0.00 1 95 0
2017 9 1 2000 73 31 0.00 0 229 0
2017 9 1 2100 72 33 0.00 1 352 0
2017 9 1 2200 70 34 0.00 0 44 0
2017 9 1 2300 70 35 0.00 2 343 0

RAWS_ELEVATION: 3480
RAWS_UNITS: English

FOLIAR_MOISTURE_CONTENT: 65
CROWN_FIRE_METHOD: ScottReinhardt

Jolly Mountain Weather – Ignition Start Designation: US Forest Service

FARSITE INPUTS FILE VERSION 1.0
FARSITE_START_TIME: 08 11 1000
FARSITE_END_TIME: 08 15 1700
FARSITE_TIMESTEP: 60

FARSITE_DISTANCE_RES: 60.0
FARSITE_PERIMETER_RES: 60.0
FARSITE_MIN_IGNITION_VERTEX_DISTANCE: 15.0
FARSITE_SPOT_GRID_RESOLUTION: 30.0

FARSITE_SPOT_PROBABILITY: 0.05
FARSITE_SPOT_IGNITION_DELAY: 15
FARSITE_MINIMUM_SPOT_DISTANCE: 60
FARSITE_ACCELERATION_ON: 1
FARSITE_BURN_PERIODS: 5
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08 12 1000 1700
08 13 1000 1700
08 14 1000 1700
08 15 1000 1700

FUEL_MOISTURES_DATA: 1
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RAWS: 599
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2017 8 8 200 68 38 0 0 172 0
2017 8 8 300 67 38 0 0 167 0
2017 8 8 400 67 38 0 0 201 0
2017 8 8 500 67 37 0 0 203 0
2017 8 8 600 68 38 0 0 203 0
2017 8 8 700 71 38 0 0 335 36
2017 8 8 800 77 33 0 1 345 6
2017 8 8 900 81 25 0 3 349 3
2017 8 8 1000 86 20 0 3 47 1
2017 8 8 1100 88 18 0 5 6 0
2017 8 8 1200 90 18 0 6 7 0
2017 8 8 1300 92 17 0 8 334 0
2017 8 8 1400 92 15 0 5 328 0
2017 8 8 1500 93 15 0 7 353 0
2017 8 8 1600 91 15 0 6 348 0
2017 8 8 1700 90 16 0 4 4 0
2017 8 8 1800 84 22 0 1 23 0
2017 8 8 1900 80 31 0 2 14 0
2017 8 8 2000 76 37 0 2 53 0
2017 8 8 2100 74 42 0 0 184 0
2017 8 8 2200 73 42 0 1 169 0
2017 8 8 2300 72 42 0 0 161 0
2017 8 9 0 72 43 0 0 154 0
2017 8 9 100 72 40 0 0 159 0
2017 8 9 200 71 40 0 0 222 0
2017 8 9 300 71 36 0 1 159 0
2017 8 9 400 72 33 0 1 159 0
2017 8 9 500 72 31 0 0 178 0
2017 8 9 600 73 31 0 0 148 0
2017 8 9 700 76 29 0 1 307 39
2017 8 9 800 81 27 0 1 351 1
2017 8 9 900 85 24 0 2 334 0
2017 8 9 1000 88 21 0 3 14 0
2017 8 9 1100 90 20 0 6 360 0
2017 8 9 1200 93 15 0 8 352 0
2017 8 9 1300 93 13 0 8 337 0
2017 8 9 1400 94 13 0 7 329 0
2017 8 9 1500 95 13 0 4 22 0
2017 8 9 1600 92 14 0 5 11 0
2017 8 9 1700 90 18 0 5 15 0
2017 8 9 1800 86 21 0 3 6 0
2017 8 9 1900 82 26 0 3 17 0
2017 8 9 2000 78 28 0 1 81 0
2017 8 9 2100 76 29 0 1 183 0
2017 8 9 2200 75 30 0 0 227 0
2017 8 9 2300 73 32 0 0 165 0
2017 8 10 0 72 33 0 0 161 0
2017 8 10 100 71 32 0 0 64 0
2017 8 10 200 72 31 0 2 155 0
2017 8 10 300 71 30 0 0 179 0
2017 8 10 400 71 29 0 0 214 0
2017 8 10 500 71 27 0 0 203 0
2017 8 10 600 71 29 0 0 180 0
2017 8 10 700 76 28 0 0 309 36
2017 8 10 800 81 23 0 2 325 0
2017 8 10 900 85 18 0 3 27 0
2017 8 10 1000 89 15 0 4 33 0
2017 8 10 1100 91 15 0 5 19 0
2017 8 10 1200 94 13 0 7 6 0
2017 8 10 1300 95 11 0 6 13 0
2017 8 10 1400 95 11 0 7 357 0
2017 8 10 1500 95 11 0 6 26 0
2017 8 10 1600 94 12 0 7 14 0
2017 8 10 1700 91 12 0 6 7 0
2017 8 10 1800 87 15 0 2 5 0
2017 8 10 1900 82 20 0 2 33 0
2017 8 10 2000 79 23 0 0 123 0
2017 8 10 2100 78 25 0 0 164 0
2017 8 10 2200 76 24 0 1 157 0
2017 8 10 2300 74 26 0 0 132 0
2017 8 11 0 74 26 0 0 176 0
2017 8 11 100 73 26 0 1 169 0
2017 8 11 200 72 26 0 0 177 0
2017 8 11 300 72 29 0 0 159 0
2017 8 11 400 71 28 0 0 172 0
2017 8 11 500 71 27 0 0 186 0
2017 8 11 600 71 27 0 0 79 0
2017 8 11 700 76 27 0 0 298 33
2017 8 11 800 81 26 0 1 338 0
2017 8 11 900 84 19 0 3 32 0
2017 8 11 1000 89 16 0 4 21 0
2017 8 11 1100 91 16 0 5 7 0
2017 8 11 1200 93 15 0 5 15 0
2017 8 11 1300 94 13 0 6 10 0
2017 8 11 1400 94 12 0 7 6 0
2017 8 11 1500 94 12 0 5 15 13
2017 8 11 1600 93 15 0 5 8 0
2017 8 11 1700 90 19 0 2 281 0
2017 8 11 1800 83 34 0 4 20 0
2017 8 11 1900 78 43 0 4 20 0
2017 8 11 2000 73 53 0 3 90 0
2017 8 11 2100 70 62 0 3 102 0
2017 8 11 2200 68 65 0 0 145 0
2017 8 11 2300 65 71 0 2 90 0
2017 8 12 0 64 73 0 0 183 0
2017 8 12 100 63 72 0 0 200 0
2017 8 12 200 66 65 0 2 190 0
2017 8 12 300 66 61 0 1 104 0
2017 8 12 400 63 68 0 1 62 0
2017 8 12 500 64 67 0 2 174 0
2017 8 12 600 65 64 0 0 191 0
2017 8 12 700 66 62 0 2 333 53
2017 8 12 800 65 62 0 3 56 84
2017 8 12 900 64 63 0 2 71 87
2017 8 12 1000 70 52 0 2 281 65
2017 8 12 1100 72 49 0 3 338 75
2017 8 12 1200 74 49 0 3 31 40
2017 8 12 1300 77 42 0 5 15 7
2017 8 12 1400 81 35 0 7 352 0
2017 8 12 1500 79 31 0 6 1 0
2017 8 12 1600 81 31 0 6 356 9
2017 8 12 1700 75 35 0 4 6 0
2017 8 12 1800 71 43 0 4 10 0
2017 8 12 1900 67 44 0 3 354 0
2017 8 12 2000 64 44 0 1 31 0
2017 8 12 2100 61 49 0 1 48 0
2017 8 12 2200 61 49 0 1 30 0
2017 8 12 2300 61 49 0 2 68 0
2017 8 13 0 59 62 0 2 12 0
2017 8 13 100 55 82 0.01 3 20 100
2017 8 13 200 53 92 0.07 1 158 100
2017 8 13 300 54 85 0.01 3 146 100
2017 8 13 400 55 79 0 1 337 0

2017 8 13 500 55 80 0 0 62 0
2017 8 13 600 54 85 0 2 354 0
2017 8 13 700 55 85 0 1 347 57
2017 8 13 800 60 76 0 5 353 20
2017 8 13 900 63 69 0 5 5 2
2017 8 13 1000 64 63 0 6 3 4
2017 8 13 1100 68 45 0 4 4 28
2017 8 13 1200 66 47 0 6 349 28
2017 8 13 1300 69 41 0 9 3 0
2017 8 13 1400 69 38 0 7 16 0
2017 8 13 1500 70 35 0 7 357 0
2017 8 13 1600 67 38 0 7 7 0
2017 8 13 1700 64 43 0 6 14 0
2017 8 13 1800 60 50 0 3 32 0
2017 8 13 1900 57 57 0 2 20 0
2017 8 13 2000 54 65 0 1 245 0
2017 8 13 2100 53 68 0 1 229 0
2017 8 13 2200 52 71 0 0 51 0
2017 8 13 2300 52 71 0 1 214 0
2017 8 14 0 51 73 0 0 152 0
2017 8 14 100 51 73 0 0 165 0
2017 8 14 200 50 74 0 0 189 0
2017 8 14 300 48 76 0 1 165 0
2017 8 14 400 48 76 0 0 214 0
2017 8 14 500 47 76 0 0 169 0
2017 8 14 600 48 75 0 0 262 0
2017 8 14 700 53 62 0 1 307 20
2017 8 14 800 57 53 0 3 357 0
2017 8 14 900 59 50 0 4 354 0
2017 8 14 1000 64 43 0 4 24 0
2017 8 14 1100 66 38 0 4 34 0
2017 8 14 1200 69 30 0 6 340 0
2017 8 14 1300 71 27 0 6 344 0
2017 8 14 1400 71 27 0 8 352 0
2017 8 14 1500 71 30 0 7 355 0
2017 8 14 1600 71 34 0 7 9 0
2017 8 14 1700 66 42 0 6 5 0
2017 8 14 1800 60 55 0 3 21 0
2017 8 14 2000 55 69 0 0 60 0
2017 8 14 2100 53 74 0 0 7 0
2017 8 14 2200 52 77 0 0 200 0
2017 8 14 2300 51 79 0 0 255 0
2017 8 15 0 50 80 0 0 181 0
2017 8 15 100 49 84 0 1 160 0
2017 8 15 200 48 86 0 0 207 0
2017 8 15 300 48 85 0 0 164 0
2017 8 15 400 47 86 0 0 226 0
2017 8 15 500 47 87 0 0 150 0
2017 8 15 600 48 84 0 0 221 0
2017 8 15 700 55 70 0 1 325 27
2017 8 15 800 61 58 0 2 307 0
2017 8 15 900 64 50 0 4 352 0
2017 8 15 1000 68 42 0 4 24 0
2017 8 15 1100 71 35 0 6 10 0
2017 8 15 1200 72 30 0 7 353 0
2017 8 15 1300 76 23 0 6 3 0
2017 8 15 1400 76 24 0 8 4 0
2017 8 15 1500 78 18 0 7 3 0
2017 8 15 1600 76 24 0 5 20 0
2017 8 15 1700 72 28 0 3 18 0
2017 8 15 1800 67 34 0 4 13 0
2017 8 15 1900 64 38 0 2 26 0
2017 8 15 2000 61 43 0 1 46 0
2017 8 15 2100 59 47 0 1 62 0
2017 8 15 2200 57 50 0 0 86 0
2017 8 15 2300 56 50 0 0 154 0
2017 8 16 0 55 50 0 0 154 0
2017 8 16 100 54 49 0 1 181 0
2017 8 16 200 53 47 0 1 178 0
2017 8 16 300 54 43 0 0 196 0
2017 8 16 400 53 44 0 1 193 0
2017 8 16 500 52 46 0 2 161 0
2017 8 16 600 54 45 0 0 184 0
2017 8 16 700 61 40 0 1 343 6
2017 8 16 800 65 37 0 2 350 0
2017 8 16 900 68 36 0 4 353 0
2017 8 16 1000 74 32 0 5 336 0
2017 8 16 1100 77 31 0 7 345 0
2017 8 16 1200 78 31 0 8 347 0
2017 8 16 1300 81 29 0 8 5 0
2017 8 16 1400 81 30 0 6 11 0
2017 8 16 1500 80 32 0 6 356 0
2017 8 16 1600 76 38 0 2 295 0
2017 8 16 1700 73 41 0 5 333 0
2017 8 16 1800 68 47 0 2 250 0
2017 8 16 1900 65 53 0 2 284 0
2017 8 16 2000 61 60 0 1 209 0
2017 8 16 2100 59 63 0 1 26 0
2017 8 16 2200 59 62 0 1 164 0
2017 8 16 2300 58 64 0 1 141 0
2017 8 17 0 57 65 0 1 163 0
2017 8 17 100 56 69 0 1 209 0
2017 8 17 200 54 72 0 0 206 0
2017 8 17 300 53 76 0 1 180 0
2017 8 17 400 53 76 0 1 174 0
2017 8 17 500 53 77 0 1 184 0
2017 8 17 600 53 79 0 0 214 0
2017 8 17 700 59 65 0 2 301 11
2017 8 17 800 63 58 0 3 310 0
2017 8 17 900 67 48 0 4 350 0
2017 8 17 1000 71 40 0 5 343 0
2017 8 17 1100 74 39 0 6 354 0
2017 8 17 1200 74 37 0 8 357 0
2017 8 17 1300 79 32 0 7 356 0
2017 8 17 1400 79 30 0 8 350 0
2017 8 17 1500 82 28 0 6 3 0
2017 8 17 1600 76 34 0 9 354 0
2017 8 17 1700 74 37 0 5 16 0
2017 8 17 1800 69 44 0 4 5 0
2017 8 17 1900 65 53 0 2 68 0
2017 8 17 2000 61 61 0 1 36 0
2017 8 17 2100 59 66 0 1 79 0
2017 8 17 2200 57 74 0 2 109 0
2017 8 17 2300 56 72 0 2 173 0
2017 8 18 0 55 73 0 1 202 0
2017 8 18 100 56 67 0 0 243 0
2017 8 18 200 55 69 0 0 113 0
2017 8 18 300 54 63 0 0 122 0
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2017 8 18 600 57 49 0 0 164 0
2017 8 18 700 63 42 0 1 19 0
2017 8 18 800 66 42 0 3 25 0
2017 8 18 900 72 35 0 4 37 0
2017 8 18 1000 74 34 0 7 353 0
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2017 8 18 1200 77 34 0 4 19 0
2017 8 18 1300 71 43 0 4 10 45
2017 8 18 1400 71 44 0 6 5 34
2017 8 18 1500 74 38 0 7 2 0
2017 8 18 1600 73 38 0 6 10 0
2017 8 18 1700 69 42 0 6 11 0
2017 8 18 1800 65 52 0 4 24 0
2017 8 18 1900 61 61 0 4 21 0
2017 8 18 2000 57 70 0 2 343 0
2017 8 18 2100 56 73 0 1 4 0
2017 8 18 2200 56 73 0 1 180 0
2017 8 18 2300 55 75 0 2 163 0
2017 8 19 0 55 73 0 2 164 0
2017 8 19 100 55 71 0 0 243 0

2017 8 19 200 54 71 0 2 249 0
2017 8 19 300 54 72 0 0 139 0
2017 8 19 400 53 70 0 1 171 0
2017 8 19 500 52 72 0 0 199 0
2017 8 19 600 52 71 0 0 260 0
2017 8 19 700 57 61 0 2 333 0
2017 8 19 800 58 60 0 3 32 0
2017 8 19 900 62 50 0 5 350 10
2017 8 19 1000 66 42 0 6 360 0
2017 8 19 1100 69 39 0 7 332 0
2017 8 19 1200 71 35 0 8 356 0
2017 8 19 1300 74 30 0 7 4 0
2017 8 19 1400 75 31 0 5 4 0
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2017 8 19 1600 71 35 0 8 348 0
2017 8 19 1700 68 38 0 7 353 0
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2017 8 19 1900 61 50 0 2 17 0
2017 8 19 2000 58 56 0 1 205 0
2017 8 19 2100 56 59 0 1 177 0
2017 8 19 2200 54 62 0 0 170 0
2017 8 19 2300 53 65 0 2 169 0
2017 8 20 0 51 68 0 2 168 0
2017 8 20 100 52 62 0 0 176 0
2017 8 20 200 52 60 0 1 172 0
2017 8 20 300 51 62 0 1 164 0
2017 8 20 400 51 60 0 2 169 0
2017 8 20 500 51 58 0 0 153 0
2017 8 20 600 53 55 0 0 195 0
2017 8 20 700 54 58 0 1 251 26
2017 8 20 800 61 44 0 1 323 23
2017 8 20 900 65 35 0 3 353 0
2017 8 20 1000 69 32 0 5 359 0
2017 8 20 1100 74 28 0 5 3 0
2017 8 20 1200 76 29 0 8 347 0
2017 8 20 1300 76 31 0 7 356 5
2017 8 20 1400 76 33 0 6 355 17
2017 8 20 1500 74 36 0 6 2 0
2017 8 20 1600 75 36 0 6 356 0
2017 8 20 1700 73 37 0 5 2 0
2017 8 20 1800 68 43 0 4 11 0
2017 8 20 1900 64 50 0 2 50 0
2017 8 20 2000 62 54 0 0 227 0
2017 8 20 2100 60 59 0 1 102 0
2017 8 20 2200 58 63 0 1 117 0
2017 8 20 2300 57 65 0 0 52 0
2017 8 21 0 56 67 0 1 146 0
2017 8 21 100 56 66 0 1 174 0
2017 8 21 200 56 65 0 0 194 0
2017 8 21 300 56 65 0 1 203 0
2017 8 21 400 57 61 0 1 168 0
2017 8 21 500 58 58 0 0 183 0
2017 8 21 600 59 56 0 0 195 0
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2017 8 21 900 69 39 0 2 2 20
2017 8 21 1000 70 40 0 1 347 69
2017 8 21 1100 76 32 0 3 57 0
2017 8 21 1200 78 30 0 7 14 0
2017 8 21 1300 80 25 0 6 29 0
2017 8 21 1400 81 23 0 6 27 0
2017 8 21 1500 81 23 0 6 15 0
2017 8 21 1600 79 25 0 6 346 0
2017 8 21 1700 78 25 0 5 342 0
2017 8 21 1800 75 27 0 4 14 0
2017 8 21 1900 73 27 0 1 62 0
2017 8 21 2000 71 29 0 1 166 0
2017 8 21 2100 69 32 0 1 160 0
2017 8 21 2200 67 33 0 0 180 0
2017 8 21 2300 67 33 0 1 150 0
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2017 8 22 100 66 34 0 1 186 0
2017 8 22 200 65 35 0 1 167 0
2017 8 22 300 65 34 0 0 203 0
2017 8 22 400 65 33 0 0 232 0
2017 8 22 500 65 33 0 0 141 0
2017 8 22 600 65 34 0 0 85 0
2017 8 22 700 71 32 0 0 302 1
2017 8 22 800 76 31 0 1 328 0
2017 8 22 900 78 26 0 3 40 0
2017 8 22 1000 81 24 0 4 25 0
2017 8 22 1100 82 22 0 4 23 0
2017 8 22 1200 84 19 0 6 15 0
2017 8 22 1300 85 19 0 6 353 0
2017 8 22 1400 86 20 0 5 358 0
2017 8 22 1500 85 20 0 6 346 0
2017 8 22 1600 84 21 0 5 14 0
2017 8 22 1700 82 28 0 4 14 0
2017 8 22 1800 77 35 0 3 8 0
2017 8 22 1900 72 41 0 1 314 0
2017 8 22 2000 69 47 0 2 51 0
2017 8 22 2100 67 52 0 0 64 0
2017 8 22 2200 65 54 0 0 46 0
2017 8 22 2300 64 56 0 1 346 0
2017 8 23 0 63 57 0 0 118 0
2017 8 23 100 61 61 0 0 82 0
2017 8 23 200 60 64 0 0 114 0
2017 8 23 300 59 66 0 0 172 0
2017 8 23 400 59 66 0 0 180 0
2017 8 23 500 60 59 0 0 175 0
2017 8 23 600 59 63 0 0 182 0
2017 8 23 700 66 51 0 1 312 0
2017 8 23 800 70 48 0 2 313 0
2017 8 23 900 73 45 0 3 26 0
2017 8 23 1000 78 36 0 5 5 0
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2017 8 23 1200 84 23 0 5 2 0
2017 8 23 1300 85 18 0 7 1 0
2017 8 23 1400 86 17 0 6 10 0
2017 8 23 1500 85 17 0 6 14 0
2017 8 23 1600 79 20 0 6 12 1
2017 8 23 1700 76 29 0 4 7 0
2017 8 23 1800 73 36 0 5 17 0
2017 8 23 1900 69 42 0 3 11 0
2017 8 23 2000 65 51 0 2 37 0
2017 8 23 2100 63 57 0 1 38 0
2017 8 23 2200 62 58 0 1 28 0
2017 8 23 2300 61 54 0 0 94 0
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2017 8 24 100 60 44 0 1 89 0
2017 8 24 200 58 56 0 3 29 0
2017 8 24 300 55 63 0 2 32 0
2017 8 24 400 55 63 0 2 44 0
2017 8 24 500 55 64 0 2 144 0
2017 8 24 600 55 65 0 1 58 0
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2017 8 24 800 61 62 0 7 354 0
2017 8 24 900 64 50 0 6 22 0
2017 8 24 1000 64 49 0 6 16 0
2017 8 24 1100 64 48 0 7 25 0
2017 8 24 1200 64 43 0 8 9 0
2017 8 24 1300 62 44 0 9 351 0
2017 8 24 1400 61 45 0 7 353 35
2017 8 24 1500 63 42 0 7 350 0
2017 8 24 1600 61 43 0 4 355 0
2017 8 24 1700 59 47 0 3 15 0
2017 8 24 1800 57 50 0 2 351 0
2017 8 24 1900 53 55 0 0 66 0
2017 8 24 2000 52 58 0 0 110 0
2017 8 24 2100 50 62 0 0 173 0

2017 8 24 2200 48 65 0 1 183 0
2017 8 24 2300 47 68 0 1 195 0
2017 8 25 0 46 68 0 1 185 0
2017 8 25 100 45 69 0 0 197 0
2017 8 25 200 44 70 0 1 207 0
2017 8 25 300 46 63 0 1 182 0
2017 8 25 400 45 64 0 1 179 0
2017 8 25 500 46 61 0 1 166 0
2017 8 25 600 46 61 0 0 145 0
2017 8 25 700 52 52 0 1 352 0
2017 8 25 800 57 44 0 2 315 0
2017 8 25 900 61 38 0 4 6 0
2017 8 25 1000 64 28 0 5 3 0
2017 8 25 1100 67 26 0 5 9 0
2017 8 25 1200 70 23 0 7 353 0
2017 8 25 1300 71 22 0 5 10 0
2017 8 25 1400 74 19 0 6 350 0
2017 8 25 1500 76 14 0 4 17 0
2017 8 25 1600 74 17 0 6 352 0
2017 8 25 1700 72 24 0 4 6 0
2017 8 25 1800 66 29 0 3 20 0
2017 8 25 1900 63 33 0 1 104 0
2017 8 25 2000 59 41 0 1 55 0
2017 8 25 2100 58 46 0 0 52 0
2017 8 25 2200 57 45 0 1 172 0
2017 8 25 2300 55 48 0 2 177 0
2017 8 26 0 55 47 0 0 141 0
2017 8 26 100 54 50 0 1 187 0
2017 8 26 200 54 49 0 0 197 0
2017 8 26 300 54 43 0 0 174 0
2017 8 26 400 54 45 0 0 164 0
2017 8 26 500 54 43 0 0 199 0
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2017 8 26 700 63 34 0 0 328 0
2017 8 26 800 66 27 0 1 340 0
2017 8 26 900 72 23 0 3 20 0
2017 8 26 1000 73 24 0 5 16 0
2017 8 26 1100 76 21 0 5 31 0
2017 8 26 1200 79 19 0 6 9 0
2017 8 26 1300 80 20 0 6 2 0
2017 8 26 1400 81 18 0 7 358 0
2017 8 26 1500 81 19 0 5 20 0
2017 8 26 1600 79 20 0 3 22 9
2017 8 26 1700 77 20 0 4 356 0
2017 8 26 1800 74 21 0 2 60 0
2017 8 26 1900 72 23 0 0 172 0
2017 8 26 2000 70 25 0 0 138 0
2017 8 26 2100 68 27 0 0 92 0
2017 8 26 2200 68 27 0 2 163 0
2017 8 26 2300 66 29 0 1 198 0
2017 8 27 0 65 30 0 0 139 0
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2017 8 27 200 65 31 0 1 165 0
2017 8 27 300 65 31 0 1 139 0
2017 8 27 400 66 30 0 1 157 0
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2017 8 27 1900 77 22 0 0 110 0
2017 8 27 2000 75 24 0 2 167 0
2017 8 27 2100 74 25 0 2 172 0
2017 8 27 2200 72 27 0 1 168 0
2017 8 27 2300 71 27 0 0 149 0
2017 8 28 0 70 28 0 0 122 0
2017 8 28 100 70 28 0 0 28 0
2017 8 28 200 70 28 0 0 190 0
2017 8 28 300 70 28 0 1 173 0
2017 8 28 400 70 27 0 1 152 0
2017 8 28 500 70 28 0 0 173 0
2017 8 28 600 69 29 0 0 123 0
2017 8 28 700 72 30 0 0 239 23
2017 8 28 800 77 26 0 1 327 3
2017 8 28 900 80 27 0 1 341 8
2017 8 28 1000 82 23 0 4 39 7
2017 8 28 1100 84 22 0 4 20 0
2017 8 28 1200 88 18 0 3 22 0
2017 8 28 1300 91 15 0 5 4 0
2017 8 28 1400 91 14 0 6 9 0
2017 8 28 1500 87 15 0 4 31 0
2017 8 28 1600 87 17 0 3 23 20
2017 8 28 1700 85 18 0 3 26 0
2017 8 28 1800 81 20 0 2 88 0
2017 8 28 1900 78 23 0 1 167 0
2017 8 28 2000 76 25 0 2 139 0
2017 8 28 2100 74 26 0 1 147 0
2017 8 28 2200 72 29 0 2 145 0
2017 8 28 2300 72 28 0 1 159 0
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2017 8 29 300 72 27 0 1 170 0
2017 8 29 400 71 27 0 0 152 0
2017 8 29 500 71 27 0 0 128 0
2017 8 29 600 70 26 0 0 183 0
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2017 8 29 800 77 26 0 1 319 6
2017 8 29 900 82 22 0 2 342 4
2017 8 29 1000 85 18 0 3 38 0
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2017 8 29 1200 90 18 0 4 33 0
2017 8 29 1300 92 14 0 6 2 0
2017 8 29 1400 94 10 0 6 13 0
2017 8 29 1500 92 13 0 5 24 0
2017 8 29 1600 89 16 0 5 3 0
2017 8 29 1700 85 23 0 5 5 0
2017 8 29 1800 79 28 0 3 356 0
2017 8 29 1900 76 31 0 0 193 0
2017 8 29 2000 74 33 0 1 94 0
2017 8 29 2100 72 34 0 2 158 0
2017 8 29 2200 70 35 0 2 183 0
2017 8 29 2300 69 37 0 1 174 0
2017 8 30 0 68 38 0 1 107 0
2017 8 30 100 68 39 0 1 78 0
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2017 8 30 300 65 42 0 1 142 0
2017 8 30 400 64 44 0 1 72 0
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2017 8 30 600 64 42 0 1 103 0
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2017 8 30 800 68 38 0 2 23 27
2017 8 30 900 67 47 0 3 3 19
2017 8 30 1000 72 39 0 4 354 17
2017 8 30 1100 77 32 0 6 351 2
2017 8 30 1200 79 25 0 9 352 0
2017 8 30 1300 81 17 0 7 360 0
2017 8 30 1400 79 20 0 7 350 0
2017 8 30 1500 75 24 0 5 8 1
2017 8 30 1600 74 28 0 3 14 0
2017 8 30 1700 69 36 0 3 22 0

2017 8 30 1800 66 40 0 3 358 0
2017 8 30 1900 63 47 0 3 14 0
2017 8 30 2000 60 55 0 1 20 0
2017 8 30 2100 59 57 0 1 102 0
2017 8 30 2200 58 60 0 0 181 0
2017 8 30 2300 57 61 0 0 73 0
2017 8 31 0 56 64 0 0 19 0
2017 8 31 100 55 66 0 0 55 0
2017 8 31 200 55 68 0 0 5 0
2017 8 31 300 53 70 0 1 180 0
2017 8 31 400 54 71 0 2 34 0
2017 8 31 500 54 71 0 1 3 0
2017 8 31 600 56 68 0 1 162 0
2017 8 31 700 60 60 0 1 293 4
2017 8 31 800 64 56 0 3 354 0
2017 8 31 900 67 50 0 4 350 0
2017 8 31 1000 71 46 0 5 355 0
2017 8 31 1100 72 44 0 8 351 0
2017 8 31 1200 75 40 0 7 333 0
2017 8 31 1300 76 37 0 7 355 0
2017 8 31 1400 77 36 0 5 15 0
2017 8 31 1500 75 38 0 5 8 3
2017 8 31 1600 75 35 0 4 359 0
2017 8 31 1700 73 38 0 3 20 0
2017 8 31 1800 68 46 0 4 359 0
2017 8 31 1900 65 50 0 3 2 0
2017 8 31 2000 63 52 0 0 322 0
2017 8 31 2100 62 53 0 0 175 0
2017 8 31 2200 60 58 0 0 160 0
2017 8 31 2300 59 55 0 0 191 0
2017 9 1 0 59 47 0 0 200 0
2017 9 1 100 59 46 0 0 125 0
2017 9 1 200 59 47 0 1 176 0
2017 9 1 300 58 41 0 1 162 0
2017 9 1 400 59 39 0 0 156 0
2017 9 1 500 59 35 0 0 130 0
2017 9 1 600 60 33 0 1 184 0
2017 9 1 700 68 23 0 0 274 0
2017 9 1 800 73 19 0 2 345 0
2017 9 1 900 76 16 0 2 15 0
2017 9 1 1000 79 16 0 4 354 0
2017 9 1 1100 82 15 0 5 16 0
2017 9 1 1200 84 11 0 6 15 0
2017 9 1 1300 87 12 0 6 1 0
2017 9 1 1400 87 14 0 6 18 0
2017 9 1 1500 87 15 0 4 7 0
2017 9 1 1600 85 17 0 4 18 0
2017 9 1 1700 82 19 0 3 22 0
2017 9 1 1800 78 23 0 2 24 0
2017 9 1 1900 75 29 0 1 275 0
2017 9 1 2000 73 31 0 0 49 0
2017 9 1 2100 72 33 0 1 172 0
2017 9 1 2200 70 34 0 0 224 0
2017 9 1 2300 70 35 0 2 163 0

RAWS_ELEVATION: 3480
RAWS_UNITS: English

\FOLIAR_MOISTURE_CONTENT: 65
CROWN_FIRE_METHOD: ScottReinhardt

Extreme Weather – Ignition Start Designation: Department of Natural Resources/Teanaway Community Forest

FARSITE INPUTS FILE VERSION 1.0
FARSITE_START_TIME: 07 29 1300
FARSITE_END_TIME: 08 02 1500
FARSITE_TIMESTEP: 120
FARSITE_DISTANCE_RES: 120
FARSITE_PERIMETER_RES: 120
FARSITE_MIN_IGNITION_VERTEX_DISTANCE: 15.0
FARSITE_SPOT_GRID_RESOLUTION: 30.0
FARSITE_SPOT_PROBABILITY: 0.05
FARSITE_SPOT_IGNITION_DELAY: 15
FARSITE_MINIMUM_SPOT_DISTANCE: 60
FARSITE_ACCELERATION_ON: 1
FARSITE_BURN_PERIODS: 5
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07 30 1300 1700
07 31 1000 1400
08 01 1000 1500
08 02 1000 1500

FUEL_MOISTURES_DATA: 1
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RAWS: 324
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2015 7 24 0400 51 76 0.00 3 298 0
2015 7 24 0500 53 70 0.00 3 313 0
2015 7 24 0600 59 60 0.00 5 132 32
2015 7 24 0700 63 54 0.00 7 148 0
2015 7 24 0800 67 48 0.00 10 121 0
2015 7 24 0900 69 39 0.00 12 146 18
2015 7 24 1000 73 32 0.00 16 153 0
2015 7 24 1100 72 34 0.00 14 169 20
2015 7 24 1200 75 32 0.00 18 143 15
2015 7 24 1300 75 33 0.00 18 145 0
2015 7 24 1400 75 35 0.00 17 164 0
2015 7 24 1500 73 40 0.00 15 209 0
2015 7 24 1600 71 44 0.00 14 156 0
2015 7 24 1700 65 55 0.00 12 152 0
2015 7 24 1800 63 58 0.00 10 174 0
2015 7 24 1900 60 64 0.00 7 185 0
2015 7 24 2000 59 66 0.00 7 126 0
2015 7 24 2100 56 73 0.00 5 200 0
2015 7 24 2200 57 71 0.00 3 281 0
2015 7 24 2300 55 75 0.00 4 164 0
2015 7 25 0000 55 77 0.00 3 168 0
2015 7 25 0100 56 78 0.00 3 43 0
2015 7 25 0200 55 82 0.00 5 111 0
2015 7 25 0300 54 88 0.00 6 145 0
2015 7 25 0400 54 88 0.00 7 152 0
2015 7 25 0500 54 86 0.00 7 165 0

2015 7 25 0600 54 86 0.00 6 157 78
2015 7 25 0700 58 74 0.00 10 152 56
2015 7 25 0800 58 66 0.00 16 143 72
2015 7 25 0900 59 61 0.00 15 135 67
2015 7 25 1000 59 58 0.00 15 154 70
2015 7 25 1100 59 57 0.00 11 172 73
2015 7 25 1200 59 56 0.00 16 142 70
2015 7 25 1300 61 53 0.00 14 162 55
2015 7 25 1400 60 54 0.00 15 146 38
2015 7 25 1500 59 48 0.00 15 161 22
2015 7 25 1600 60 47 0.00 11 190 0
2015 7 25 1700 58 52 0.00 11 159 0
2015 7 25 1800 54 60 0.00 10 178 0
2015 7 25 1900 53 62 0.00 7 162 0
2015 7 25 2000 51 63 0.00 8 336 0
2015 7 25 2100 49 70 0.00 5 209 0
2015 7 25 2200 49 72 0.00 8 139 0
2015 7 25 2300 49 70 0.00 8 143 0
2015 7 26 0000 50 67 0.00 6 83 0
2015 7 26 0100 48 73 0.00 7 150 0
2015 7 26 0200 47 78 0.00 4 142 0
2015 7 26 0300 47 78 0.00 3 118 0
2015 7 26 0400 47 75 0.00 6 162 0
2015 7 26 0500 49 72 0.00 6 254 0
2015 7 26 0600 52 65 0.00 6 141 21
2015 7 26 0700 57 57 0.00 8 129 10
2015 7 26 0800 56 60 0.00 13 152 28
2015 7 26 0900 62 50 0.00 14 151 0
2015 7 26 1000 63 45 0.00 18 145 0
2015 7 26 1100 66 42 0.00 17 167 8
2015 7 26 1200 64 42 0.00 19 190 0
2015 7 26 1300 67 39 0.00 18 185 0
2015 7 26 1400 65 39 0.00 18 178 0
2015 7 26 1500 64 38 0.00 16 146 0
2015 7 26 1600 63 39 0.00 15 140 0
2015 7 26 1700 55 61 0.00 16 152 0
2015 7 26 1800 52 67 0.00 11 178 0
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2015 7 27 1100 63 44 0.00 18 153 24
2015 7 27 1200 67 38 0.00 20 183 17
2015 7 27 1300 69 35 0.00 18 155 0
2015 7 27 1400 67 39 0.00 24 141 0
2015 7 27 1500 66 40 0.00 21 143 0
2015 7 27 1600 65 41 0.00 17 161 0
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2015 7 28 0700 60 51 0.00 7 172 0
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2015 7 29 0200 56 62 0.00 3 325 0
2015 7 29 0300 56 65 0.00 2 310 0
2015 7 29 0400 57 60 0.00 3 357 0
2015 7 29 0500 57 60 0.00 2 330 0
2015 7 29 0600 65 45 0.00 3 128 35
2015 7 29 0700 71 34 0.00 5 145 0
2015 7 29 0800 74 24 0.00 8 185 0
2015 7 29 0900 77 23 0.00 10 194 0
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2015 7 29 1200 84 15 0.00 15 145 0
2015 7 29 1300 85 14 0.00 15 142 0
2015 7 29 1400 86 13 0.00 13 177 0
2015 7 29 1500 86 14 0.00 20 147 0
2015 7 29 1600 85 13 0.00 11 170 0
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2015 7 29 1800 76 19 0.00 10 186 0
2015 7 29 1900 73 22 0.00 6 158 0
2015 7 29 2000 70 25 0.00 3 88 0
2015 7 29 2100 69 26 0.00 3 310 0
2015 7 29 2200 67 28 0.00 3 317 0
2015 7 29 2300 66 29 0.00 2 328 0
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2015 7 30 0300 65 33 0.00 2 319 0
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2015 7 30 1400 93 12 0.00 11 127 0
2015 7 30 1500 92 12 0.00 13 130 0
2015 7 30 1600 91 13 0.00 11 142 0
2015 7 30 1700 86 18 0.00 11 168 0
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2015 7 30 2100 75 22 0.00 3 317 0
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2015 7 31 0500 69 23 0.00 3 334 0
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2015 7 31 0700 83 15 0.00 4 142 0
2015 7 31 0800 86 12 0.00 7 152 0
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2015 8 1 0300 66 22 0.00 3 319 0
2015 8 1 0400 65 23 0.00 3 317 0
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2015 8 1 0600 74 22 0.00 4 128 29
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2015 8 1 0800 83 19 0.00 7 161 0
2015 8 1 0900 86 20 0.00 12 135 0
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2015 8 1 1500 95 7 0.00 15 149 0
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2015 8 2 0300 67 20 0.00 4 352 0
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2015 8 2 0700 79 14 0.00 5 150 0
2015 8 2 0800 82 14 0.00 7 186 0
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2015 8 2 1000 90 12 0.00 11 152 0
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2015 8 2 1200 94 7 0.00 15 153 0
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2015 8 2 2000 73 34 0.00 8 200 0
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2015 8 2 2300 70 37 0.00 5 198 0
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2015 8 3 0400 65 39 0.00 3 276 0
2015 8 3 0500 65 40 0.00 2 319 0
2015 8 3 0600 69 34 0.00 3 84 28
2015 8 3 0700 72 34 0.00 7 151 26
2015 8 3 0800 77 29 0.00 9 124 7
2015 8 3 0900 75 31 0.00 10 158 41
2015 8 3 1000 72 33 0.00 9 147 72
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2015 8 3 1200 73 32 0.00 9 143 67
2015 8 3 1300 73 33 0.00 8 155 75
2015 8 3 1400 74 34 0.00 6 136 72
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2015 8 3 1600 73 34 0.00 7 167 30
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2015 8 4 0300 57 67 0.00 3 268 0
2015 8 4 0400 57 67 0.00 2 316 0
2015 8 4 0500 58 65 0.00 2 152 0
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2015 8 4 0700 66 53 0.00 6 150 0
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2015 8 4 1400 78 18 0.00 16 148 0
2015 8 4 1500 76 21 0.00 17 152 0
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2015 8 4 2300 55 48 0.00 5 248 0
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2015 8 5 0900 69 39 0.00 12 136 0
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RAWS_ELEVATION: 3480
RAWS_UNITS: English

FOLIAR_MOISTURE_CONTENT: 65
CROWN_FIRE_METHOD: ScottReinhardt

Extreme Weather – Ignition Start Designation: US Forest Service

FARSITE INPUTS FILE VERSION 1.0
FARSITE_START_TIME: 07 29 1300
FARSITE_END_TIME: 08 02 1500
FARSITE_TIMESTEP: 120
FARSITE_DISTANCE_RES: 120
FARSITE_PERIMETER_RES: 120
FARSITE_MIN_IGNITION_VERTEX_DISTANCE: 15.0
FARSITE_SPOT_GRID_RESOLUTION: 30.0
FARSITE_SPOT_PROBABILITY: 0.05
FARSITE_SPOT_IGNITION_DELAY: 15
FARSITE_MINIMUM_SPOT_DISTANCE: 60
FARSITE_ACCELERATION_ON: 1
FARSITE_BURN_PERIODS: 5
07 29 1300 1700
07 30 1300 1700
07 31 1000 1400
08 01 1000 1500
08 02 1000 1500

FUEL_MOISTURES_DATA: 1
0 3 4 8 25 60

RAWS: 324
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2015 7 24 700 63 54 0 7 328 0
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2015 7 24 1000 73 32 0 16 333 0
2015 7 24 1100 72 34 0 14 349 20
2015 7 24 1200 75 32 0 18 323 15
2015 7 24 1300 75 33 0 18 325 0
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2015 7 25 1000 59 58 0 15 334 70
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2015 7 25 1200 59 56 0 16 322 70
2015 7 25 1300 61 53 0 14 342 55
2015 7 25 1400 60 54 0 15 326 38
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2015 7 25 2300 49 70 0 8 323 0
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2015 7 29 1900 73 22 0 6 338 0
2015 7 29 2000 70 25 0 3 268 0
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2015 7 29 2200 67 28 0 3 137 0
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2015 7 30 200 64 33 0 2 131 0
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2015 7 30 2100 75 22 0 3 137 0
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2015 8 3 2200 62 49 0 5 355 0
2015 8 3 2300 61 55 0 5 280 0
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2015 8 4 100 60 61 0 3 93 0
2015 8 4 200 57 66 0 4 20 0
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2015 8 4 900 72 39 0 17 316 0
2015 8 4 1000 76 35 0 17 333 0
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2015 8 4 1200 77 21 0 20 359 0
2015 8 4 1300 79 18 0 16 318 0
2015 8 4 1400 78 18 0 16 328 0
2015 8 4 1500 76 21 0 17 332 0
2015 8 4 1600 74 24 0 15 322 0
2015 8 4 1700 68 30 0 16 355 0
2015 8 4 1800 64 39 0 10 7 0
2015 8 4 1900 61 43 0 8 334 0
2015 8 4 2000 58 47 0 7 138 0
2015 8 4 2100 57 48 0 4 254 0
2015 8 4 2200 57 46 0 6 224 0
2015 8 4 2300 55 48 0 5 68 0
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2015 8 5 200 54 50 0 6 238 0
2015 8 5 300 53 56 0 4 134 0
2015 8 5 400 53 63 0 3 152 0
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2015 8 5 700 62 51 0 8 331 0
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2015 8 5 1400 69 34 0 18 357 0
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2015 8 5 2000 55 66 0 13 304 0
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2015 8 5 2300 50 78 0 8 332 0
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2015 8 6 700 58 57 0 6 317 0
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2015 8 6 900 64 49 0 14 323 0
2015 8 6 1000 67 41 0 13 332 0
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2015 8 6 1800 62 51 0 7 332 0
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RAWS_ELEVATION: 3480
RAWS_UNITS: English

FOLIAR_MOISTURE_CONTENT: 65
CROWN_FIRE_METHOD: ScottReinhardt

Randig Weather Simulations

Jolly Mountain Weather – NNE Wind Direction

NUMFIRES: 8000
DURATION: 1100
RESOLUTION: 90
SPOTPROBABILITY: 0.05
OUTPUTFIREPERIMS: 1

FUEL_MOISTURES_DATA: 1
0 4 4 8 45 68

CONDITIONING_PERIOD_START: 08 11 1000
CONDITIONING_PERIOD_END: 08 15 1700
RAWS_ELEVATION: 3480
RAWS_UNITS: English

RAWS: 599

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2017 8 8 0200 68 38 0.00 0 352 0
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2017 8 8 0400 67 38 0.00 0 21 0
2017 8 8 0500 67 37 0.00 0 23 0
2017 8 8 0600 68 38 0.00 0 23 0
2017 8 8 0700 71 38 0.00 0 155 36
2017 8 8 0800 77 33 0.00 1 165 6
2017 8 8 0900 81 25 0.00 3 169 3
2017 8 8 1000 86 20 0.00 3 227 1
2017 8 8 1100 88 18 0.00 5 186 0
2017 8 8 1200 90 18 0.00 6 187 0
2017 8 8 1300 92 17 0.00 8 154 0
2017 8 8 1400 92 15 0.00 5 148 0

2017 8 8 1500 93 15 0.00 7 173 0
2017 8 8 1600 91 15 0.00 6 168 0
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2017 8 8 1800 84 22 0.00 1 203 0
2017 8 8 1900 80 31 0.00 2 194 0
2017 8 8 2000 76 37 0.00 2 233 0
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2017 8 8 2200 73 42 0.00 1 349 0
2017 8 8 2300 72 42 0.00 0 341 0
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2017 8 9 0700 76 29 0.00 1 127 39
2017 8 9 0800 81 27 0.00 1 171 1
2017 8 9 0900 85 24 0.00 2 154 0
2017 8 9 1000 88 21 0.00 3 194 0
2017 8 9 1100 90 20 0.00 6 180 0
2017 8 9 1200 93 15 0.00 8 172 0
2017 8 9 1300 93 13 0.00 8 157 0
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2017 8 9 1700 90 18 0.00 5 195 0
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2017 8 10 0200 72 31 0.00 2 335 0
2017 8 10 0300 71 30 0.00 0 359 0
2017 8 10 0400 71 29 0.00 0 34 0
2017 8 10 0500 71 27 0.00 0 23 0
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2017 8 10 0700 76 28 0.00 0 129 36
2017 8 10 0800 81 23 0.00 2 145 0
2017 8 10 0900 85 18 0.00 3 207 0
2017 8 10 1000 89 15 0.00 4 213 0
2017 8 10 1100 91 15 0.00 5 199 0
2017 8 10 1200 94 13 0.00 7 186 0
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2017 8 10 1400 95 11 0.00 7 177 0
2017 8 10 1500 95 11 0.00 6 206 0
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2017 8 10 2200 76 24 0.00 1 337 0
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2017 8 11 0100 73 26 0.00 1 349 0
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2017 8 12 1200 74 49 0.00 3 211 40
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2017 8 13 0300 54 85 0.01 3 326 100
2017 8 13 0400 55 79 0.00 1 157 0
2017 8 13 0500 55 80 0.00 0 242 0
2017 8 13 0600 54 85 0.00 2 174 0
2017 8 13 0700 55 85 0.00 1 167 57
2017 8 13 0800 60 76 0.00 5 173 20
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2017 8 13 1000 64 63 0.00 6 183 4
2017 8 13 1100 68 45 0.00 4 184 28
2017 8 13 1200 66 47 0.00 6 169 28
2017 8 13 1300 69 41 0.00 9 183 0
2017 8 13 1400 69 38 0.00 7 196 0
2017 8 13 1500 70 35 0.00 7 177 0
2017 8 13 1600 67 38 0.00 7 187 0
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2017 8 13 2300 52 71 0.00 1 34 0
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2017 8 14 0200 50 74 0.00 0 9 0
2017 8 14 0300 48 76 0.00 1 345 0
2017 8 14 0400 48 76 0.00 0 34 0
2017 8 14 0500 47 76 0.00 0 349 0
2017 8 14 0600 48 75 0.00 0 82 0
2017 8 14 0700 53 62 0.00 1 127 20
2017 8 14 0800 57 53 0.00 3 177 0
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2017 8 14 1200 69 30 0.00 6 160 0
2017 8 14 1300 71 27 0.00 6 164 0
2017 8 14 1400 71 27 0.00 8 172 0
2017 8 14 1500 71 30 0.00 7 175 0
2017 8 14 1600 71 34 0.00 7 189 0
2017 8 14 1700 66 42 0.00 6 185 0
2017 8 14 1800 60 55 0.00 3 201 0
2017 8 14 2000 55 69 0.00 0 240 0
2017 8 14 2100 53 74 0.00 0 187 0
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2017 8 14 2300 51 79 0.00 0 75 0
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2017 8 15 1200 72 30 0.00 7 173 0
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2017 8 15 1700 72 28 0.00 3 198 0
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2017 8 16 0500 52 46 0.00 2 341 0
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2017 8 16 0700 61 40 0.00 1 163 6
2017 8 16 0800 65 37 0.00 2 170 0
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2017 8 17 1700 74 37 0.00 5 196 0
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2017 8 19 1600 71 35 0.00 8 168 0
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2017 8 19 2300 53 65 0.00 2 349 0
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2017 8 20 0200 52 60 0.00 1 352 0
2017 8 20 0300 51 62 0.00 1 344 0
2017 8 20 0400 51 60 0.00 2 349 0
2017 8 20 0500 51 58 0.00 0 333 0
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2017 8 20 0700 54 58 0.00 1 71 26

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2017 8 22 1300 85 19 0.00 6 173 0
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2017 8 26 1600 79 20 0.00 3 202 9
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2017 8 28 2100 74 26 0.00 1 327 0
2017 8 28 2200 72 29 0.00 2 325 0
2017 8 28 2300 72 28 0.00 1 339 0
2017 8 29 0000 72 28 0.00 0 328 0
2017 8 29 0100 71 29 0.00 0 337 0
2017 8 29 0200 72 28 0.00 0 23 0
2017 8 29 0300 72 27 0.00 1 350 0
2017 8 29 0400 71 27 0.00 0 332 0
2017 8 29 0500 71 27 0.00 0 308 0
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2017 8 29 0700 74 25 0.00 0 94 12
2017 8 29 0800 77 26 0.00 1 139 6
2017 8 29 0900 82 22 0.00 2 162 4
2017 8 29 1000 85 18 0.00 3 218 0
2017 8 29 1100 88 19 0.00 4 204 0
2017 8 29 1200 90 18 0.00 4 213 0
2017 8 29 1300 92 14 0.00 6 182 0
2017 8 29 1400 94 10 0.00 6 193 0
2017 8 29 1500 92 13 0.00 5 204 0
2017 8 29 1600 89 16 0.00 5 183 0
2017 8 29 1700 85 23 0.00 5 185 0
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2017 8 29 1900 76 31 0.00 0 13 0
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2017 8 30 0100 68 39 0.00 1 258 0
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2017 8 30 0900 67 47 0.00 3 183 19
2017 8 30 1000 72 39 0.00 4 174 17
2017 8 30 1100 77 32 0.00 6 171 2
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2017 8 30 1300 81 17 0.00 7 180 0
2017 8 30 1400 79 20 0.00 7 170 0
2017 8 30 1500 75 24 0.00 5 188 1
2017 8 30 1600 74 28 0.00 3 194 0
2017 8 30 1700 69 36 0.00 3 202 0
2017 8 30 1800 66 40 0.00 3 178 0
2017 8 30 1900 63 47 0.00 3 194 0
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2017 8 31 0400 54 71 0.00 2 214 0
2017 8 31 0500 54 71 0.00 1 183 0
2017 8 31 0600 56 68 0.00 1 342 0
2017 8 31 0700 60 60 0.00 1 113 4
2017 8 31 0800 64 56 0.00 3 174 0
2017 8 31 0900 67 50 0.00 4 170 0
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2017 8 31 1200 75 40 0.00 7 153 0
2017 8 31 1300 76 37 0.00 7 175 0
2017 8 31 1400 77 36 0.00 5 195 0
2017 8 31 1500 75 38 0.00 5 188 3
2017 8 31 1600 75 35 0.00 4 179 0
2017 8 31 1700 73 38 0.00 3 200 0
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2017 9 1 0200 59 47 0.00 1 356 0
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2017 9 1 0400 59 39 0.00 0 336 0
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2017 9 1 0700 68 23 0.00 0 94 0
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2017 9 1 1100 82 15 0.00 5 196 0
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2017 9 1 1300 87 12 0.00 6 181 0
2017 9 1 1400 87 14 0.00 6 198 0
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2017 9 1 2000 73 31 0.00 0 229 0
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2017 9 1 2200 70 34 0.00 0 44 0
2017 9 1 2300 70 35 0.00 2 343 0

FOLIAR_MOISTURE_CONTENT: 65
CROWN_FIRE_METHOD: ScottReinhardt
WIND_SPEED: 6
WIND_DIRECTION: 210
SPREAD_DIRECTION_FROM_MAX: 0
GRIDDED_WINDS_GENERATE: Yes
GRIDDED_WINDS_RESOLUTION: 180

Jolly Mountain Weather – SSW Wind Direction

NUMFIRES: 8000
DURATION: 1100
RESOLUTION: 90
SPOTPROBABILITY: 0.05
OUTPUTFIREPERIMS: 1

FUEL_MOISTURES_DATA: 1
0 4 4 8 45 68

CONDITIONING_PERIOD_START: 08 11 1000
CONDITIONING_PERIOD_END: 08 15 1700
RAWS_ELEVATION: 3480
RAWS_UNITS: English

RAWS: 599
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2017 8 8 100 68 36 0 0 146 0
2017 8 8 200 68 38 0 0 172 0
2017 8 8 300 67 38 0 0 167 0
2017 8 8 400 67 38 0 0 201 0
2017 8 8 500 67 37 0 0 203 0
2017 8 8 600 68 38 0 0 203 0
2017 8 8 700 71 38 0 0 335 36
2017 8 8 800 77 33 0 1 345 6
2017 8 8 900 81 25 0 3 349 3
2017 8 8 1000 86 20 0 3 47 1
2017 8 8 1100 88 18 0 5 6 0
2017 8 8 1200 90 18 0 6 7 0
2017 8 8 1300 92 17 0 8 334 0
2017 8 8 1400 92 15 0 5 328 0
2017 8 8 1500 93 15 0 7 353 0
2017 8 8 1600 91 15 0 6 348 0
2017 8 8 1700 90 16 0 4 4 0
2017 8 8 1800 84 22 0 1 23 0
2017 8 8 1900 80 31 0 2 14 0
2017 8 8 2000 76 37 0 2 53 0
2017 8 8 2100 74 42 0 0 184 0
2017 8 8 2200 73 42 0 1 169 0
2017 8 8 2300 72 42 0 0 161 0
2017 8 9 0 72 43 0 0 154 0
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2017 8 9 200 71 40 0 0 222 0
2017 8 9 300 71 36 0 1 159 0
2017 8 9 400 72 33 0 1 159 0
2017 8 9 500 72 31 0 0 178 0
2017 8 9 600 73 31 0 0 148 0
2017 8 9 700 76 29 0 1 307 39
2017 8 9 800 81 27 0 1 351 1
2017 8 9 900 85 24 0 2 334 0
2017 8 9 1000 88 21 0 3 14 0
2017 8 9 1100 90 20 0 6 360 0
2017 8 9 1200 93 15 0 8 352 0
2017 8 9 1300 93 13 0 8 337 0
2017 8 9 1400 94 13 0 7 329 0
2017 8 9 1500 95 13 0 4 22 0
2017 8 9 1600 92 14 0 5 11 0
2017 8 9 1700 90 18 0 5 15 0
2017 8 9 1800 86 21 0 3 6 0
2017 8 9 1900 82 26 0 3 17 0
2017 8 9 2000 78 28 0 1 81 0
2017 8 9 2100 76 29 0 1 183 0
2017 8 9 2200 75 30 0 0 227 0
2017 8 9 2300 73 32 0 0 165 0
2017 8 10 0 72 33 0 0 161 0
2017 8 10 100 71 32 0 0 64 0
2017 8 10 200 72 31 0 2 155 0
2017 8 10 300 71 30 0 0 179 0
2017 8 10 400 71 29 0 0 214 0
2017 8 10 500 71 27 0 0 203 0

2017 8 10 600 71 29 0 0 180 0
2017 8 10 700 76 28 0 0 309 36
2017 8 10 800 81 23 0 2 325 0
2017 8 10 900 85 18 0 3 27 0
2017 8 10 1000 89 15 0 4 33 0
2017 8 10 1100 91 15 0 5 19 0
2017 8 10 1200 94 13 0 7 6 0
2017 8 10 1300 95 11 0 6 13 0
2017 8 10 1400 95 11 0 7 357 0
2017 8 10 1500 95 11 0 6 26 0
2017 8 10 1600 94 12 0 7 14 0
2017 8 10 1700 91 12 0 6 7 0
2017 8 10 1800 87 15 0 2 5 0
2017 8 10 1900 82 20 0 2 33 0
2017 8 10 2000 79 23 0 0 123 0
2017 8 10 2100 78 25 0 0 164 0
2017 8 10 2200 76 24 0 1 157 0
2017 8 10 2300 74 26 0 0 132 0
2017 8 11 0 74 26 0 0 176 0
2017 8 11 100 73 26 0 1 169 0
2017 8 11 200 72 26 0 0 177 0
2017 8 11 300 72 29 0 0 159 0
2017 8 11 400 71 28 0 0 172 0
2017 8 11 500 71 27 0 0 186 0
2017 8 11 600 71 27 0 0 79 0
2017 8 11 700 76 27 0 0 298 33
2017 8 11 800 81 26 0 1 338 0
2017 8 11 900 84 19 0 3 32 0
2017 8 11 1000 89 16 0 4 21 0
2017 8 11 1100 91 16 0 5 7 0
2017 8 11 1200 93 15 0 5 15 0
2017 8 11 1300 94 13 0 6 10 0
2017 8 11 1400 94 12 0 7 6 0
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2017 8 11 1600 93 15 0 5 8 0
2017 8 11 1700 90 19 0 2 281 0
2017 8 11 1800 83 34 0 4 20 0
2017 8 11 1900 78 43 0 4 20 0
2017 8 11 2000 73 53 0 3 90 0
2017 8 11 2100 70 62 0 3 102 0
2017 8 11 2200 68 65 0 0 145 0
2017 8 11 2300 65 71 0 2 90 0
2017 8 12 0 64 73 0 0 183 0
2017 8 12 100 63 72 0 0 200 0
2017 8 12 200 66 65 0 2 190 0
2017 8 12 300 66 61 0 1 104 0
2017 8 12 400 63 68 0 1 62 0
2017 8 12 500 64 67 0 2 174 0
2017 8 12 600 65 64 0 0 191 0
2017 8 12 700 66 62 0 2 333 53
2017 8 12 800 65 62 0 3 56 84
2017 8 12 900 64 63 0 2 71 87
2017 8 12 1000 70 52 0 2 281 65
2017 8 12 1100 72 49 0 3 338 75
2017 8 12 1200 74 49 0 3 31 40
2017 8 12 1300 77 42 0 5 15 7
2017 8 12 1400 81 35 0 7 352 0
2017 8 12 1500 79 31 0 6 1 0
2017 8 12 1600 81 31 0 6 356 9
2017 8 12 1700 75 35 0 4 6 0
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2017 8 13 300 54 85 0.01 3 146 100

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2017 8 13 700 55 85 0 1 347 57
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2017 8 13 900 63 69 0 5 5 2
2017 8 13 1000 64 63 0 6 3 4
2017 8 13 1100 68 45 0 4 4 28
2017 8 13 1200 66 47 0 6 349 28
2017 8 13 1300 69 41 0 9 3 0
2017 8 13 1400 69 38 0 7 16 0
2017 8 13 1500 70 35 0 7 357 0
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2017 8 13 1700 64 43 0 6 14 0
2017 8 13 1800 60 50 0 3 32 0
2017 8 13 1900 57 57 0 2 20 0
2017 8 13 2000 54 65 0 1 245 0
2017 8 13 2100 53 68 0 1 229 0
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2017 8 13 2300 52 71 0 1 214 0
2017 8 14 0 51 73 0 0 152 0
2017 8 14 100 51 73 0 0 165 0
2017 8 14 200 50 74 0 0 189 0
2017 8 14 300 48 76 0 1 165 0
2017 8 14 400 48 76 0 0 214 0
2017 8 14 500 47 76 0 0 169 0
2017 8 14 600 48 75 0 0 262 0
2017 8 14 700 53 62 0 1 307 20
2017 8 14 800 57 53 0 3 357 0
2017 8 14 900 59 50 0 4 354 0
2017 8 14 1000 64 43 0 4 24 0
2017 8 14 1100 66 38 0 4 34 0
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2017 8 14 1300 71 27 0 6 344 0
2017 8 14 1400 71 27 0 8 352 0
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2017 8 14 1600 71 34 0 7 9 0
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2017 8 15 0 50 80 0 0 181 0
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2017 8 15 1600 76 24 0 5 20 0
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2017 8 15 2100 59 47 0 1 62 0
2017 8 15 2200 57 50 0 0 86 0
2017 8 15 2300 56 50 0 0 154 0
2017 8 16 0 55 50 0 0 154 0
2017 8 16 100 54 49 0 1 181 0
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2017 8 16 400 53 44 0 1 193 0
2017 8 16 500 52 46 0 2 161 0
2017 8 16 600 54 45 0 0 184 0
2017 8 16 700 61 40 0 1 343 6
2017 8 16 800 65 37 0 2 350 0
2017 8 16 900 68 36 0 4 353 0
2017 8 16 1000 74 32 0 5 336 0
2017 8 16 1100 77 31 0 7 345 0
2017 8 16 1200 78 31 0 8 347 0
2017 8 16 1300 81 29 0 8 5 0
2017 8 16 1400 81 30 0 6 11 0
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2017 8 16 1700 73 41 0 5 333 0
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2017 8 16 1900 65 53 0 2 284 0
2017 8 16 2000 61 60 0 1 209 0
2017 8 16 2100 59 63 0 1 26 0
2017 8 16 2200 59 62 0 1 164 0
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2017 8 17 400 53 76 0 1 174 0
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2017 8 17 2300 56 72 0 2 173 0
2017 8 18 0 55 73 0 1 202 0
2017 8 18 100 56 67 0 0 243 0
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2017 8 20 1500 74 36 0 6 2 0
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2017 8 21 500 58 58 0 0 183 0
2017 8 21 600 59 56 0 0 195 0
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2017 8 21 900 69 39 0 2 2 20
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2017 8 21 1100 76 32 0 3 57 0
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2017 8 21 1300 80 25 0 6 29 0
2017 8 21 1400 81 23 0 6 27 0
2017 8 21 1500 81 23 0 6 15 0
2017 8 21 1600 79 25 0 6 346 0
2017 8 21 1700 78 25 0 5 342 0
2017 8 21 1800 75 27 0 4 14 0
2017 8 21 1900 73 27 0 1 62 0
2017 8 21 2000 71 29 0 1 166 0
2017 8 21 2100 69 32 0 1 160 0
2017 8 21 2200 67 33 0 0 180 0

2017 8 21 2300 67 33 0 1 150 0
2017 8 22 0 66 35 0 1 165 0
2017 8 22 100 66 34 0 1 186 0
2017 8 22 200 65 35 0 1 167 0
2017 8 22 300 65 34 0 0 203 0
2017 8 22 400 65 33 0 0 232 0
2017 8 22 500 65 33 0 0 141 0
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2017 8 22 1000 81 24 0 4 25 0
2017 8 22 1100 82 22 0 4 23 0
2017 8 22 1200 84 19 0 6 15 0
2017 8 22 1300 85 19 0 6 353 0
2017 8 22 1400 86 20 0 5 358 0
2017 8 22 1500 85 20 0 6 346 0
2017 8 22 1600 84 21 0 5 14 0
2017 8 22 1700 82 28 0 4 14 0
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2017 8 22 1900 72 41 0 1 314 0
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2017 8 23 200 60 64 0 0 114 0
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2017 8 29 1200 90 18 0 4 33 0
2017 8 29 1300 92 14 0 6 2 0
2017 8 29 1400 94 10 0 6 13 0
2017 8 29 1500 92 13 0 5 24 0
2017 8 29 1600 89 16 0 5 3 0
2017 8 29 1700 85 23 0 5 5 0
2017 8 29 1800 79 28 0 3 356 0
2017 8 29 1900 76 31 0 0 193 0
2017 8 29 2000 74 33 0 1 94 0
2017 8 29 2100 72 34 0 2 158 0
2017 8 29 2200 70 35 0 2 183 0
2017 8 29 2300 69 37 0 1 174 0
2017 8 30 0 68 38 0 1 107 0
2017 8 30 100 68 39 0 1 78 0
2017 8 30 200 64 44 0 1 105 0
2017 8 30 300 65 42 0 1 142 0
2017 8 30 400 64 44 0 1 72 0
2017 8 30 500 64 47 0 1 195 0
2017 8 30 600 64 42 0 1 103 0
2017 8 30 700 65 40 0 3 63 46
2017 8 30 800 68 38 0 2 23 27
2017 8 30 900 67 47 0 3 3 19
2017 8 30 1000 72 39 0 4 354 17
2017 8 30 1100 77 32 0 6 351 2
2017 8 30 1200 79 25 0 9 352 0
2017 8 30 1300 81 17 0 7 360 0
2017 8 30 1400 79 20 0 7 350 0
2017 8 30 1500 75 24 0 5 8 1
2017 8 30 1600 74 28 0 3 14 0

2017 8 30 1700 69 36 0 3 22 0
2017 8 30 1800 66 40 0 3 358 0
2017 8 30 1900 63 47 0 3 14 0
2017 8 30 2000 60 55 0 1 20 0
2017 8 30 2100 59 57 0 1 102 0
2017 8 30 2200 58 60 0 0 181 0
2017 8 30 2300 57 61 0 0 73 0
2017 8 31 0 56 64 0 0 19 0
2017 8 31 100 55 66 0 0 55 0
2017 8 31 200 55 68 0 0 5 0
2017 8 31 300 53 70 0 1 180 0
2017 8 31 400 54 71 0 2 34 0
2017 8 31 500 54 71 0 1 3 0
2017 8 31 600 56 68 0 1 162 0
2017 8 31 700 60 60 0 1 293 4
2017 8 31 800 64 56 0 3 354 0
2017 8 31 900 67 50 0 4 350 0
2017 8 31 1000 71 46 0 5 355 0
2017 8 31 1100 72 44 0 8 351 0
2017 8 31 1200 75 40 0 7 333 0
2017 8 31 1300 76 37 0 7 355 0
2017 8 31 1400 77 36 0 5 15 0
2017 8 31 1500 75 38 0 5 8 3
2017 8 31 1600 75 35 0 4 359 0
2017 8 31 1700 73 38 0 3 20 0
2017 8 31 1800 68 46 0 4 359 0
2017 8 31 1900 65 50 0 3 2 0
2017 8 31 2000 63 52 0 0 322 0
2017 8 31 2100 62 53 0 0 175 0
2017 8 31 2200 60 58 0 0 160 0
2017 8 31 2300 59 55 0 0 191 0
2017 9 1 0 59 47 0 0 200 0
2017 9 1 100 59 46 0 0 125 0
2017 9 1 200 59 47 0 1 176 0
2017 9 1 300 58 41 0 1 162 0
2017 9 1 400 59 39 0 0 156 0
2017 9 1 500 59 35 0 0 130 0
2017 9 1 600 60 33 0 1 184 0
2017 9 1 700 68 23 0 0 274 0
2017 9 1 800 73 19 0 2 345 0
2017 9 1 900 76 16 0 2 15 0
2017 9 1 1000 79 16 0 4 354 0
2017 9 1 1100 82 15 0 5 16 0
2017 9 1 1200 84 11 0 6 15 0
2017 9 1 1300 87 12 0 6 1 0
2017 9 1 1400 87 14 0 6 18 0
2017 9 1 1500 87 15 0 4 7 0
2017 9 1 1600 85 17 0 4 18 0
2017 9 1 1700 82 19 0 3 22 0
2017 9 1 1800 78 23 0 2 24 0
2017 9 1 1900 75 29 0 1 275 0
2017 9 1 2000 73 31 0 0 49 0
2017 9 1 2100 72 33 0 1 172 0
2017 9 1 2200 70 34 0 0 224 0
2017 9 1 2300 70 35 0 2 163 0

FOLIAR_MOISTURE_CONTENT: 65
CROWN_FIRE_METHOD: ScottReinhardt
WIND_SPEED: 6
WIND_DIRECTION: 30
SPREAD_DIRECTION_FROM_MAX: 0
GRIDDED_WINDS_GENERATE: Yes
GRIDDED_WINDS_RESOLUTION: 180

Extreme Weather – NNE Wind Direction

NUMFIRES: 8000
DURATION: 1100
RESOLUTION: 90
SPOTPROBABILITY: 0.05
OUTPUTFIREPERIMS: 1

FUEL_MOISTURES_DATA: 1
0 3 4 8 25 60

CONDITIONING_PERIOD_START: 07 29 1300
CONDITIONING_PERIOD_END: 08 02 1500
RAWS_ELEVATION: 3480
RAWS_UNITS: English

RAWS: 324
2015 7 24 0000 52 71 0.00 3 312 0
2015 7 24 0100 52 73 0.00 3 333 0
2015 7 24 0200 51 73 0.00 4 290 0
2015 7 24 0300 51 77 0.00 3 20 0
2015 7 24 0400 51 76 0.00 3 298 0
2015 7 24 0500 53 70 0.00 3 313 0
2015 7 24 0600 59 60 0.00 5 132 32
2015 7 24 0700 63 54 0.00 7 148 0
2015 7 24 0800 67 48 0.00 10 121 0
2015 7 24 0900 69 39 0.00 12 146 18
2015 7 24 1000 73 32 0.00 16 153 0
2015 7 24 1100 72 34 0.00 14 169 20
2015 7 24 1200 75 32 0.00 18 143 15
2015 7 24 1300 75 33 0.00 18 145 0
2015 7 24 1400 75 35 0.00 17 164 0
2015 7 24 1500 73 40 0.00 15 209 0
2015 7 24 1600 71 44 0.00 14 156 0
2015 7 24 1700 65 55 0.00 12 152 0
2015 7 24 1800 63 58 0.00 10 174 0
2015 7 24 1900 60 64 0.00 7 185 0
2015 7 24 2000 59 66 0.00 7 126 0
2015 7 24 2100 56 73 0.00 5 200 0
2015 7 24 2200 57 71 0.00 3 281 0
2015 7 24 2300 55 75 0.00 4 164 0
2015 7 25 0000 55 77 0.00 3 168 0
2015 7 25 0100 56 78 0.00 3 43 0
2015 7 25 0200 55 82 0.00 5 111 0
2015 7 25 0300 54 88 0.00 6 145 0
2015 7 25 0400 54 88 0.00 7 152 0
2015 7 25 0500 54 86 0.00 7 165 0
2015 7 25 0600 54 86 0.00 6 157 78
2015 7 25 0700 58 74 0.00 10 152 56
2015 7 25 0800 58 66 0.00 16 143 72
2015 7 25 0900 59 61 0.00 15 135 67
2015 7 25 1000 59 58 0.00 15 154 70
2015 7 25 1100 59 57 0.00 11 172 73

2015 7 25 1200 59 56 0.00 16 142 70
2015 7 25 1300 61 53 0.00 14 162 55
2015 7 25 1400 60 54 0.00 15 146 38
2015 7 25 1500 59 48 0.00 15 161 22
2015 7 25 1600 60 47 0.00 11 190 0
2015 7 25 1700 58 52 0.00 11 159 0
2015 7 25 1800 54 60 0.00 10 178 0
2015 7 25 1900 53 62 0.00 7 162 0
2015 7 25 2000 51 63 0.00 8 336 0
2015 7 25 2100 49 70 0.00 5 209 0
2015 7 25 2200 49 72 0.00 8 139 0
2015 7 25 2300 49 70 0.00 8 143 0
2015 7 26 0000 50 67 0.00 6 83 0
2015 7 26 0100 48 73 0.00 7 150 0
2015 7 26 0200 47 78 0.00 4 142 0
2015 7 26 0300 47 78 0.00 3 118 0
2015 7 26 0400 47 75 0.00 6 162 0
2015 7 26 0500 49 72 0.00 6 254 0
2015 7 26 0600 52 65 0.00 6 141 21
2015 7 26 0700 57 57 0.00 8 129 10
2015 7 26 0800 56 60 0.00 13 152 28
2015 7 26 0900 62 50 0.00 14 151 0
2015 7 26 1000 63 45 0.00 18 145 0
2015 7 26 1100 66 42 0.00 17 167 8
2015 7 26 1200 64 42 0.00 19 190 0
2015 7 26 1300 67 39 0.00 18 185 0
2015 7 26 1400 65 39 0.00 18 178 0
2015 7 26 1500 64 38 0.00 16 146 0
2015 7 26 1600 63 39 0.00 15 140 0
2015 7 26 1700 55 61 0.00 16 152 0
2015 7 26 1800 52 67 0.00 11 178 0
2015 7 26 1900 50 65 0.00 5 254 0
2015 7 26 2000 49 66 0.00 6 75 0
2015 7 26 2100 49 64 0.00 4 29 0
2015 7 26 2200 47 71 0.00 2 324 0
2015 7 26 2300 58 55 0.00 6 137 0
2015 7 27 0800 60 51 0.00 10 142 0
2015 7 27 0900 62 44 0.00 11 135 28
2015 7 27 1000 61 50 0.00 18 144 35
2015 7 27 1100 63 44 0.00 18 153 24
2015 7 27 1200 67 38 0.00 20 183 17
2015 7 27 1300 69 35 0.00 18 155 0
2015 7 27 1400 67 39 0.00 24 141 0
2015 7 27 1500 66 40 0.00 21 143 0
2015 7 27 1600 65 41 0.00 17 161 0
2015 7 27 1700 61 45 0.00 13 148 0
2015 7 27 1800 58 49 0.00 10 169 0
2015 7 27 1900 55 55 0.00 11 158 0
2015 7 27 2000 53 62 0.00 4 95 0
2015 7 27 2100 52 67 0.00 3 302 0
2015 7 27 2200 51 68 0.00 3 310 0
2015 7 27 2300 50 69 0.00 3 326 0
2015 7 28 0000 49 71 0.00 3 316 0
2015 7 28 0100 49 72 0.00 3 312 0
2015 7 28 0200 48 74 0.00 3 319 0
2015 7 28 0300 56 57 0.00 3 146 36
2015 7 28 0700 60 51 0.00 7 172 0
2015 7 28 0800 66 39 0.00 8 153 0
2015 7 28 0900 69 35 0.00 10 151 0
2015 7 28 1000 71 29 0.00 14 152 0
2015 7 28 1100 73 27 0.00 13 140 0
2015 7 28 1200 74 25 0.00 14 138 0
2015 7 28 1300 77 23 0.00 13 144 0
2015 7 28 1400 78 22 0.00 13 142 0
2015 7 28 1500 78 26 0.00 15 131 0
2015 7 28 1600 75 34 0.00 14 157 0
2015 7 28 1700 72 38 0.00 12 159 0
2015 7 28 1800 69 43 0.00 11 183 0
2015 7 28 1900 65 48 0.00 8 150 0
2015 7 28 2000 62 53 0.00 6 145 0

2015 7 28 2100 60 58 0.00 3 93 0
2015 7 28 2200 59 60 0.00 3 306 0
2015 7 28 2300 58 62 0.00 3 325 0
2015 7 29 0000 57 64 0.00 3 312 0
2015 7 29 0100 57 61 0.00 3 348 0
2015 7 29 0200 56 62 0.00 3 325 0
2015 7 29 0300 56 65 0.00 2 310 0
2015 7 29 0400 57 60 0.00 3 357 0
2015 7 29 0500 57 60 0.00 2 330 0
2015 7 29 0600 65 45 0.00 3 128 35
2015 7 29 0700 71 34 0.00 5 145 0
2015 7 29 0800 74 24 0.00 8 185 0
2015 7 29 0900 77 23 0.00 10 194 0
2015 7 29 1000 81 19 0.00 13 147 0
2015 7 29 1100 83 14 0.00 14 155 0
2015 7 29 1200 84 15 0.00 15 145 0
2015 7 29 1300 85 14 0.00 15 142 0
2015 7 29 1400 86 13 0.00 13 177 0
2015 7 29 1500 86 14 0.00 20 147 0
2015 7 29 1600 85 13 0.00 11 170 0
2015 7 29 1700 80 16 0.00 12 175 0
2015 7 29 1800 76 19 0.00 10 186 0
2015 7 29 1900 73 22 0.00 6 158 0
2015 7 29 2000 70 25 0.00 3 88 0
2015 7 29 2100 69 26 0.00 3 310 0
2015 7 29 2200 67 28 0.00 3 317 0
2015 7 29 2300 66 29 0.00 2 328 0
2015 7 30 0000 65 31 0.00 3 319 0
2015 7 30 0100 66 30 0.00 2 341 0
2015 7 30 0200 64 33 0.00 2 311 0
2015 7 30 0300 65 33 0.00 2 319 0
2015 7 30 0400 65 31 0.00 2 353 0
2015 7 30 0500 65 34 0.00 2 317 0
2015 7 30 0600 72 29 0.00 3 116 34
2015 7 30 0700 80 23 0.00 4 192 0
2015 7 30 0800 82 19 0.00 9 158 0
2015 7 30 0900 86 17 0.00 12 139 0
2015 7 30 1000 87 14 0.00 14 142 0
2015 7 30 1100 89 13 0.00 15 136 0
2015 7 30 1200 89 13 0.00 15 160 0
2015 7 30 1300 92 13 0.00 13 107 0
2015 7 30 1400 93 12 0.00 11 127 0
2015 7 30 1500 92 12 0.00 13 130 0
2015 7 30 1600 91 13 0.00 11 142 0
2015 7 30 1700 86 18 0.00 11 168 0
2015 7 30 1800 82 20 0.00 10 233 0
2015 7 30 1900 80 19 0.00 7 144 0
2015 7 30 2000 77 21 0.00 3 313 0
2015 7 30 2100 75 22 0.00 3 317 0
2015 7 30 2200 74 24 0.00 3 310 0
2015 7 30 2300 72 25 0.00 3 313 0
2015 7 31 0000 72 22 0.00 3 310 0
2015 7 31 0100 71 20 0.00 3 312 0
2015 7 31 0200 70 18 0.00 3 309 0
2015 7 31 0300 69 17 0.00 3 328 0
2015 7 31 0400 69 16 0.00 2 316 0
2015 7 31 0500 69 23 0.00 3 334 0
2015 7 31 0600 76 19 0.00 2 35 31
2015 7 31 0700 83 15 0.00 4 142 0
2015 7 31 0800 86 12 0.00 7 152 0
2015 7 31 0900 90 10 0.00 14 156 0
2015 7 31 1000 95 8 0.00 12 193 0
2015 7 31 1100 94 7 0.00 13 162 0
2015 7 31 1200 95 6 0.00 17 158 0
2015 7 31 1300 99 8 0.00 13 129 0
2015 7 31 1400 98 7 0.00 14 146 0
2015 7 31 1500 95 7 0.00 13 170 0
2015 7 31 1600 93 7 0.00 13 128 0
2015 7 31 1700 86 10 0.00 13 159 0
2015 7 31 1800 82 12 0.00 9 175 0

2015 7 31 1900 78 16 0.00 10 240 0
2015 7 31 2000 75 18 0.00 5 206 0
2015 7 31 2100 73 21 0.00 3 257 0
2015 7 31 2200 71 25 0.00 3 253 0
2015 7 31 2300 70 25 0.00 3 313 0
2015 8 1 0000 68 25 0.00 3 314 0
2015 8 1 0100 67 24 0.00 3 327 0
2015 8 1 0200 67 23 0.00 3 324 0
2015 8 1 0300 66 22 0.00 3 319 0
2015 8 1 0400 65 23 0.00 3 317 0
2015 8 1 0500 65 24 0.00 2 244 0
2015 8 1 0600 74 22 0.00 4 128 29
2015 8 1 0700 79 20 0.00 6 160 0
2015 8 1 0800 83 19 0.00 7 161 0
2015 8 1 0900 86 20 0.00 12 135 0
2015 8 1 1000 91 15 0.00 15 144 0
2015 8 1 1100 92 12 0.00 15 155 0
2015 8 1 1200 93 10 0.00 20 135 0
2015 8 1 1300 95 9 0.00 16 197 0
2015 8 1 1400 95 6 0.00 18 148 0
2015 8 1 1500 95 7 0.00 15 149 0
2015 8 1 1600 91 10 0.00 14 168 0
2015 8 1 1700 85 13 0.00 14 125 0
2015 8 1 1800 80 15 0.00 6 151 0
2015 8 1 1900 76 18 0.00 11 161 0
2015 8 1 2000 74 19 0.00 4 248 0
2015 8 1 2100 71 22 0.00 3 268 0
2015 8 1 2200 70 22 0.00 3 302 0
2015 8 1 2300 69 22 0.00 3 322 0
2015 8 2 0000 67 24 0.00 3 322 0
2015 8 2 0100 67 22 0.00 3 357 0
2015 8 2 0200 67 22 0.00 3 307 0
2015 8 2 0300 67 20 0.00 4 352 0
2015 8 2 0400 68 15 0.00 3 346 0
2015 8 2 0500 69 17 0.00 2 315 0
2015 8 2 0600 74 19 0.00 2 26 26
2015 8 2 0700 79 14 0.00 5 150 0
2015 8 2 0800 82 14 0.00 7 186 0
2015 8 2 0900 85 11 0.00 10 109 10
2015 8 2 1000 90 12 0.00 11 152 0
2015 8 2 1100 90 12 0.00 13 144 0
2015 8 2 1200 94 7 0.00 15 153 0
2015 8 2 1300 93 9 0.00 12 141 9
2015 8 2 1400 87 12 0.00 12 168 48
2015 8 2 1500 85 16 0.00 13 147 54
2015 8 2 1600 81 21 0.00 11 152 69
2015 8 2 1700 77 29 0.00 11 195 0
2015 8 2 1800 78 25 0.00 8 52 0
2015 8 2 1900 74 34 0.00 7 194 0
2015 8 2 2000 73 34 0.00 8 200 0
2015 8 2 2100 71 38 0.00 8 232 0
2015 8 2 2200 70 38 0.00 4 252 0
2015 8 2 2300 70 37 0.00 5 198 0
2015 8 3 0000 69 35 0.00 4 186 0
2015 8 3 0100 68 37 0.00 4 245 0
2015 8 3 0200 66 37 0.00 3 233 0
2015 8 3 0300 66 36 0.00 3 336 0
2015 8 3 0400 65 39 0.00 3 276 0
2015 8 3 0500 65 40 0.00 2 319 0
2015 8 3 0600 69 34 0.00 3 84 28
2015 8 3 0700 72 34 0.00 7 151 26
2015 8 3 0800 77 29 0.00 9 124 7
2015 8 3 0900 75 31 0.00 10 158 41
2015 8 3 1000 72 33 0.00 9 147 72
2015 8 3 1100 71 34 0.00 9 146 83
2015 8 3 1200 73 32 0.00 9 143 67
2015 8 3 1300 73 33 0.00 8 155 75
2015 8 3 1400 74 34 0.00 6 136 72
2015 8 3 1500 74 34 0.00 7 191 50
2015 8 3 1600 73 34 0.00 7 167 30

2015 8 3 1700 72 34 0.00 7 199 0
2015 8 3 1800 69 37 0.00 7 176 0
2015 8 3 1900 67 36 0.00 8 166 0
2015 8 3 2000 65 39 0.00 6 148 0
2015 8 3 2100 63 43 0.00 6 200 0
2015 8 3 2200 62 49 0.00 5 175 0
2015 8 3 2300 61 55 0.00 5 100 0
2015 8 4 0000 60 60 0.00 3 146 0
2015 8 4 0100 60 61 0.00 3 273 0
2015 8 4 0200 57 66 0.00 4 200 0
2015 8 4 0300 57 67 0.00 3 268 0
2015 8 4 0400 57 67 0.00 2 316 0
2015 8 4 0500 58 65 0.00 2 152 0
2015 8 4 0600 59 65 0.00 2 157 59
2015 8 4 0700 66 53 0.00 6 150 0
2015 8 4 0800 70 46 0.00 10 156 0
2015 8 4 0900 72 39 0.00 17 136 0
2015 8 4 1000 76 35 0.00 17 153 0
2015 8 4 1100 77 32 0.00 17 142 0
2015 8 4 1200 77 21 0.00 20 179 0
2015 8 4 1300 79 18 0.00 16 138 0
2015 8 4 1400 78 18 0.00 16 148 0
2015 8 4 1500 76 21 0.00 17 152 0
2015 8 4 1600 74 24 0.00 15 142 0
2015 8 4 1700 68 30 0.00 16 175 0
2015 8 4 1800 64 39 0.00 10 187 0
2015 8 4 1900 61 43 0.00 8 154 0
2015 8 4 2000 58 47 0.00 7 318 0
2015 8 4 2100 57 48 0.00 4 74 0
2015 8 4 2200 57 46 0.00 6 44 0
2015 8 4 2300 55 48 0.00 5 248 0
2015 8 5 0000 54 54 0.00 7 134 0
2015 8 5 0100 54 50 0.00 7 87 0
2015 8 5 0200 54 50 0.00 6 58 0
2015 8 5 0300 53 56 0.00 4 314 0
2015 8 5 0400 53 63 0.00 3 332 0
2015 8 5 0500 55 56 0.00 3 308 0
2015 8 5 0600 58 53 0.00 5 115 30
2015 8 5 0700 62 51 0.00 8 151 0
2015 8 5 0800 66 46 0.00 12 98 0
2015 8 5 0900 69 39 0.00 12 136 0
2015 8 5 1000 70 29 0.00 18 210 0
2015 8 5 1100 72 31 0.00 20 140 0
2015 8 5 1200 72 29 0.00 19 179 0
2015 8 5 1300 70 31 0.00 17 156 0
2015 8 5 1400 69 34 0.00 18 177 0
2015 8 5 1500 67 39 0.00 18 195 0
2015 8 5 1600 66 41 0.00 17 142 0
2015 8 5 1700 60 50 0.00 11 193 0
2015 8 5 1800 58 56 0.00 11 189 0
2015 8 5 1900 56 64 0.00 10 131 0
2015 8 5 2000 55 66 0.00 13 124 0
2015 8 5 2100 54 67 0.00 10 244 0
2015 8 5 2200 53 72 0.00 10 234 0
2015 8 5 2300 50 78 0.00 8 152 0
2015 8 6 0000 49 85 0.00 6 150 0
2015 8 6 0100 49 83 0.00 7 170 0
2015 8 6 0200 48 81 0.00 5 71 0
2015 8 6 0300 49 77 0.00 4 49 0
2015 8 6 0400 48 76 0.00 2 315 0
2015 8 6 0500 48 78 0.00 3 321 0
2015 8 6 0600 54 67 0.00 4 110 42
2015 8 6 0700 58 57 0.00 6 137 0
2015 8 6 0800 61 52 0.00 12 155 0
2015 8 6 0900 64 49 0.00 14 143 0
2015 8 6 1000 67 41 0.00 13 152 0
2015 8 6 1100 69 35 0.00 14 153 0
2015 8 6 1200 72 32 0.00 17 149 0
2015 8 6 1300 73 33 0.00 16 143 0
2015 8 6 1400 73 35 0.00 19 152 0

2015 8 6 1500 72 36 0.00 16 144 0
2015 8 6 1600 71 38 0.00 17 141 0
2015 8 6 1700 66 45 0.00 12 143 0
2015 8 6 1800 62 51 0.00 7 152 0
2015 8 6 1900 59 56 0.00 6 208 0
2015 8 6 2000 57 60 0.00 2 211 0
2015 8 6 2100 55 67 0.00 2 209 0
2015 8 6 2200 53 71 0.00 3 246 0

FOLIAR_MOISTURE_CONTENT: 65
CROWN_FIRE_METHOD: ScottReinhardt
WIND_SPEED: 15
WIND_DIRECTION: 210
SPREAD_DIRECTION_FROM_MAX: 0
GRIDDED_WINDS_GENERATE: Yes
GRIDDED_WINDS_RESOLUTION: 180

Extreme Weather – SSW Wind Direction

NUMFIRES: 8000
DURATION: 1100
RESOLUTION: 90
SPOTPROBABILITY: 0.05
OUTPUTFIREPERIMS: 1

FUEL_MOISTURES_DATA: 1
0 3 4 8 25 60

CONDITIONING_PERIOD_START: 07 29 1300
CONDITIONING_PERIOD_END: 08 02 1500
RAWS_ELEVATION: 3480
RAWS_UNITS: English

RAWS: 324
2015 7 24 0 52 71 0 3 132 0
2015 7 24 100 52 73 0 3 153 0
2015 7 24 200 51 73 0 4 110 0
2015 7 24 300 51 77 0 3 200 0
2015 7 24 400 51 76 0 3 118 0
2015 7 24 500 53 70 0 3 133 0
2015 7 24 600 59 60 0 5 312 32
2015 7 24 700 63 54 0 7 328 0
2015 7 24 800 67 48 0 10 301 0
2015 7 24 900 69 39 0 12 326 18
2015 7 24 1000 73 32 0 16 333 0
2015 7 24 1100 72 34 0 14 349 20
2015 7 24 1200 75 32 0 18 323 15
2015 7 24 1300 75 33 0 18 325 0
2015 7 24 1400 75 35 0 17 344 0
2015 7 24 1500 73 40 0 15 29 0
2015 7 24 1600 71 44 0 14 336 0
2015 7 24 1700 65 55 0 12 332 0
2015 7 24 1800 63 58 0 10 354 0
2015 7 24 1900 60 64 0 7 5 0
2015 7 24 2000 59 66 0 7 306 0
2015 7 24 2100 56 73 0 5 20 0
2015 7 24 2200 57 71 0 3 101 0
2015 7 24 2300 55 75 0 4 344 0

2015 7 25 0 55 77 0 3 348 0
2015 7 25 100 56 78 0 3 223 0
2015 7 25 200 55 82 0 5 291 0
2015 7 25 300 54 88 0 6 325 0
2015 7 25 400 54 88 0 7 332 0
2015 7 25 500 54 86 0 7 345 0
2015 7 25 600 54 86 0 6 337 78
2015 7 25 700 58 74 0 10 332 56
2015 7 25 800 58 66 0 16 323 72
2015 7 25 900 59 61 0 15 315 67
2015 7 25 1000 59 58 0 15 334 70
2015 7 25 1100 59 57 0 11 352 73
2015 7 25 1200 59 56 0 16 322 70
2015 7 25 1300 61 53 0 14 342 55
2015 7 25 1400 60 54 0 15 326 38
2015 7 25 1500 59 48 0 15 341 22
2015 7 25 1600 60 47 0 11 10 0
2015 7 25 1700 58 52 0 11 339 0
2015 7 25 1800 54 60 0 10 358 0
2015 7 25 1900 53 62 0 7 342 0
2015 7 25 2000 51 63 0 8 156 0
2015 7 25 2100 49 70 0 5 29 0
2015 7 25 2200 49 72 0 8 319 0
2015 7 25 2300 49 70 0 8 323 0
2015 7 26 0 50 67 0 6 263 0
2015 7 26 100 48 73 0 7 330 0
2015 7 26 200 47 78 0 4 322 0
2015 7 26 300 47 78 0 3 298 0
2015 7 26 400 47 75 0 6 342 0
2015 7 26 500 49 72 0 6 74 0
2015 7 26 600 52 65 0 6 321 21
2015 7 26 700 57 57 0 8 309 10
2015 7 26 800 56 60 0 13 332 28
2015 7 26 900 62 50 0 14 331 0
2015 7 26 1000 63 45 0 18 325 0
2015 7 26 1100 66 42 0 17 347 8
2015 7 26 1200 64 42 0 19 10 0
2015 7 26 1300 67 39 0 18 5 0
2015 7 26 1400 65 39 0 18 358 0
2015 7 26 1500 64 38 0 16 326 0
2015 7 26 1600 63 39 0 15 320 0
2015 7 26 1700 55 61 0 16 332 0
2015 7 26 1800 52 67 0 11 358 0
2015 7 26 1900 50 65 0 5 74 0
2015 7 26 2000 49 66 0 6 255 0
2015 7 26 2100 49 64 0 4 209 0
2015 7 26 2200 47 71 0 2 144 0
2015 7 26 2300 58 55 0 6 317 0
2015 7 27 800 60 51 0 10 322 0
2015 7 27 900 62 44 0 11 315 28
2015 7 27 1000 61 50 0 18 324 35
2015 7 27 1100 63 44 0 18 333 24
2015 7 27 1200 67 38 0 20 3 17
2015 7 27 1300 69 35 0 18 335 0
2015 7 27 1400 67 39 0 24 321 0
2015 7 27 1500 66 40 0 21 323 0
2015 7 27 1600 65 41 0 17 341 0
2015 7 27 1700 61 45 0 13 328 0
2015 7 27 1800 58 49 0 10 349 0
2015 7 27 1900 55 55 0 11 338 0
2015 7 27 2000 53 62 0 4 275 0
2015 7 27 2100 52 67 0 3 122 0
2015 7 27 2200 51 68 0 3 130 0
2015 7 27 2300 50 69 0 3 146 0
2015 7 28 0 49 71 0 3 136 0
2015 7 28 100 49 72 0 3 132 0
2015 7 28 200 48 74 0 3 139 0
2015 7 28 300 56 57 0 3 326 36
2015 7 28 700 60 51 0 7 352 0
2015 7 28 800 66 39 0 8 333 0

2015 7 28 900 69 35 0 10 331 0
2015 7 28 1000 71 29 0 14 332 0
2015 7 28 1100 73 27 0 13 320 0
2015 7 28 1200 74 25 0 14 318 0
2015 7 28 1300 77 23 0 13 324 0
2015 7 28 1400 78 22 0 13 322 0
2015 7 28 1500 78 26 0 15 311 0
2015 7 28 1600 75 34 0 14 337 0
2015 7 28 1700 72 38 0 12 339 0
2015 7 28 1800 69 43 0 11 3 0
2015 7 28 1900 65 48 0 8 330 0
2015 7 28 2000 62 53 0 6 325 0
2015 7 28 2100 60 58 0 3 273 0
2015 7 28 2200 59 60 0 3 126 0
2015 7 28 2300 58 62 0 3 145 0
2015 7 29 0 57 64 0 3 132 0
2015 7 29 100 57 61 0 3 168 0
2015 7 29 200 56 62 0 3 145 0
2015 7 29 300 56 65 0 2 130 0
2015 7 29 400 57 60 0 3 177 0
2015 7 29 500 57 60 0 2 150 0
2015 7 29 600 65 45 0 3 308 35
2015 7 29 700 71 34 0 5 325 0
2015 7 29 800 74 24 0 8 5 0
2015 7 29 900 77 23 0 10 14 0
2015 7 29 1000 81 19 0 13 327 0
2015 7 29 1100 83 14 0 14 335 0
2015 7 29 1200 84 15 0 15 325 0
2015 7 29 1300 85 14 0 15 322 0
2015 7 29 1400 86 13 0 13 357 0
2015 7 29 1500 86 14 0 20 327 0
2015 7 29 1600 85 13 0 11 350 0
2015 7 29 1700 80 16 0 12 355 0
2015 7 29 1800 76 19 0 10 6 0
2015 7 29 1900 73 22 0 6 338 0
2015 7 29 2000 70 25 0 3 268 0
2015 7 29 2100 69 26 0 3 130 0
2015 7 29 2200 67 28 0 3 137 0
2015 7 29 2300 66 29 0 2 148 0
2015 7 30 0 65 31 0 3 139 0
2015 7 30 100 66 30 0 2 161 0
2015 7 30 200 64 33 0 2 131 0
2015 7 30 300 65 33 0 2 139 0
2015 7 30 400 65 31 0 2 173 0
2015 7 30 500 65 34 0 2 137 0
2015 7 30 600 72 29 0 3 296 34
2015 7 30 700 80 23 0 4 12 0
2015 7 30 800 82 19 0 9 338 0
2015 7 30 900 86 17 0 12 319 0
2015 7 30 1000 87 14 0 14 322 0
2015 7 30 1100 89 13 0 15 316 0
2015 7 30 1200 89 13 0 15 340 0
2015 7 30 1300 92 13 0 13 287 0
2015 7 30 1400 93 12 0 11 307 0
2015 7 30 1500 92 12 0 13 310 0
2015 7 30 1600 91 13 0 11 322 0
2015 7 30 1700 86 18 0 11 348 0
2015 7 30 1800 82 20 0 10 53 0
2015 7 30 1900 80 19 0 7 324 0
2015 7 30 2000 77 21 0 3 133 0
2015 7 30 2100 75 22 0 3 137 0
2015 7 30 2200 74 24 0 3 130 0
2015 7 30 2300 72 25 0 3 133 0
2015 7 31 0 72 22 0 3 130 0
2015 7 31 100 71 20 0 3 132 0
2015 7 31 200 70 18 0 3 129 0
2015 7 31 300 69 17 0 3 148 0
2015 7 31 400 69 16 0 2 136 0
2015 7 31 500 69 23 0 3 154 0
2015 7 31 600 76 19 0 2 215 31

2015 7 31 700 83 15 0 4 322 0
2015 7 31 800 86 12 0 7 332 0
2015 7 31 900 90 10 0 14 336 0
2015 7 31 1000 95 8 0 12 13 0
2015 7 31 1100 94 7 0 13 342 0
2015 7 31 1200 95 6 0 17 338 0
2015 7 31 1300 99 8 0 13 309 0
2015 7 31 1400 98 7 0 14 326 0
2015 7 31 1500 95 7 0 13 350 0
2015 7 31 1600 93 7 0 13 308 0
2015 7 31 1700 86 10 0 13 339 0
2015 7 31 1800 82 12 0 9 355 0
2015 7 31 1900 78 16 0 10 60 0
2015 7 31 2000 75 18 0 5 26 0
2015 7 31 2100 73 21 0 3 77 0
2015 7 31 2200 71 25 0 3 73 0
2015 7 31 2300 70 25 0 3 133 0
2015 8 1 0 68 25 0 3 134 0
2015 8 1 100 67 24 0 3 147 0
2015 8 1 200 67 23 0 3 144 0
2015 8 1 300 66 22 0 3 139 0
2015 8 1 400 65 23 0 3 137 0
2015 8 1 500 65 24 0 2 64 0
2015 8 1 600 74 22 0 4 308 29
2015 8 1 700 79 20 0 6 340 0
2015 8 1 800 83 19 0 7 341 0
2015 8 1 900 86 20 0 12 315 0
2015 8 1 1000 91 15 0 15 324 0
2015 8 1 1100 92 12 0 15 335 0
2015 8 1 1200 93 10 0 20 315 0
2015 8 1 1300 95 9 0 16 17 0
2015 8 1 1400 95 6 0 18 328 0
2015 8 1 1500 95 7 0 15 329 0
2015 8 1 1600 91 10 0 14 348 0
2015 8 1 1700 85 13 0 14 305 0
2015 8 1 1800 80 15 0 6 331 0
2015 8 1 1900 76 18 0 11 341 0
2015 8 1 2000 74 19 0 4 68 0
2015 8 1 2100 71 22 0 3 88 0
2015 8 1 2200 70 22 0 3 122 0
2015 8 1 2300 69 22 0 3 142 0
2015 8 2 0 67 24 0 3 142 0
2015 8 2 100 67 22 0 3 177 0
2015 8 2 200 67 22 0 3 127 0
2015 8 2 300 67 20 0 4 172 0
2015 8 2 400 68 15 0 3 166 0
2015 8 2 500 69 17 0 2 135 0
2015 8 2 600 74 19 0 2 206 26
2015 8 2 700 79 14 0 5 330 0
2015 8 2 800 82 14 0 7 6 0
2015 8 2 900 85 11 0 10 289 10
2015 8 2 1000 90 12 0 11 332 0
2015 8 2 1100 90 12 0 13 324 0
2015 8 2 1200 94 7 0 15 333 0
2015 8 2 1300 93 9 0 12 321 9
2015 8 2 1400 87 12 0 12 348 48
2015 8 2 1500 85 16 0 13 327 54
2015 8 2 1600 81 21 0 11 332 69
2015 8 2 1700 77 29 0 11 15 0
2015 8 2 1800 78 25 0 8 232 0
2015 8 2 1900 74 34 0 7 14 0
2015 8 2 2000 73 34 0 8 20 0
2015 8 2 2100 71 38 0 8 52 0
2015 8 2 2200 70 38 0 4 72 0
2015 8 2 2300 70 37 0 5 18 0
2015 8 3 0 69 35 0 4 6 0
2015 8 3 100 68 37 0 4 65 0
2015 8 3 200 66 37 0 3 53 0
2015 8 3 300 66 36 0 3 156 0
2015 8 3 400 65 39 0 3 96 0

2015 8 3 500 65 40 0 2 139 0
2015 8 3 600 69 34 0 3 264 28
2015 8 3 700 72 34 0 7 331 26
2015 8 3 800 77 29 0 9 304 7
2015 8 3 900 75 31 0 10 338 41
2015 8 3 1000 72 33 0 9 327 72
2015 8 3 1100 71 34 0 9 326 83
2015 8 3 1200 73 32 0 9 323 67
2015 8 3 1300 73 33 0 8 335 75
2015 8 3 1400 74 34 0 6 316 72
2015 8 3 1500 74 34 0 7 11 50
2015 8 3 1600 73 34 0 7 347 30
2015 8 3 1700 72 34 0 7 19 0
2015 8 3 1800 69 37 0 7 356 0
2015 8 3 1900 67 36 0 8 346 0
2015 8 3 2000 65 39 0 6 328 0
2015 8 3 2100 63 43 0 6 20 0
2015 8 3 2200 62 49 0 5 355 0
2015 8 3 2300 61 55 0 5 280 0
2015 8 4 0 60 60 0 3 326 0
2015 8 4 100 60 61 0 3 93 0
2015 8 4 200 57 66 0 4 20 0
2015 8 4 300 57 67 0 3 88 0
2015 8 4 400 57 67 0 2 136 0
2015 8 4 500 58 65 0 2 332 0
2015 8 4 600 59 65 0 2 337 59
2015 8 4 700 66 53 0 6 330 0
2015 8 4 800 70 46 0 10 336 0
2015 8 4 900 72 39 0 17 316 0
2015 8 4 1000 76 35 0 17 333 0
2015 8 4 1100 77 32 0 17 322 0
2015 8 4 1200 77 21 0 20 359 0
2015 8 4 1300 79 18 0 16 318 0
2015 8 4 1400 78 18 0 16 328 0
2015 8 4 1500 76 21 0 17 332 0
2015 8 4 1600 74 24 0 15 322 0
2015 8 4 1700 68 30 0 16 355 0
2015 8 4 1800 64 39 0 10 7 0
2015 8 4 1900 61 43 0 8 334 0
2015 8 4 2000 58 47 0 7 138 0
2015 8 4 2100 57 48 0 4 254 0
2015 8 4 2200 57 46 0 6 224 0
2015 8 4 2300 55 48 0 5 68 0
2015 8 5 0 54 54 0 7 314 0
2015 8 5 100 54 50 0 7 267 0
2015 8 5 200 54 50 0 6 238 0
2015 8 5 300 53 56 0 4 134 0
2015 8 5 400 53 63 0 3 152 0
2015 8 5 500 55 56 0 3 128 0
2015 8 5 600 58 53 0 5 295 30
2015 8 5 700 62 51 0 8 331 0
2015 8 5 800 66 46 0 12 278 0
2015 8 5 900 69 39 0 12 316 0
2015 8 5 1000 70 29 0 18 30 0
2015 8 5 1100 72 31 0 20 320 0
2015 8 5 1200 72 29 0 19 359 0
2015 8 5 1300 70 31 0 17 336 0
2015 8 5 1400 69 34 0 18 357 0
2015 8 5 1500 67 39 0 18 15 0
2015 8 5 1600 66 41 0 17 322 0
2015 8 5 1700 60 50 0 11 13 0
2015 8 5 1800 58 56 0 11 9 0
2015 8 5 1900 56 64 0 10 311 0
2015 8 5 2000 55 66 0 13 304 0
2015 8 5 2100 54 67 0 10 64 0
2015 8 5 2200 53 72 0 10 54 0
2015 8 5 2300 50 78 0 8 332 0
2015 8 6 0 49 85 0 6 330 0
2015 8 6 100 49 83 0 7 350 0
2015 8 6 200 48 81 0 5 251 0

2015 8 6 300 49 77 0 4 229 0
2015 8 6 400 48 76 0 2 135 0
2015 8 6 500 48 78 0 3 141 0
2015 8 6 600 54 67 0 4 290 42
2015 8 6 700 58 57 0 6 317 0
2015 8 6 800 61 52 0 12 335 0
2015 8 6 900 64 49 0 14 323 0
2015 8 6 1000 67 41 0 13 332 0
2015 8 6 1100 69 35 0 14 333 0
2015 8 6 1200 72 32 0 17 329 0
2015 8 6 1300 73 33 0 16 323 0
2015 8 6 1400 73 35 0 19 332 0
2015 8 6 1500 72 36 0 16 324 0
2015 8 6 1600 71 38 0 17 321 0
2015 8 6 1700 66 45 0 12 323 0
2015 8 6 1800 62 51 0 7 332 0
2015 8 6 1900 59 56 0 6 28 0
2015 8 6 2000 57 60 0 2 31 0
2015 8 6 2100 55 67 0 2 29 0
2015 8 6 2200 53 71 0 3 66 0

FOLIAR_MOISTURE_CONTENT: 65
CROWN_FIRE_METHOD: ScottReinhardt
WIND_SPEED: 15
WIND_DIRECTION: 30
SPREAD_DIRECTION_FROM_MAX: 0
GRIDDED_WINDS_GENERATE: Yes
GRIDDED_WINDS_RESOLUTION: 180

APPENDIX D

Wilcoxon test comparing untreated average fire size to treated average fire size across all treatment widths, ignition start designations, weather scenarios and treatment placements. N=20

Treatment Width	Ignition Start Designation	Weather Scenario	Treatment Placement	group1	group2	p-value
50	USFS	E	USFS	Control	CC_PB_B	1
50	USFS	E	TCF	Control	CC_PB_B	1
50	USFS	E	Collab	Control	CC_PB_B	0.39
50	USFS	E	USFS	Control	R30	1
50	USFS	E	TCF	Control	R30	1
50	USFS	E	Collab	Control	R30	1
50	USFS	E	USFS	Control	R40	1
50	USFS	E	TCF	Control	R40	1
50	USFS	E	Collab	Control	R40	1
50	USFS	E	USFS	Control	R60	1
50	USFS	E	TCF	Control	R60	1
50	USFS	E	Collab	Control	R60	1
50	USFS	E	USFS	Control	Shadetree_PB	1
50	USFS	E	TCF	Control	Shadetree_PB	1
50	USFS	E	Collab	Control	Shadetree_PB	1
50	USFS	JM	USFS	Control	CC_PB_B	1
50	USFS	JM	TCF	Control	CC_PB_B	1
50	USFS	JM	Collab	Control	CC_PB_B	0.00266
50	USFS	JM	USFS	Control	R30	1
50	USFS	JM	TCF	Control	R30	1
50	USFS	JM	Collab	Control	R30	0.13143
50	USFS	JM	USFS	Control	R40	1
50	USFS	JM	TCF	Control	R40	1
50	USFS	JM	Collab	Control	R40	0.39
50	USFS	JM	USFS	Control	R60	1
50	USFS	JM	TCF	Control	R60	1
50	USFS	JM	Collab	Control	R60	1
50	USFS	JM	USFS	Control	Shadetree_PB	1
50	USFS	JM	TCF	Control	Shadetree_PB	1
50	USFS	JM	Collab	Control	Shadetree_PB	0.39
50	TCF	E	USFS	Control	CC_PB_B	1
50	TCF	E	TCF	Control	CC_PB_B	1
50	TCF	E	Collab	Control	CC_PB_B	1
50	TCF	E	USFS	Control	R30	1
50	TCF	E	TCF	Control	R30	1

50	TCF	E	Collab	Control	R30	1
50	TCF	E	USFS	Control	R40	1
50	TCF	E	TCF	Control	R40	1
50	TCF	E	Collab	Control	R40	1
50	TCF	E	USFS	Control	R60	1
50	TCF	E	TCF	Control	R60	1
50	TCF	E	Collab	Control	R60	1
50	TCF	E	USFS	Control	Shadetree_PB	1
50	TCF	E	TCF	Control	Shadetree_PB	1
50	TCF	E	Collab	Control	Shadetree_PB	1
50	TCF	JM	USFS	Control	CC_PB_B	1
50	TCF	JM	TCF	Control	CC_PB_B	1
50	TCF	JM	Collab	Control	CC_PB_B	1
50	TCF	JM	USFS	Control	R30	1
50	TCF	JM	TCF	Control	R30	1
50	TCF	JM	Collab	Control	R30	1
50	TCF	JM	USFS	Control	R40	1
50	TCF	JM	TCF	Control	R40	1
50	TCF	JM	Collab	Control	R40	1
50	TCF	JM	USFS	Control	R60	1
50	TCF	JM	TCF	Control	R60	1
50	TCF	JM	Collab	Control	R60	1
50	TCF	JM	USFS	Control	Shadetree_PB	1
50	TCF	JM	TCF	Control	Shadetree_PB	1
50	TCF	JM	Collab	Control	Shadetree_PB	1
100	USFS	E	USFS	Control	CC_PB_B	1
100	USFS	E	TCF	Control	CC_PB_B	1
100	USFS	E	Collab	Control	CC_PB_B	0.000172
100	USFS	E	USFS	Control	R30	1
100	USFS	E	TCF	Control	R30	1
100	USFS	E	Collab	Control	R30	0.31473
100	USFS	E	USFS	Control	R40	1
100	USFS	E	TCF	Control	R40	1
100	USFS	E	Collab	Control	R40	0.19188
100	USFS	E	USFS	Control	R60	1
100	USFS	E	TCF	Control	R60	1
100	USFS	E	Collab	Control	R60	0.78
100	USFS	E	USFS	Control	Shadetree_PB	1
100	USFS	E	TCF	Control	Shadetree_PB	1
100	USFS	E	Collab	Control	Shadetree_PB	1
100	USFS	JM	USFS	Control	CC_PB_B	0.000271
100	USFS	JM	TCF	Control	CC_PB_B	0.06864
100	USFS	JM	Collab	Control	CC_PB_B	3.20E-10
100	USFS	JM	USFS	Control	R30	0.3822
100	USFS	JM	TCF	Control	R30	0.009633

100	USFS	JM	Collab	Control	R30	5.19E-11
100	USFS	JM	USFS	Control	R40	0.39
100	USFS	JM	TCF	Control	R40	1
100	USFS	JM	Collab	Control	R40	3.01E-06
100	USFS	JM	USFS	Control	R60	0.11661
100	USFS	JM	TCF	Control	R60	1
100	USFS	JM	Collab	Control	R60	3.74E-06
100	USFS	JM	USFS	Control	Shadetree_PB	1
100	USFS	JM	TCF	Control	Shadetree_PB	0.012051
100	USFS	JM	Collab	Control	Shadetree_PB	4.84E-07
100	TCF	E	USFS	Control	CC_PB_B	1
100	TCF	E	TCF	Control	CC_PB_B	1
100	TCF	E	Collab	Control	CC_PB_B	1
100	TCF	E	USFS	Control	R30	1
100	TCF	E	TCF	Control	R30	1
100	TCF	E	Collab	Control	R30	1
100	TCF	E	USFS	Control	R40	1
100	TCF	E	TCF	Control	R40	1
100	TCF	E	Collab	Control	R40	1
100	TCF	E	USFS	Control	R60	1
100	TCF	E	TCF	Control	R60	1
100	TCF	E	Collab	Control	R60	1
100	TCF	E	USFS	Control	Shadetree_PB	1
100	TCF	E	TCF	Control	Shadetree_PB	1
100	TCF	E	Collab	Control	Shadetree_PB	1
100	TCF	JM	USFS	Control	CC_PB_B	1
100	TCF	JM	TCF	Control	CC_PB_B	1
100	TCF	JM	Collab	Control	CC_PB_B	4.13E-11
100	TCF	JM	USFS	Control	R30	1
100	TCF	JM	TCF	Control	R30	1
100	TCF	JM	Collab	Control	R30	4.72E-08
100	TCF	JM	USFS	Control	R40	1
100	TCF	JM	TCF	Control	R40	1
100	TCF	JM	Collab	Control	R40	1.12E-07
100	TCF	JM	USFS	Control	R60	1
100	TCF	JM	TCF	Control	R60	1
100	TCF	JM	Collab	Control	R60	8.97E-09
100	TCF	JM	USFS	Control	Shadetree_PB	1
100	TCF	JM	TCF	Control	Shadetree_PB	1
100	TCF	JM	Collab	Control	Shadetree_PB	8.27E-10
150	USFS	E	USFS	Control	CC_PB_B	1
150	USFS	E	TCF	Control	CC_PB_B	1
150	USFS	E	Collab	Control	CC_PB_B	1.99E-12
150	USFS	E	USFS	Control	R30	1
150	USFS	E	TCF	Control	R30	1

150	USFS	E	Collab	Control	R30	0.000317
150	USFS	E	USFS	Control	R40	1
150	USFS	E	TCF	Control	R40	1
150	USFS	E	Collab	Control	R40	3.86E-05
150	USFS	E	USFS	Control	R60	1
150	USFS	E	TCF	Control	R60	1
150	USFS	E	Collab	Control	R60	0.00064
150	USFS	E	USFS	Control	Shadetree_PB	1
150	USFS	E	TCF	Control	Shadetree_PB	1
150	USFS	E	Collab	Control	Shadetree_PB	0.00087
150	USFS	JM	USFS	Control	CC_PB_B	1.22E-08
150	USFS	JM	TCF	Control	CC_PB_B	1.18E-09
150	USFS	JM	Collab	Control	CC_PB_B	6.12E-27
150	USFS	JM	USFS	Control	R30	0.003108
150	USFS	JM	TCF	Control	R30	0.013689
150	USFS	JM	Collab	Control	R30	4.60E-21
150	USFS	JM	USFS	Control	R40	0.000117
150	USFS	JM	TCF	Control	R40	0.000111
150	USFS	JM	Collab	Control	R40	2.03E-22
150	USFS	JM	USFS	Control	R60	0.000217
150	USFS	JM	TCF	Control	R60	0.000499
150	USFS	JM	Collab	Control	R60	1.15E-17
150	USFS	JM	USFS	Control	Shadetree_PB	0.000107
150	USFS	JM	TCF	Control	Shadetree_PB	1.87E-08
150	USFS	JM	Collab	Control	Shadetree_PB	1.55E-17
150	TCF	E	USFS	Control	CC_PB_B	1
150	TCF	E	TCF	Control	CC_PB_B	1
150	TCF	E	Collab	Control	CC_PB_B	0.13494
150	TCF	E	USFS	Control	R30	1
150	TCF	E	TCF	Control	R30	1
150	TCF	E	Collab	Control	R30	1
150	TCF	E	USFS	Control	R40	1
150	TCF	E	TCF	Control	R40	1
150	TCF	E	Collab	Control	R40	1
150	TCF	E	USFS	Control	R60	1
150	TCF	E	TCF	Control	R60	1
150	TCF	E	Collab	Control	R60	1
150	TCF	E	USFS	Control	Shadetree_PB	1
150	TCF	E	TCF	Control	Shadetree_PB	1
150	TCF	E	Collab	Control	Shadetree_PB	1
150	TCF	JM	USFS	Control	CC_PB_B	3.05E-05
150	TCF	JM	TCF	Control	CC_PB_B	0.000208
150	TCF	JM	Collab	Control	CC_PB_B	1.49E-13
150	TCF	JM	USFS	Control	R30	0.78
150	TCF	JM	TCF	Control	R30	1

150	TCF	JM	Collab	Control	R30	6.63E-15
150	TCF	JM	USFS	Control	R40	1
150	TCF	JM	TCF	Control	R40	0.2613
150	TCF	JM	Collab	Control	R40	1.88E-14
150	TCF	JM	USFS	Control	R60	1
150	TCF	JM	TCF	Control	R60	0.04017
150	TCF	JM	Collab	Control	R60	1.37E-14
150	TCF	JM	USFS	Control	Shadetree_PB	0.05733
150	TCF	JM	TCF	Control	Shadetree_PB	0.39
150	TCF	JM	Collab	Control	Shadetree_PB	2.06E-14
200	USFS	E	USFS	Control	CC_PB_B	1
200	USFS	E	TCF	Control	CC_PB_B	0.0008
200	USFS	E	Collab	Control	CC_PB_B	2.77E-17
200	USFS	E	USFS	Control	R30	1
200	USFS	E	TCF	Control	R30	0.22698
200	USFS	E	Collab	Control	R30	2.06E-11
200	USFS	E	USFS	Control	R40	1
200	USFS	E	TCF	Control	R40	1
200	USFS	E	Collab	Control	R40	1.90E-10
200	USFS	E	USFS	Control	R60	1
200	USFS	E	TCF	Control	R60	1
200	USFS	E	Collab	Control	R60	3.14E-08
200	USFS	E	USFS	Control	Shadetree_PB	0.39
200	USFS	E	TCF	Control	Shadetree_PB	0.32799
200	USFS	E	Collab	Control	Shadetree_PB	6.16E-12
200	USFS	JM	USFS	Control	CC_PB_B	1.86E-13
200	USFS	JM	TCF	Control	CC_PB_B	1.77E-21
200	USFS	JM	Collab	Control	CC_PB_B	6.75E-25
200	USFS	JM	USFS	Control	R30	1.20E-06
200	USFS	JM	TCF	Control	R30	6.90E-14
200	USFS	JM	Collab	Control	R30	9.63E-27
200	USFS	JM	USFS	Control	R40	1.35E-06
200	USFS	JM	TCF	Control	R40	5.30E-14
200	USFS	JM	Collab	Control	R40	4.84E-27
200	USFS	JM	USFS	Control	R60	7.45E-08
200	USFS	JM	TCF	Control	R60	1.40E-10
200	USFS	JM	Collab	Control	R60	4.06E-27
200	USFS	JM	USFS	Control	Shadetree_PB	0.000118
200	USFS	JM	TCF	Control	Shadetree_PB	5.30E-11
200	USFS	JM	Collab	Control	Shadetree_PB	6.75E-28
200	TCF	E	USFS	Control	CC_PB_B	1
200	TCF	E	TCF	Control	CC_PB_B	1
200	TCF	E	Collab	Control	CC_PB_B	0.000983
200	TCF	E	USFS	Control	R30	1
200	TCF	E	TCF	Control	R30	1

200	TCF	E	Collab	Control	R30	1
200	TCF	E	USFS	Control	R40	1
200	TCF	E	TCF	Control	R40	1
200	TCF	E	Collab	Control	R40	1
200	TCF	E	USFS	Control	R60	1
200	TCF	E	TCF	Control	R60	1
200	TCF	E	Collab	Control	R60	0.13572
200	TCF	E	USFS	Control	Shadetree_PB	1
200	TCF	E	TCF	Control	Shadetree_PB	1
200	TCF	E	Collab	Control	Shadetree_PB	1
200	TCF	JM	USFS	Control	CC_PB_B	7.64E-10
200	TCF	JM	TCF	Control	CC_PB_B	6.32E-15
200	TCF	JM	Collab	Control	CC_PB_B	2.03E-13
200	TCF	JM	USFS	Control	R30	0.000449
200	TCF	JM	TCF	Control	R30	2.54E-05
200	TCF	JM	Collab	Control	R30	6.28E-13
200	TCF	JM	USFS	Control	R40	1.64E-05
200	TCF	JM	TCF	Control	R40	8.93E-05
200	TCF	JM	Collab	Control	R40	7.84E-15
200	TCF	JM	USFS	Control	R60	2.28E-06
200	TCF	JM	TCF	Control	R60	6.28E-10
200	TCF	JM	Collab	Control	R60	9.17E-14
200	TCF	JM	USFS	Control	Shadetree_PB	0.00117
200	TCF	JM	TCF	Control	Shadetree_PB	2.18E-08
200	TCF	JM	Collab	Control	Shadetree_PB	7.57E-15
250	USFS	E	USFS	Control	CC_PB_B	0.21528
250	USFS	E	TCF	Control	CC_PB_B	5.69E-06
250	USFS	E	Collab	Control	CC_PB_B	3.45E-16
250	USFS	E	USFS	Control	R30	1
250	USFS	E	TCF	Control	R30	0.06201
250	USFS	E	Collab	Control	R30	1.16E-15
250	USFS	E	USFS	Control	R40	1
250	USFS	E	TCF	Control	R40	0.004056
250	USFS	E	Collab	Control	R40	4.45E-16
250	USFS	E	USFS	Control	R60	1
250	USFS	E	TCF	Control	R60	8.85E-05
250	USFS	E	Collab	Control	R60	1.12E-15
250	USFS	E	USFS	Control	Shadetree_PB	1
250	USFS	E	TCF	Control	Shadetree_PB	0.37284
250	USFS	E	Collab	Control	Shadetree_PB	1.11E-16
250	USFS	JM	USFS	Control	CC_PB_B	5.38E-18
250	USFS	JM	TCF	Control	CC_PB_B	4.45E-26
250	USFS	JM	Collab	Control	CC_PB_B	1.12E-28
250	USFS	JM	USFS	Control	R30	1.27E-16
250	USFS	JM	TCF	Control	R30	2.26E-19

250	USFS	JM	Collab	Control	R30	7.96E-28
250	USFS	JM	USFS	Control	R40	4.25E-13
250	USFS	JM	TCF	Control	R40	1.38E-23
250	USFS	JM	Collab	Control	R40	5.73E-26
250	USFS	JM	USFS	Control	R60	7.14E-11
250	USFS	JM	TCF	Control	R60	2.71E-23
250	USFS	JM	Collab	Control	R60	1.03E-26
250	USFS	JM	USFS	Control	Shadetree_PB	3.40E-11
250	USFS	JM	TCF	Control	Shadetree_PB	3.86E-18
250	USFS	JM	Collab	Control	Shadetree_PB	9.56E-26
250	TCF	E	USFS	Control	CC_PB_B	1
250	TCF	E	TCF	Control	CC_PB_B	0.022932
250	TCF	E	Collab	Control	CC_PB_B	6.63E-05
250	TCF	E	USFS	Control	R30	1
250	TCF	E	TCF	Control	R30	1
250	TCF	E	Collab	Control	R30	0.25545
250	TCF	E	USFS	Control	R40	1
250	TCF	E	TCF	Control	R40	1
250	TCF	E	Collab	Control	R40	0.06825
250	TCF	E	USFS	Control	R60	1
250	TCF	E	TCF	Control	R60	1
250	TCF	E	Collab	Control	R60	0.11349
250	TCF	E	USFS	Control	Shadetree_PB	1
250	TCF	E	TCF	Control	Shadetree_PB	1
250	TCF	E	Collab	Control	Shadetree_PB	1
250	TCF	JM	USFS	Control	CC_PB_B	4.45E-11
250	TCF	JM	TCF	Control	CC_PB_B	2.25E-13
250	TCF	JM	Collab	Control	CC_PB_B	2.55E-13
250	TCF	JM	USFS	Control	R30	2.96E-11
250	TCF	JM	TCF	Control	R30	2.20E-12
250	TCF	JM	Collab	Control	R30	2.00E-13
250	TCF	JM	USFS	Control	R40	5.23E-05
250	TCF	JM	TCF	Control	R40	9.20E-15
250	TCF	JM	Collab	Control	R40	6.44E-13
250	TCF	JM	USFS	Control	R60	1.20E-11
250	TCF	JM	TCF	Control	R60	3.26E-13
250	TCF	JM	Collab	Control	R60	8.15E-15
250	TCF	JM	USFS	Control	Shadetree_PB	3.94E-09
250	TCF	JM	TCF	Control	Shadetree_PB	1.06E-14
250	TCF	JM	Collab	Control	Shadetree_PB	1.35E-13
600	USFS	E	USFS	Control	CC_PB_B	4.60E-10
600	USFS	E	TCF	Control	CC_PB_B	1.51E-14
600	USFS	E	Collab	Control	CC_PB_B	5.62E-30
600	USFS	E	USFS	Control	R30	6.86E-11
600	USFS	E	TCF	Control	R30	4.45E-16

600	USFS	E	Collab	Control	R30	8.85E-27
600	USFS	E	USFS	Control	R40	1.67E-18
600	USFS	E	TCF	Control	R40	9.09E-23
600	USFS	E	Collab	Control	R40	7.02E-26
600	USFS	E	USFS	Control	R60	3.48E-14
600	USFS	E	TCF	Control	R60	1.08E-17
600	USFS	E	Collab	Control	R60	9.05E-23
600	USFS	E	USFS	Control	Shadetree_PB	2.49E-17
600	USFS	E	TCF	Control	Shadetree_PB	5.54E-16
600	USFS	E	Collab	Control	Shadetree_PB	1.68E-26
600	TCF	E	USFS	Control	CC_PB_B	0.1248
600	TCF	E	TCF	Control	CC_PB_B	3.83E-20
600	TCF	E	Collab	Control	CC_PB_B	6.16E-29
600	TCF	E	USFS	Control	R30	0.24141
600	TCF	E	TCF	Control	R30	5.85E-12
600	TCF	E	Collab	Control	R30	3.49E-16
600	TCF	E	USFS	Control	R40	1
600	TCF	E	TCF	Control	R40	2.98E-11
600	TCF	E	Collab	Control	R40	1.92E-16
600	TCF	E	USFS	Control	R60	0.78
600	TCF	E	TCF	Control	R60	6.55E-10
600	TCF	E	Collab	Control	R60	1.59E-15
600	TCF	E	USFS	Control	Shadetree_PB	0.05343
600	TCF	E	TCF	Control	Shadetree_PB	2.91E-14
600	TCF	E	Collab	Control	Shadetree_PB	1.94E-14
700	USFS	E	USFS	Control	CC_PB_B	4.68E-13
700	USFS	E	TCF	Control	CC_PB_B	1.19E-18
700	USFS	E	Collab	Control	CC_PB_B	2.16E-21
700	USFS	E	USFS	Control	R30	1.96E-18
700	USFS	E	TCF	Control	R30	7.53E-14
700	USFS	E	Collab	Control	R30	2.45E-26
700	USFS	E	USFS	Control	R40	1.08E-11
700	USFS	E	TCF	Control	R40	1.50E-15
700	USFS	E	Collab	Control	R40	2.40E-31
700	USFS	E	USFS	Control	R60	1.51E-23
700	USFS	E	TCF	Control	R60	2.18E-14
700	USFS	E	Collab	Control	R60	1.42E-28
700	USFS	E	USFS	Control	Shadetree_PB	3.25E-19
700	USFS	E	TCF	Control	Shadetree_PB	3.90E-12
700	USFS	E	Collab	Control	Shadetree_PB	1.29E-29
700	TCF	E	USFS	Control	CC_PB_B	0.001053
700	TCF	E	TCF	Control	CC_PB_B	3.94E-11
700	TCF	E	Collab	Control	CC_PB_B	2.75E-30
700	TCF	E	USFS	Control	R30	0.0975
700	TCF	E	TCF	Control	R30	7.18E-12

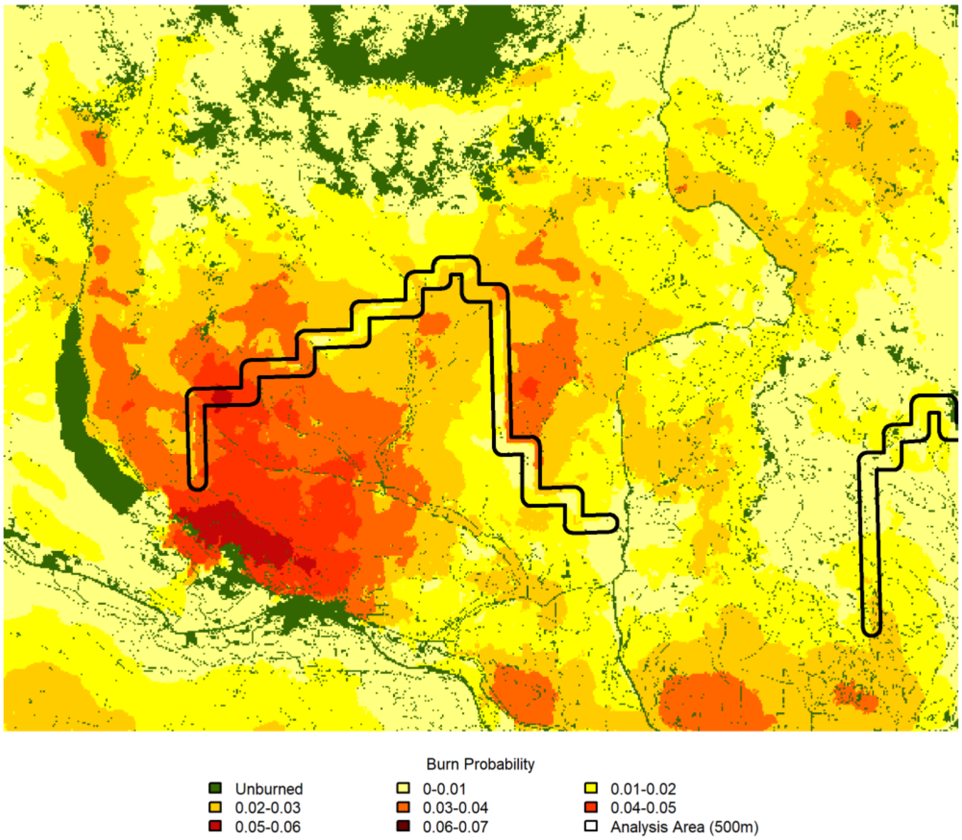
700	TCF	E	Collab	Control	R30	5.85E-18
700	TCF	E	USFS	Control	R40	0.027534
700	TCF	E	TCF	Control	R40	4.06E-13
700	TCF	E	Collab	Control	R40	1.28E-15
700	TCF	E	USFS	Control	R60	0.12285
700	TCF	E	TCF	Control	R60	3.17E-09
700	TCF	E	Collab	Control	R60	1.33E-13
700	TCF	E	USFS	Control	Shadetree_PB	0.037947
700	TCF	E	TCF	Control	Shadetree_PB	2.11E-12
700	TCF	E	Collab	Control	Shadetree_PB	2.64E-18
750	USFS	E	USFS	Control	CC_PB_B	4.88E-13
750	USFS	E	TCF	Control	CC_PB_B	2.32E-19
750	USFS	E	Collab	Control	CC_PB_B	1.10E-21
750	USFS	E	USFS	Control	R30	3.28E-17
750	USFS	E	TCF	Control	R30	1.47E-21
750	USFS	E	Collab	Control	R30	4.88E-24
750	USFS	E	USFS	Control	R40	1.27E-15
750	USFS	E	TCF	Control	R40	7.92E-14
750	USFS	E	Collab	Control	R40	8.00E-23
750	USFS	E	USFS	Control	R60	6.44E-20
750	USFS	E	TCF	Control	R60	5.42E-16
750	USFS	E	Collab	Control	R60	5.58E-28
750	USFS	E	USFS	Control	Shadetree_PB	1.12E-14
750	USFS	E	TCF	Control	Shadetree_PB	1.33E-17
750	USFS	E	Collab	Control	Shadetree_PB	5.30E-30
750	TCF	E	USFS	Control	CC_PB_B	0.13143
750	TCF	E	TCF	Control	CC_PB_B	5.03E-18
750	TCF	E	Collab	Control	CC_PB_B	6.40E-24
750	TCF	E	USFS	Control	R30	0.23985
750	TCF	E	TCF	Control	R30	7.53E-11
750	TCF	E	Collab	Control	R30	9.32E-18
750	TCF	E	USFS	Control	R40	0.010881
750	TCF	E	TCF	Control	R40	6.24E-12
750	TCF	E	Collab	Control	R40	1.07E-17
750	TCF	E	USFS	Control	R60	1
750	TCF	E	TCF	Control	R60	1.12E-11
750	TCF	E	Collab	Control	R60	5.34E-14
750	TCF	E	USFS	Control	Shadetree_PB	0.015483
750	TCF	E	TCF	Control	Shadetree_PB	3.22E-14
750	TCF	E	Collab	Control	Shadetree_PB	1.40E-13

APPENDIX E

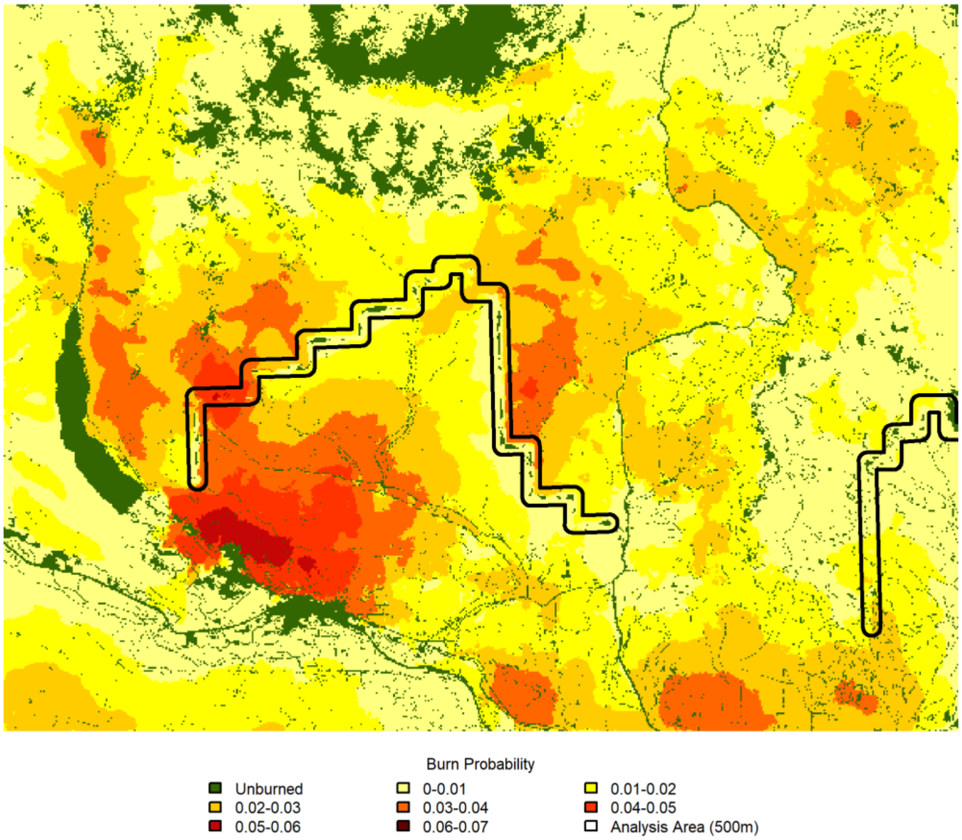
Conditional burn probability maps derived from Randig simulations for all treatment widths, treatment types, treatment placements and wind scenarios.

Extreme Weather Scenario

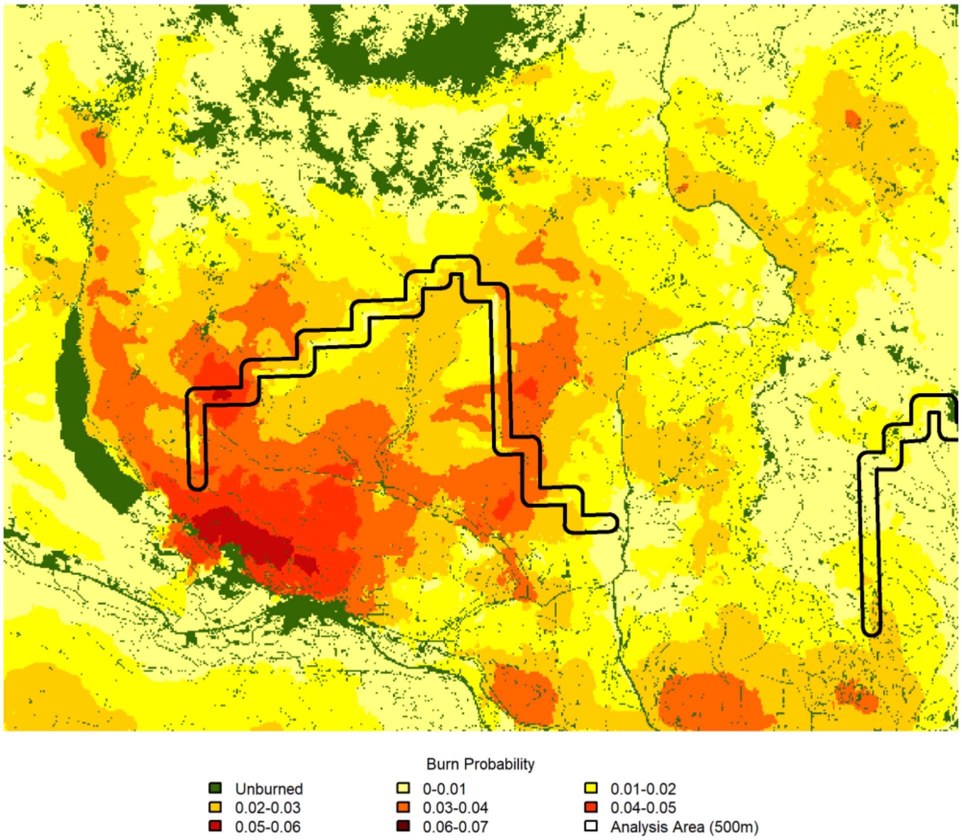
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



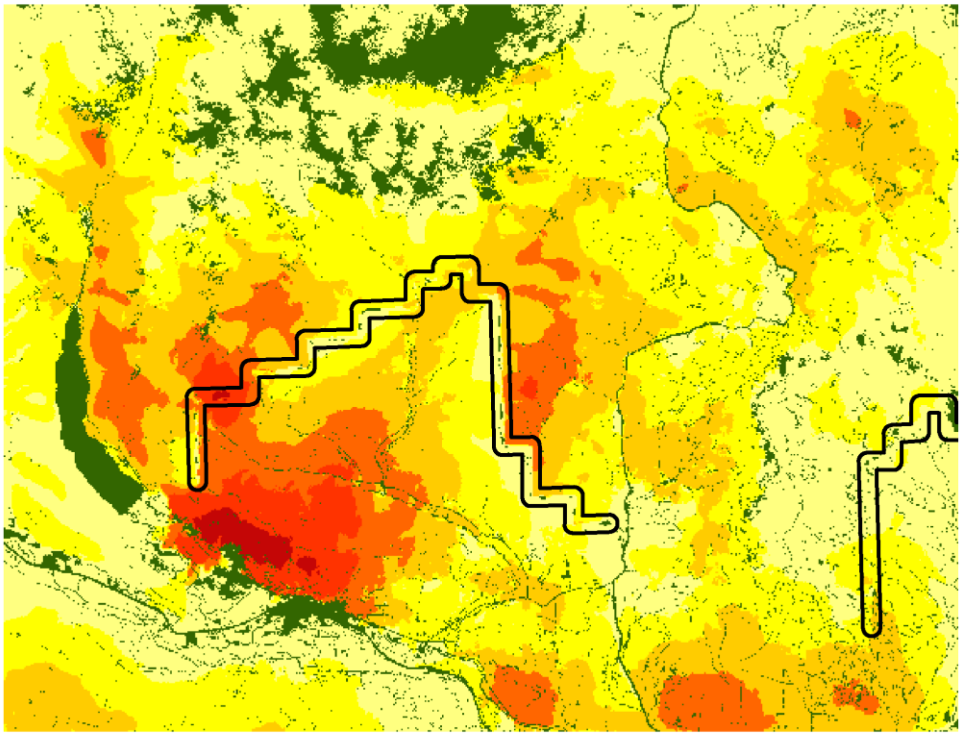
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



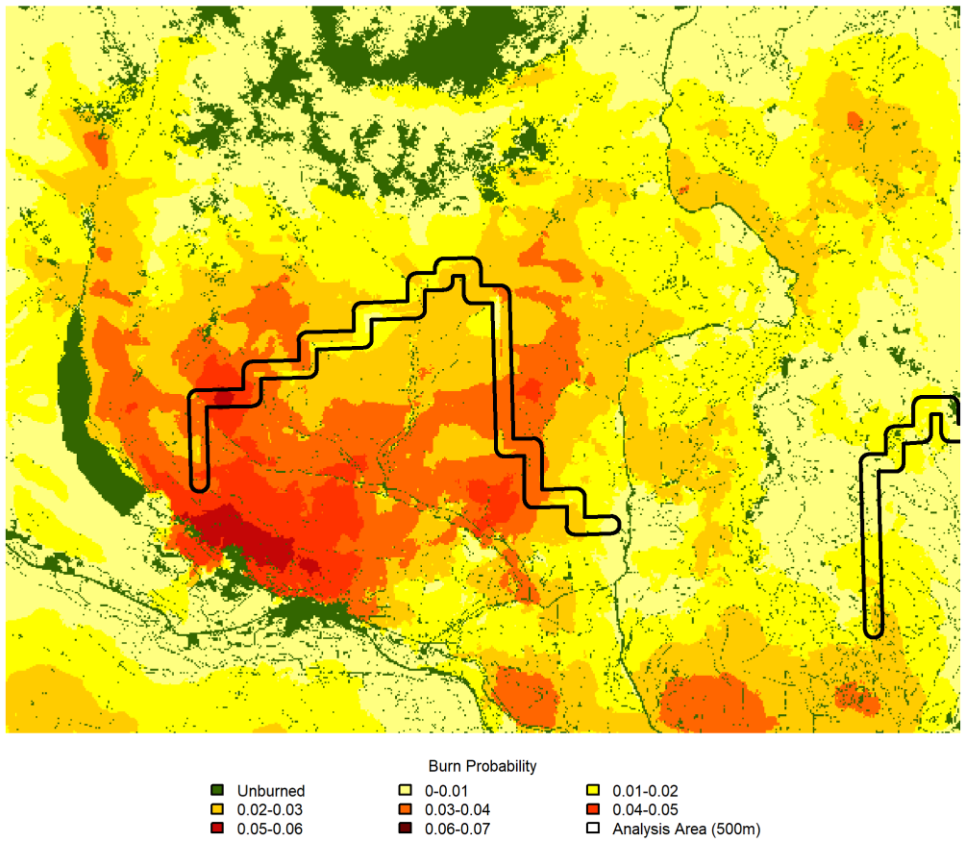
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



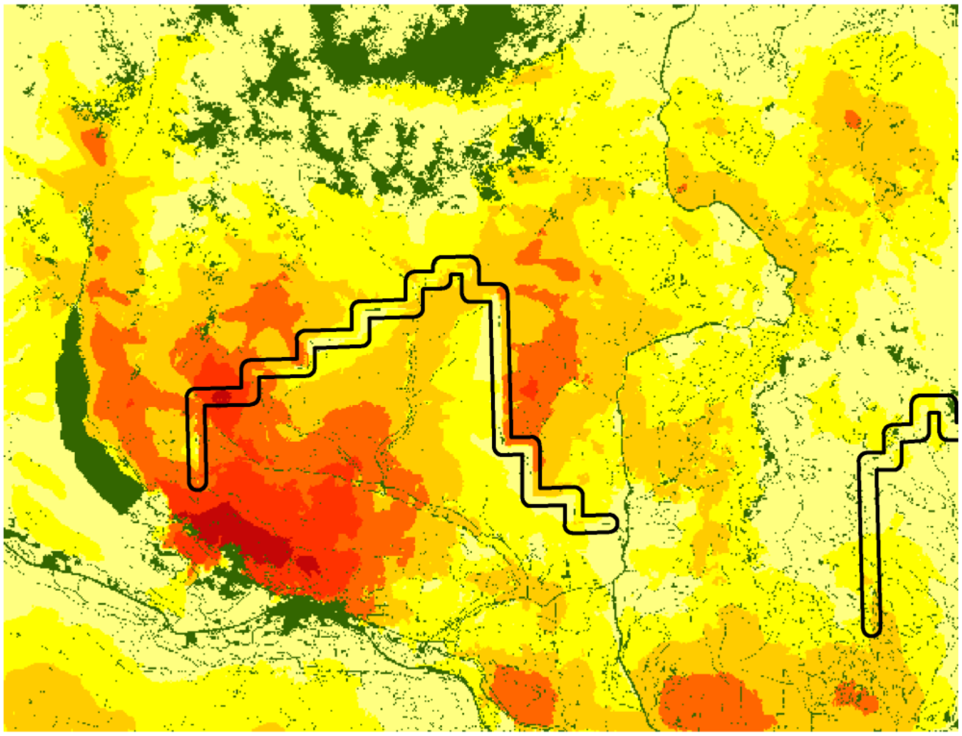
Burn Probability

Unburned
0-0.01
0.01-0.02
0.02-0.03
0.03-0.04
0.04-0.05
0.05-0.06
0.06-0.07
Analysis Area (500m)

Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



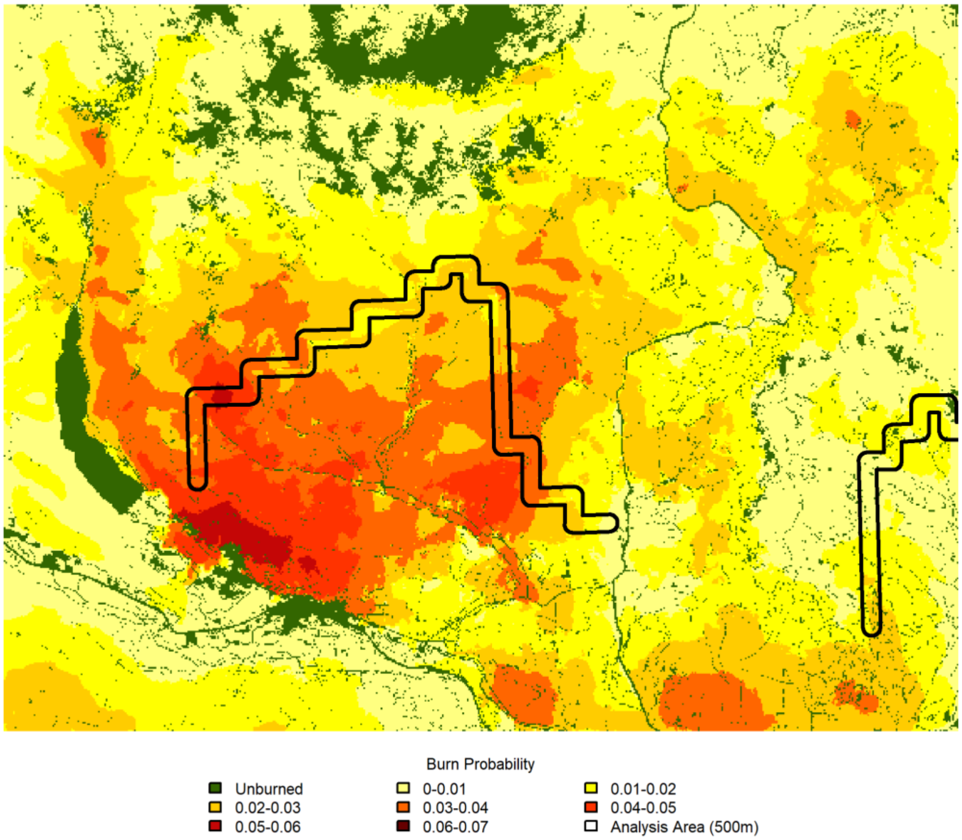
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



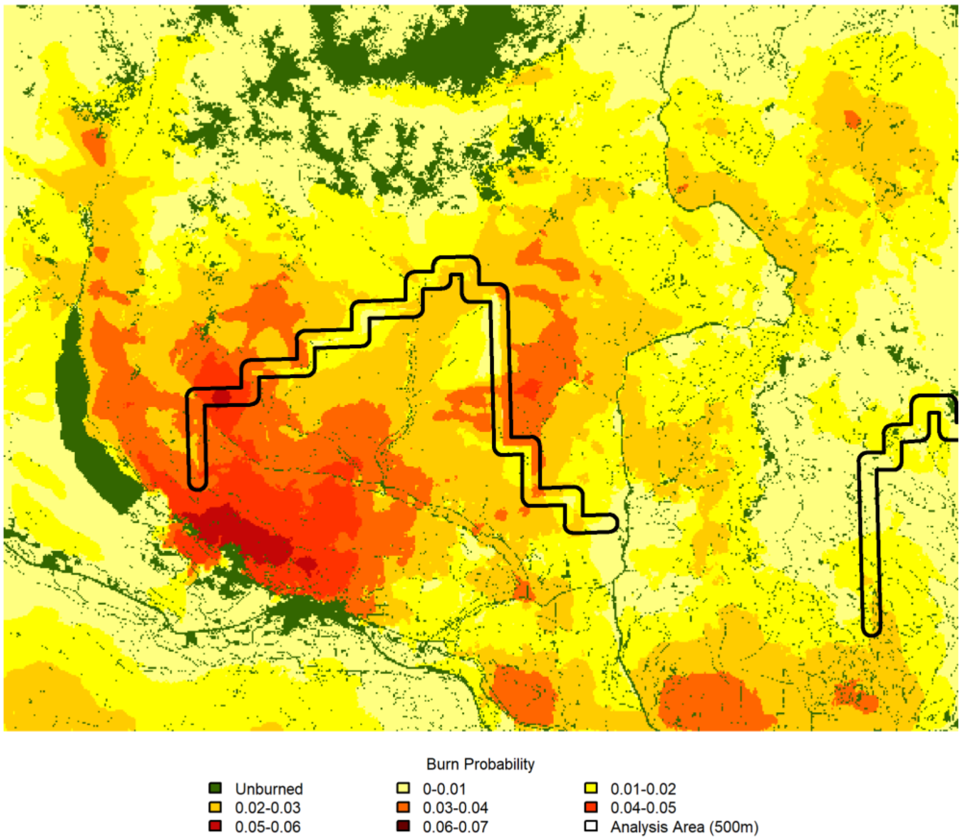
Burn Probability

Unburned	0-0.01	0.01-0.02
0.02-0.03	0.03-0.04	0.04-0.05
0.05-0.06	0.06-0.07	Analysis Area (500m)

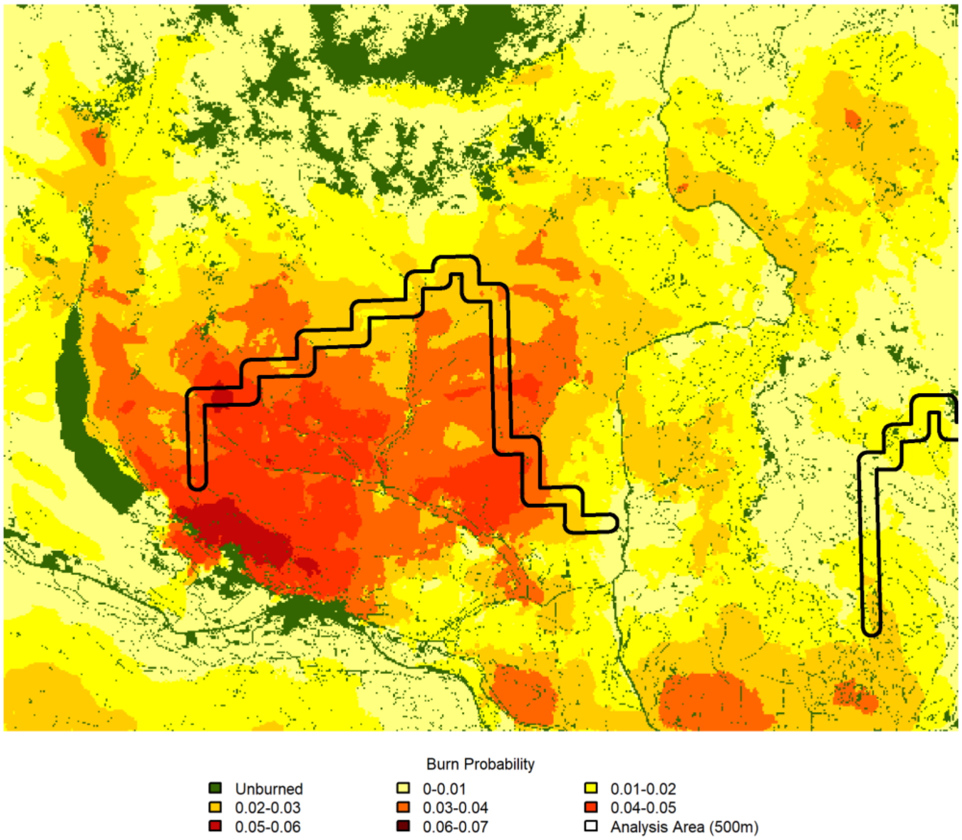
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



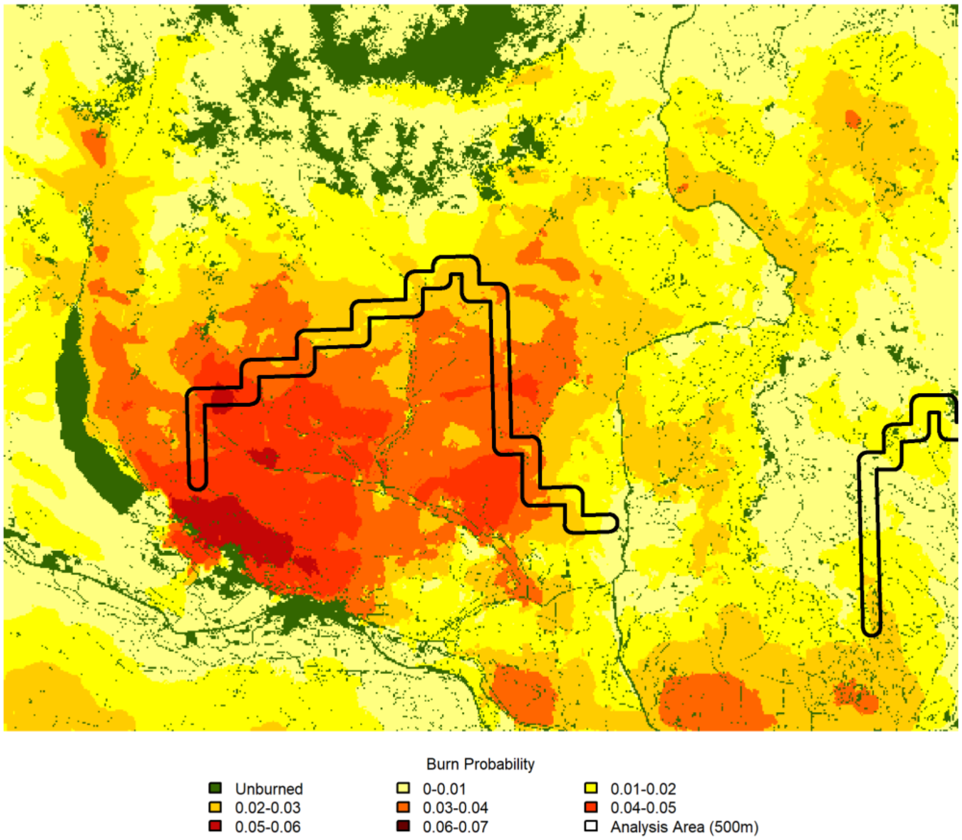
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



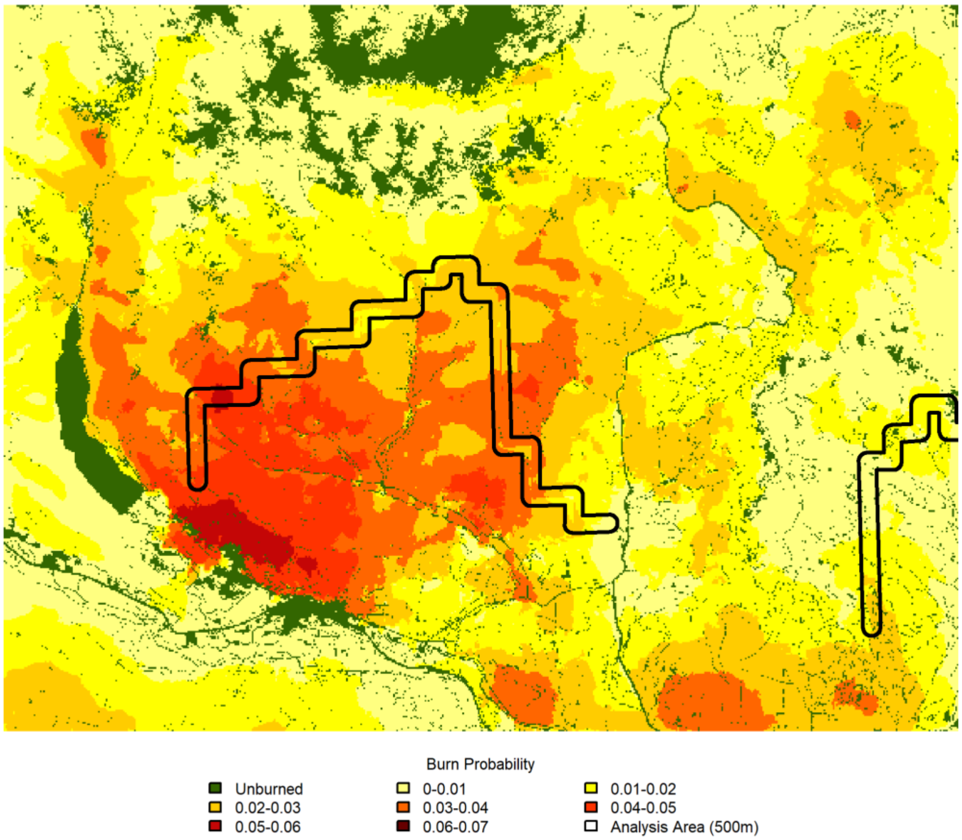
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



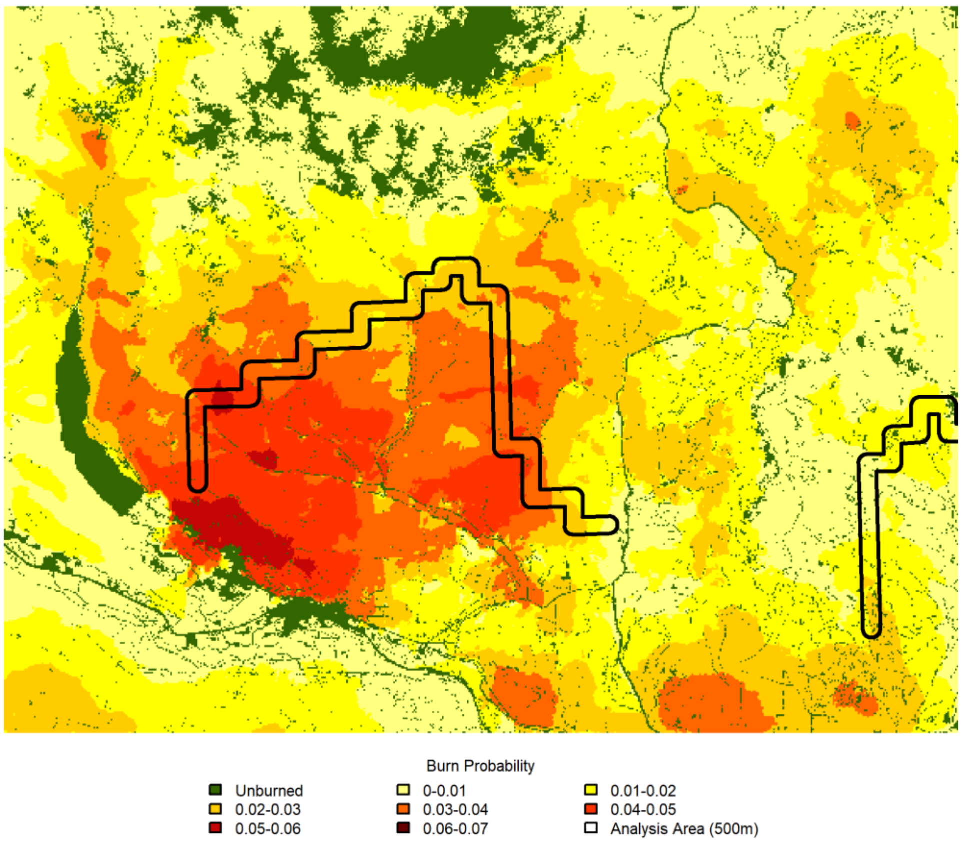
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



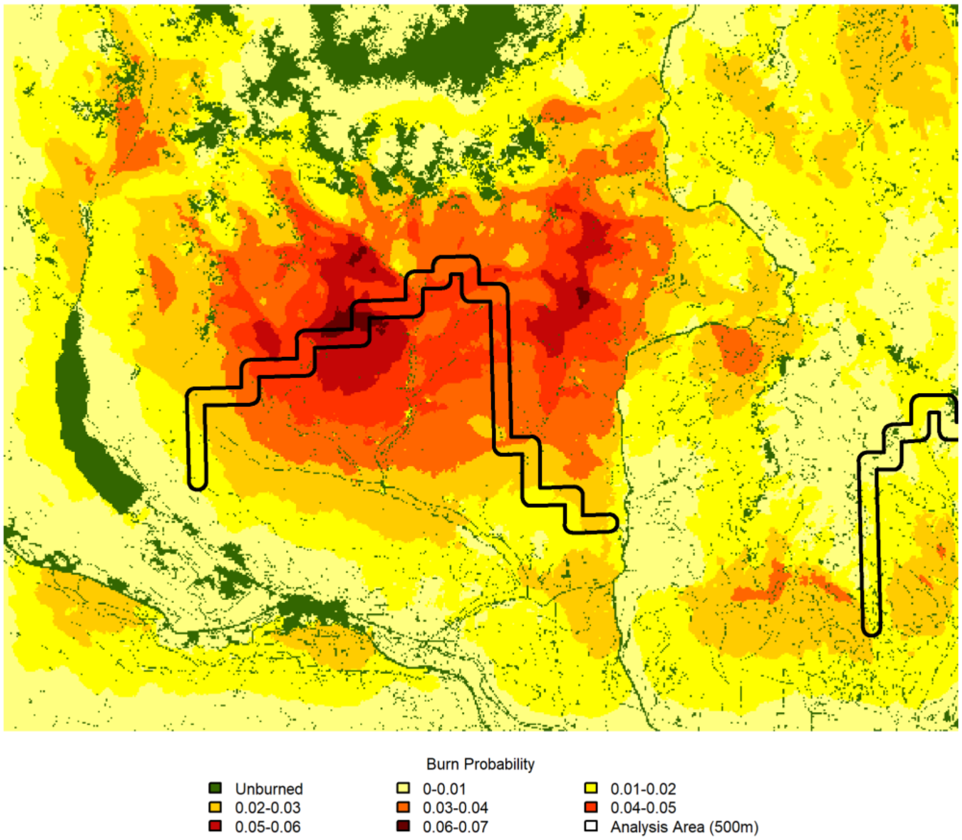
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



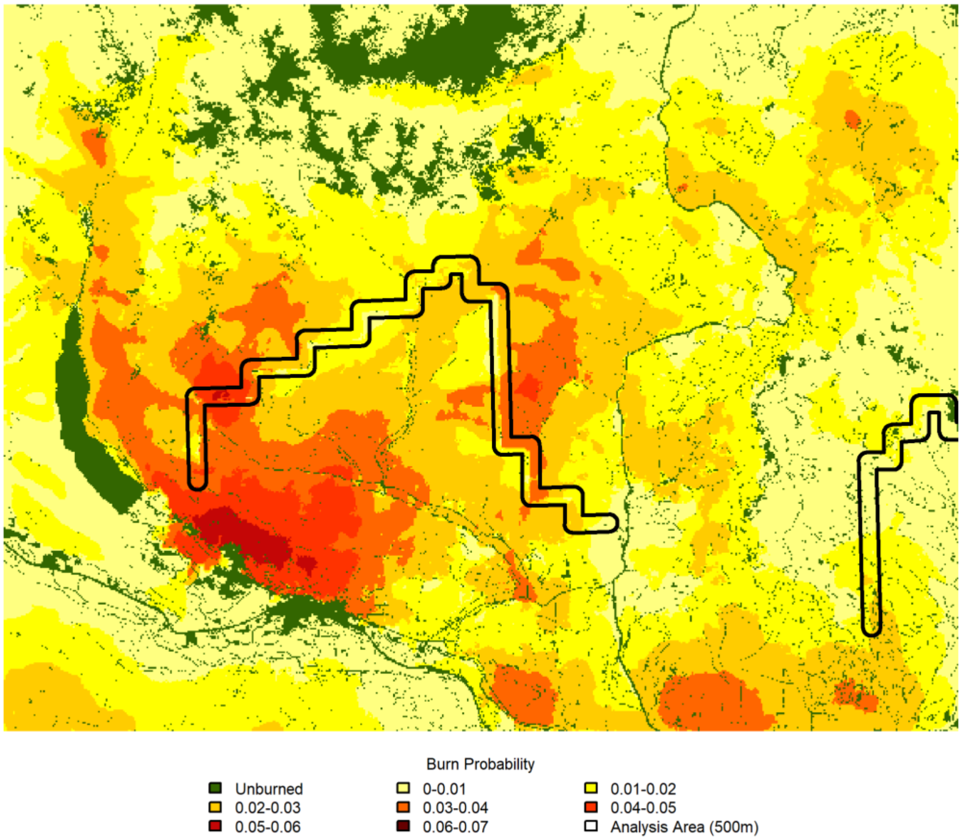
Untreated Simulations
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather



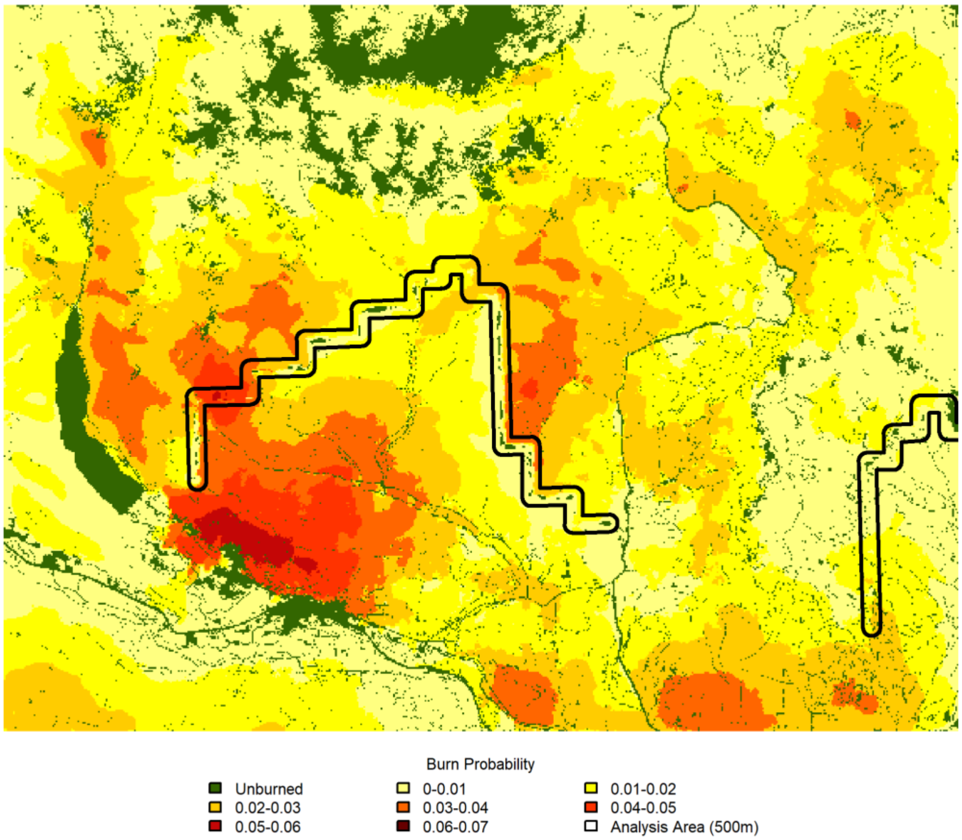
Untreated Simulations
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather



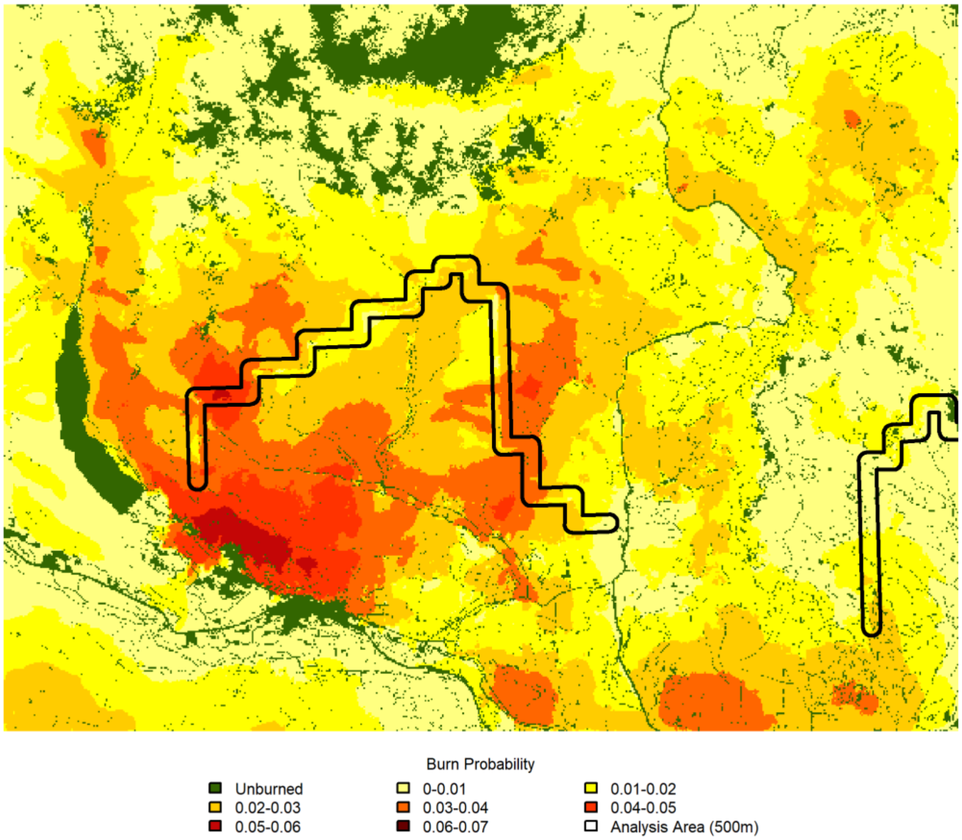
Reduction of 60% Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



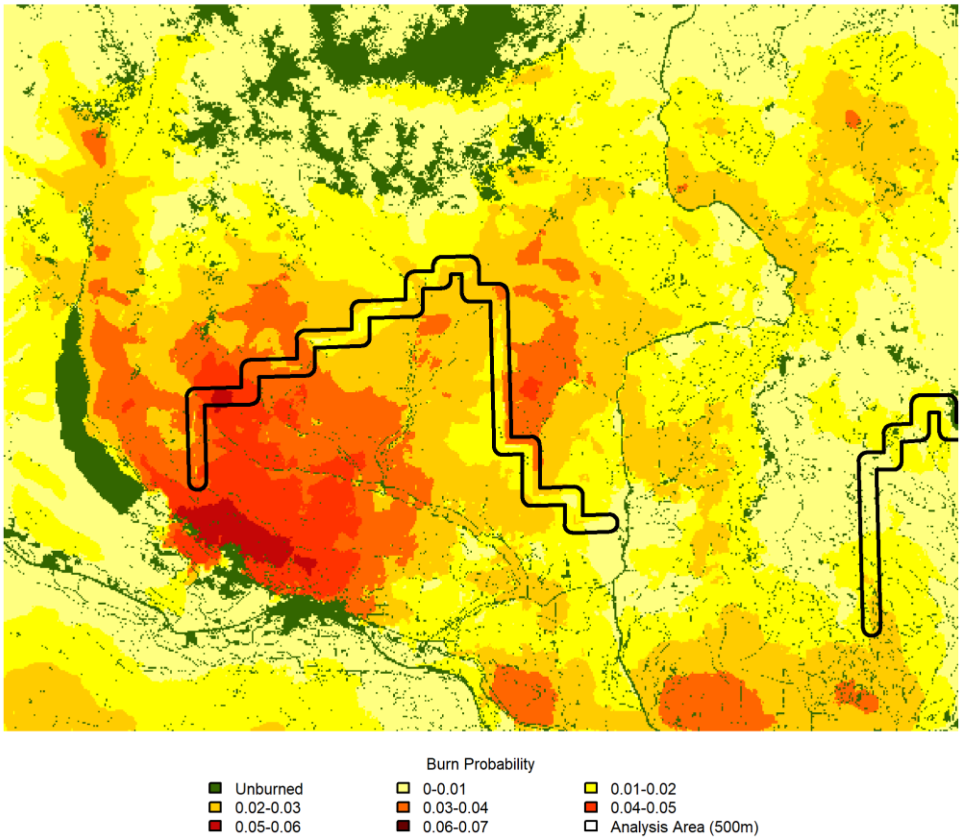
Reduction of 60% Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



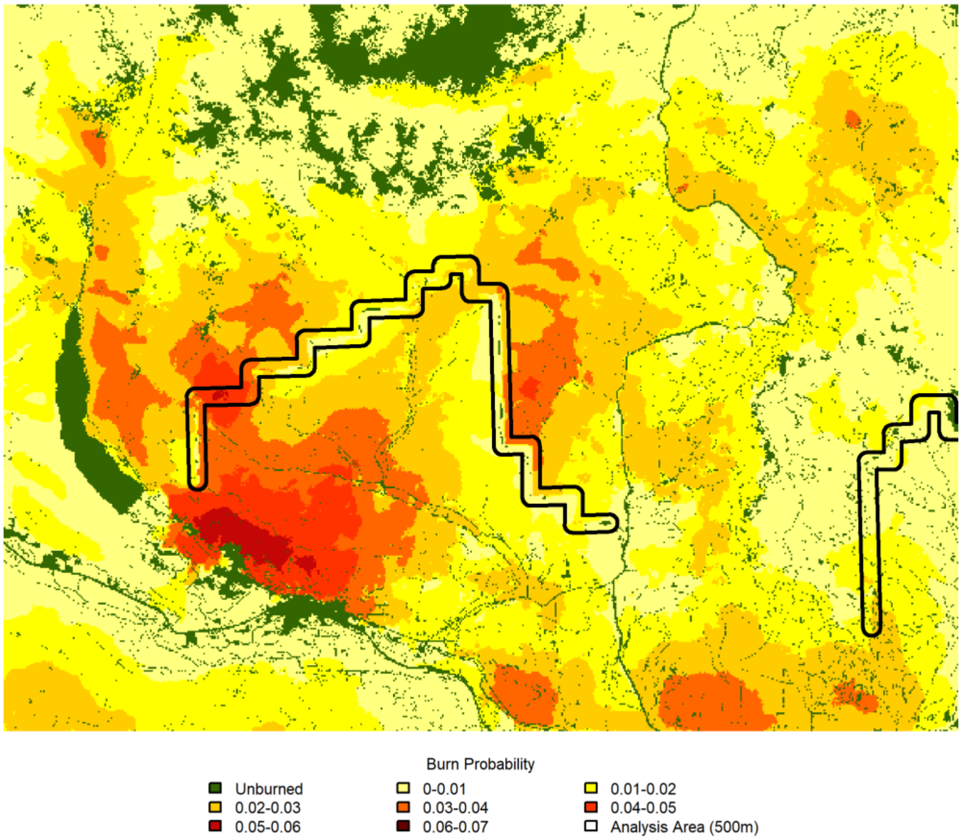
Reduction of 60% Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



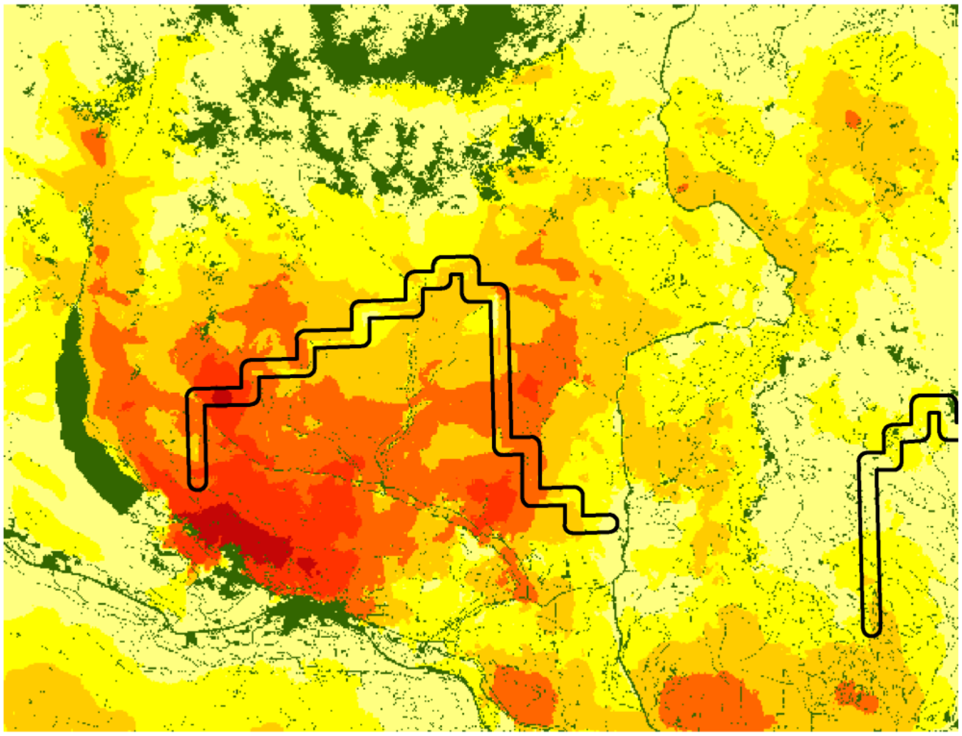
Reduction of 60% Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



Reduction of 60% Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



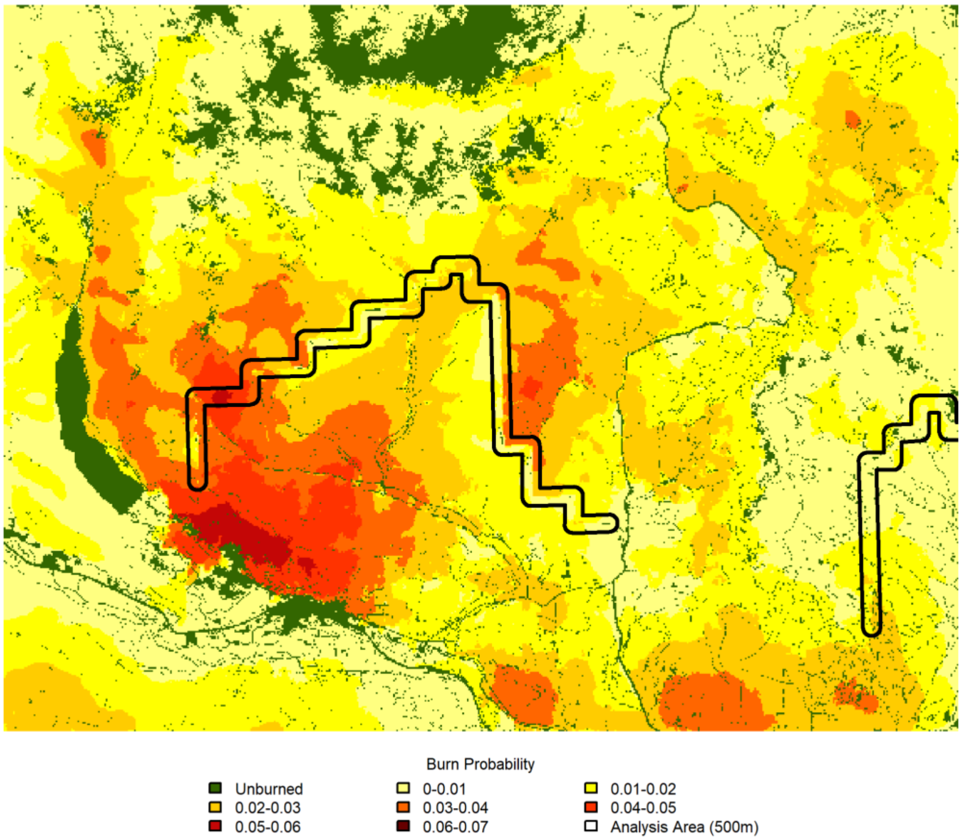
Reduction of 60% Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



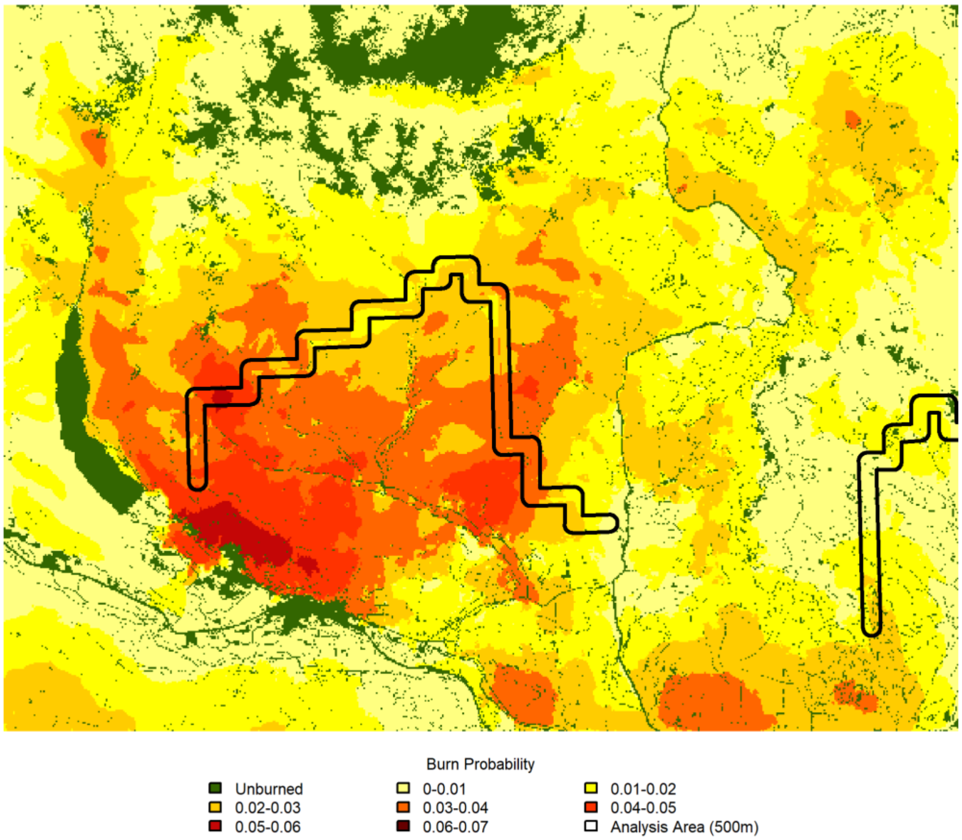
Burn Probability

Unburned	0-0.01	0.01-0.02
0.02-0.03	0.03-0.04	0.04-0.05
0.05-0.06	0.06-0.07	Analysis Area (500m)

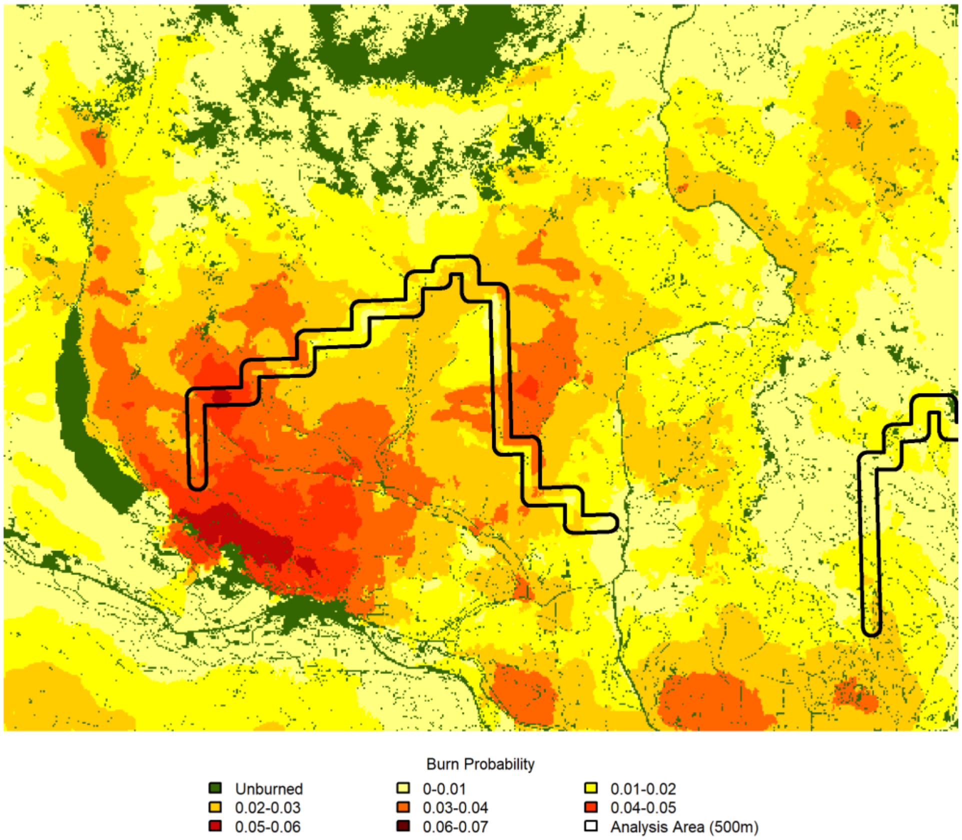
Reduction of 60% Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



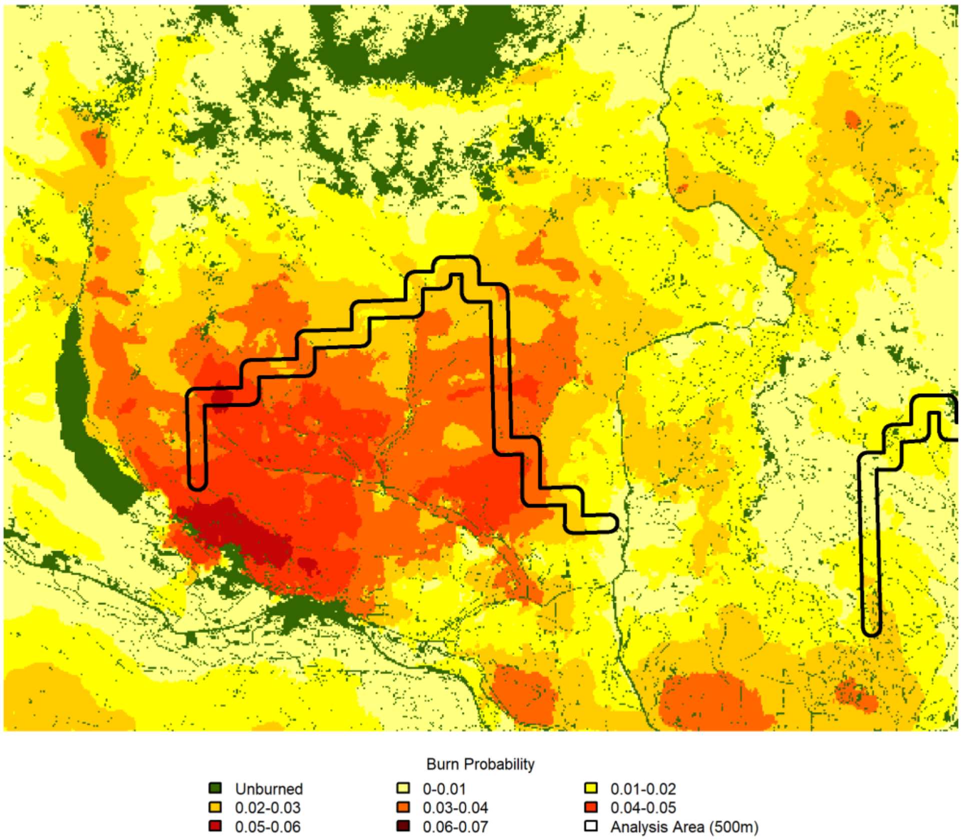
Reduction of 60% Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



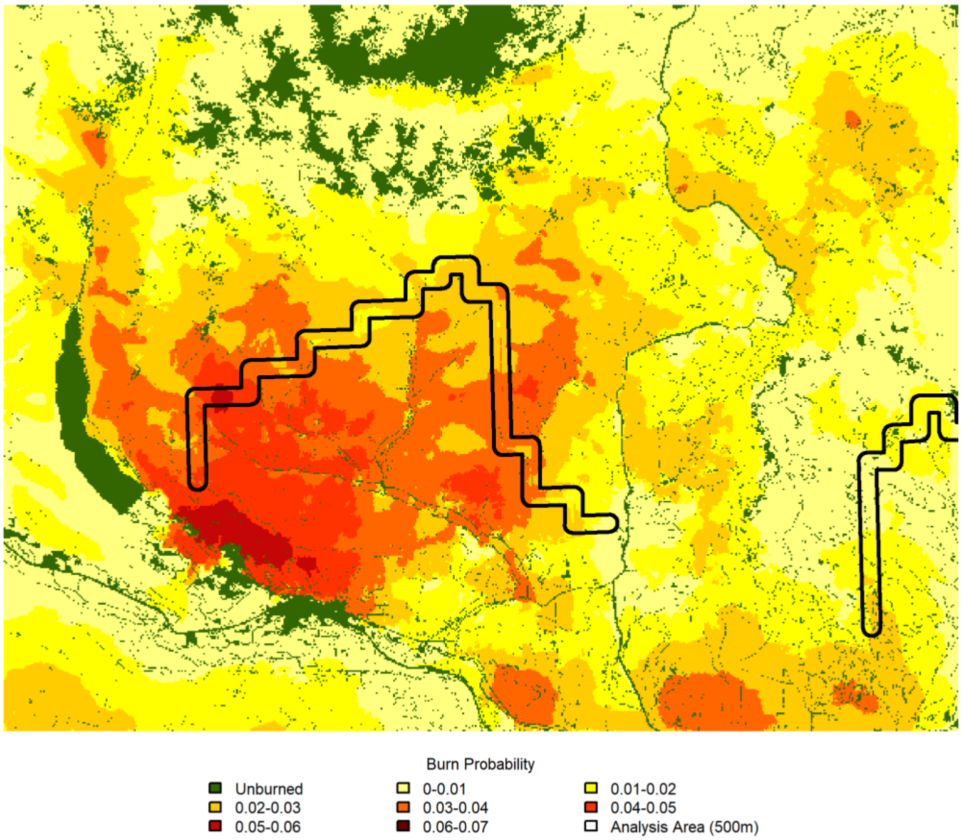
Reduction of 60% Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



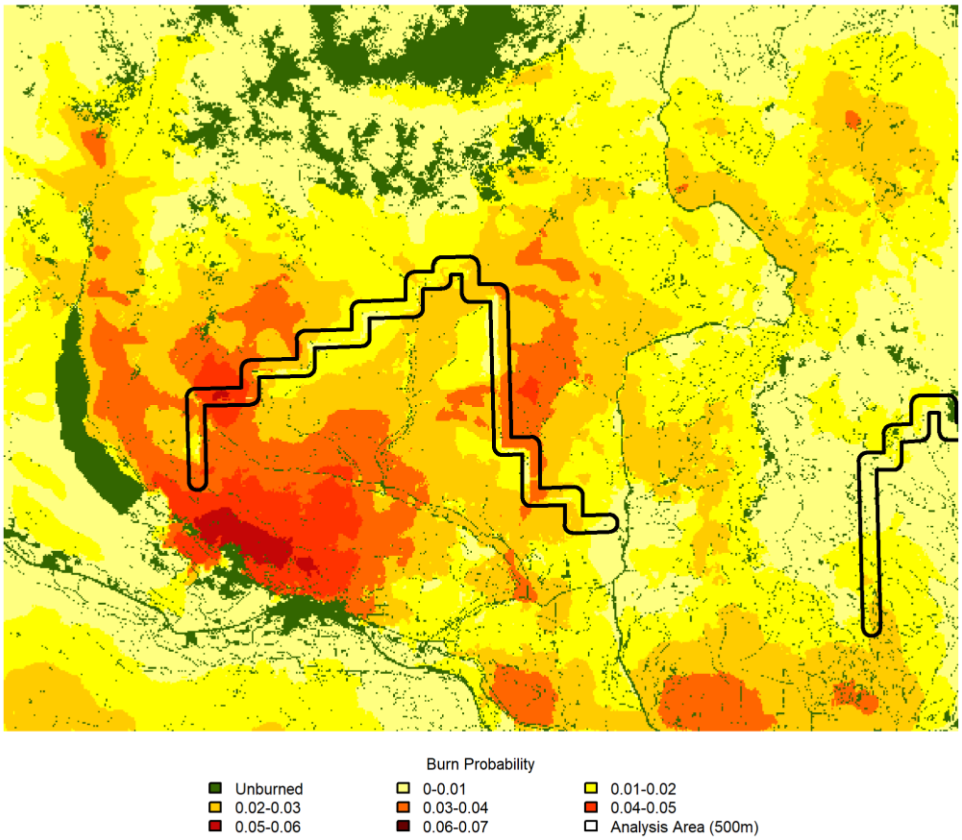
Reduction of 60% Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



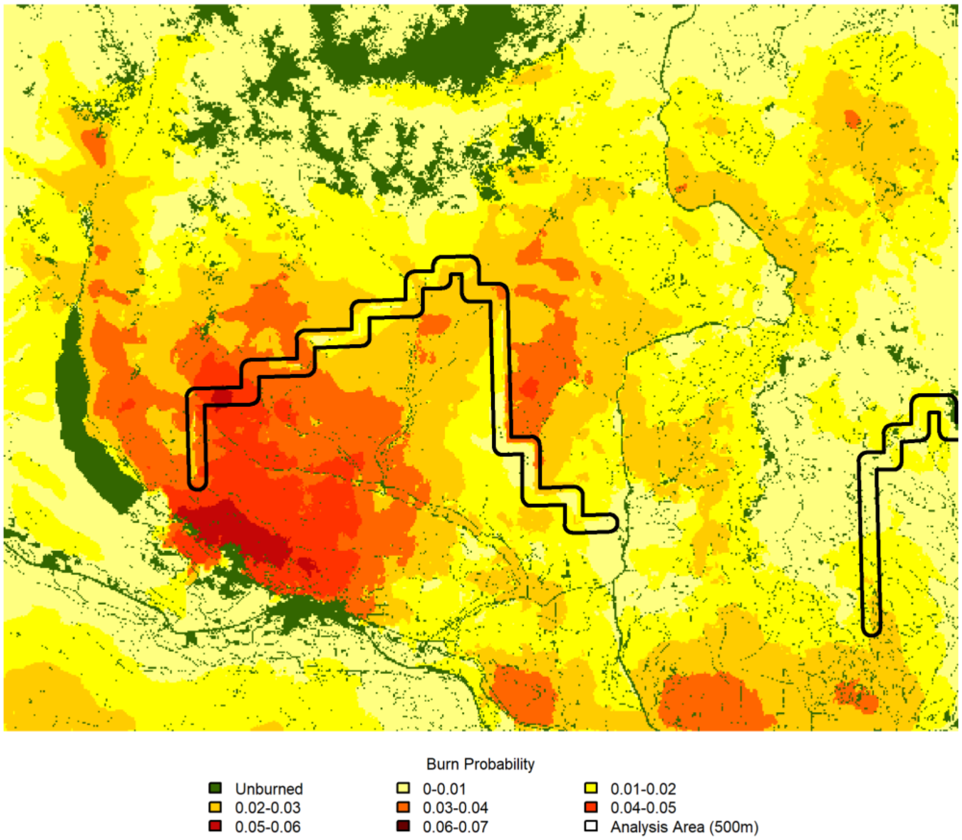
Reduction of 60% Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



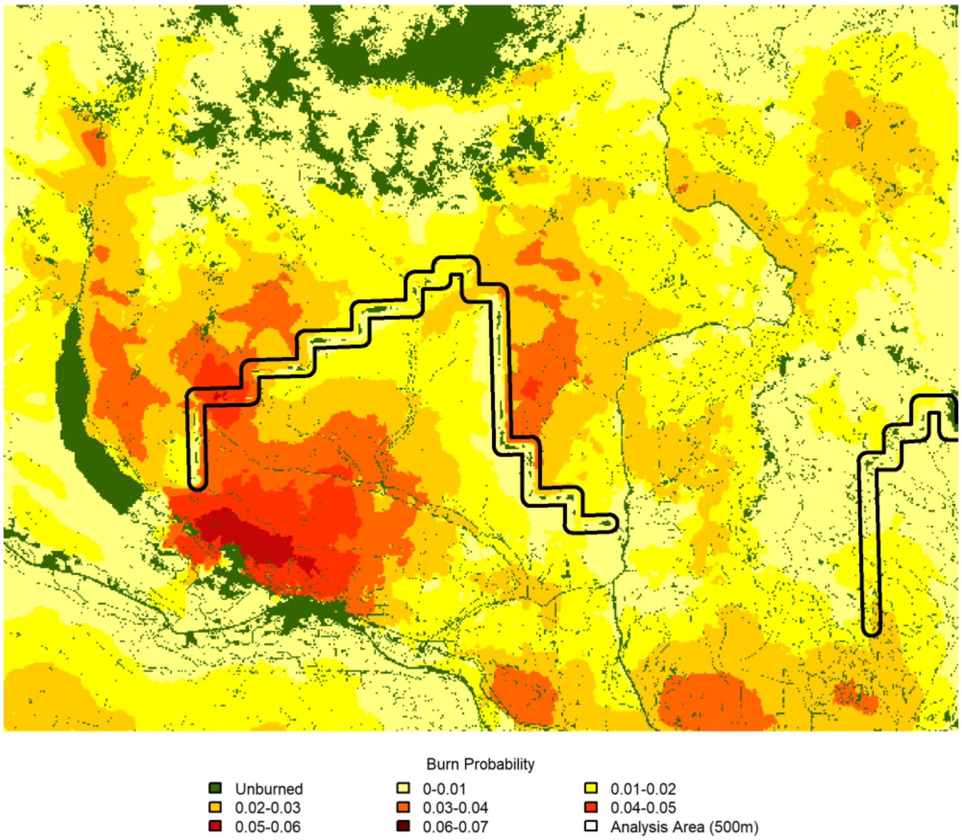
Reduction of 40% Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



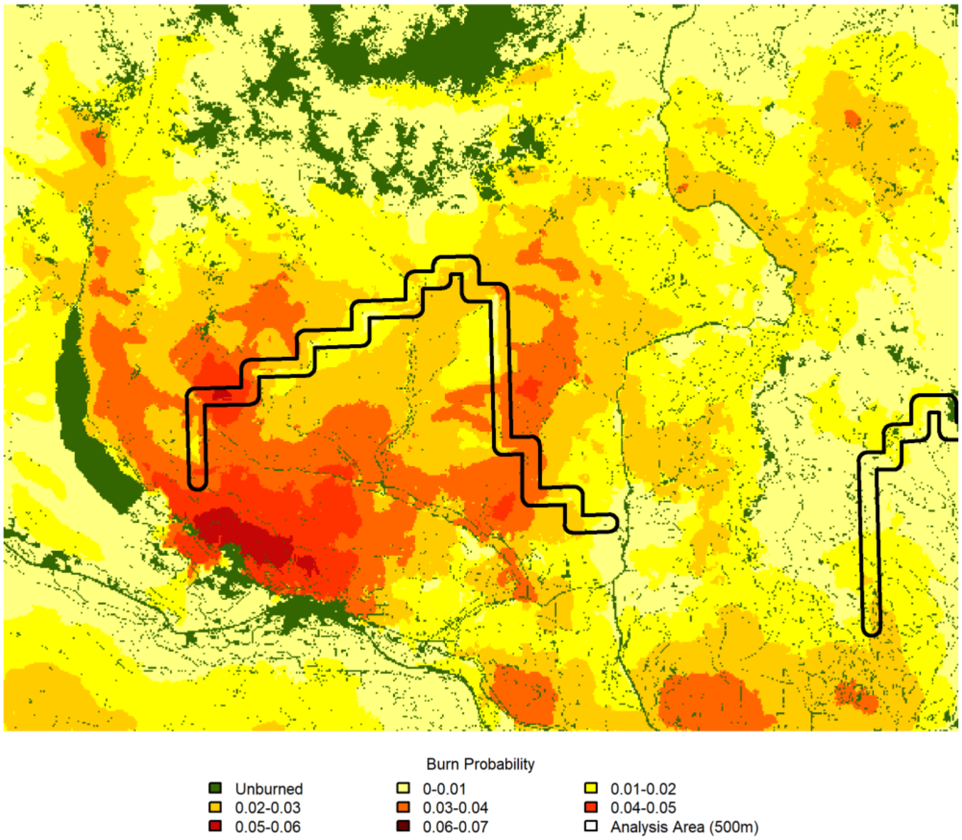
Reduction of 40% Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



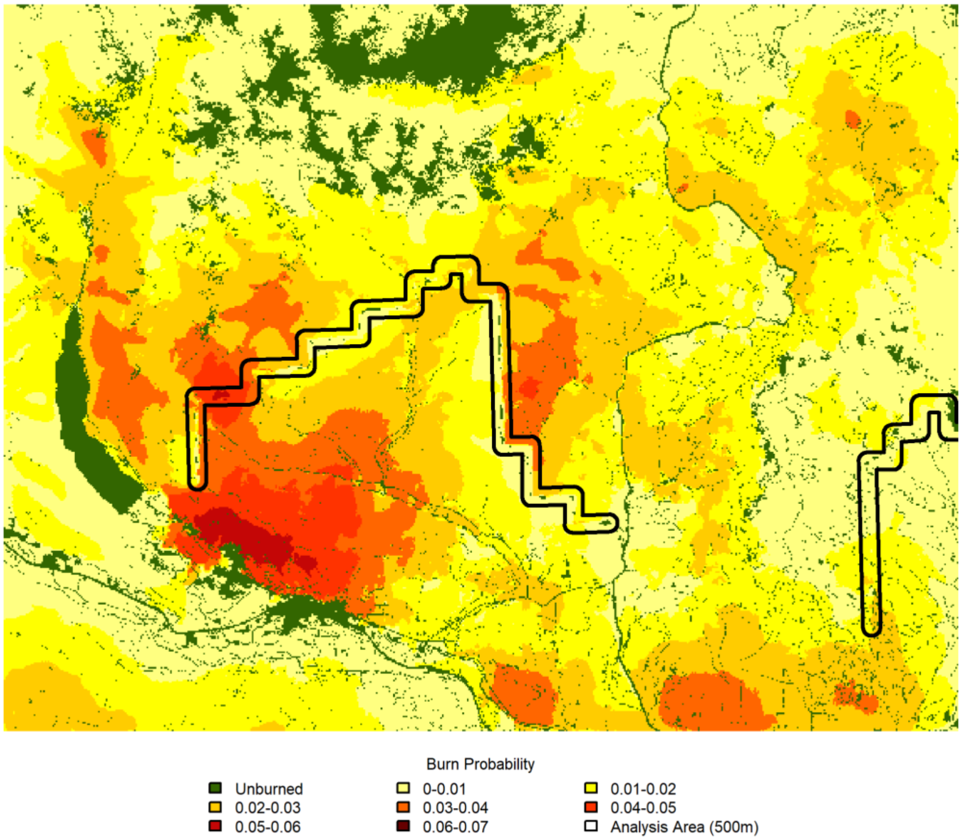
Reduction of 40% Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



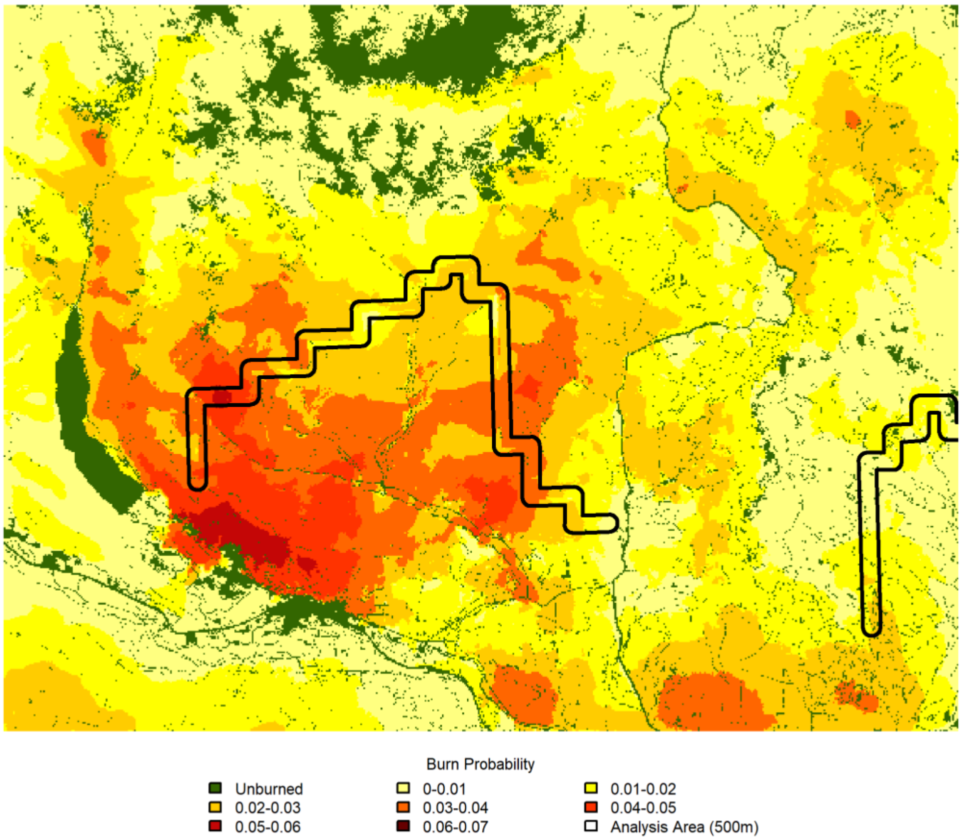
Reduction of 40% Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



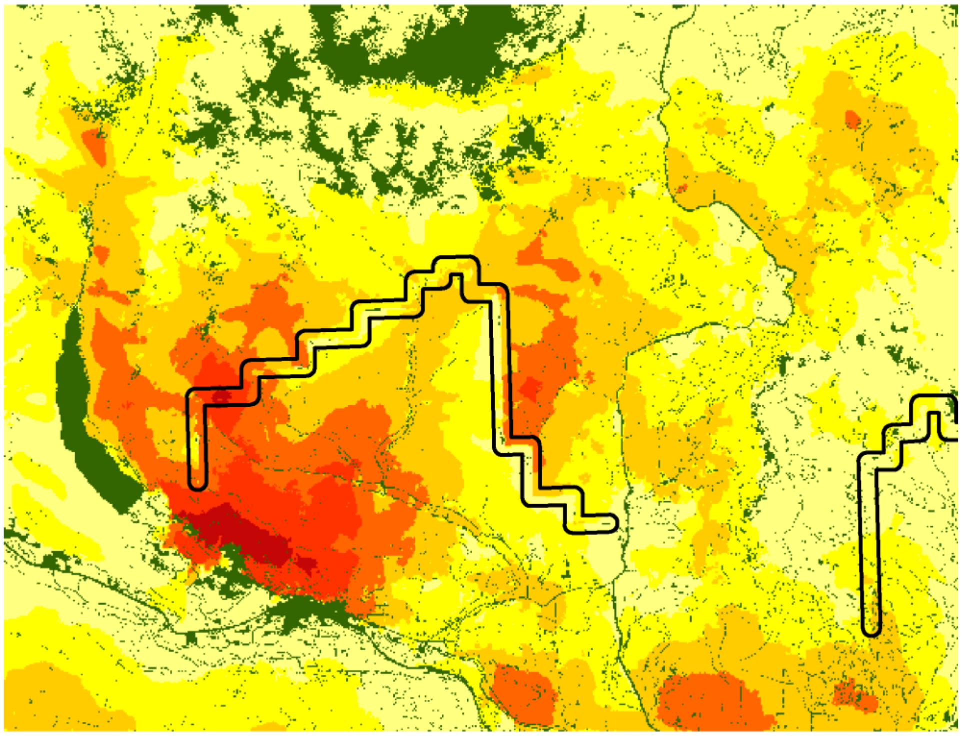
Reduction of 40% Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



Reduction of 40% Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



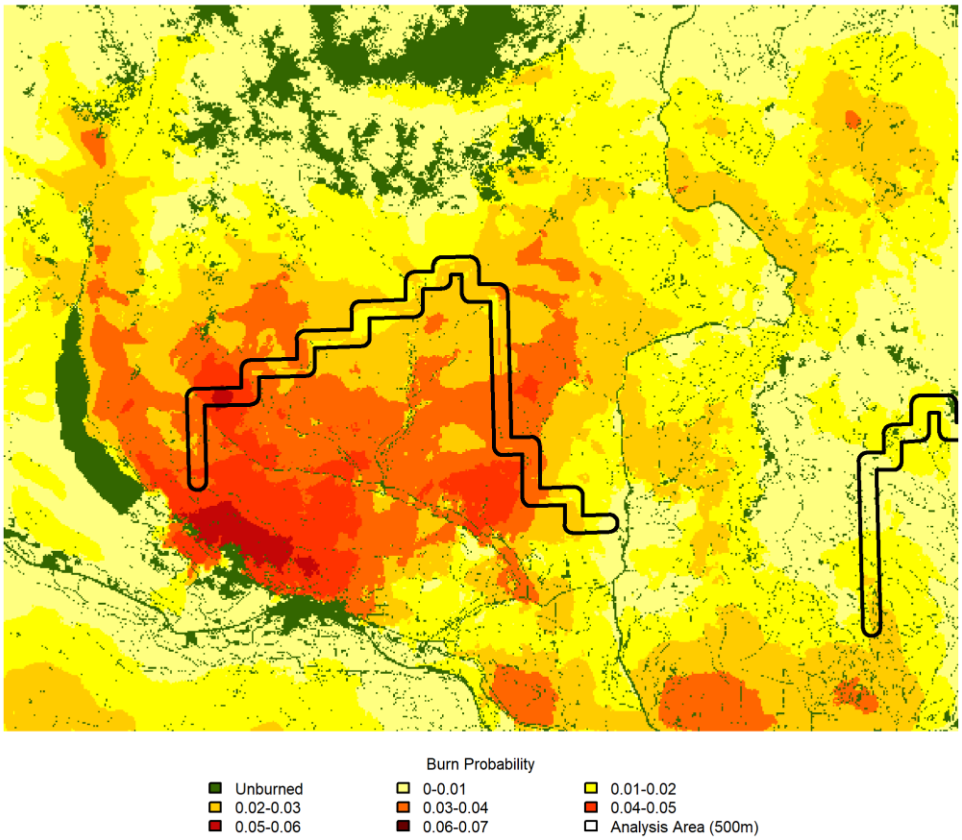
Reduction of 40% Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



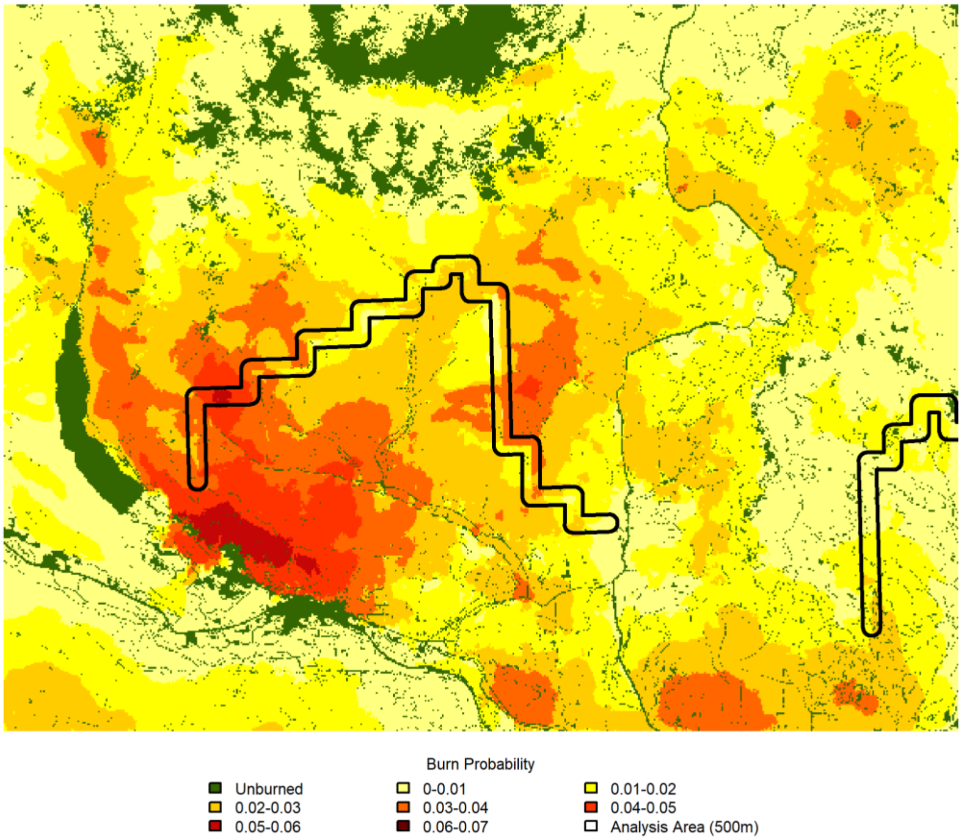
Burn Probability

Unburned	0-0.01	0.01-0.02
0.02-0.03	0.03-0.04	0.04-0.05
0.05-0.06	0.06-0.07	Analysis Area (500m)

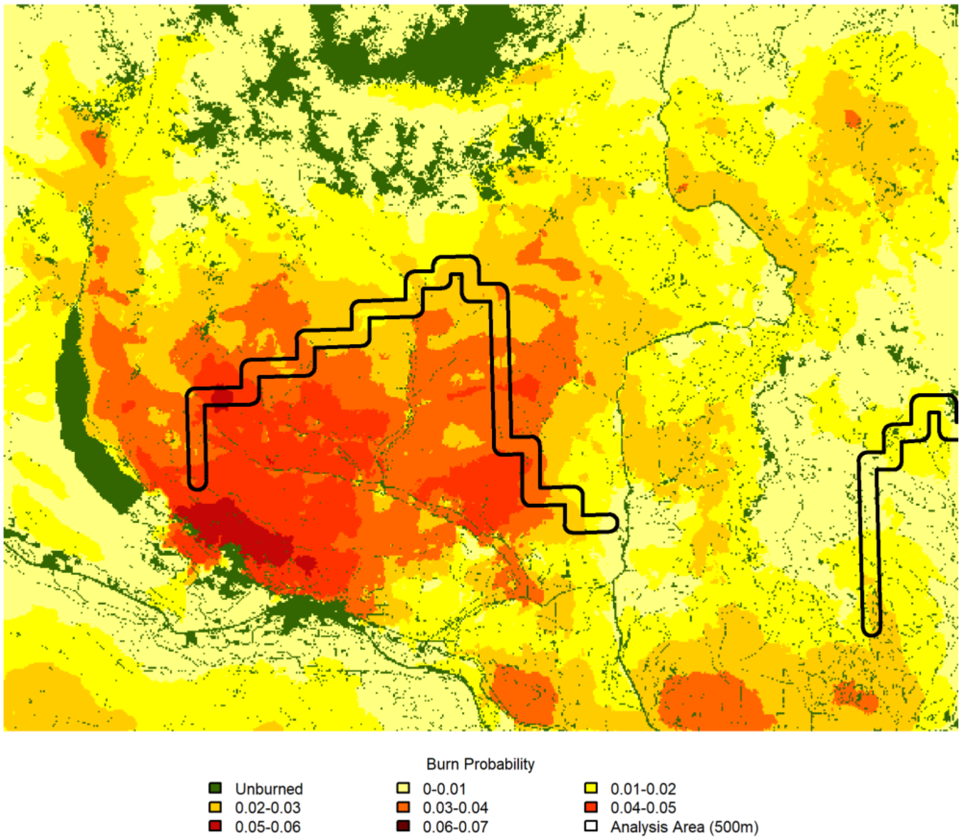
Reduction of 40% Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



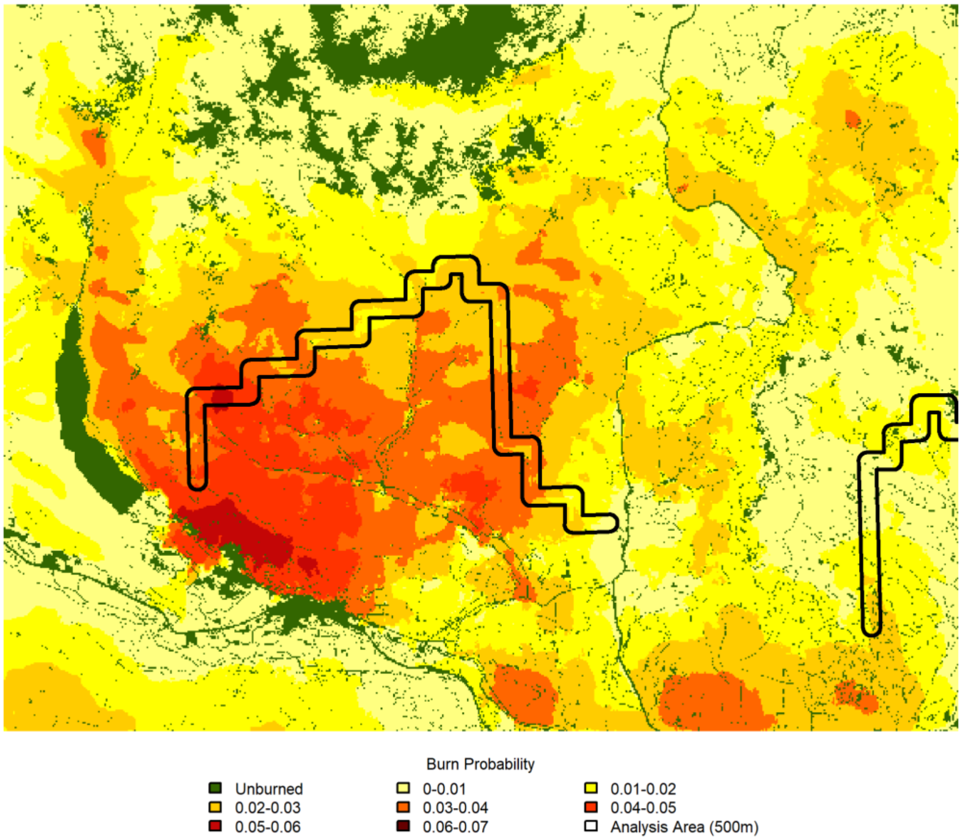
Reduction of 40% Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



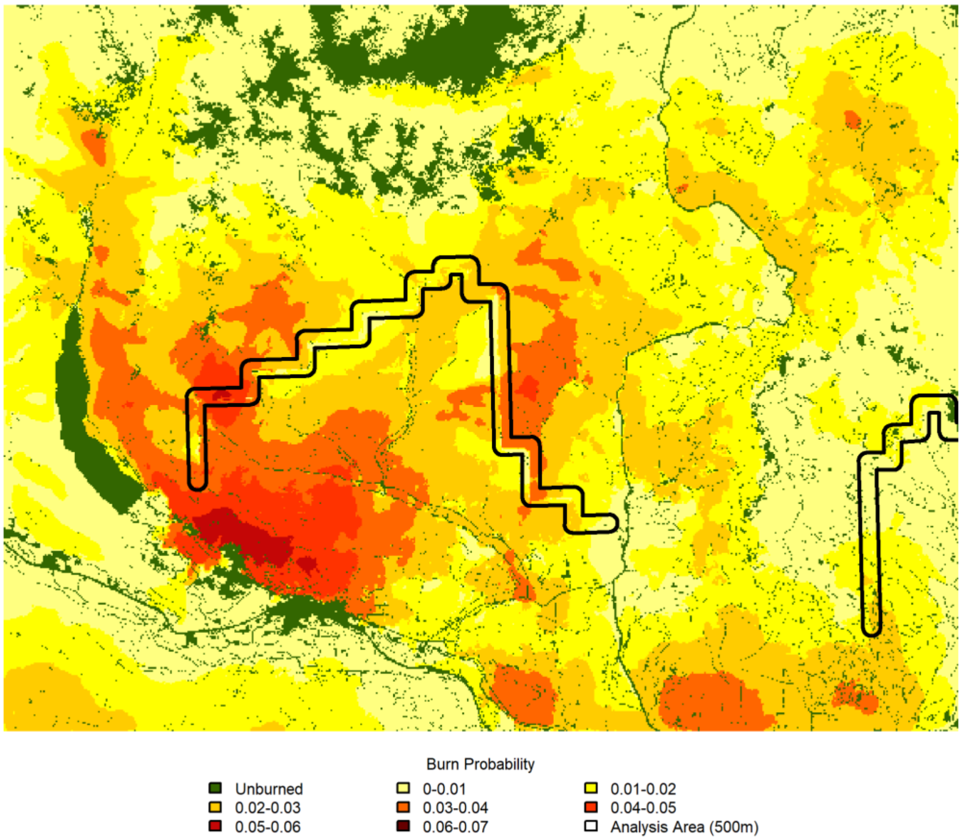
Reduction of 40% Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



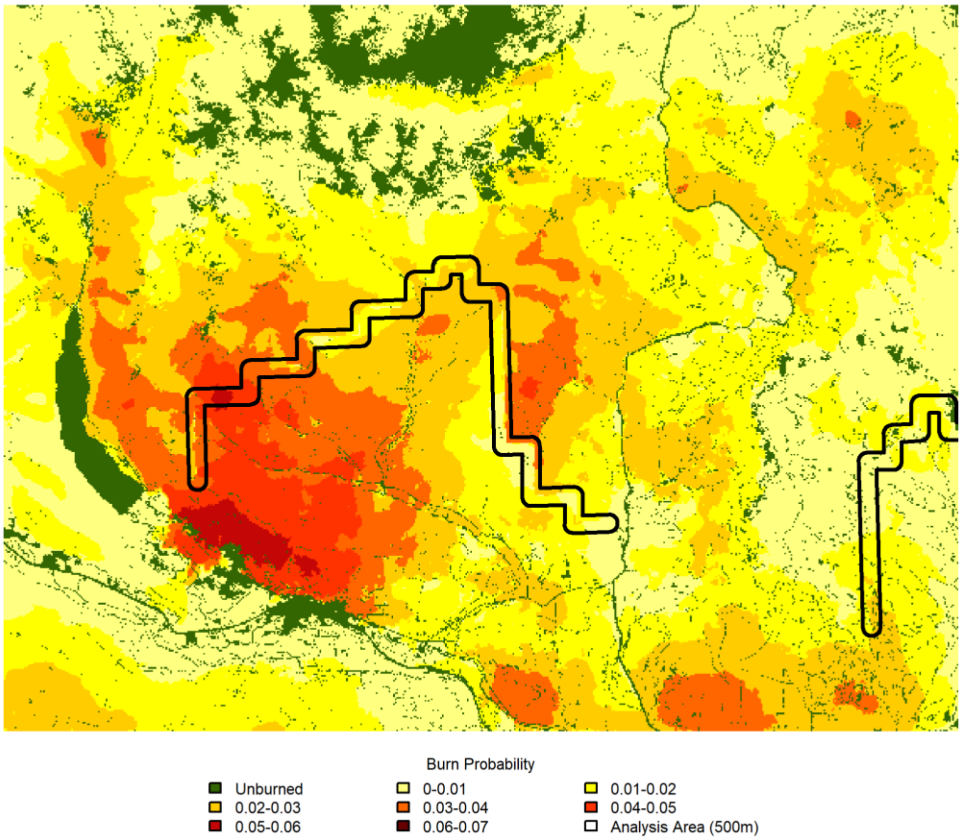
Reduction of 40% Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



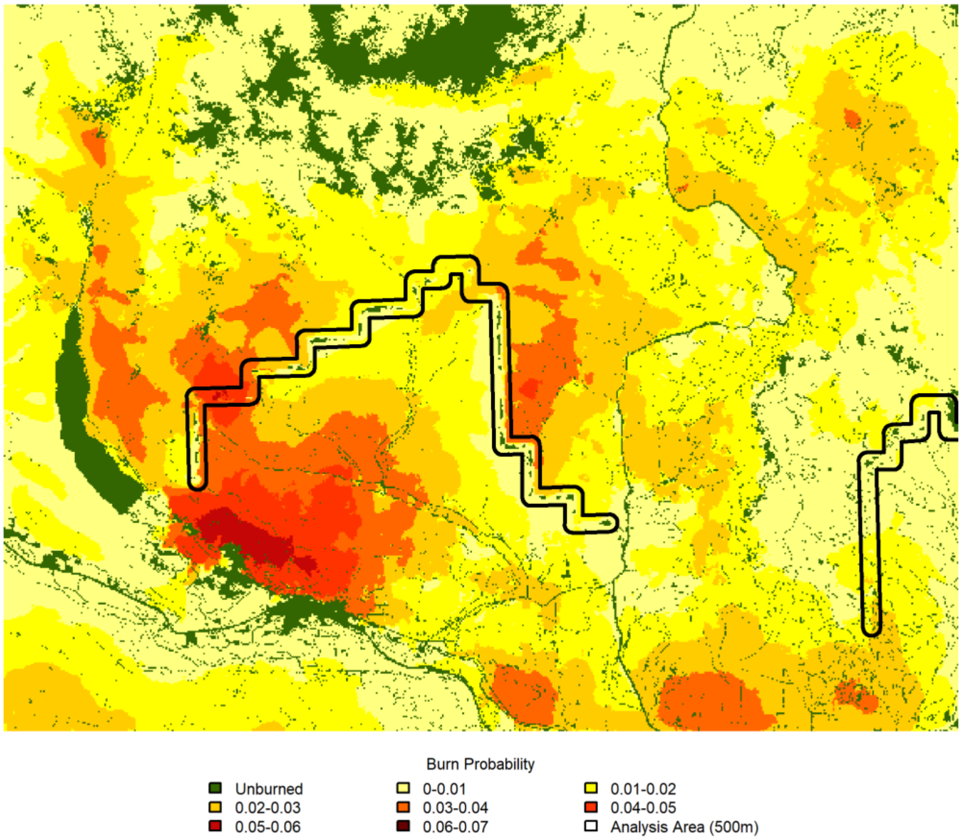
Reduction of 30% Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



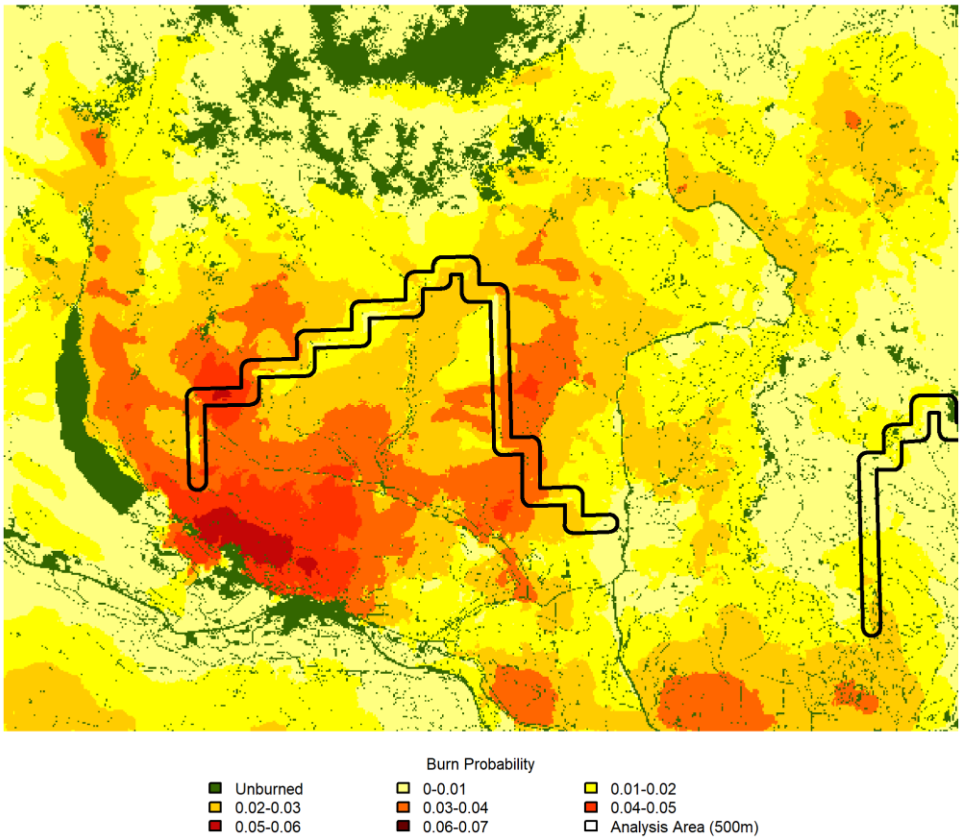
Reduction of 30% Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



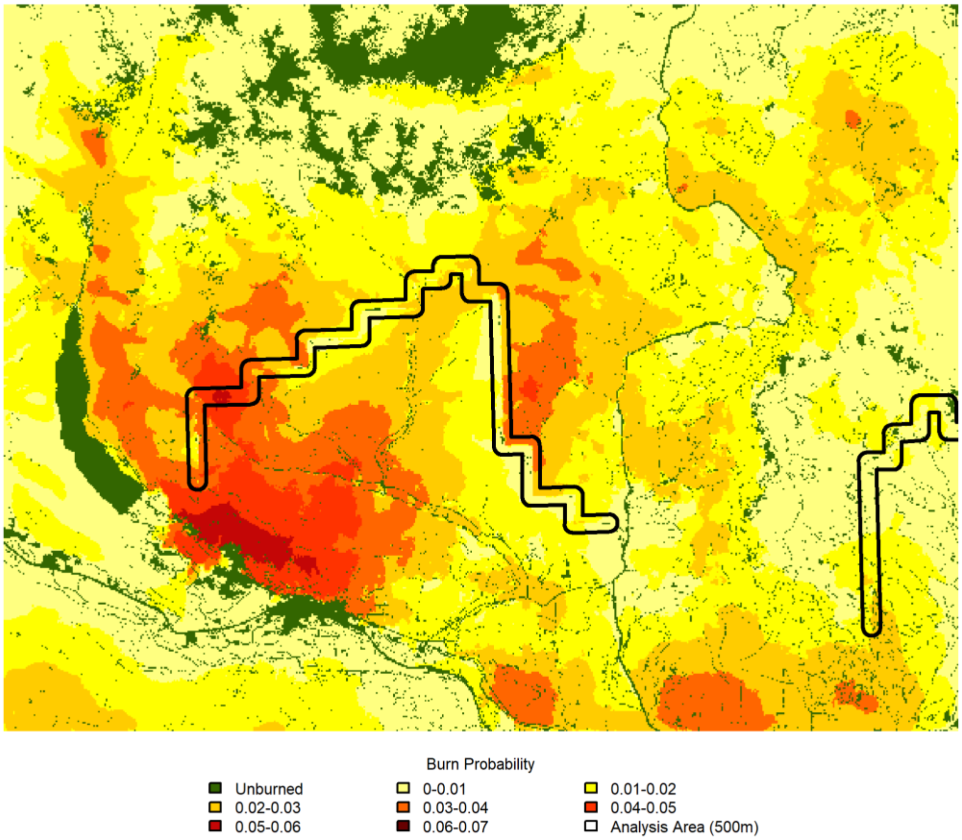
Reduction of 30% Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



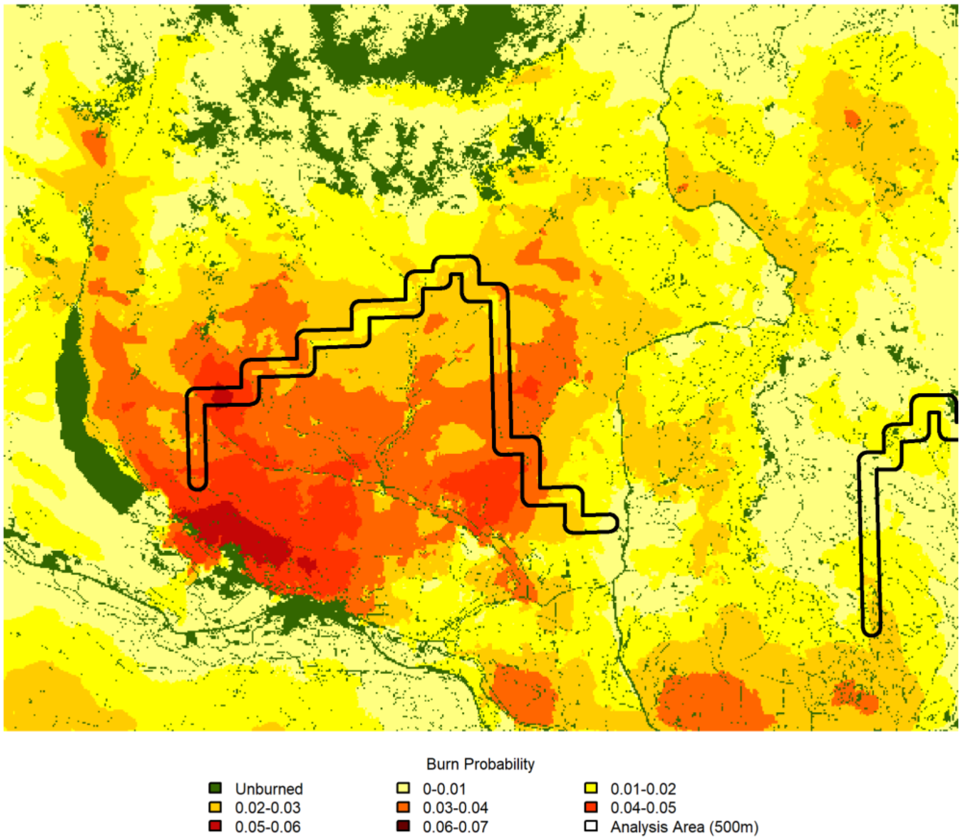
Reduction of 30% Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



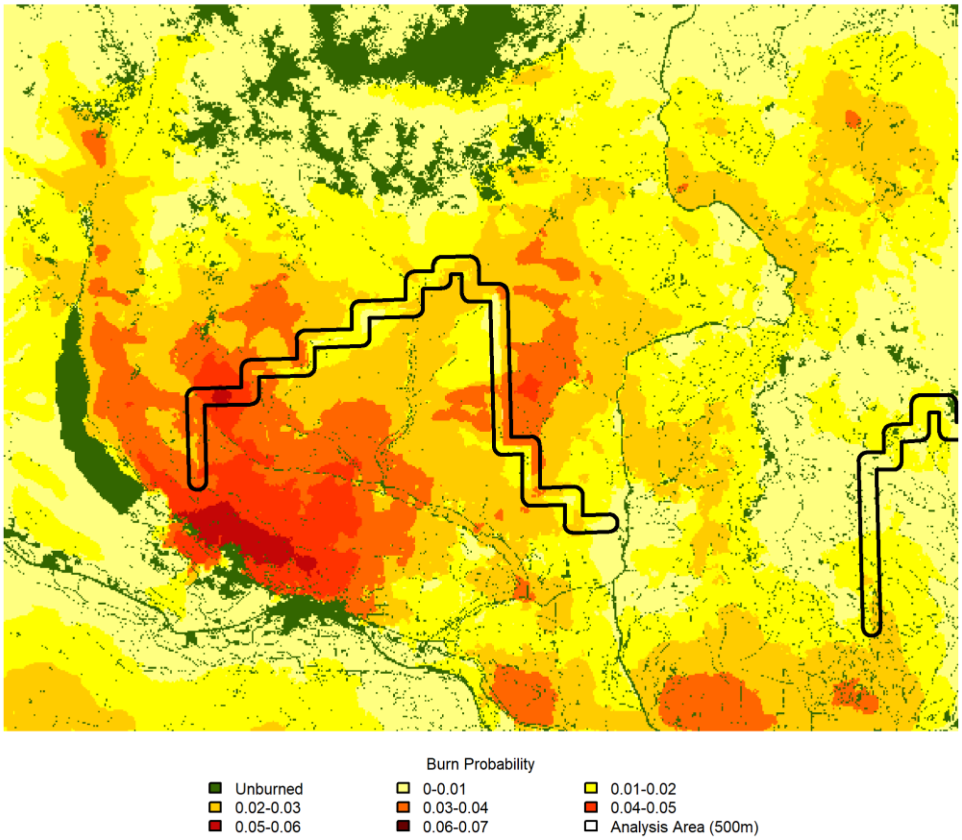
Reduction of 30% Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



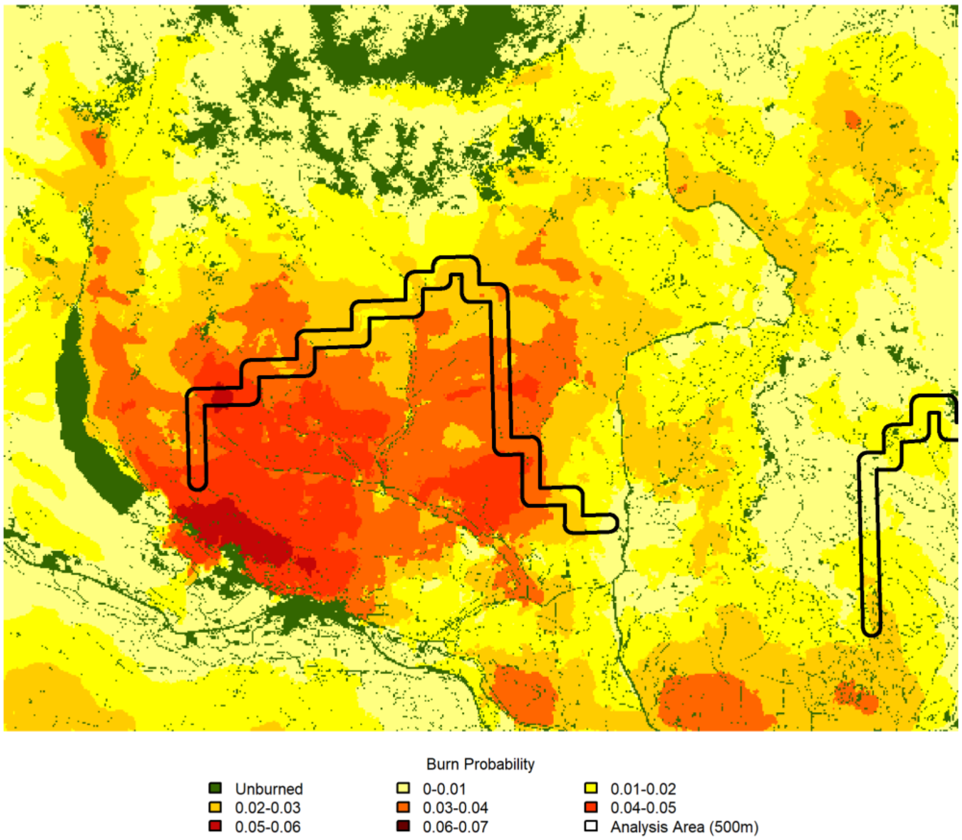
Reduction of 30% Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



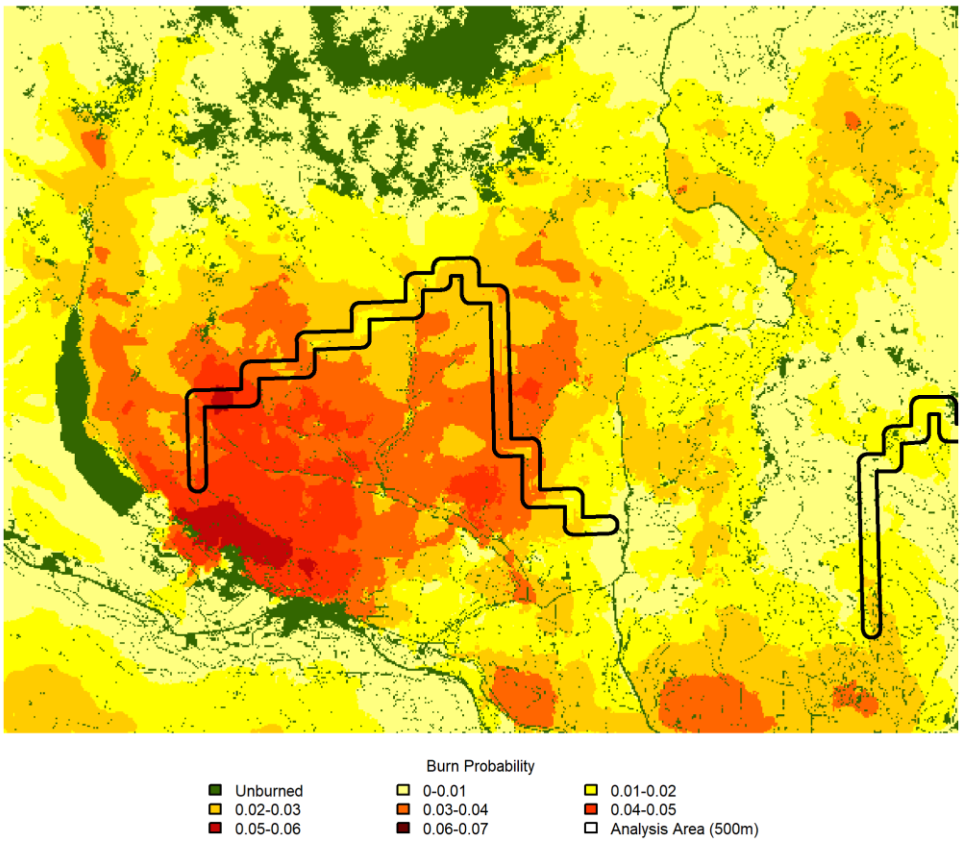
Reduction of 30% Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



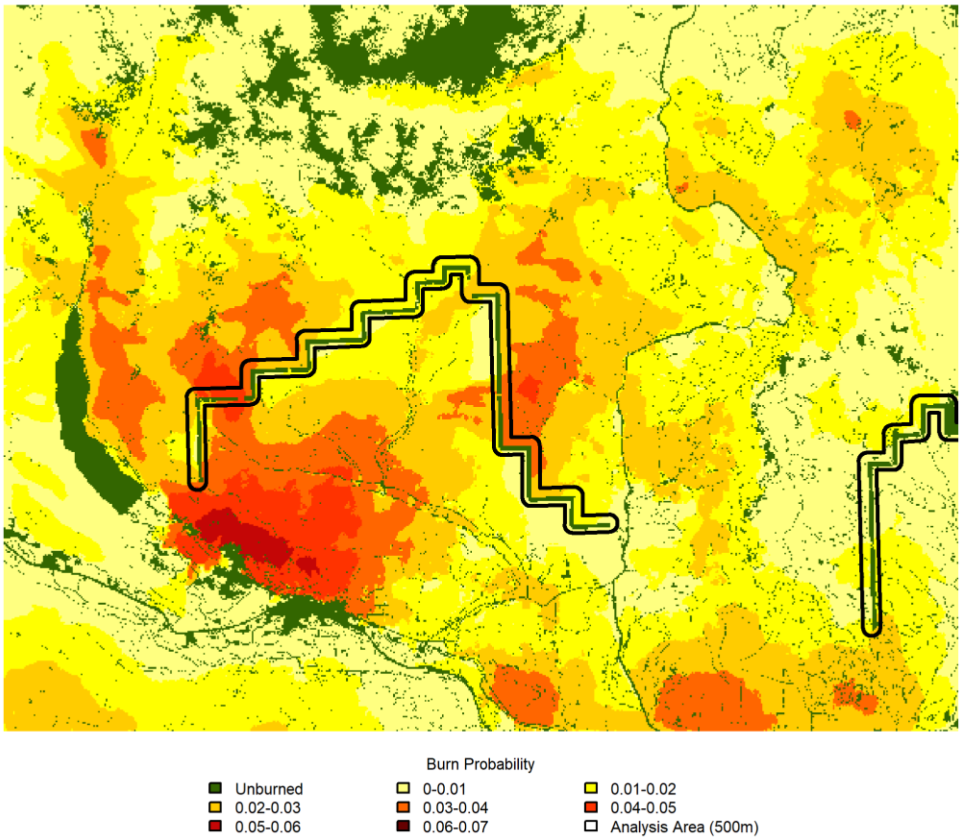
Reduction of 30% Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



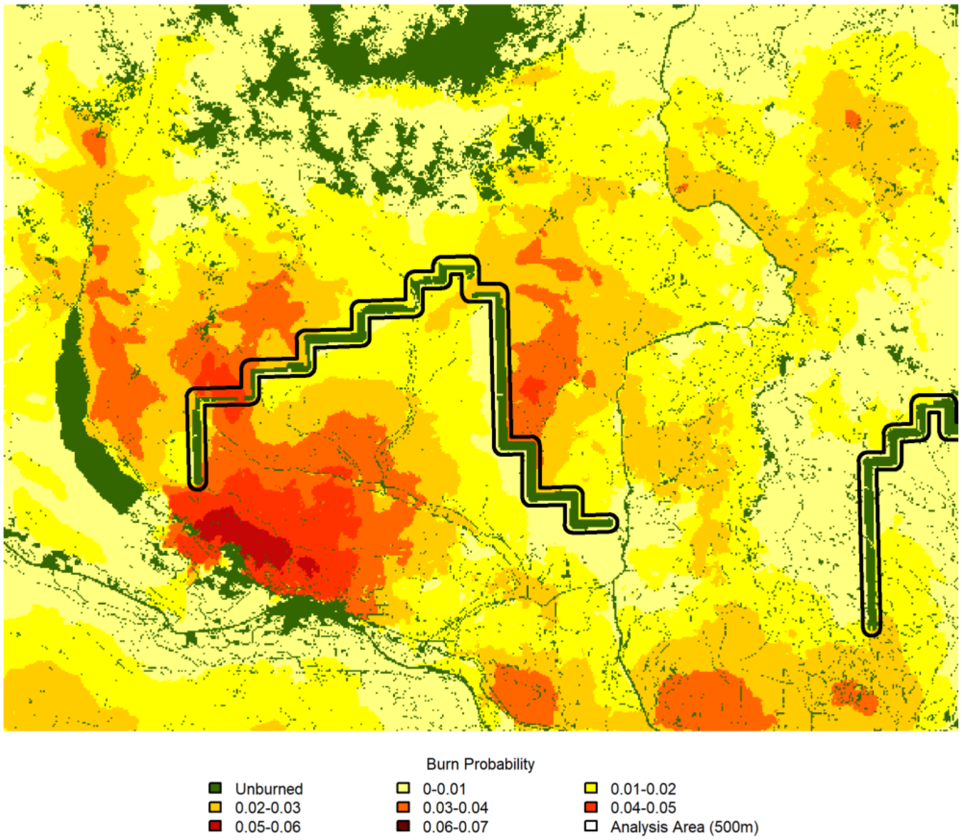
Reduction of 30% Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



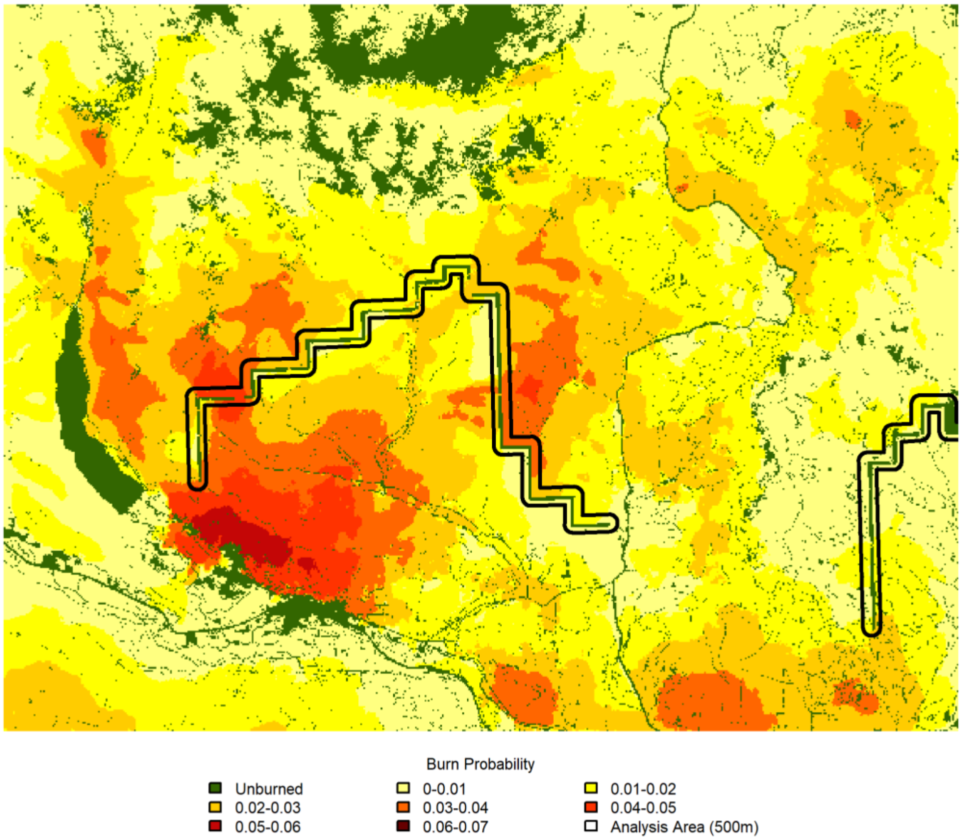
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



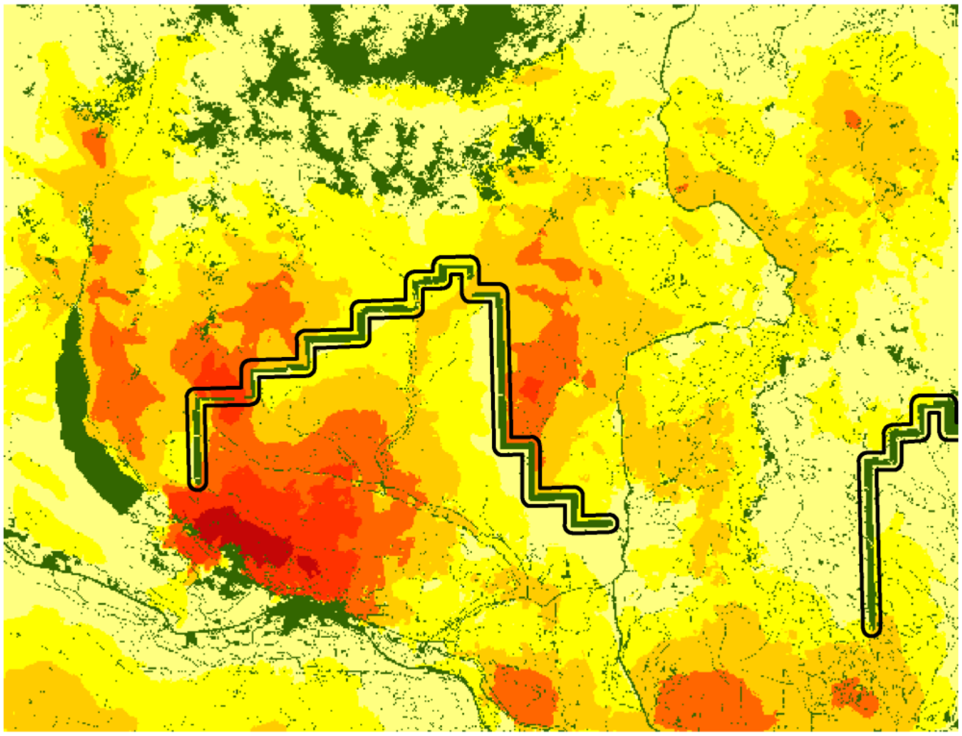
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



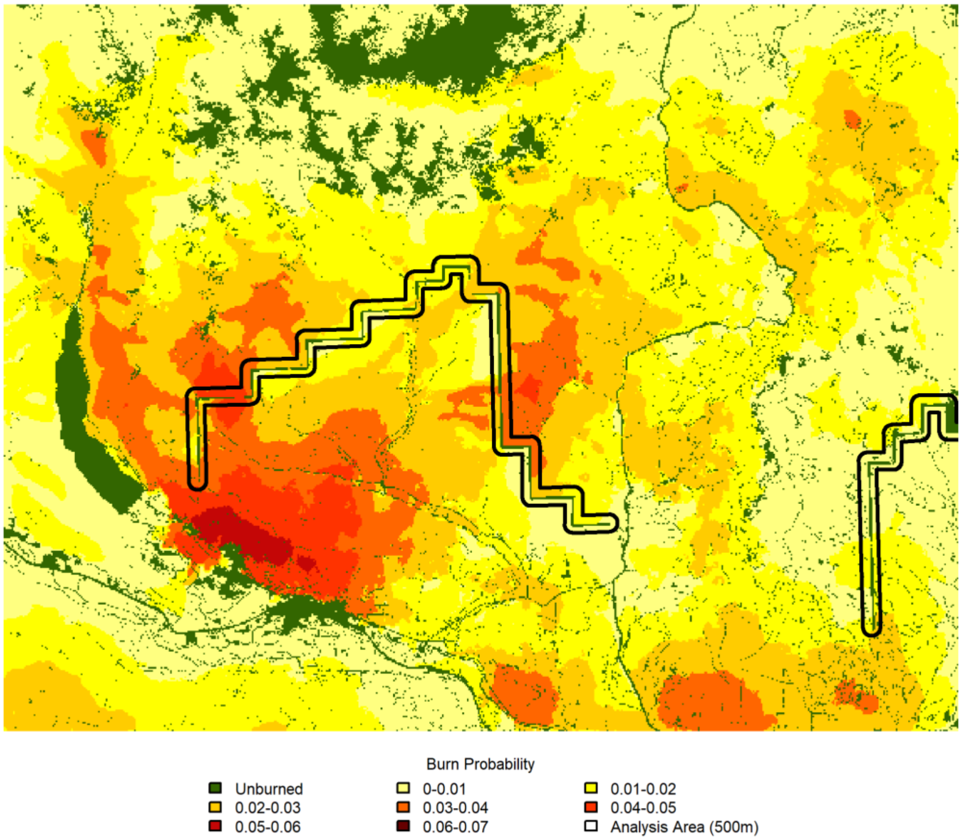
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



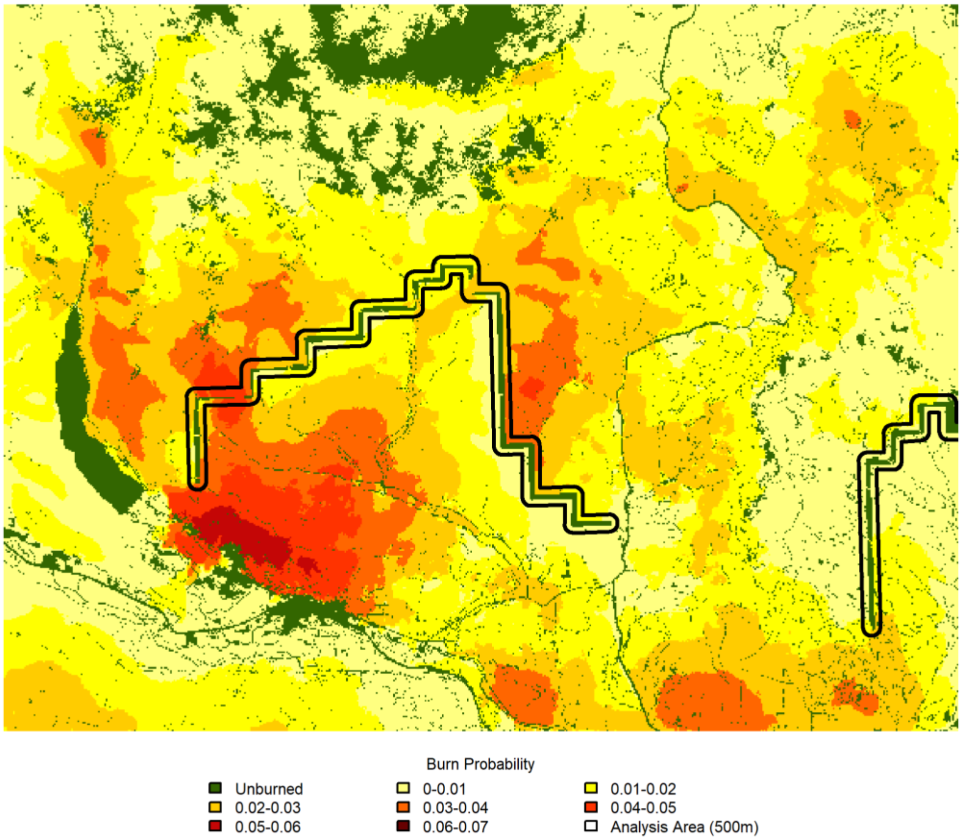
Burn Probability

Unburned | 0-0.01 | 0.01-0.02
0.02-0.03 | 0.03-0.04 | 0.04-0.05
0.05-0.06 | 0.06-0.07 | Analysis Area (500m)

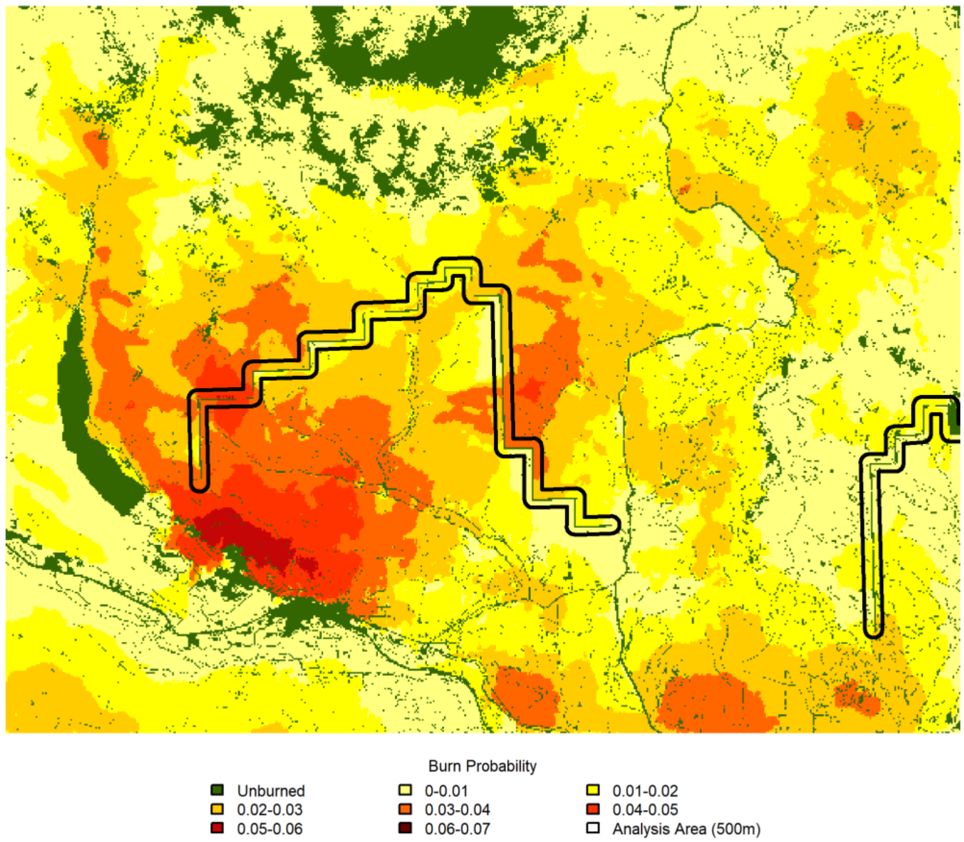
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



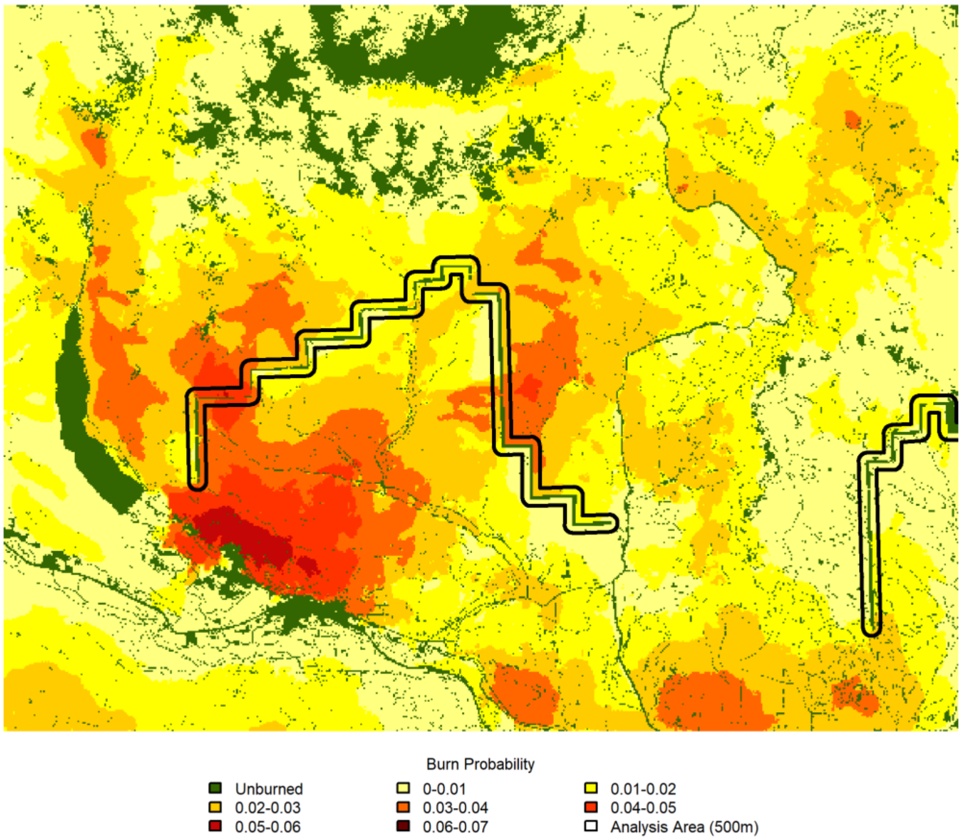
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



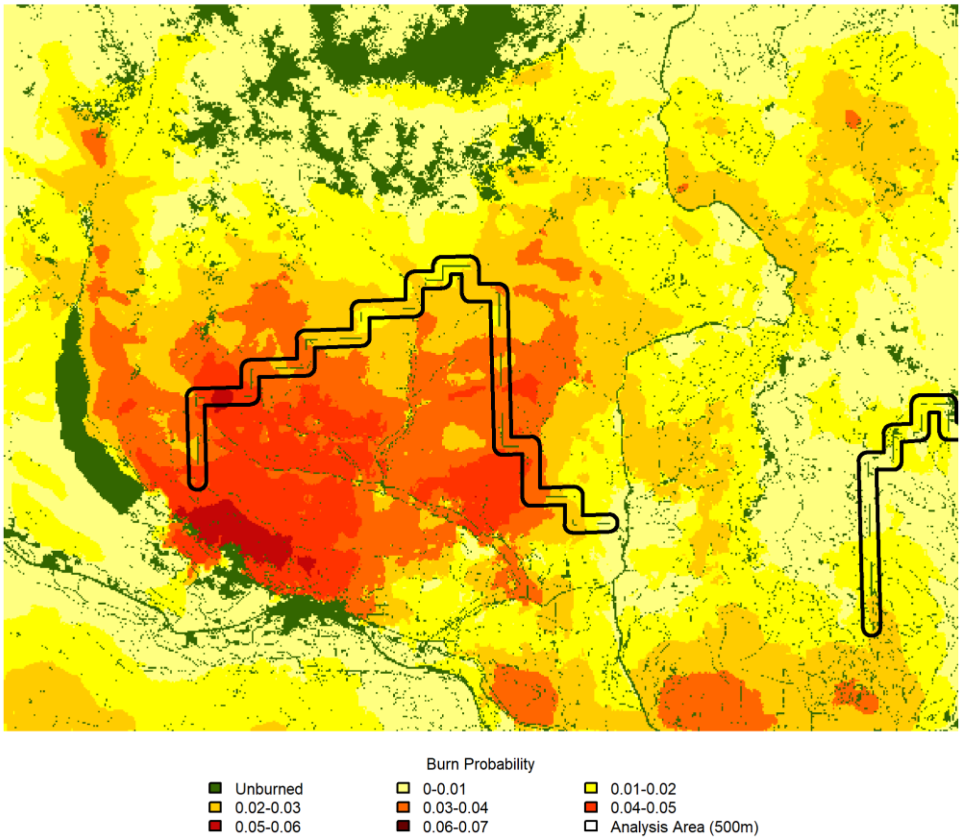
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



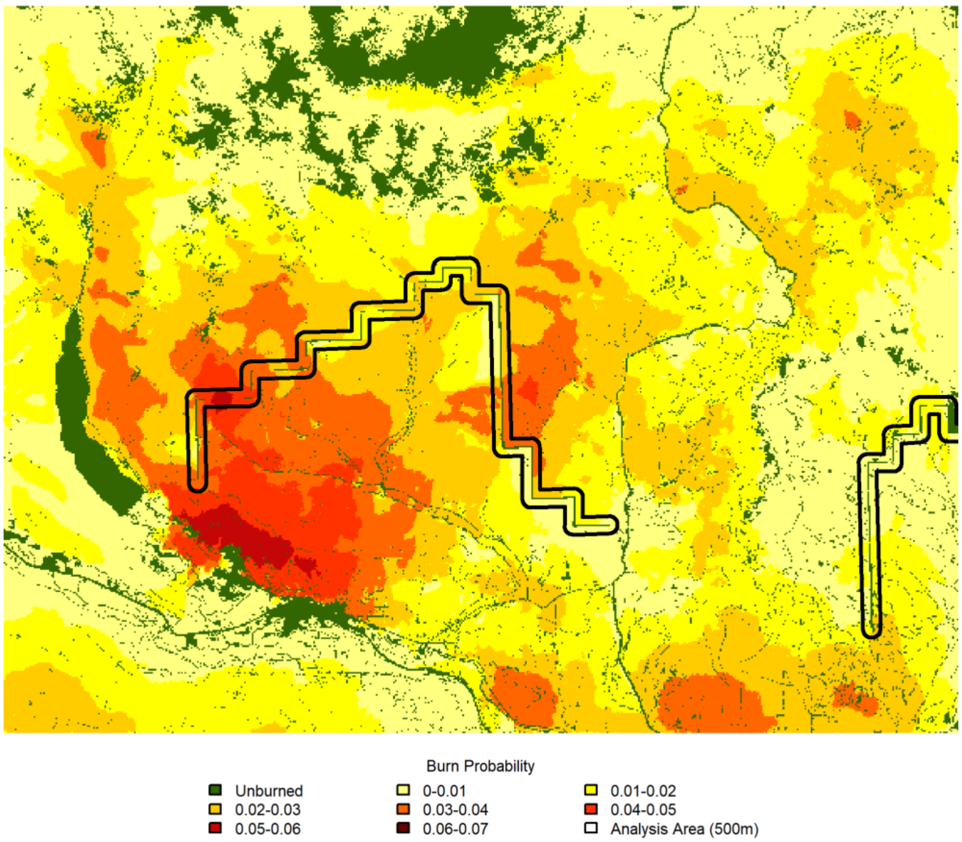
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



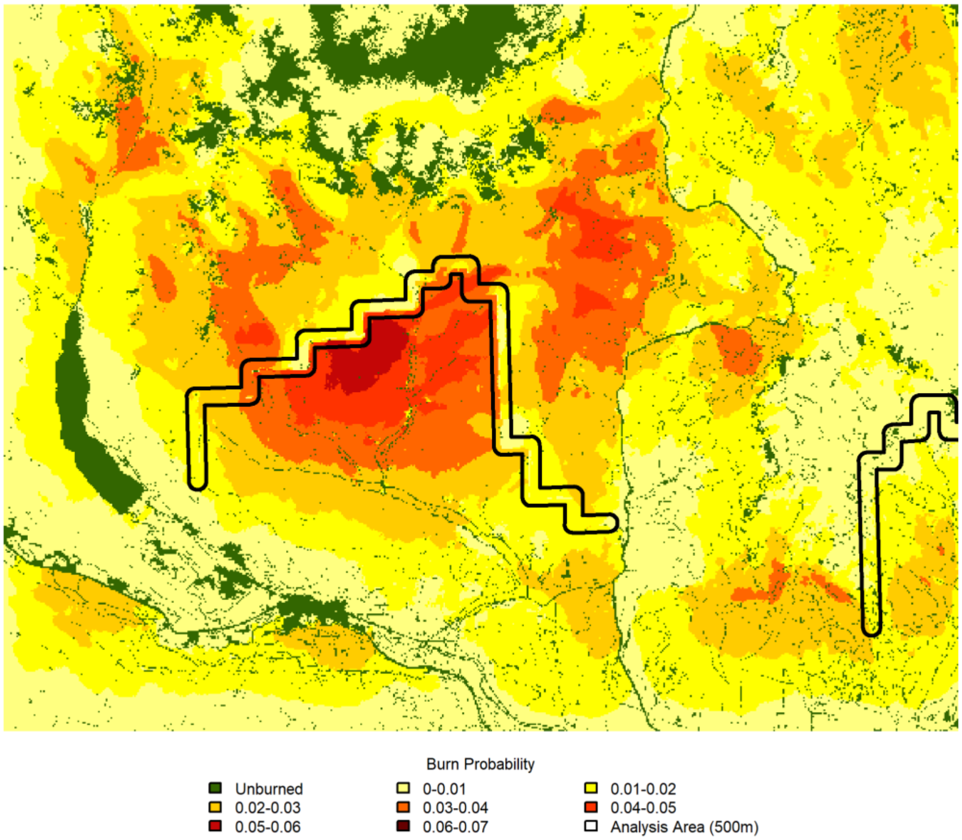
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



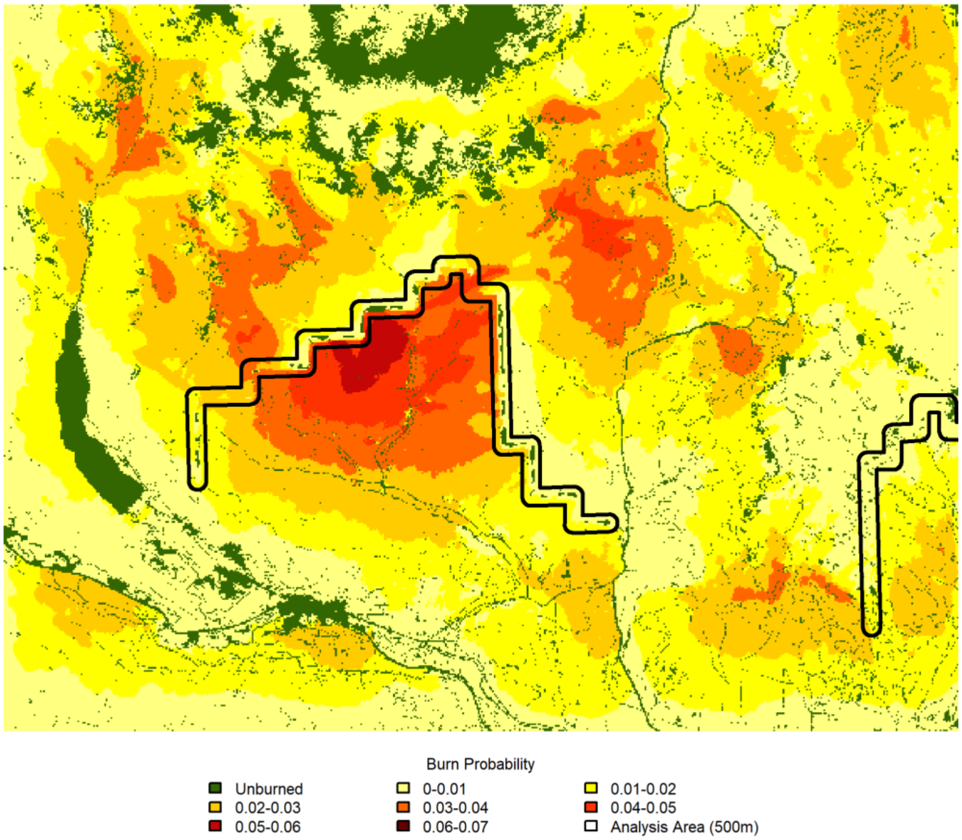
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



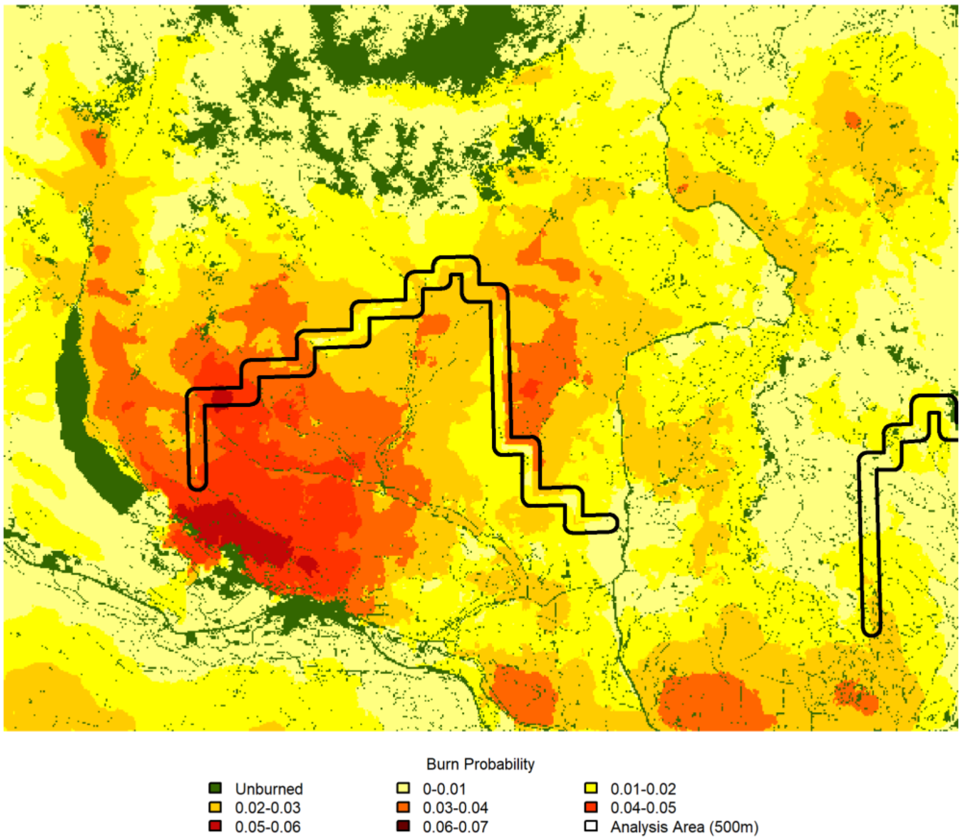
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



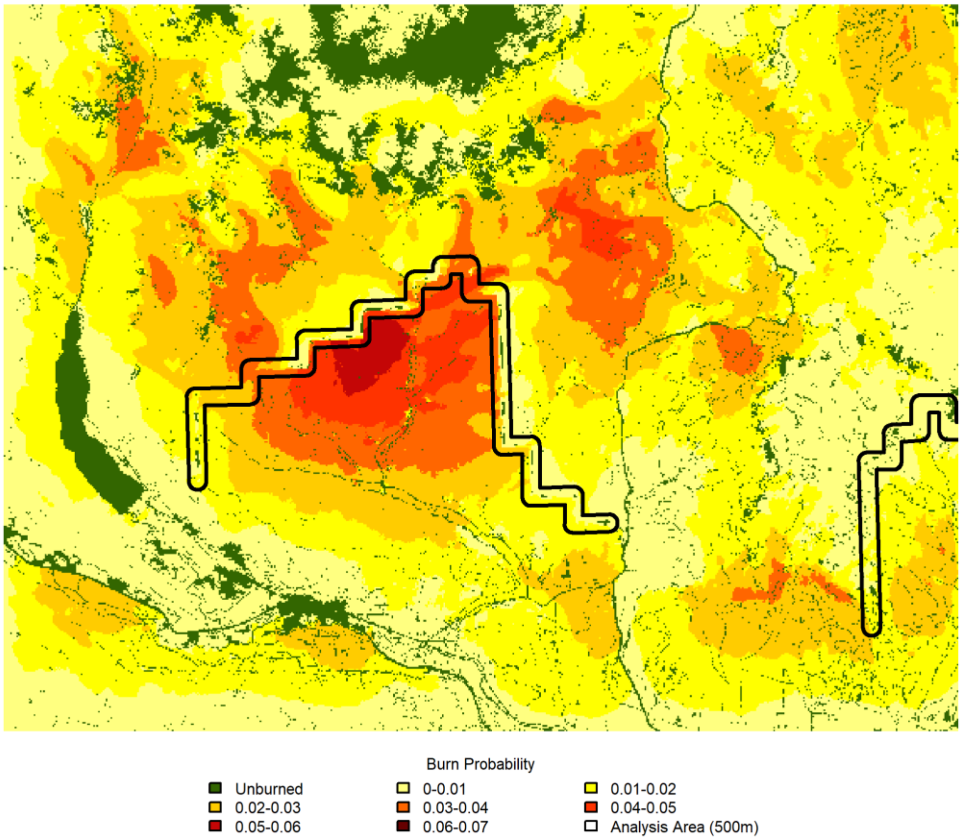
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



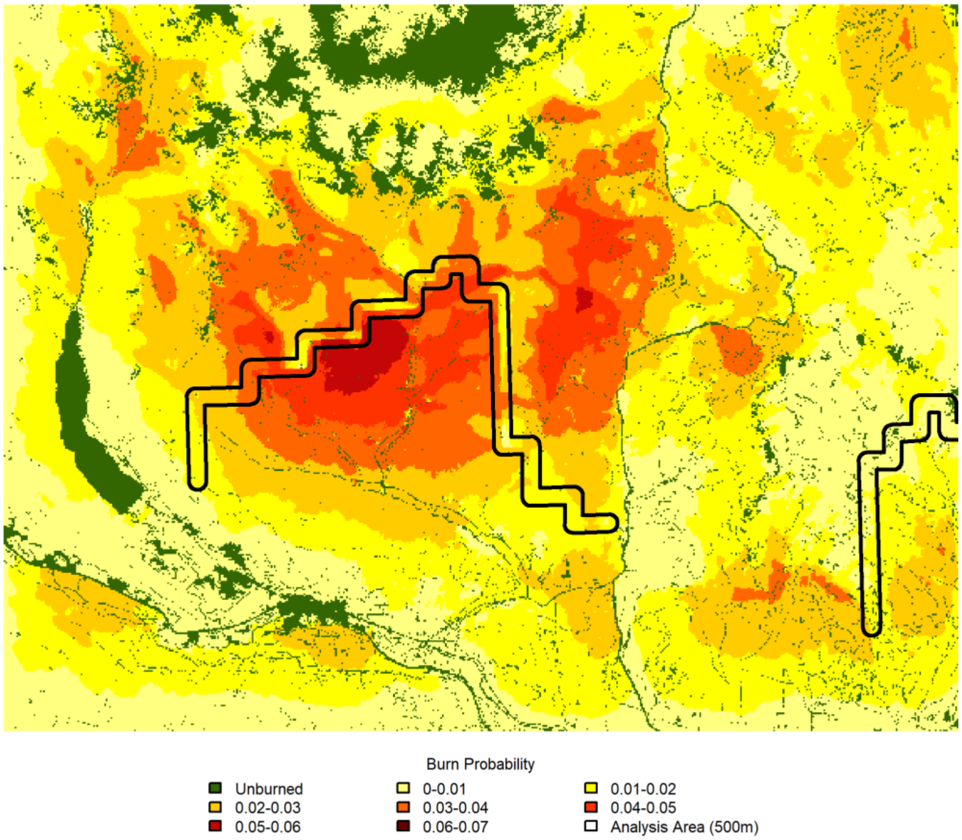
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



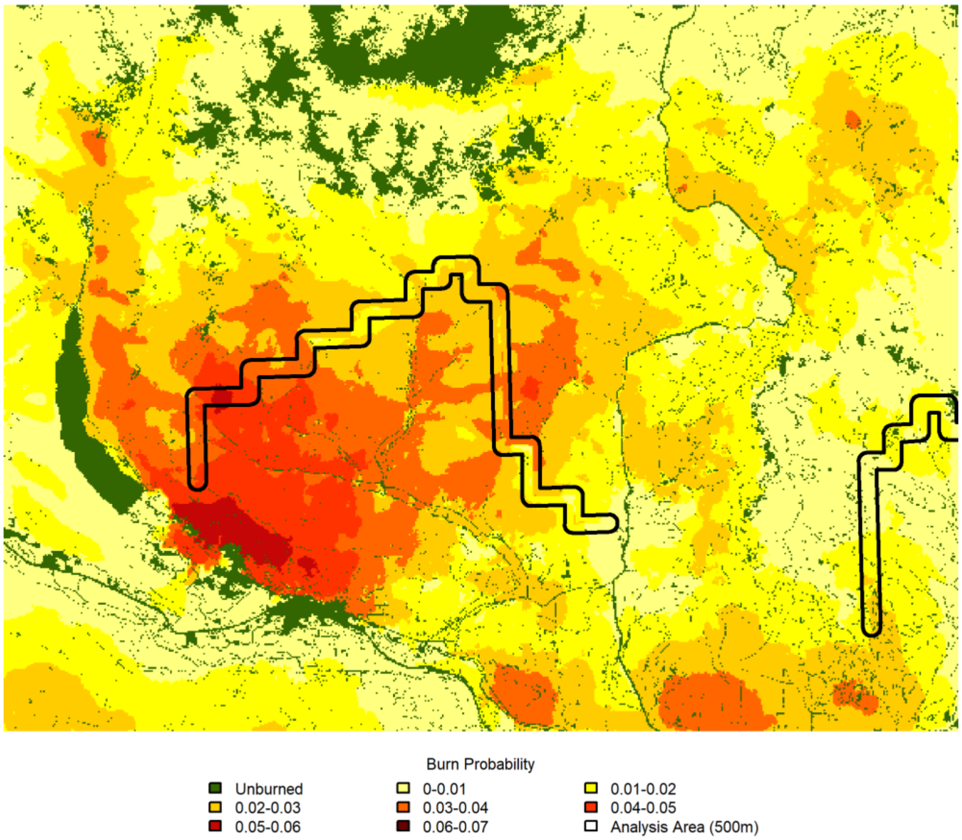
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



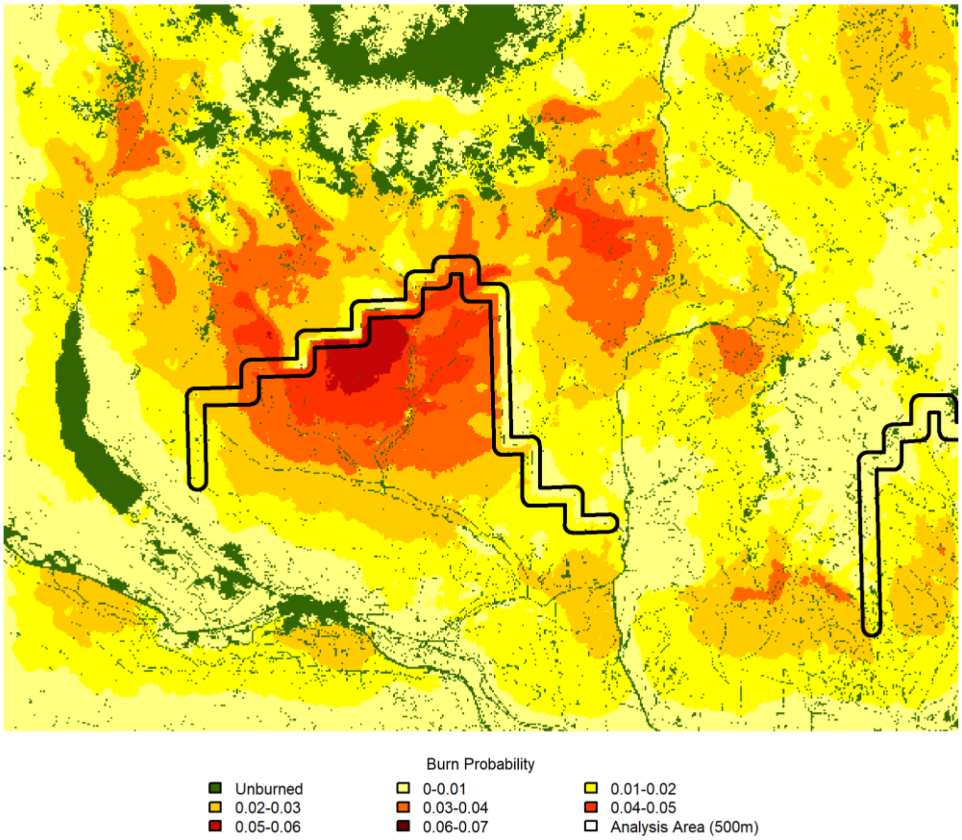
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



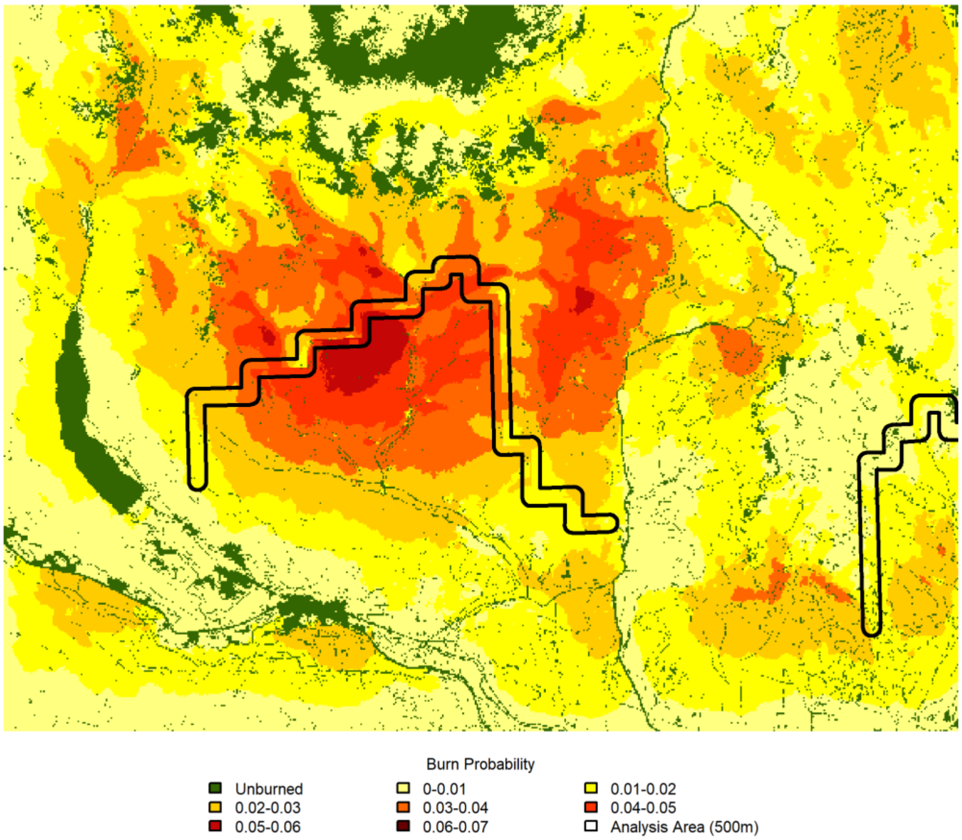
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



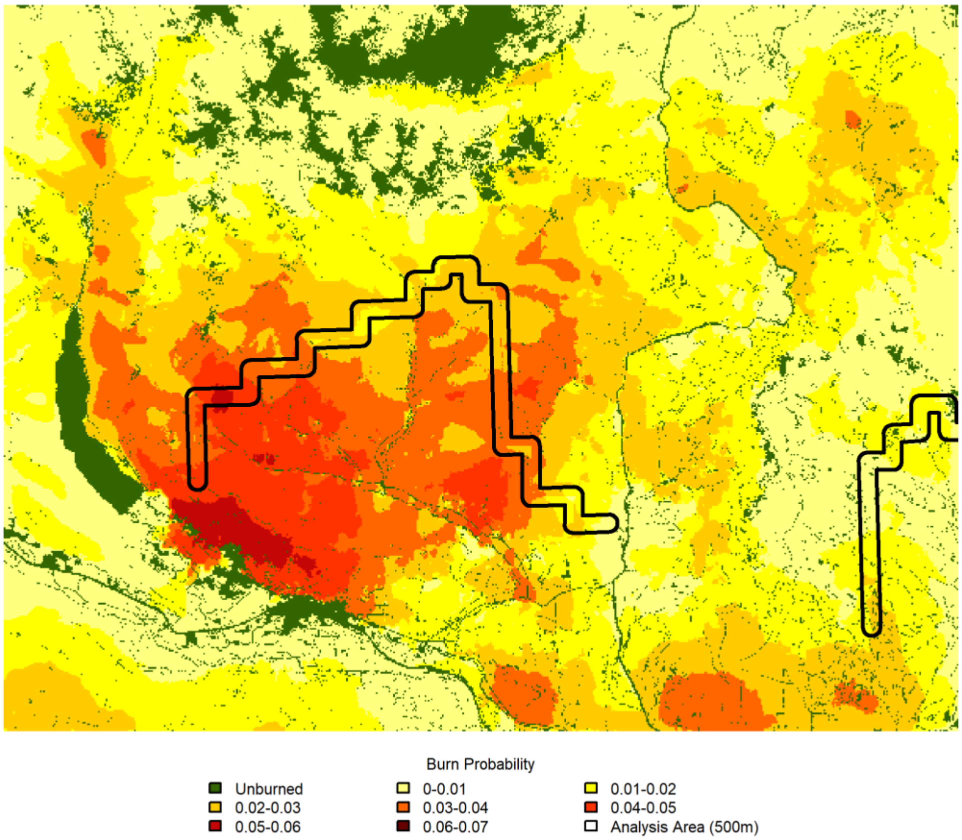
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



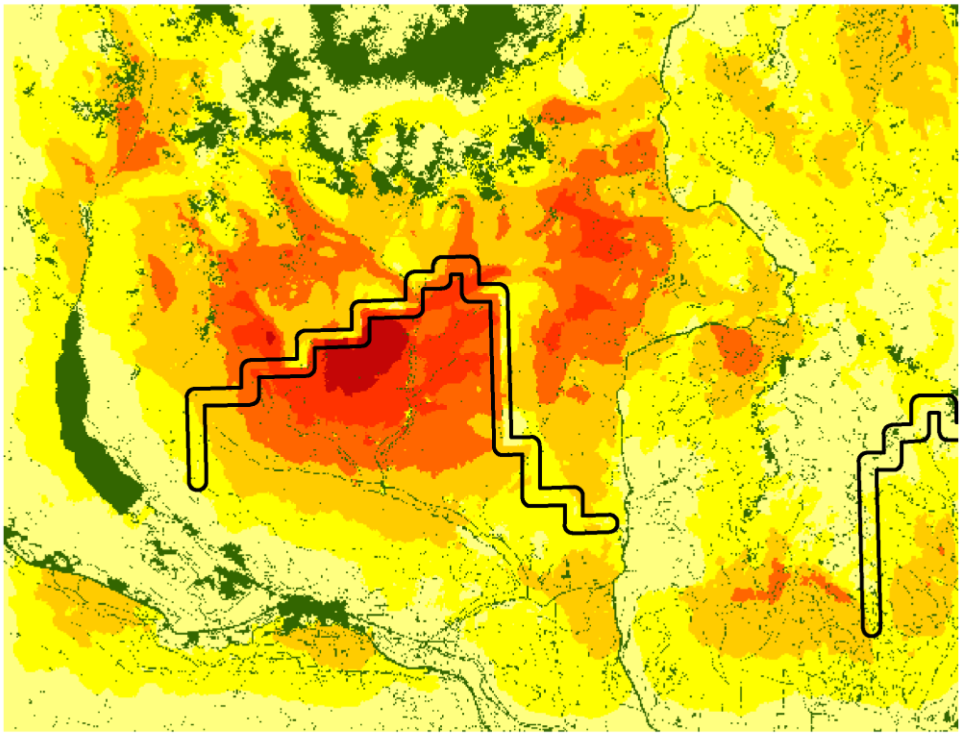
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



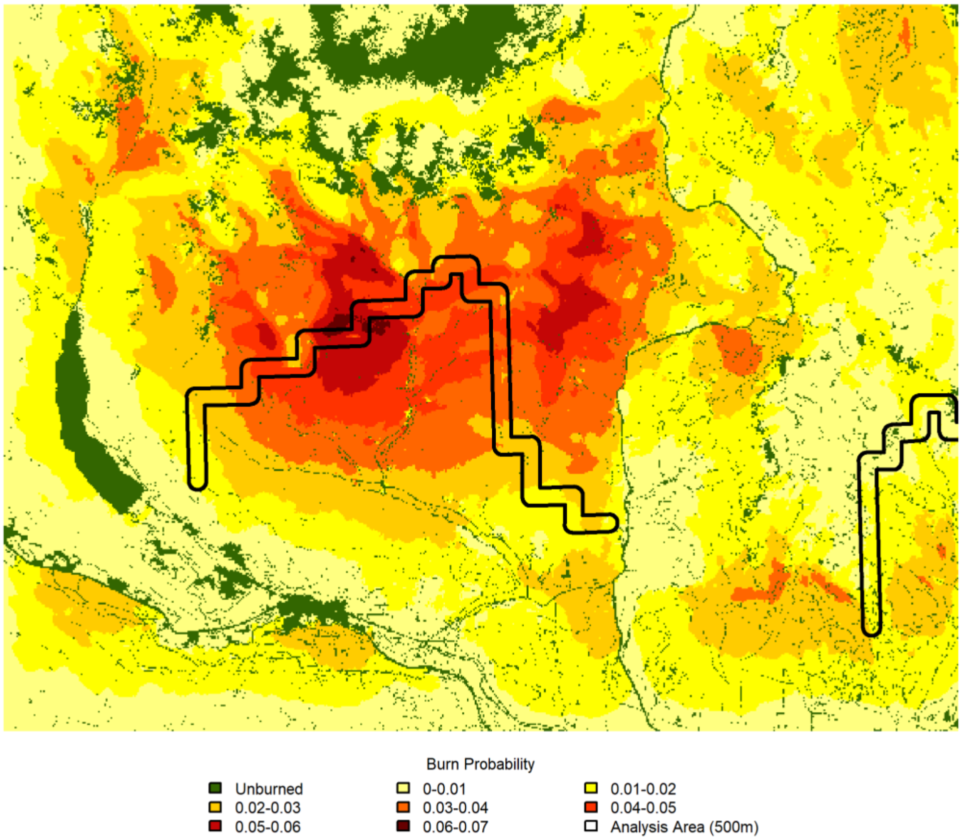
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



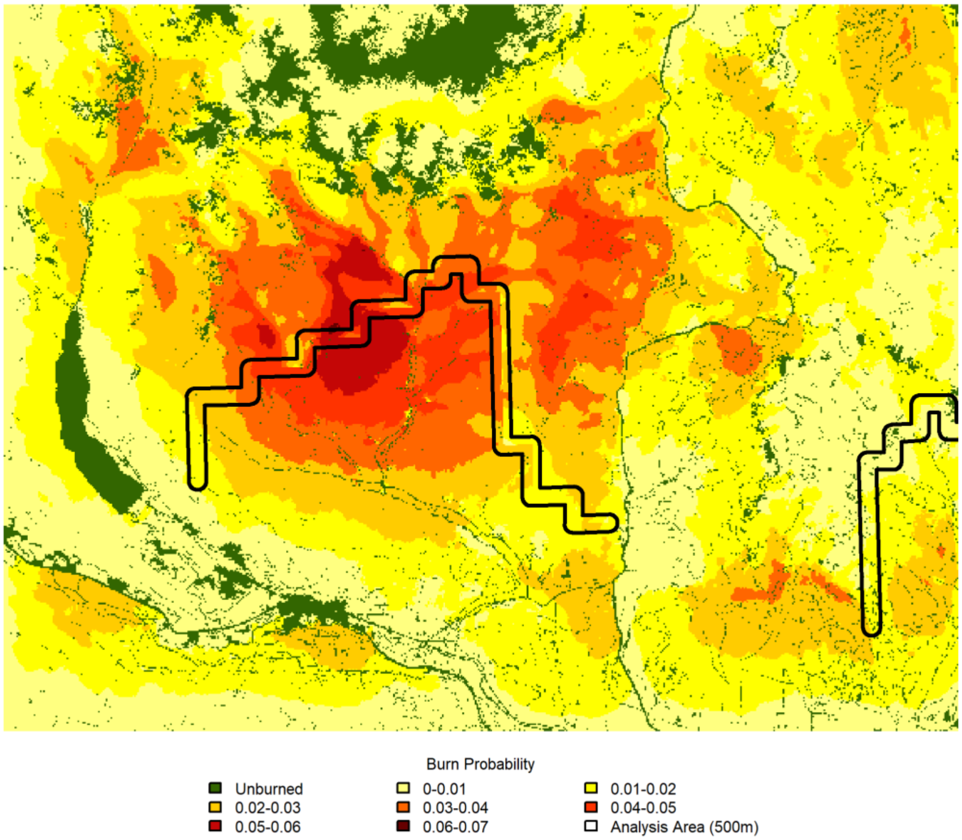
Burn Probability

Unburned	0-0.01	0.01-0.02
0.02-0.03	0.03-0.04	0.04-0.05
0.05-0.06	0.06-0.07	Analysis Area (500m)

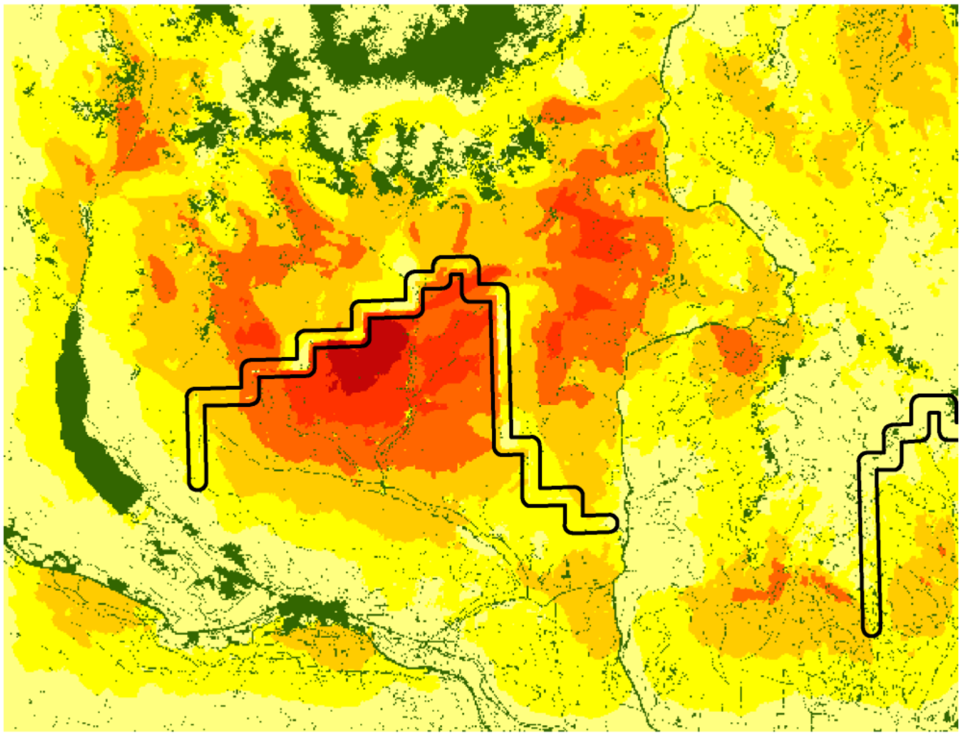
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment

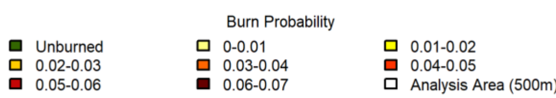


Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment

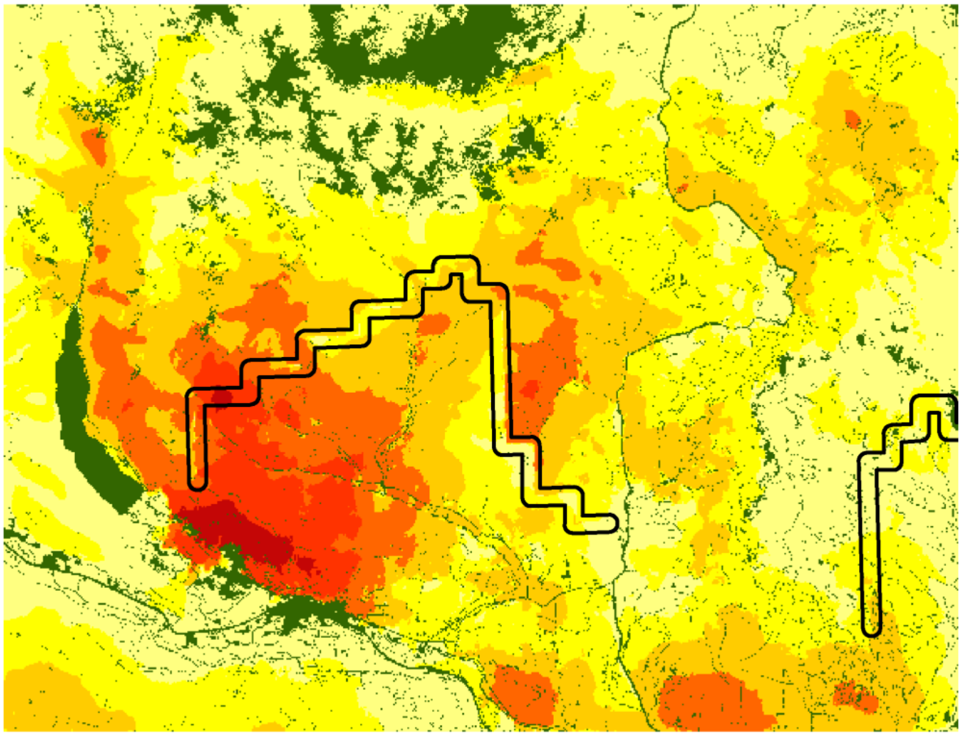


Reduction of 60% Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment





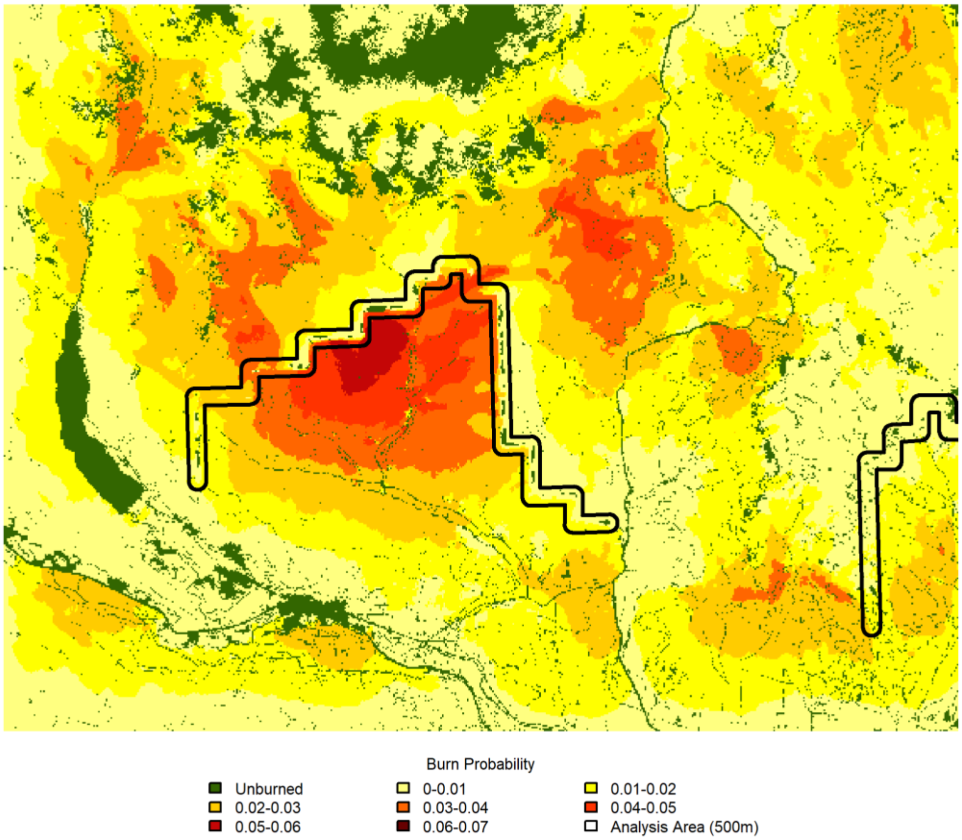
Reduction of 60% Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



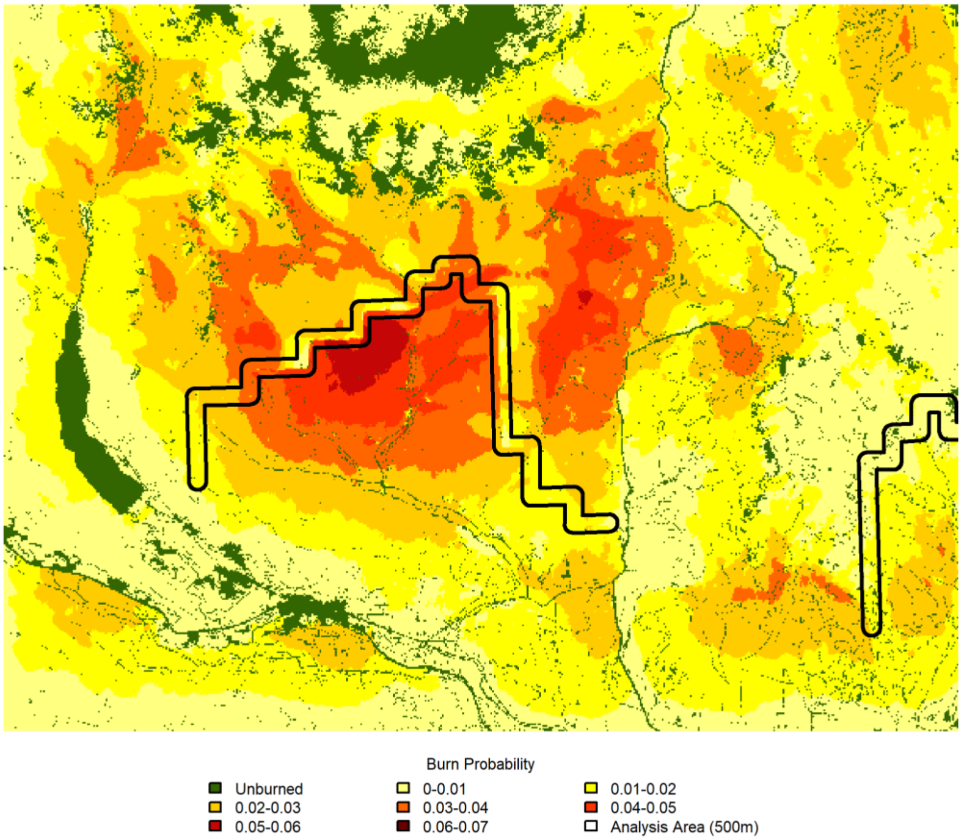
Burn Probability

Unburned
0-0.01
0.01-0.02
0.02-0.03
0.03-0.04
0.04-0.05
0.05-0.06
0.06-0.07
Analysis Area (500m)

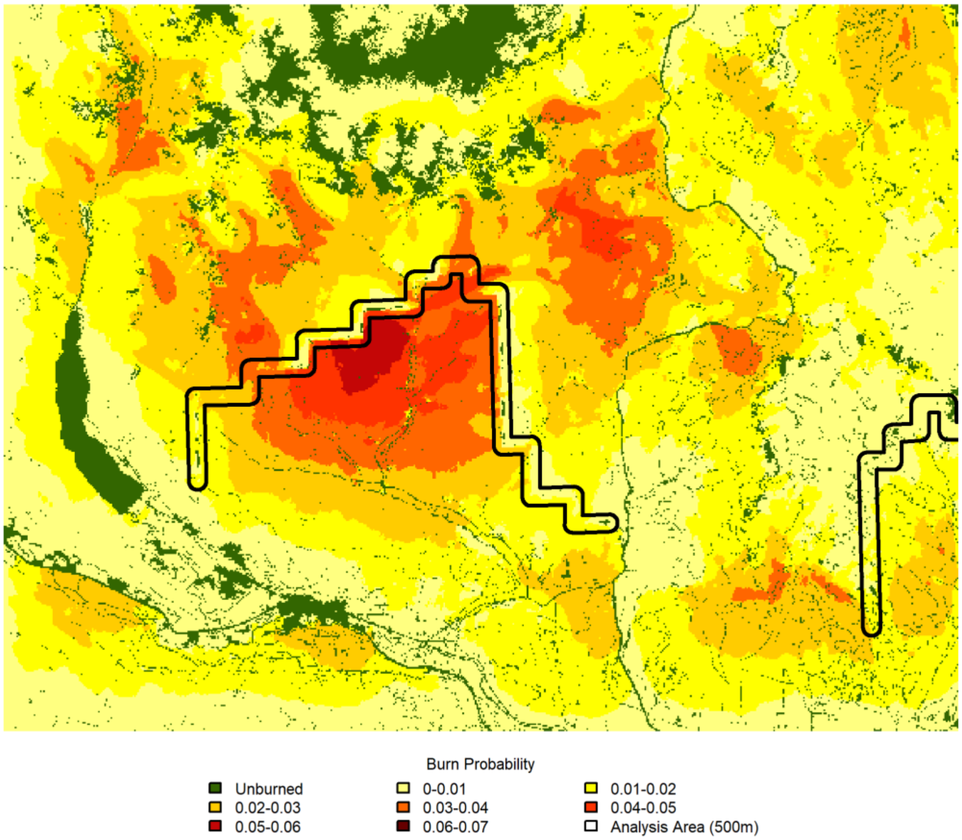
Reduction of 60% Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



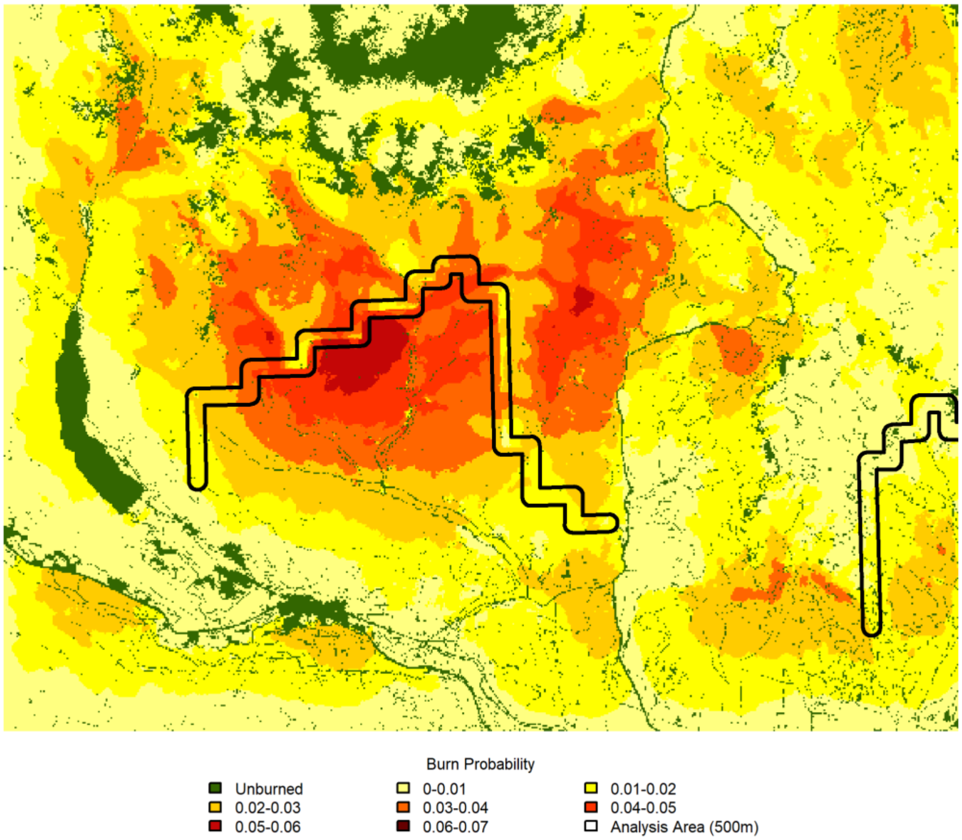
Reduction of 60% Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



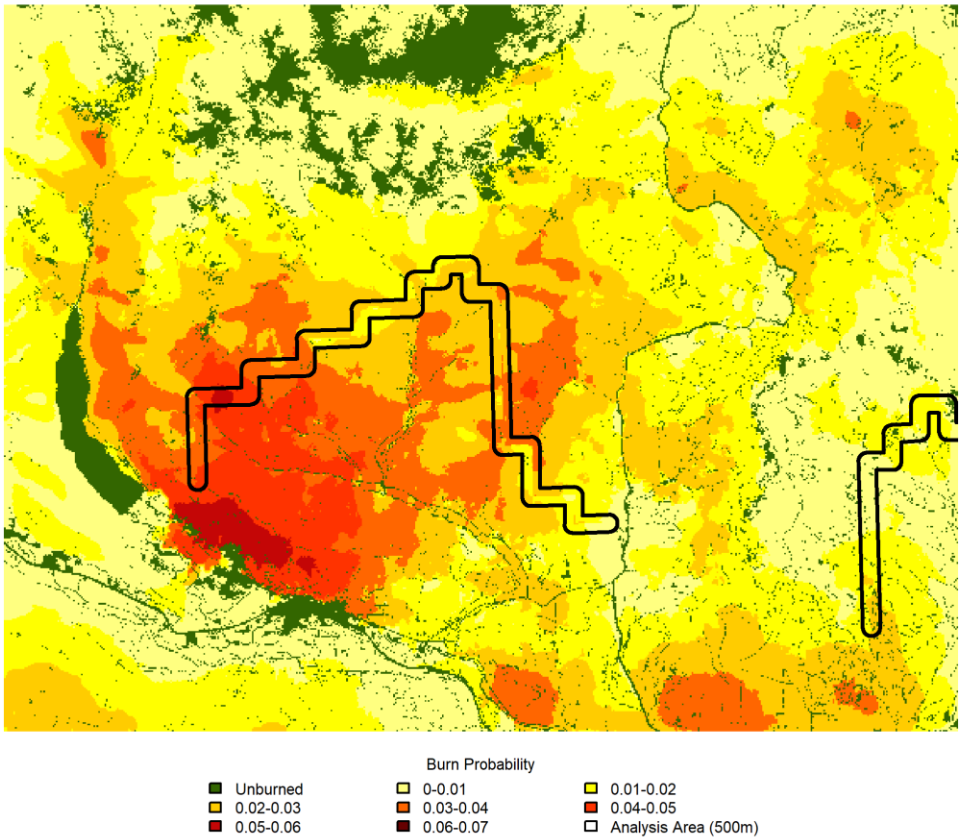
Reduction of 60% Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



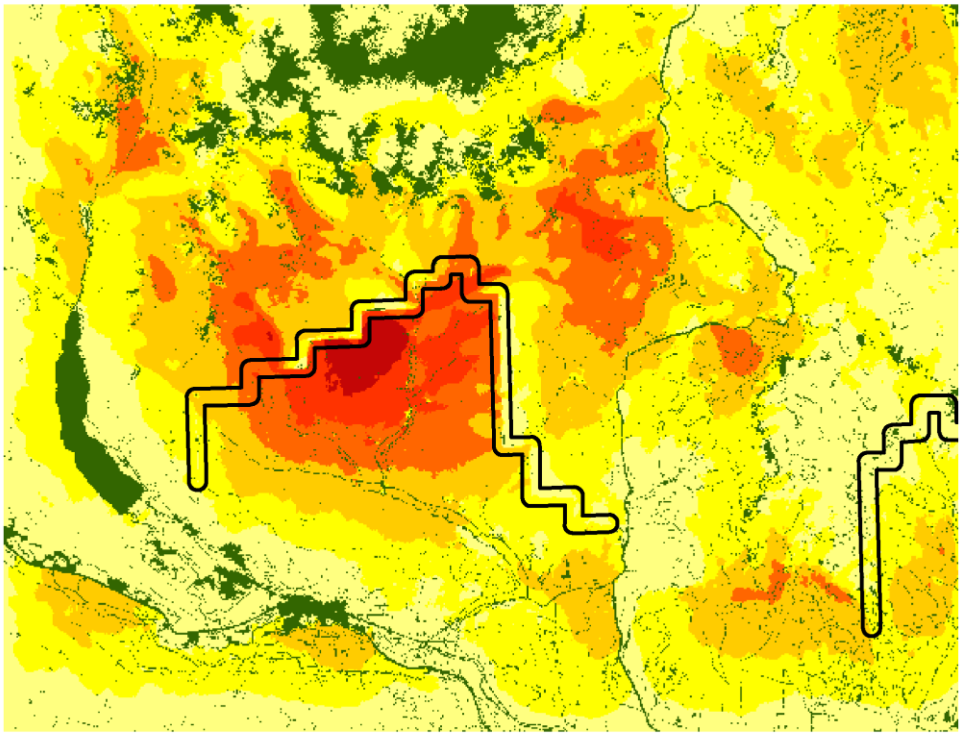
Reduction of 60% Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



Reduction of 60% Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



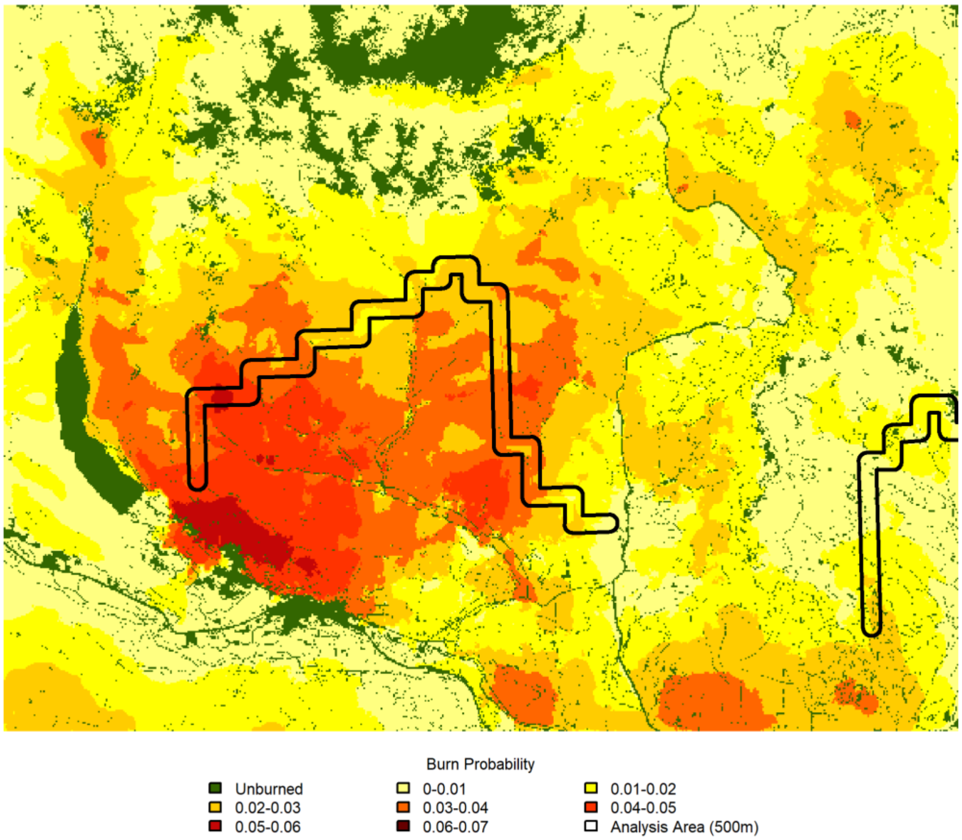
Reduction of 60% Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



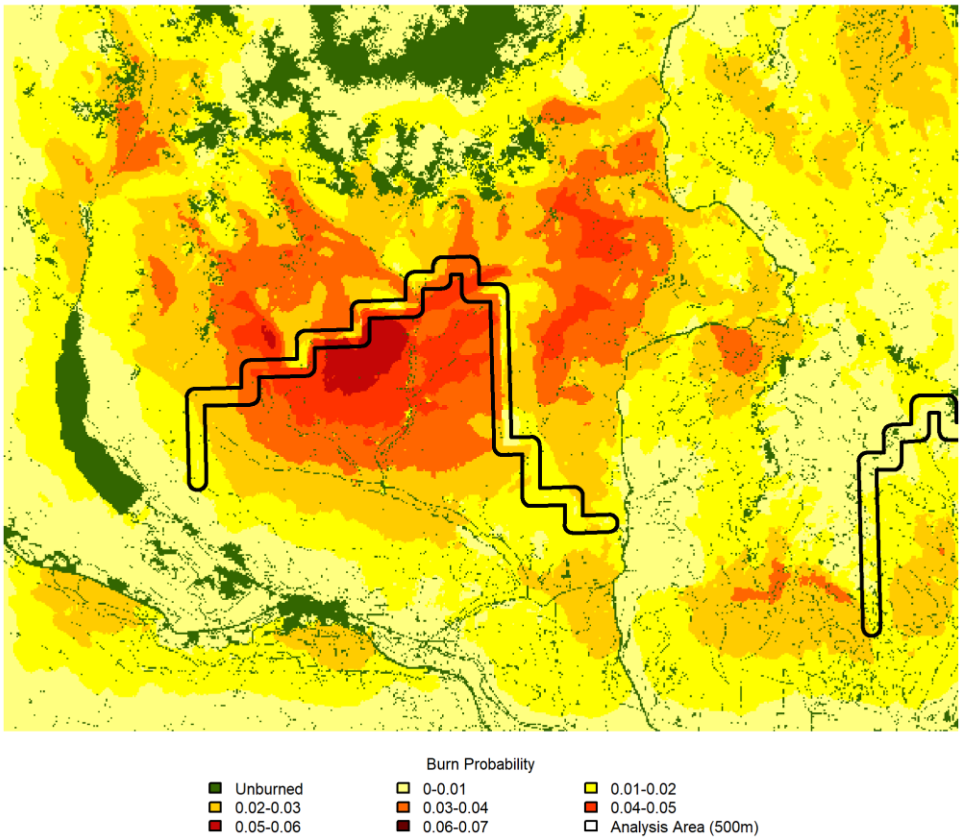
Burn Probability

Unburned	0-0.01	0.01-0.02
0.02-0.03	0.03-0.04	0.04-0.05
0.05-0.06	0.06-0.07	Analysis Area (500m)

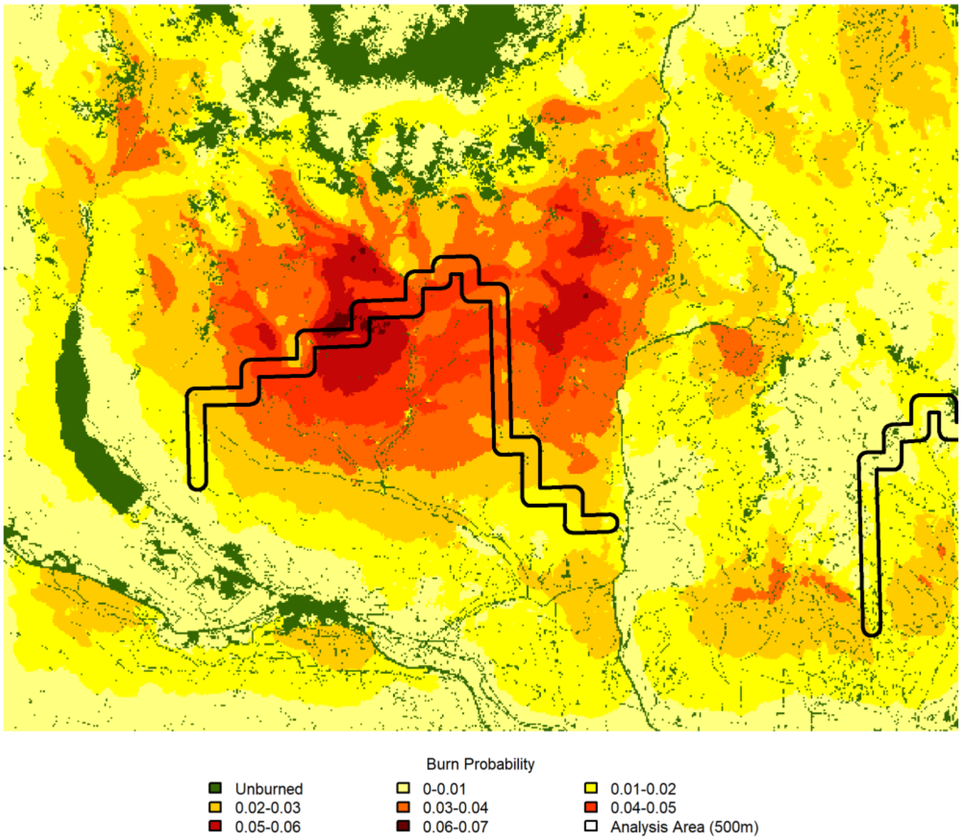
Reduction of 60% Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



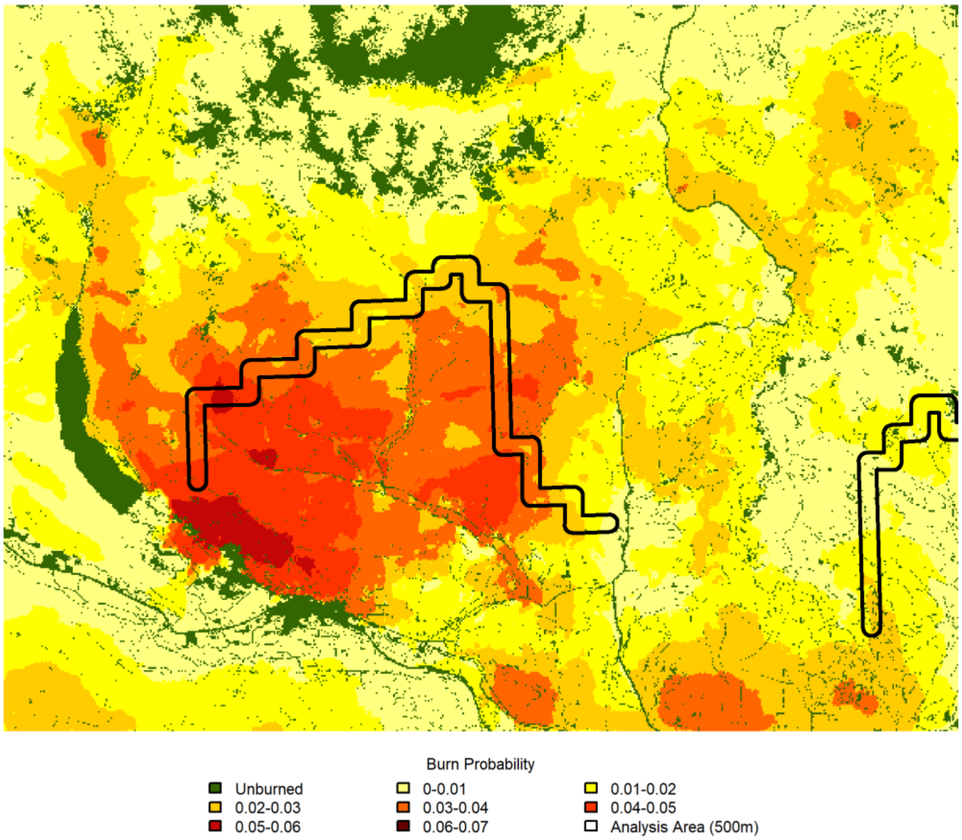
Reduction of 60% Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



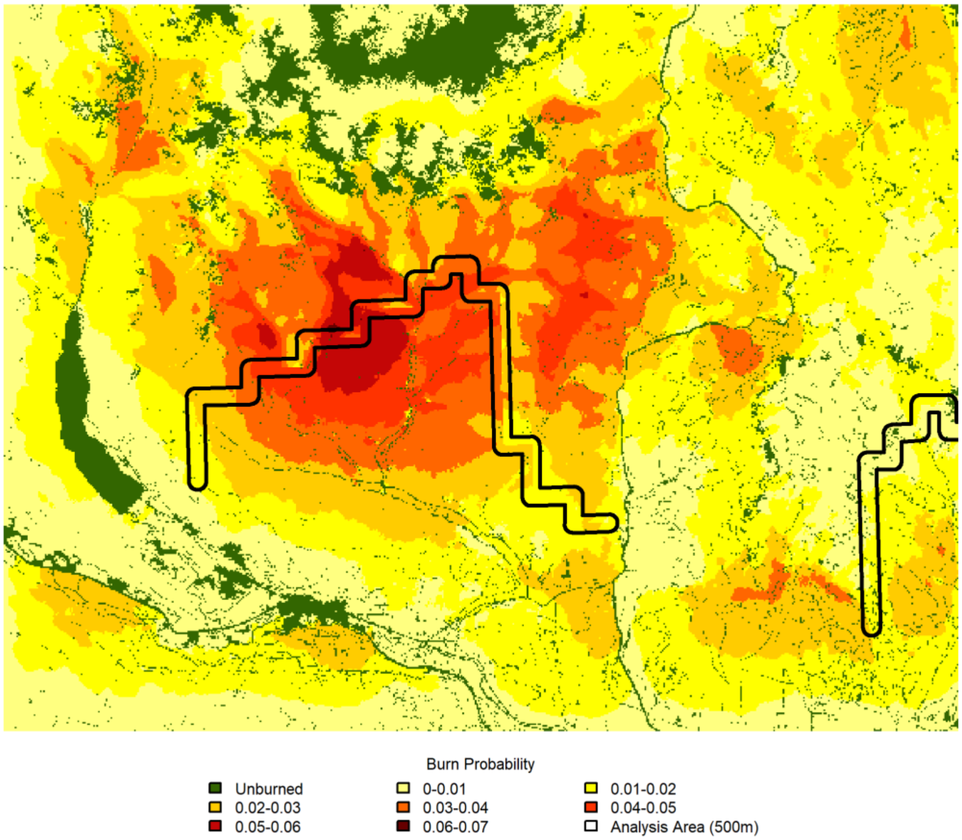
Reduction of 60% Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



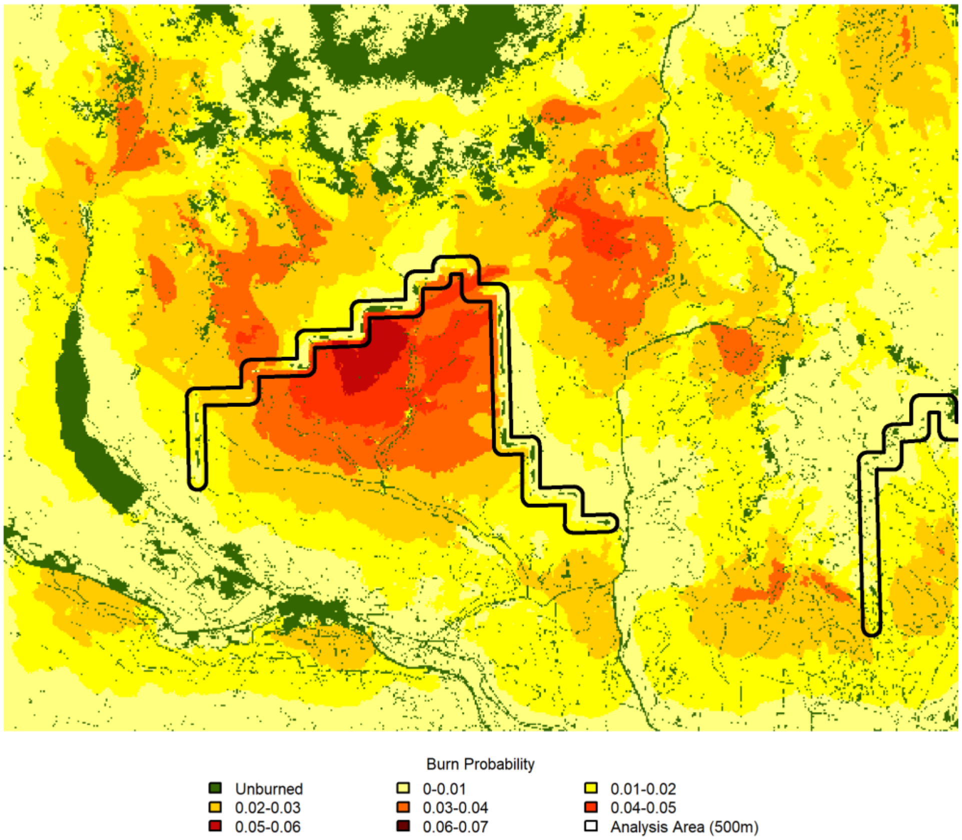
Reduction of 60% Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



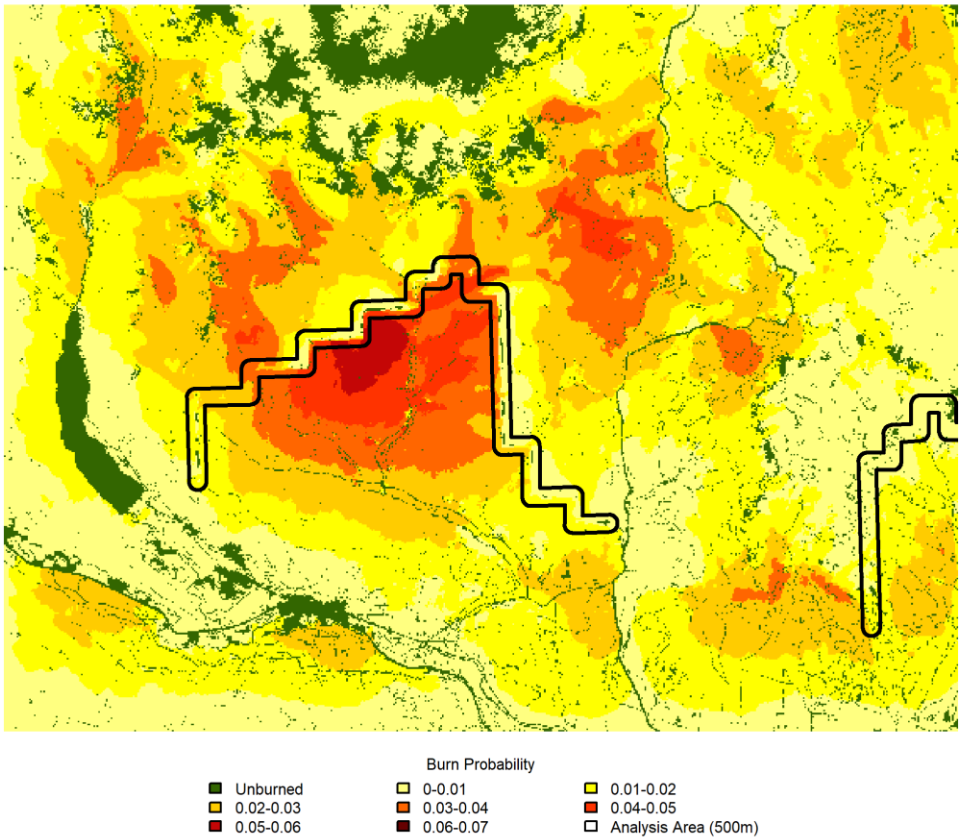
Reduction of 60% Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



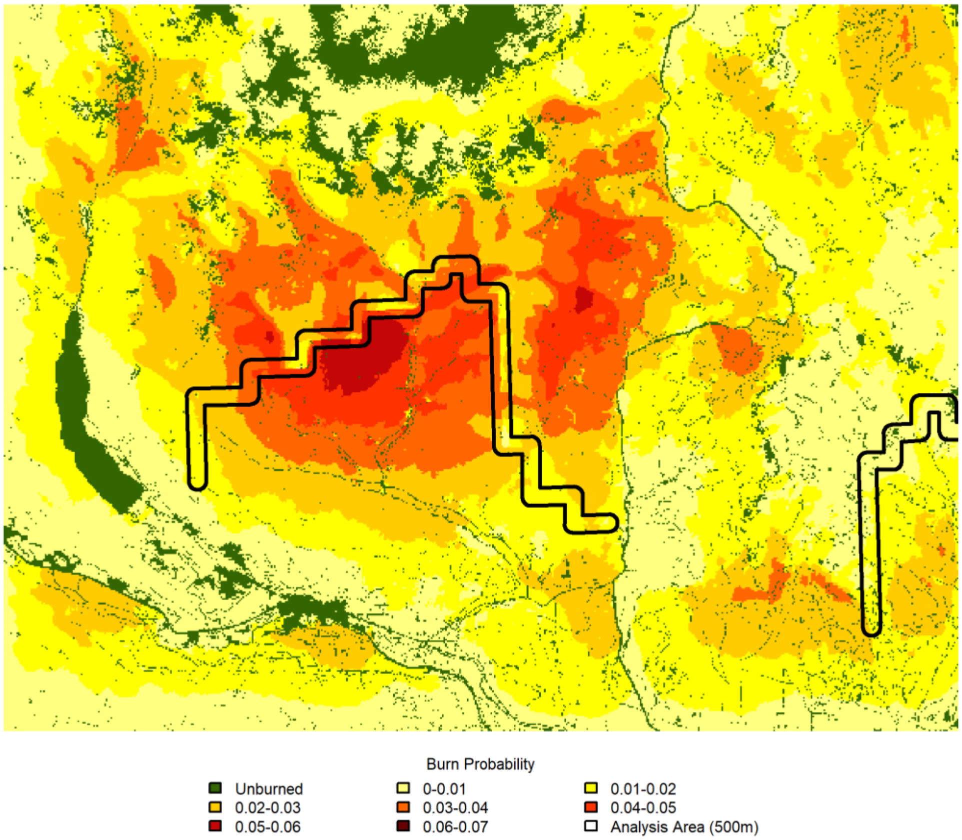
Reduction of 40% Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



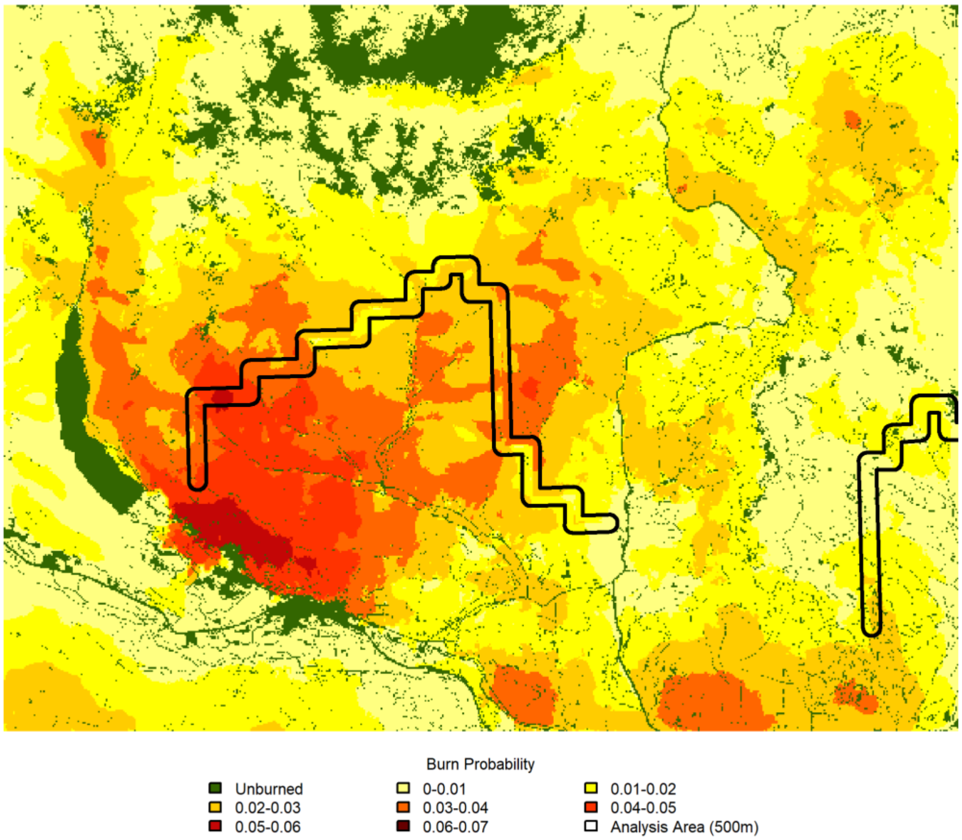
Reduction of 40% Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



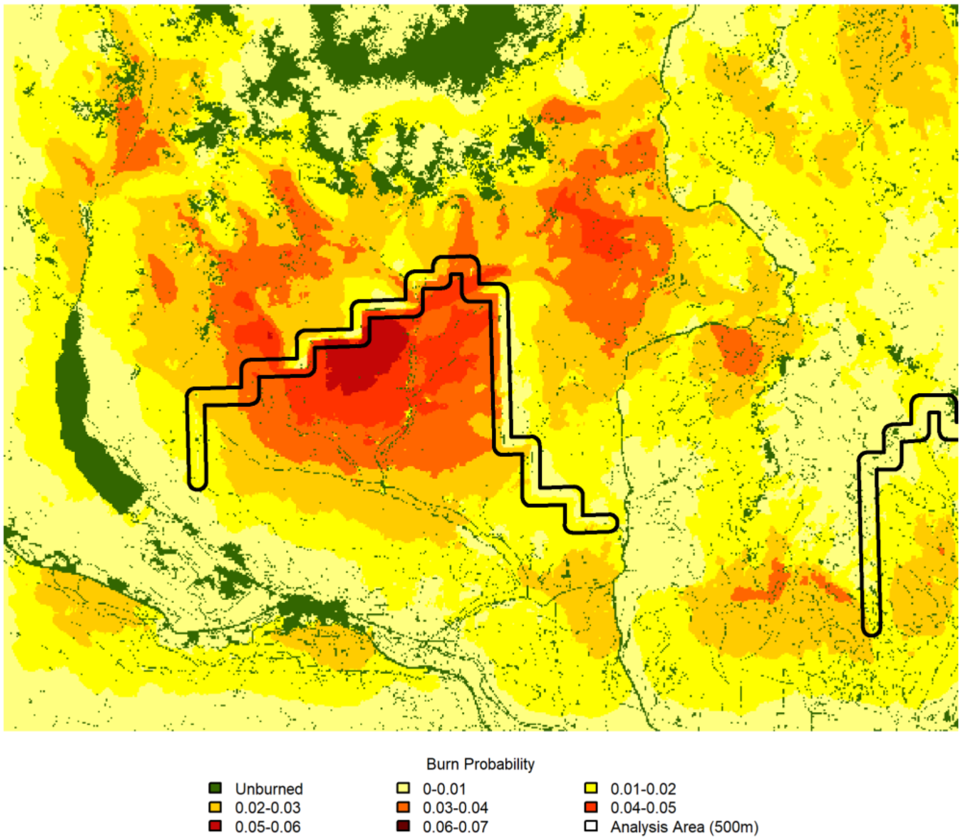
Reduction of 40% Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



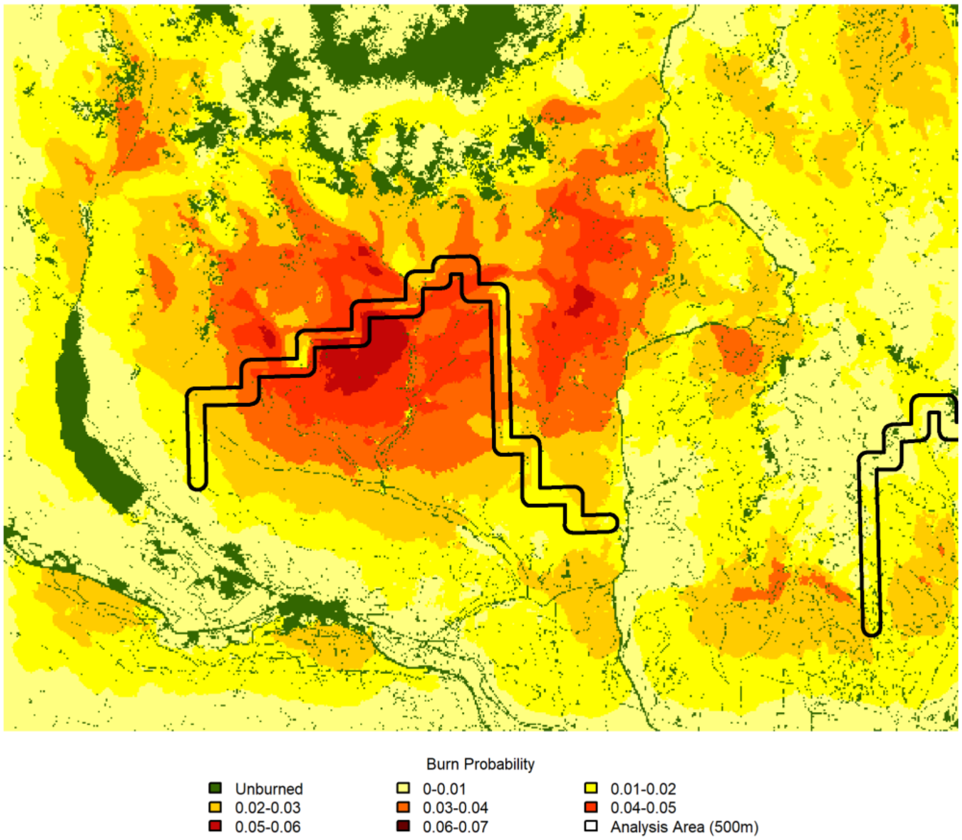
Reduction of 40% Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



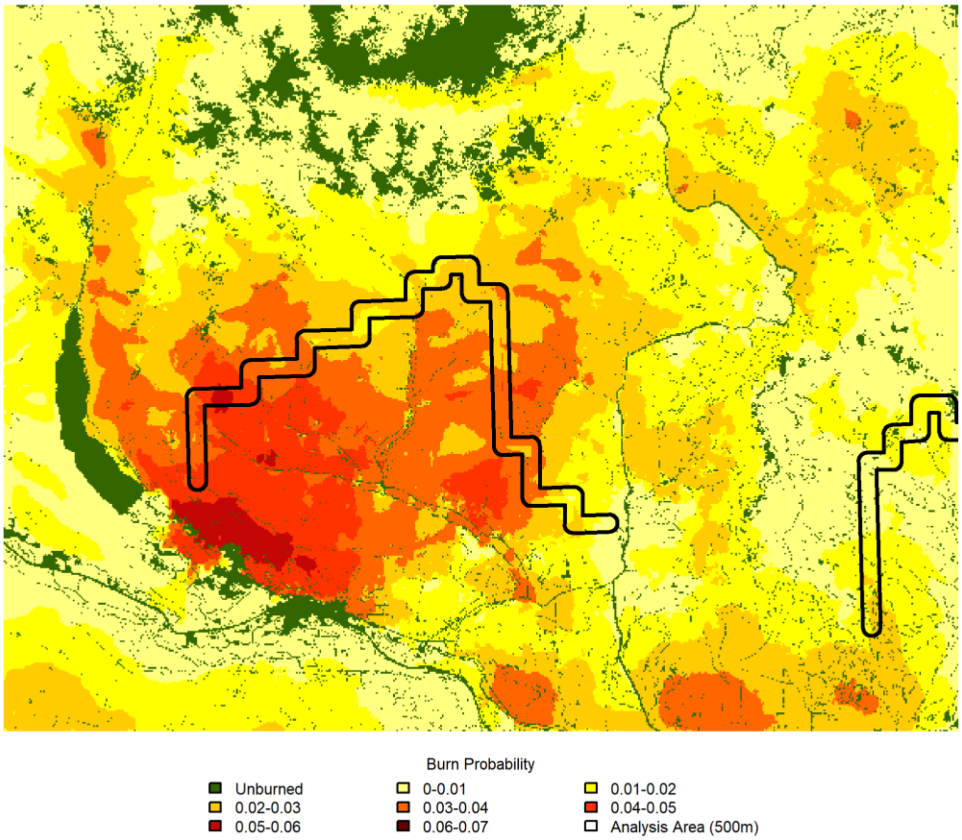
Reduction of 40% Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



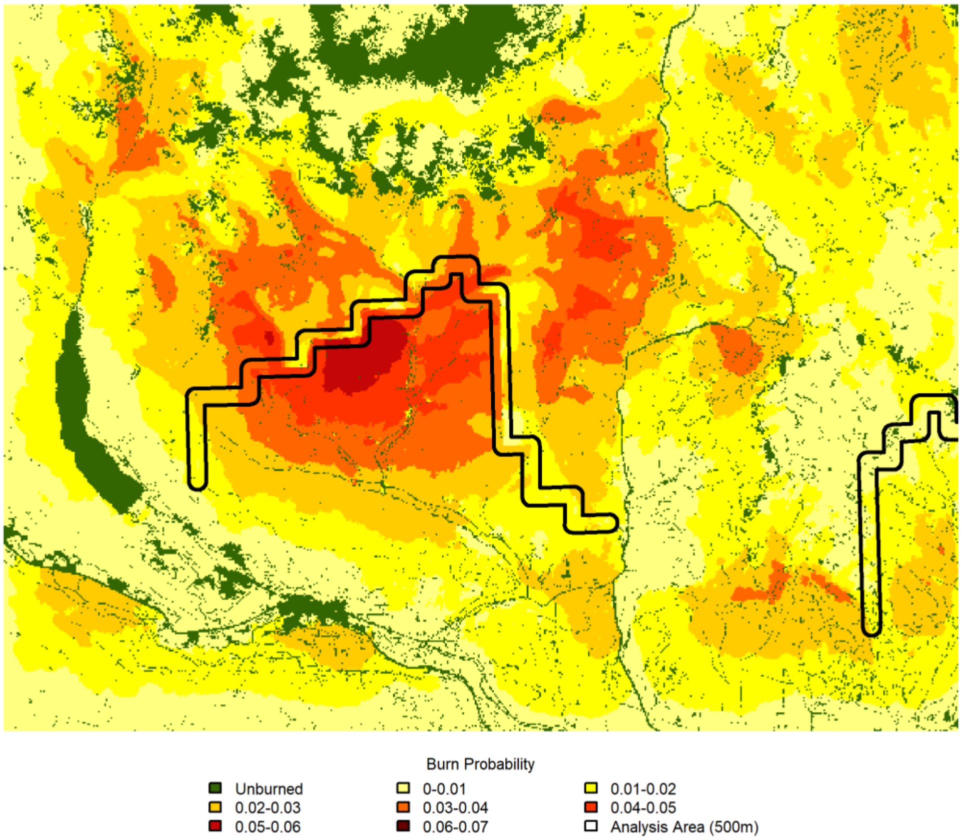
Reduction of 40% Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



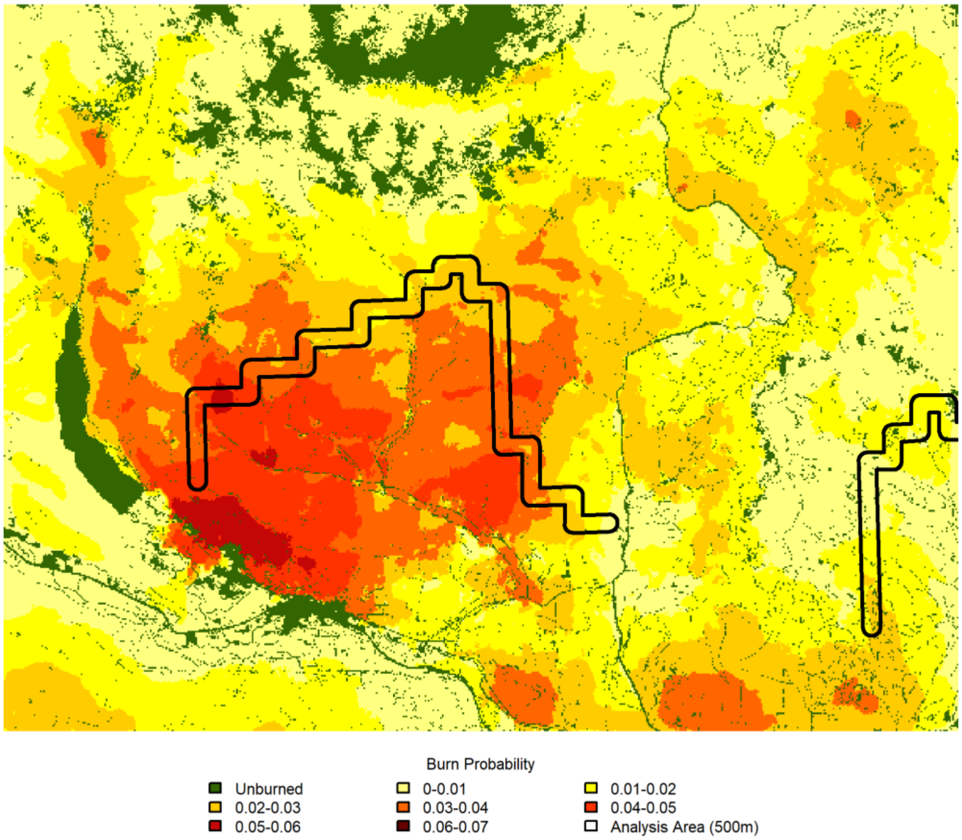
Reduction of 40% Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



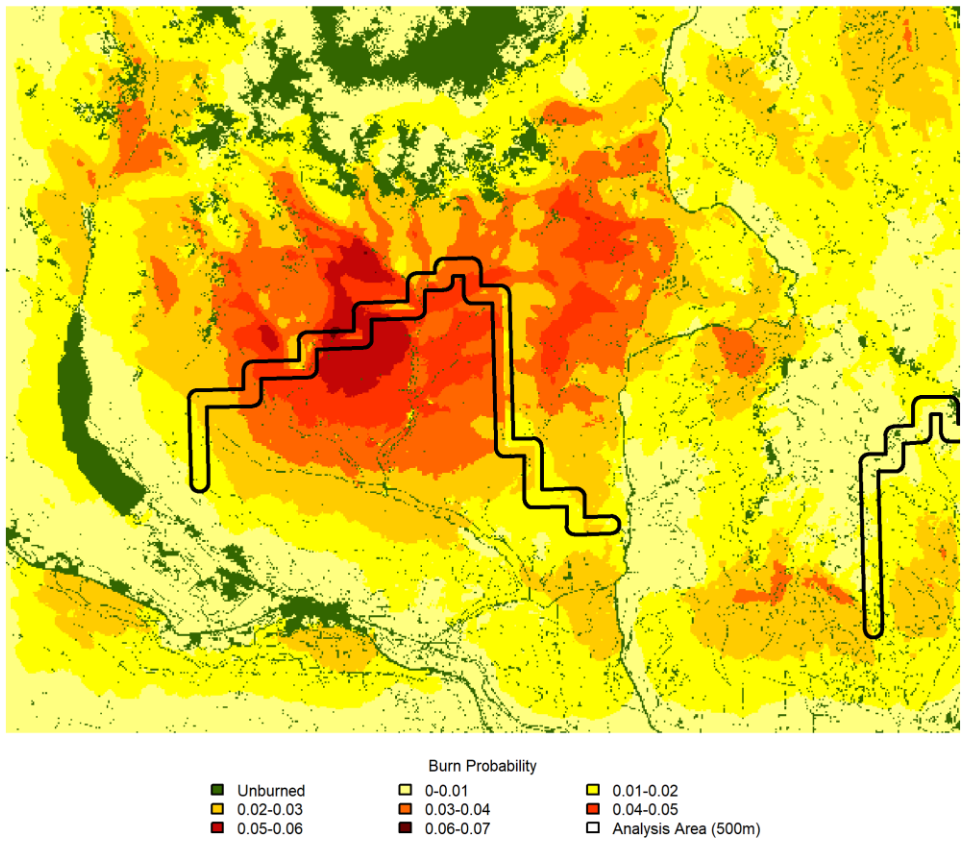
Reduction of 40% Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



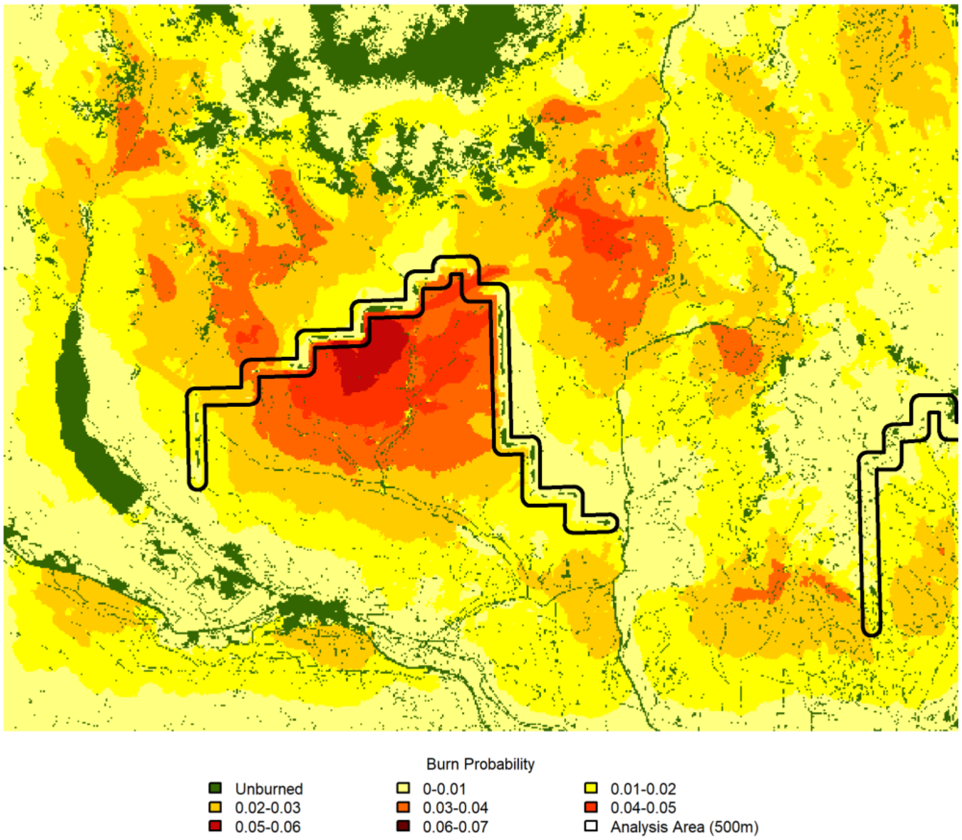
Reduction of 40% Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



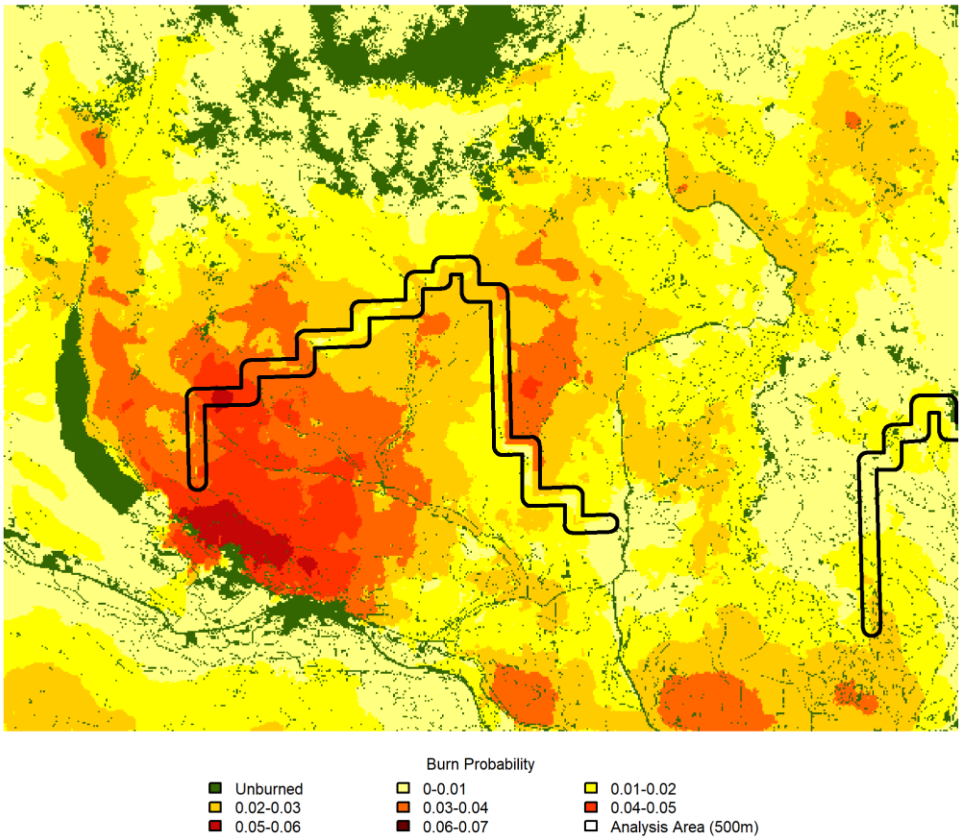
Reduction of 40% Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



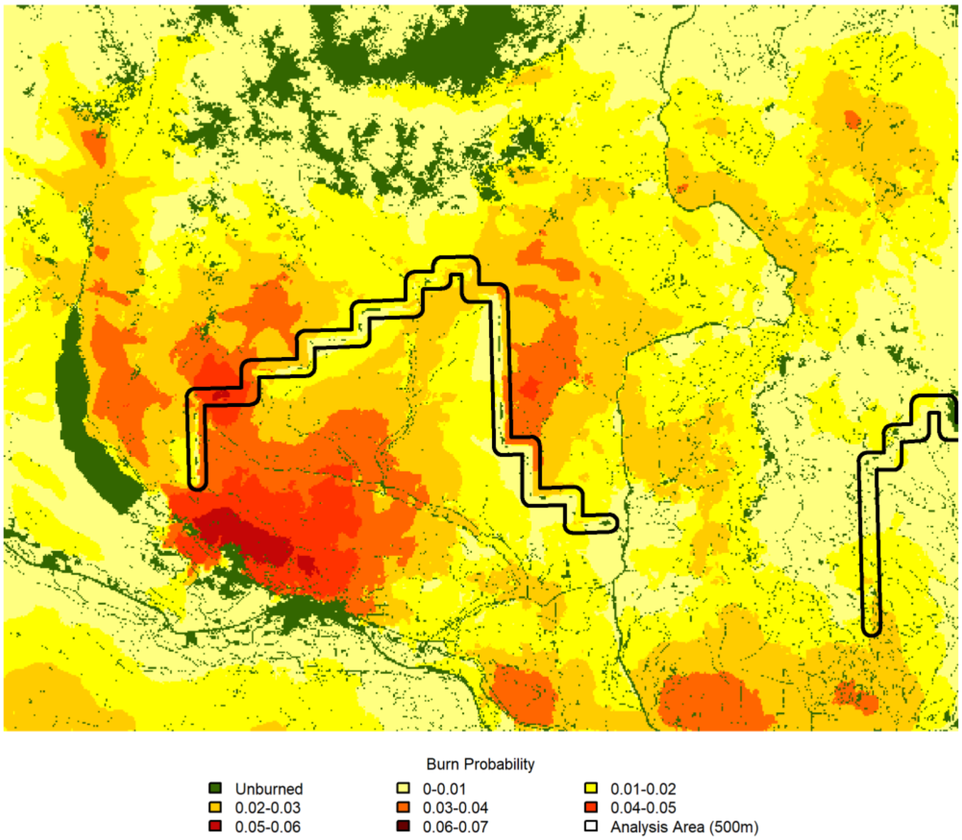
Reduction of 30% Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



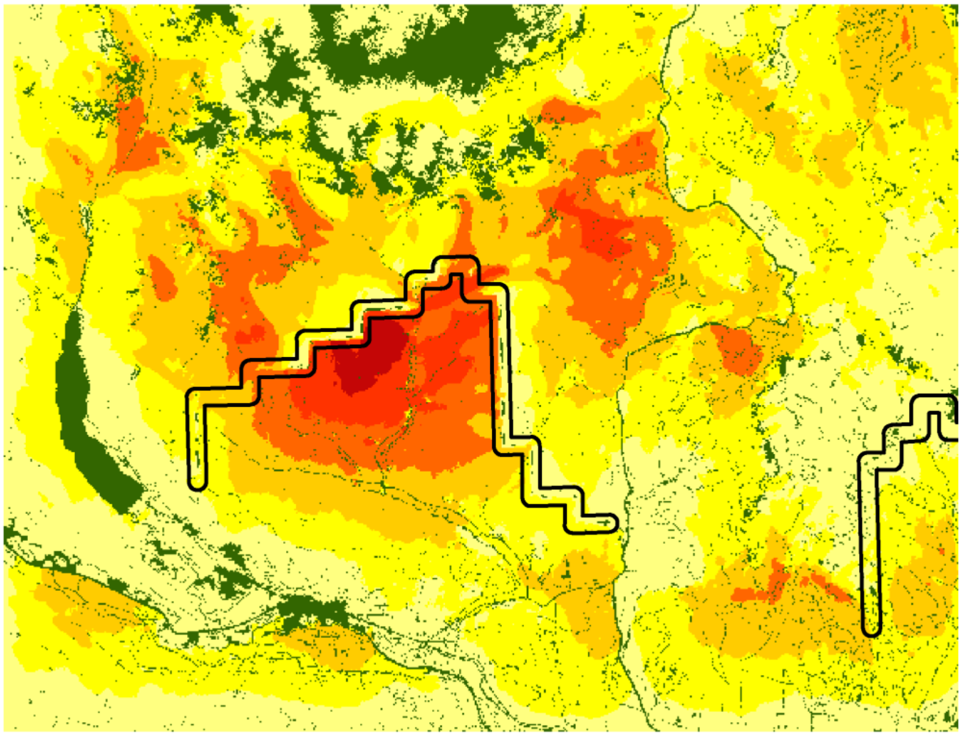
Reduction of 30% Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



Reduction of 30% Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



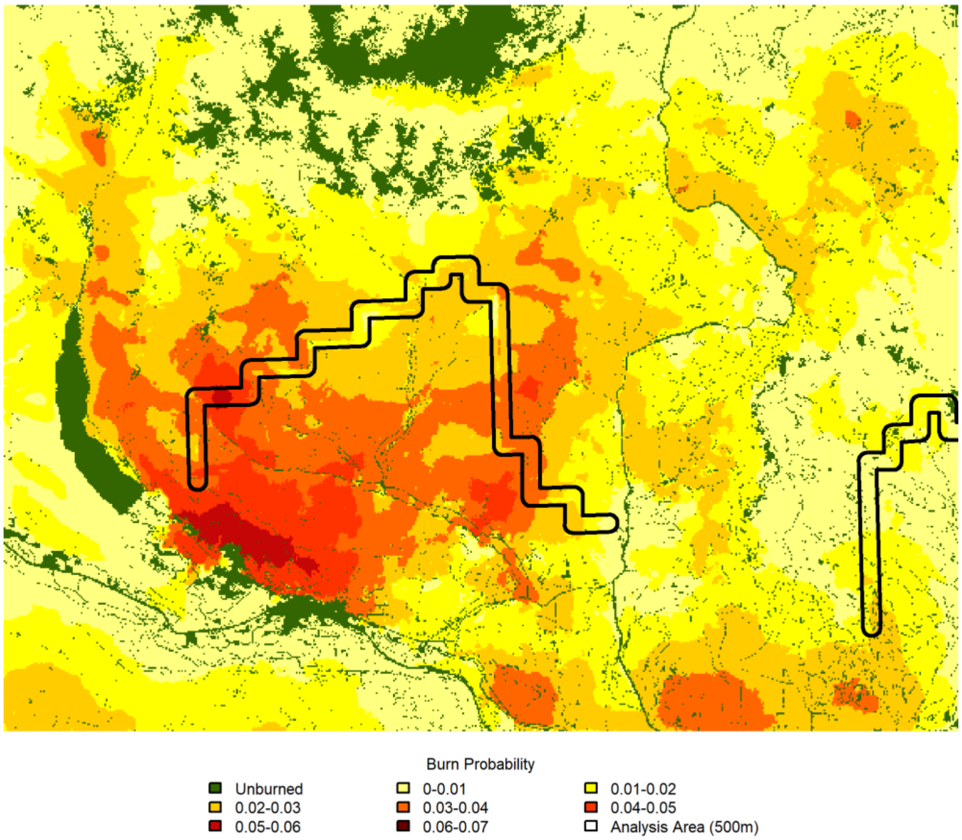
Reduction of 30% Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



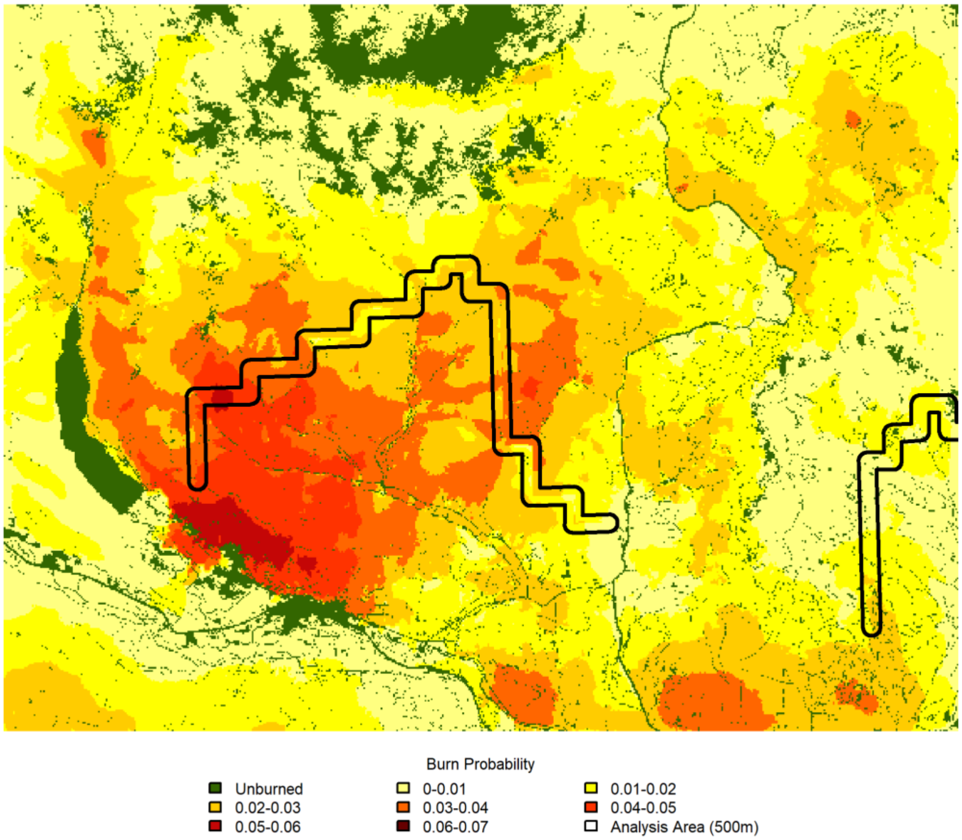
Burn Probability

Unburned	0-0.01	0.01-0.02
0.02-0.03	0.03-0.04	0.04-0.05
0.05-0.06	0.06-0.07	Analysis Area (500m)

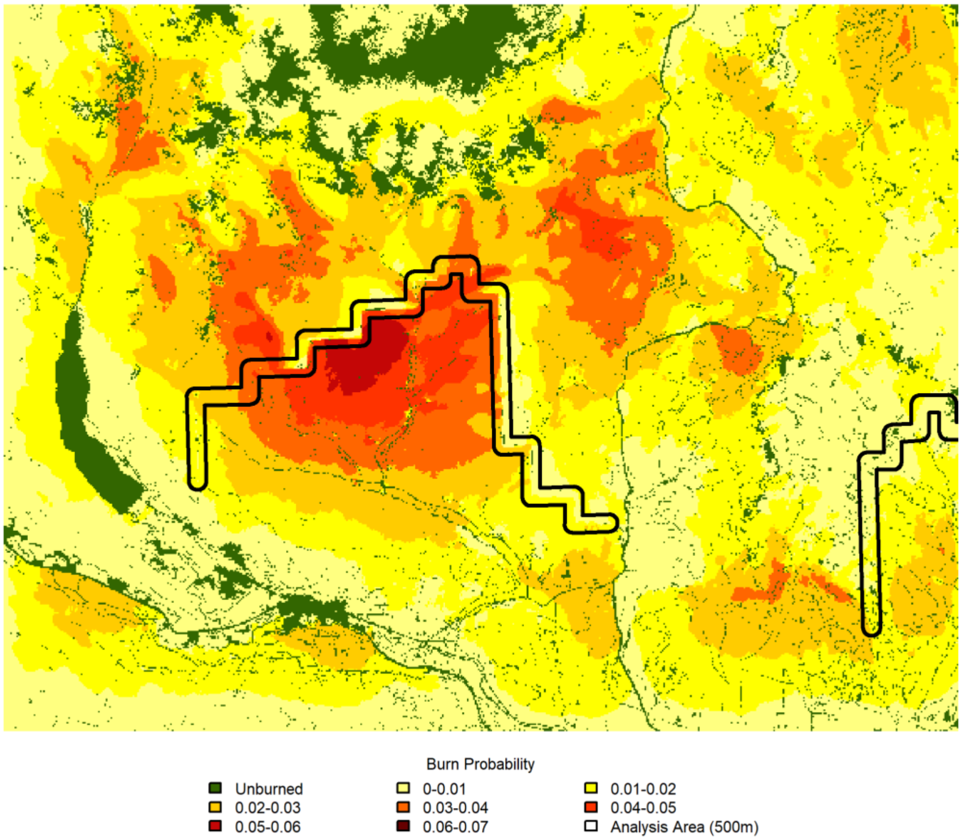
Reduction of 30% Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



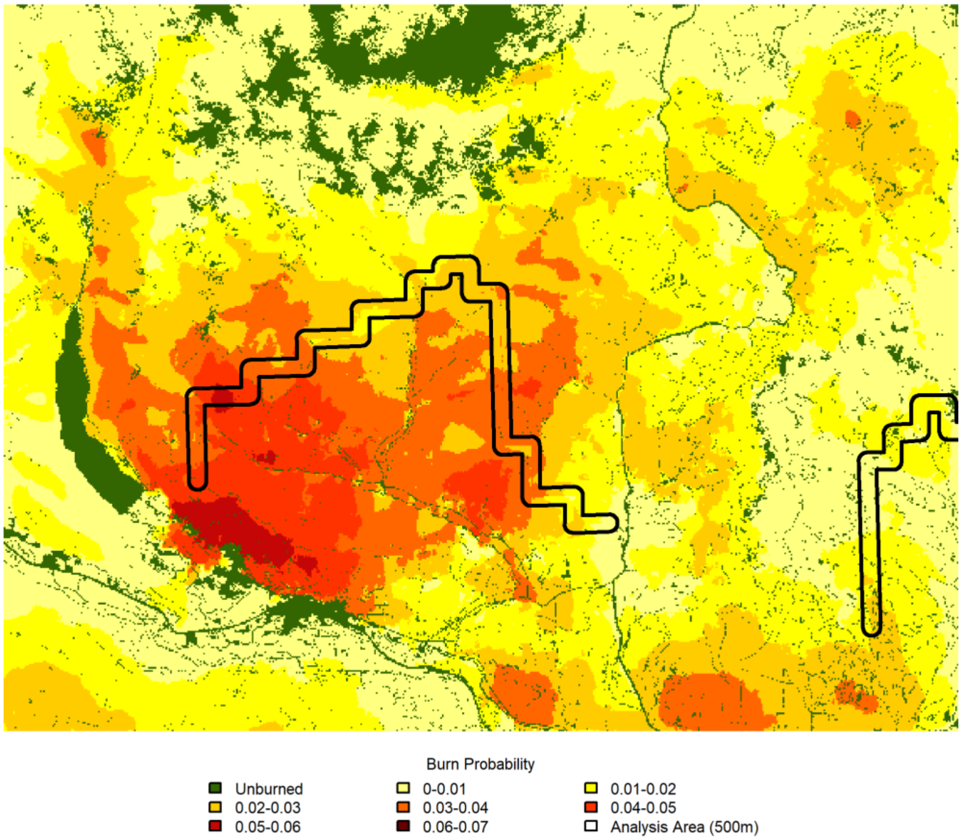
Reduction of 30% Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



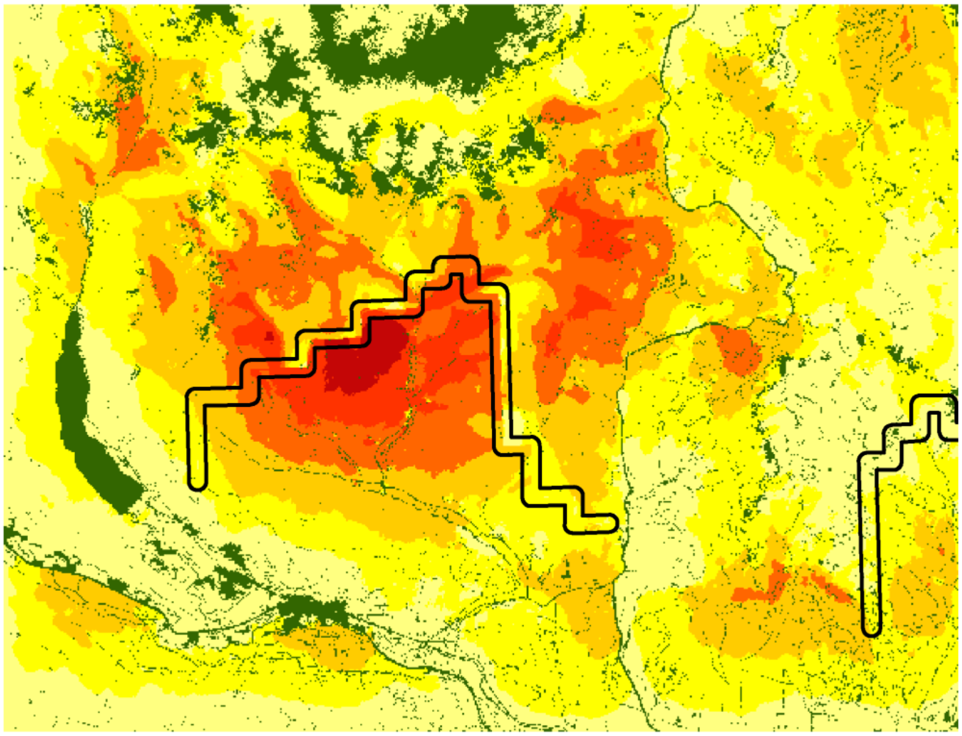
Reduction of 30% Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



Reduction of 30% Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



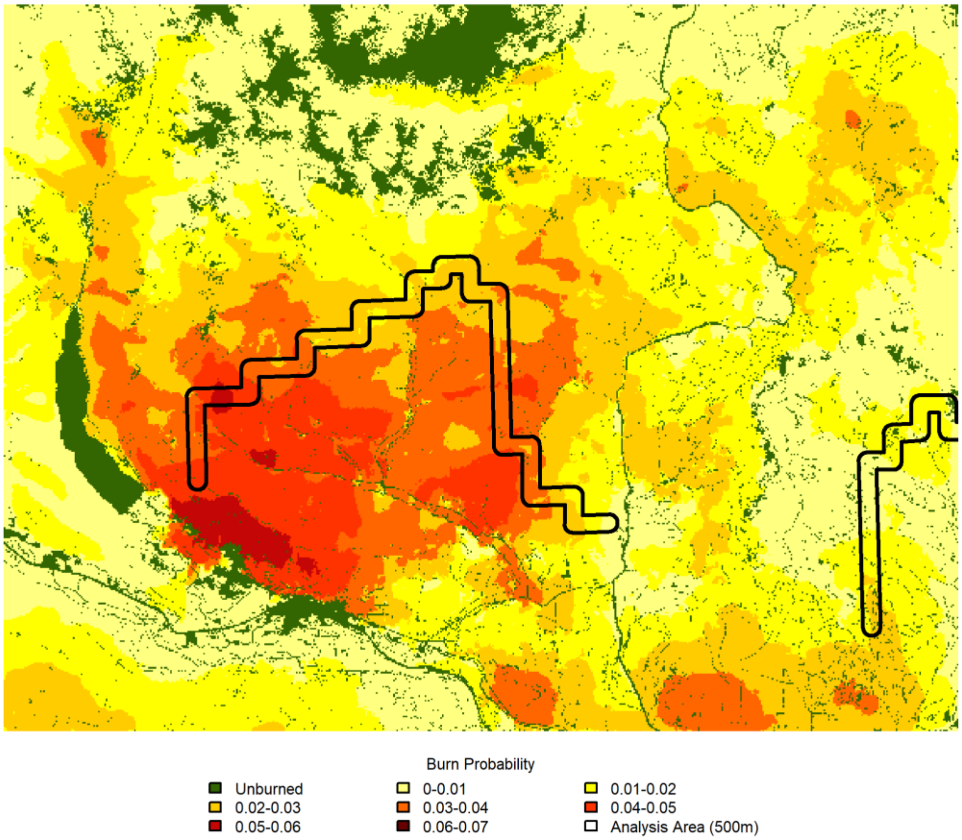
Reduction of 30% Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



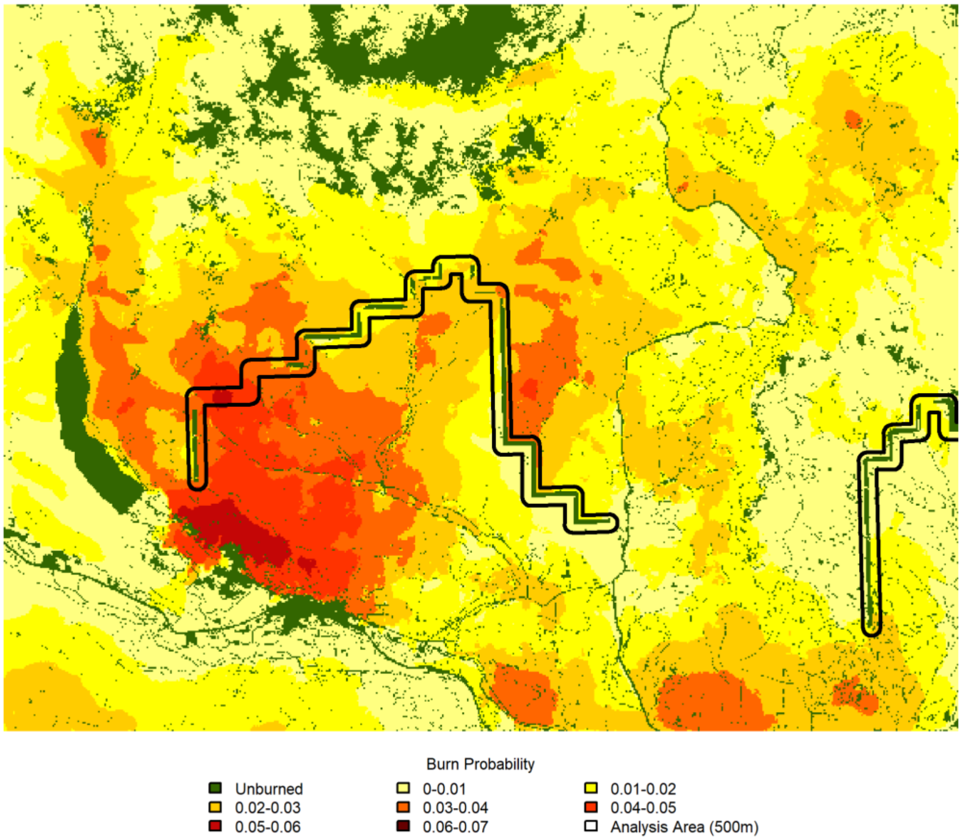
Burn Probability

Unburned	0-0.01	0.01-0.02
0.02-0.03	0.03-0.04	0.04-0.05
0.05-0.06	0.06-0.07	Analysis Area (500m)

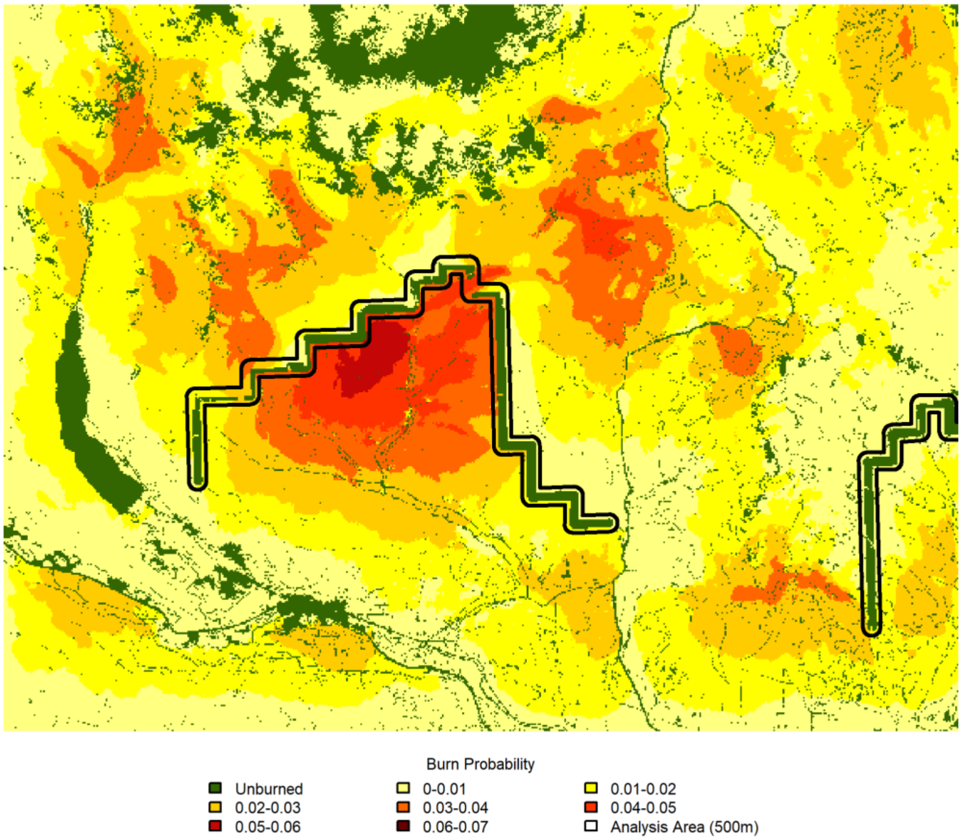
Reduction of 30% Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



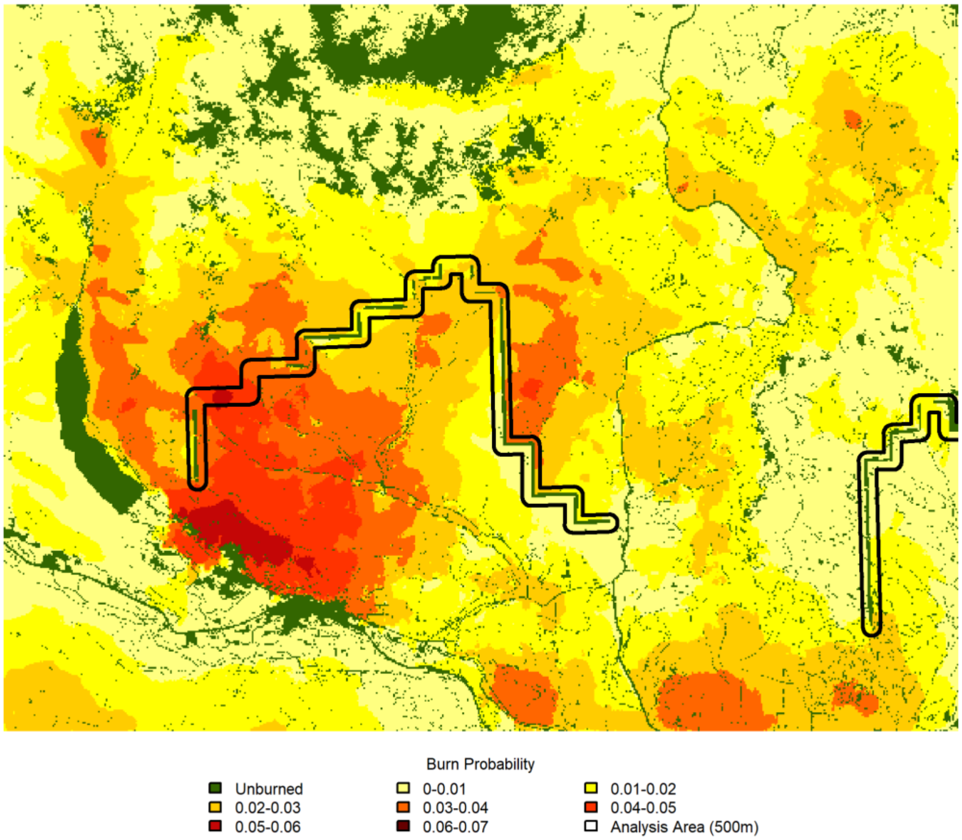
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



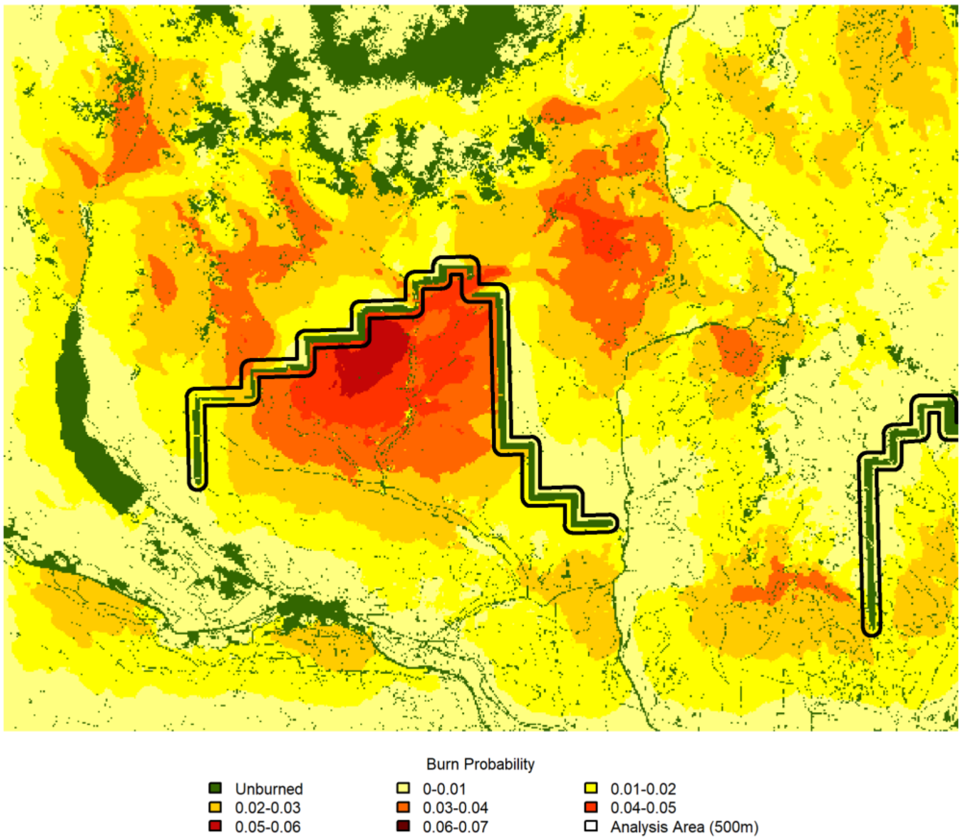
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



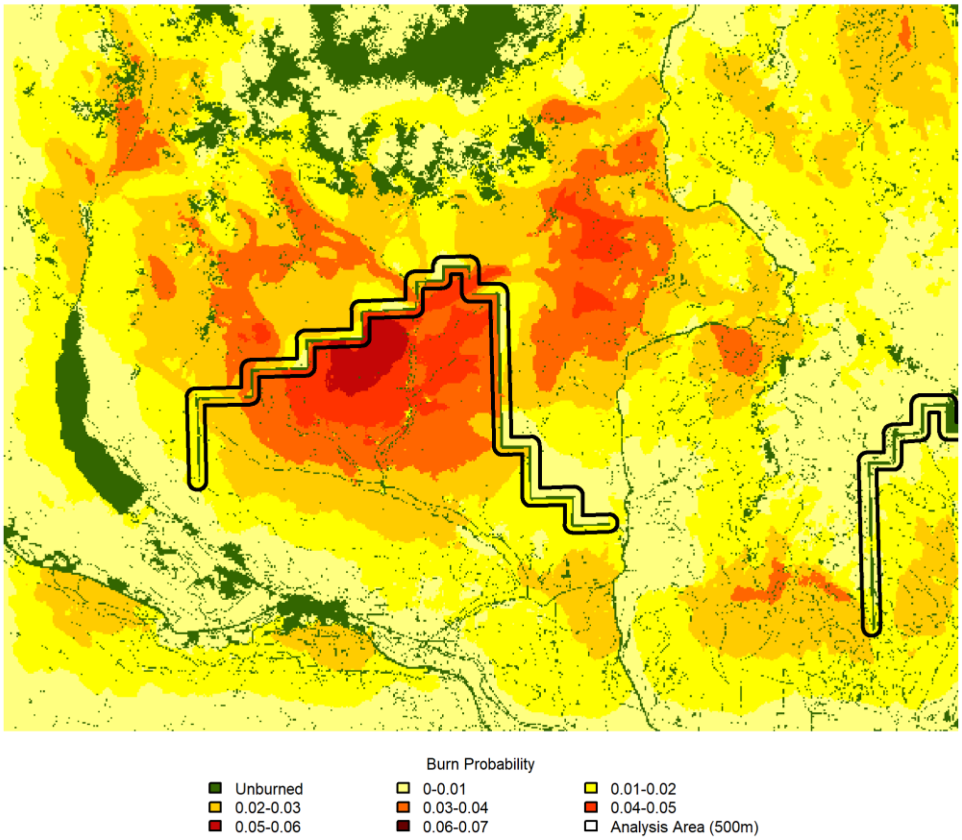
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



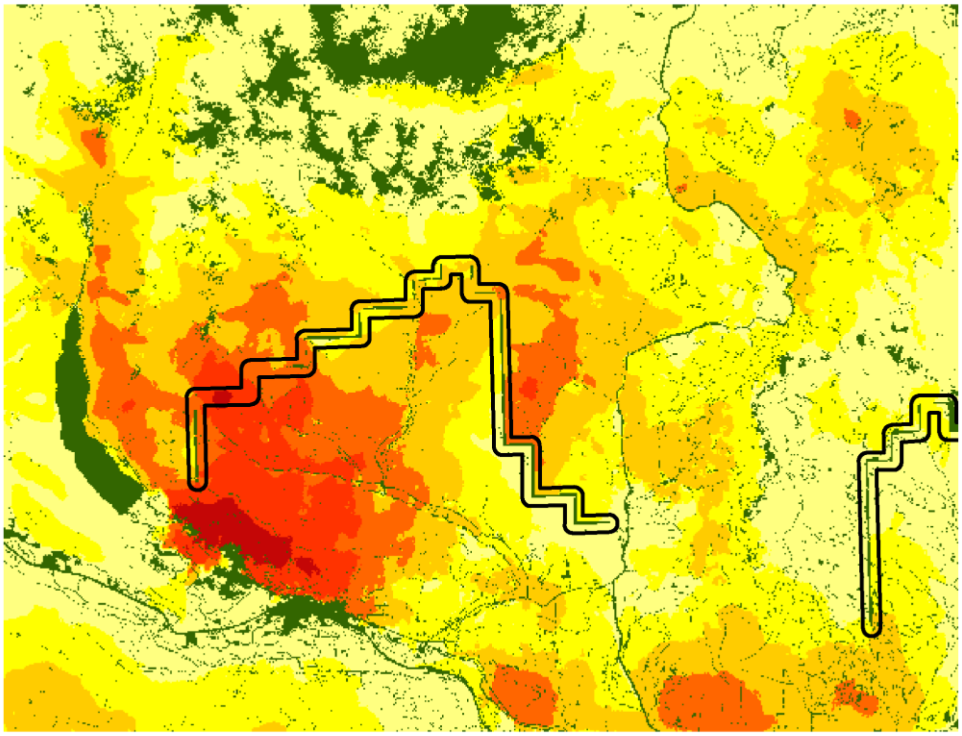
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



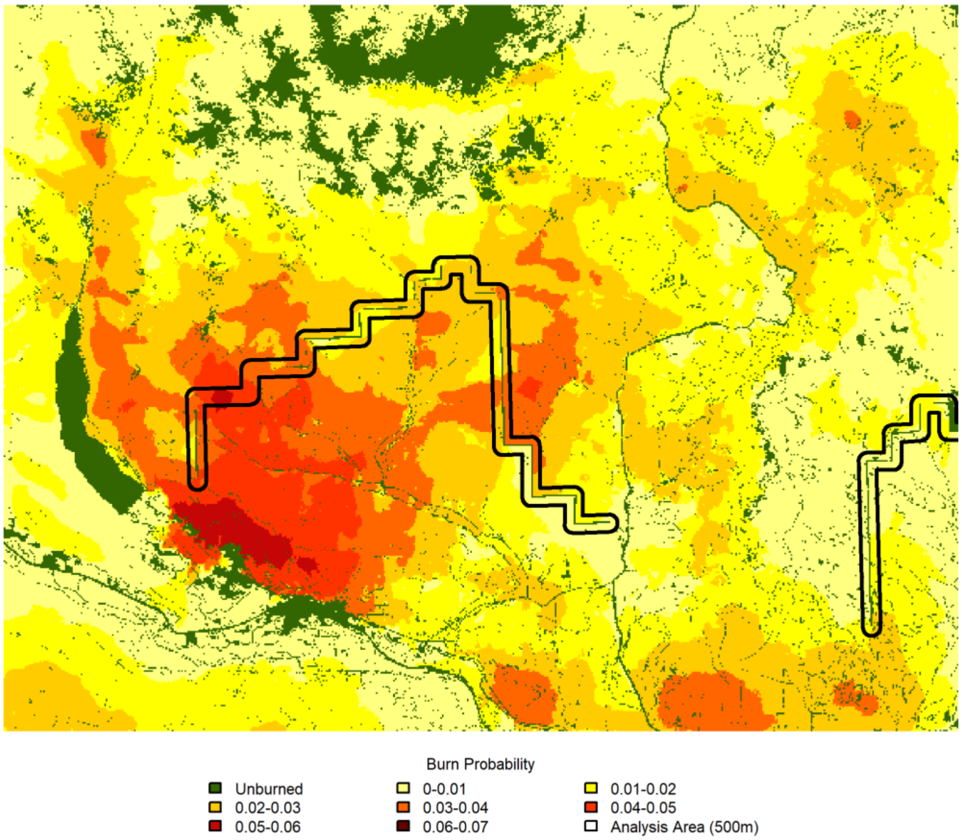
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



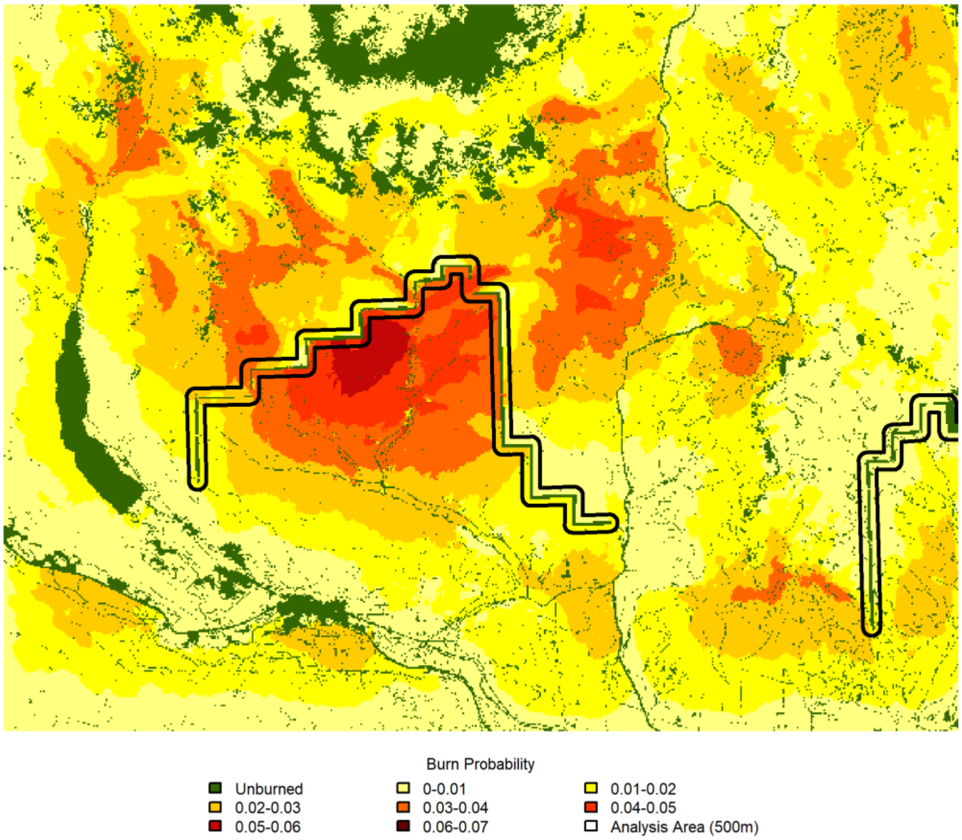
Burn Probability

Unburned	0-0.01	0.01-0.02
0.02-0.03	0.03-0.04	0.04-0.05
0.05-0.06	0.06-0.07	Analysis Area (500m)

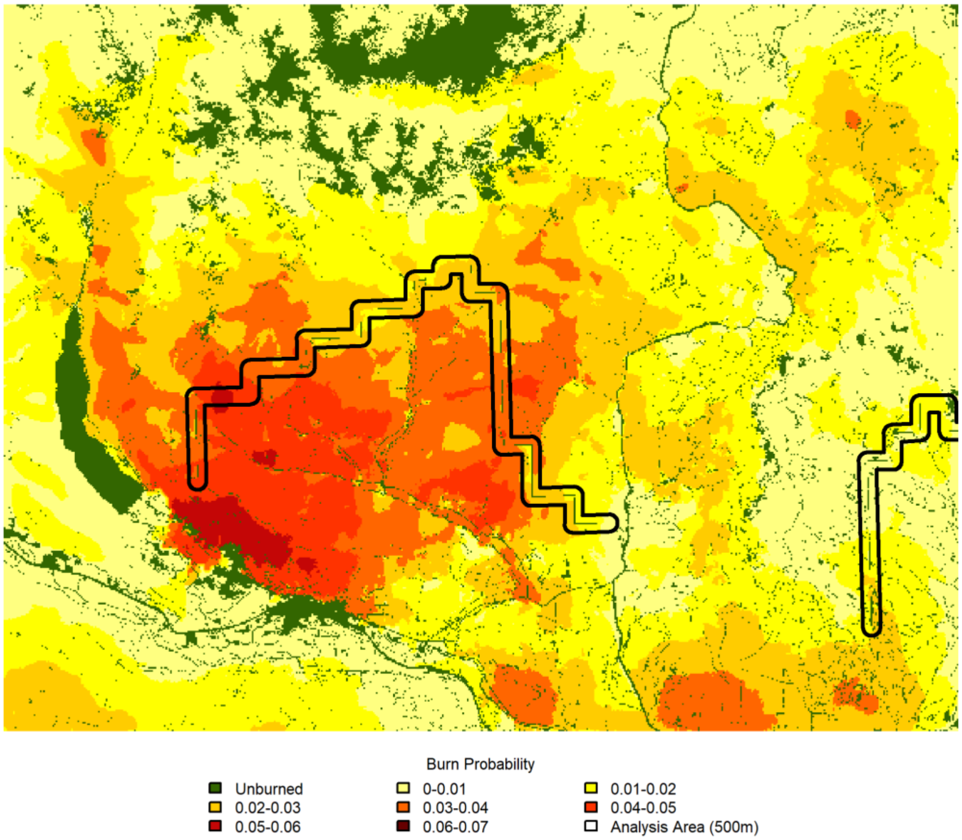
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



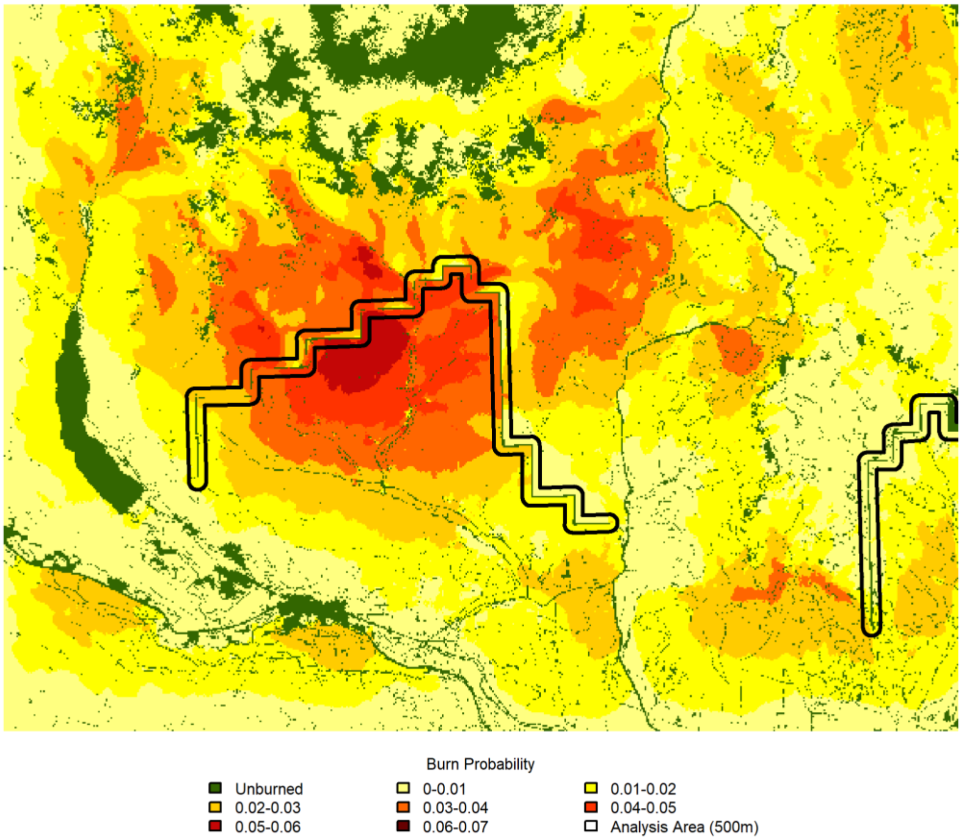
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



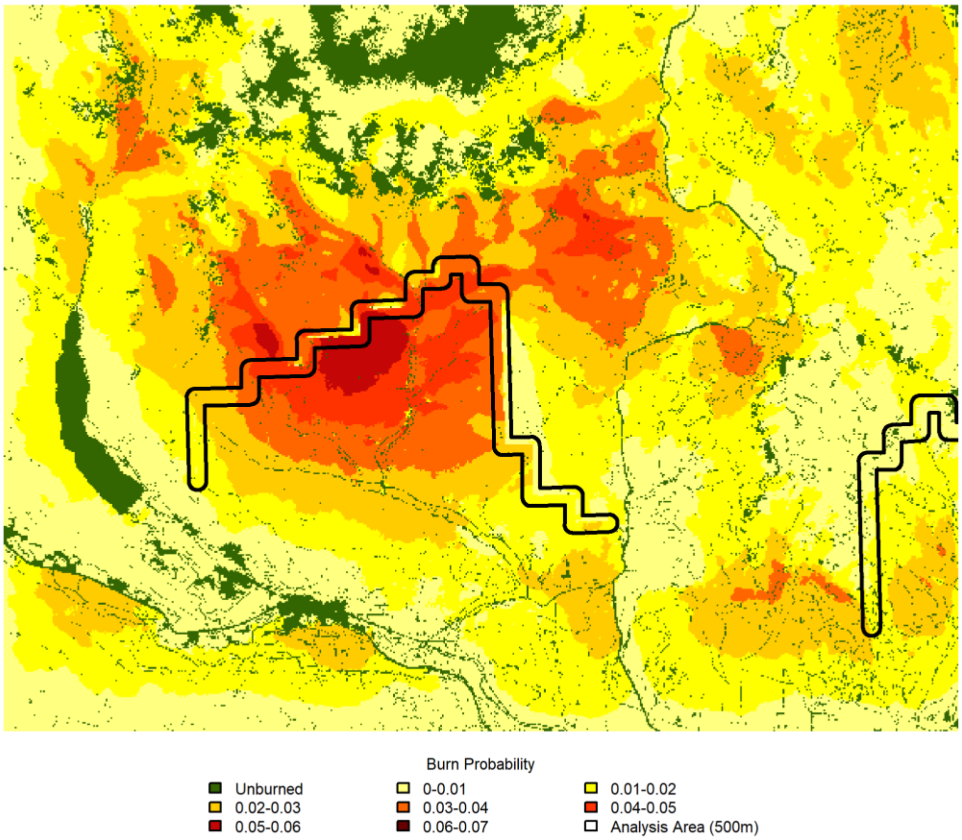
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



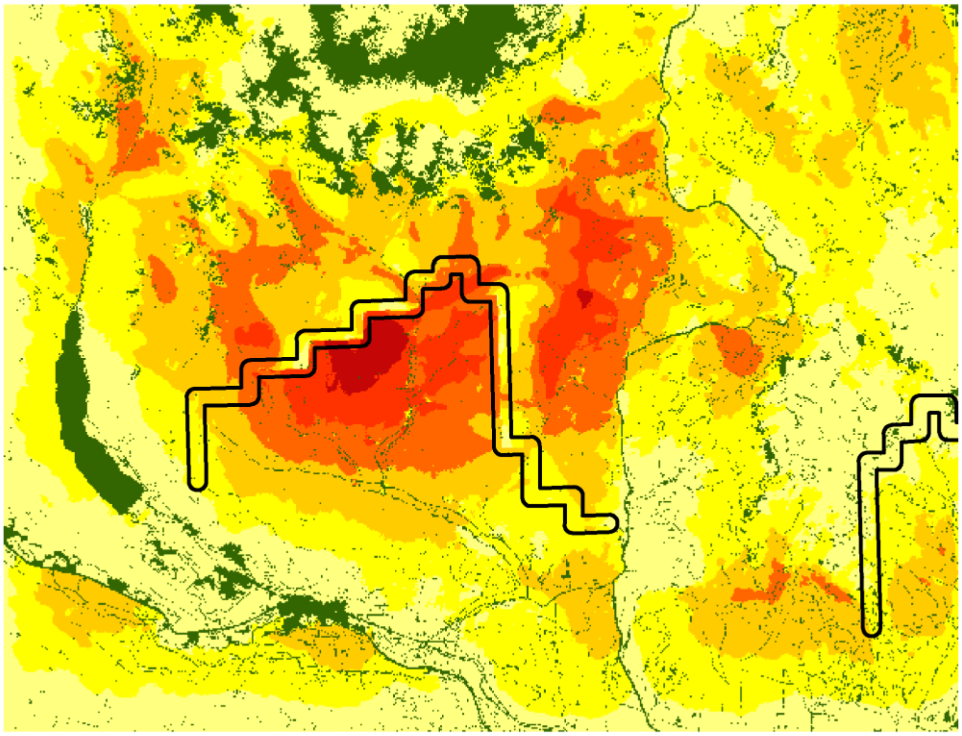
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



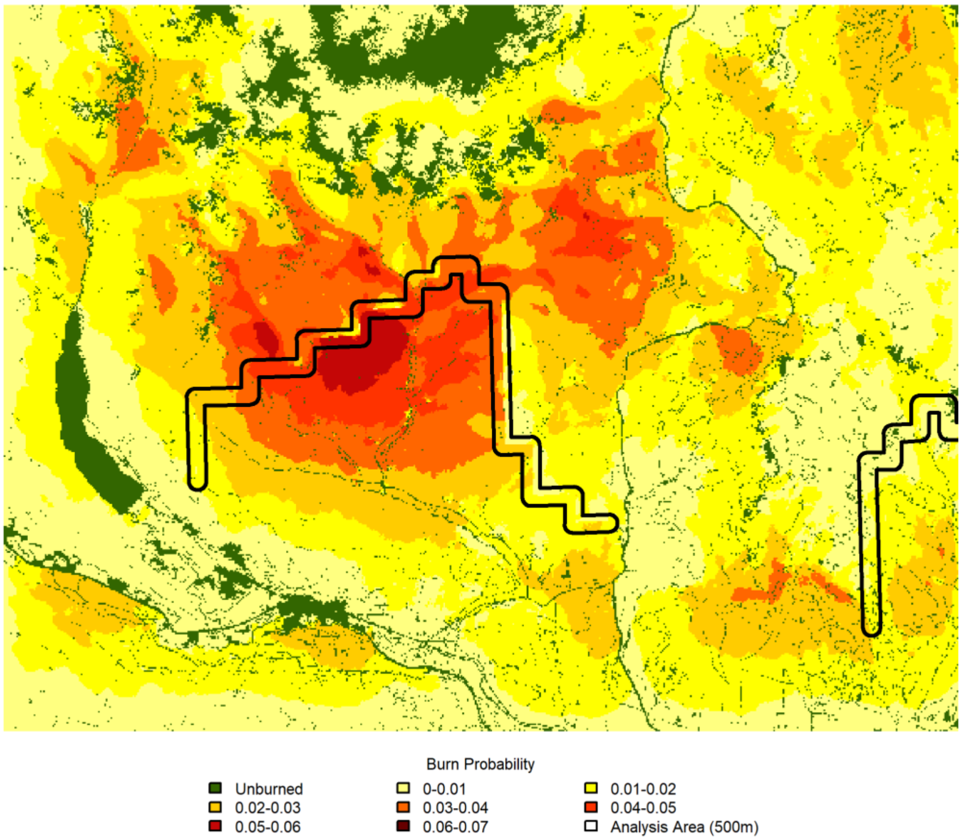
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



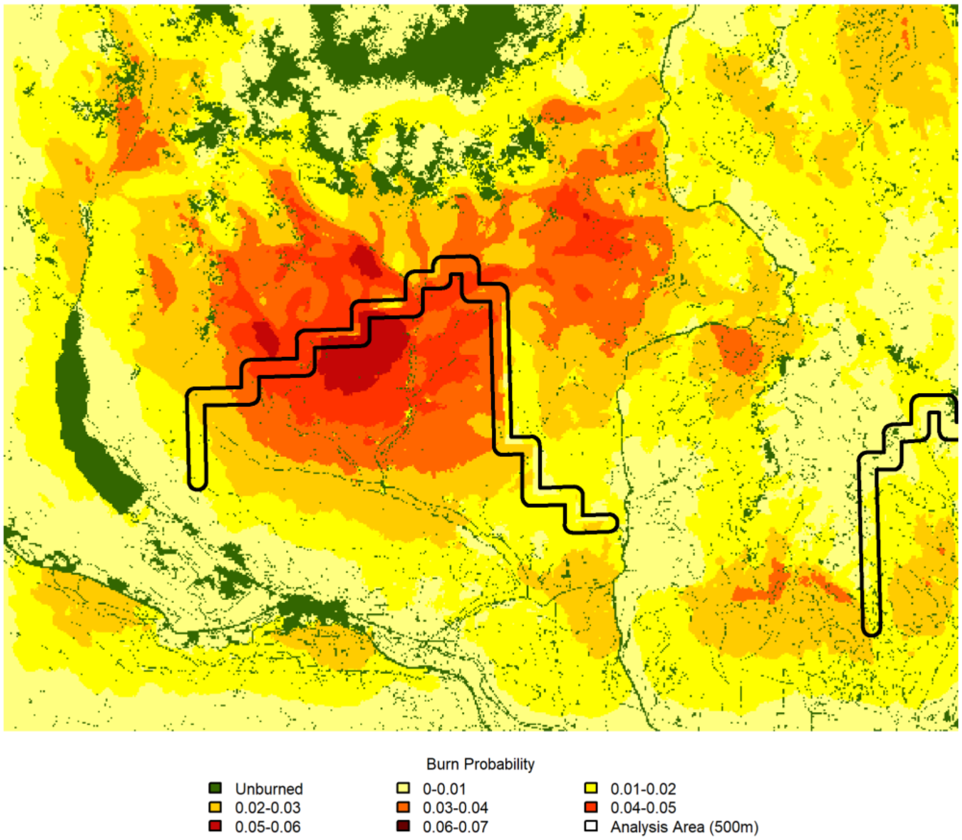
Burn Probability

Unburned	0-0.01	0.01-0.02
0.02-0.03	0.03-0.04	0.04-0.05
0.05-0.06	0.06-0.07	Analysis Area (500m)

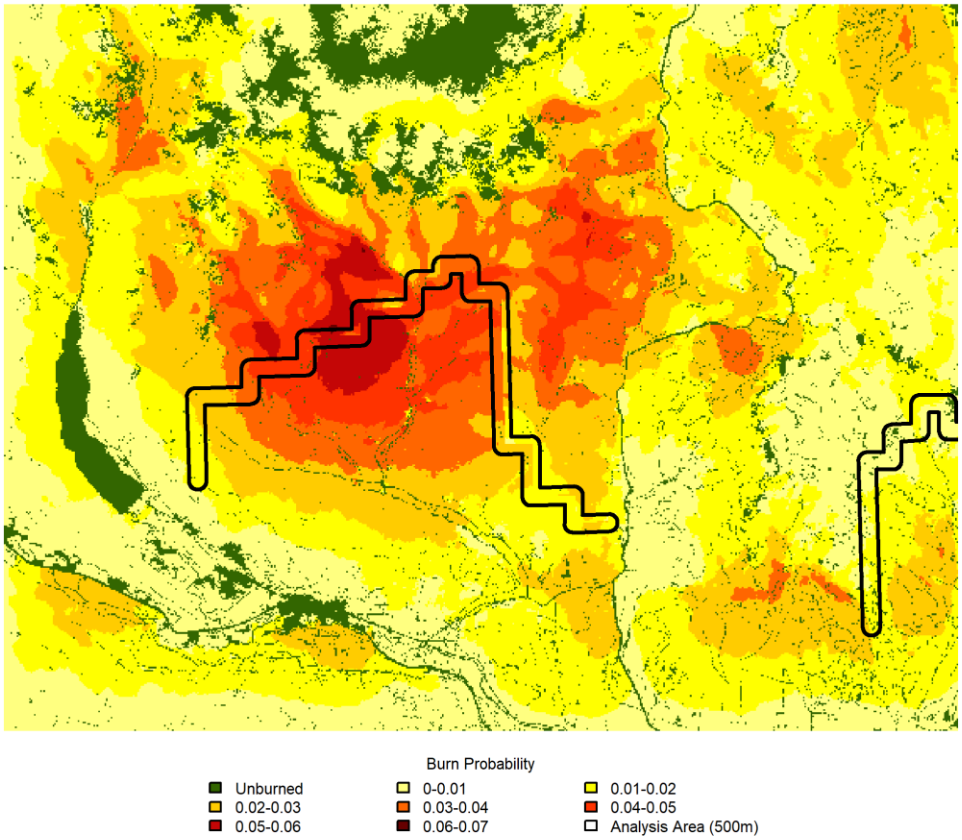
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



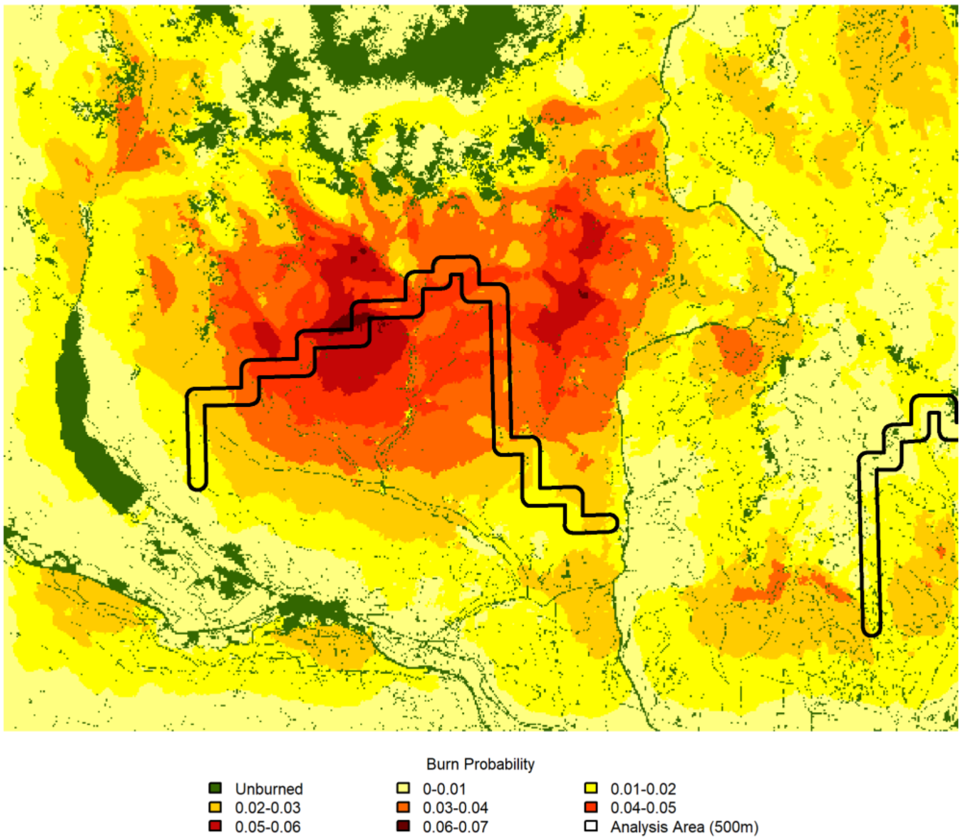
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



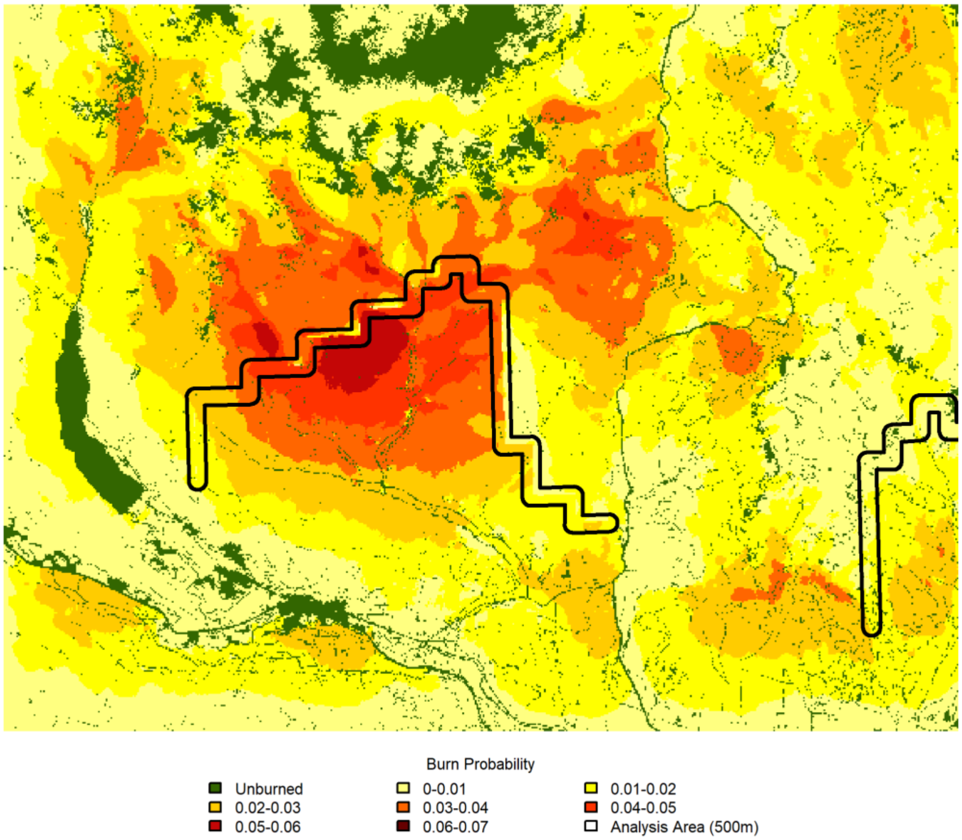
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



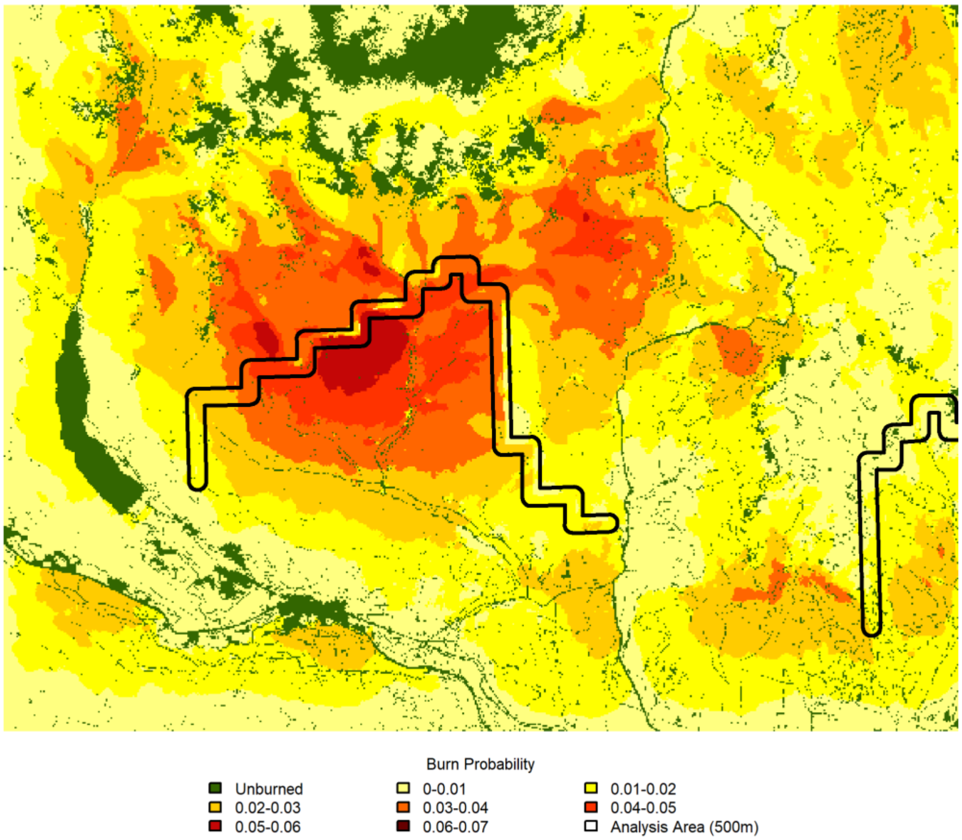
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



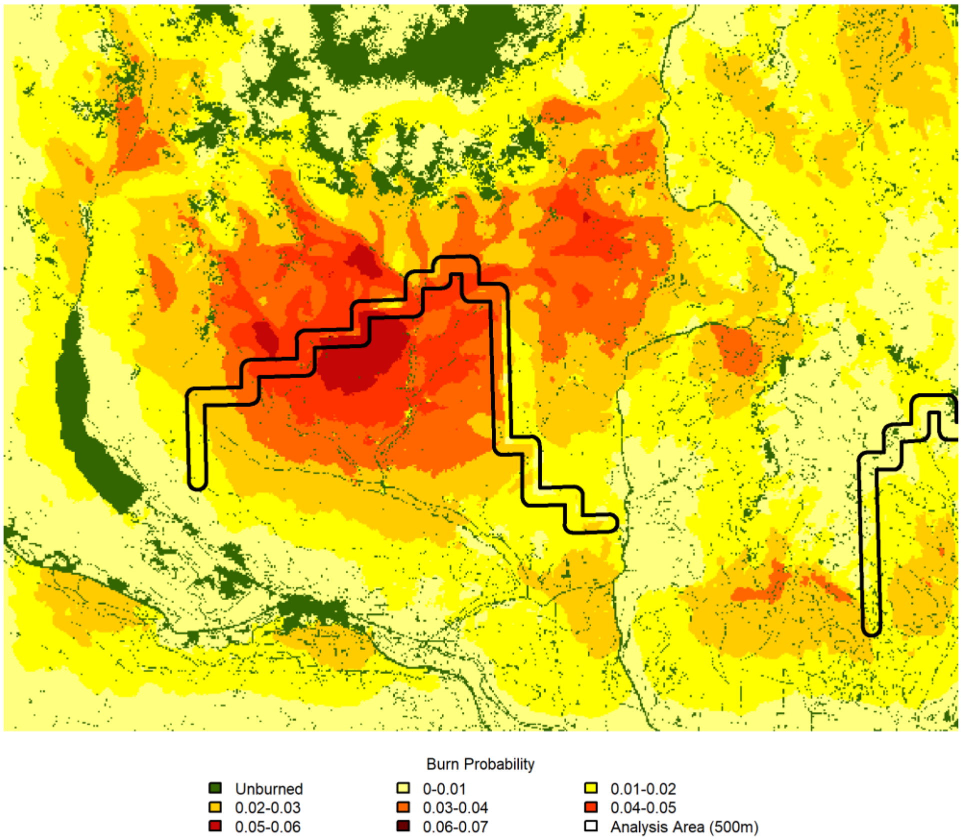
Reduction of 60% Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



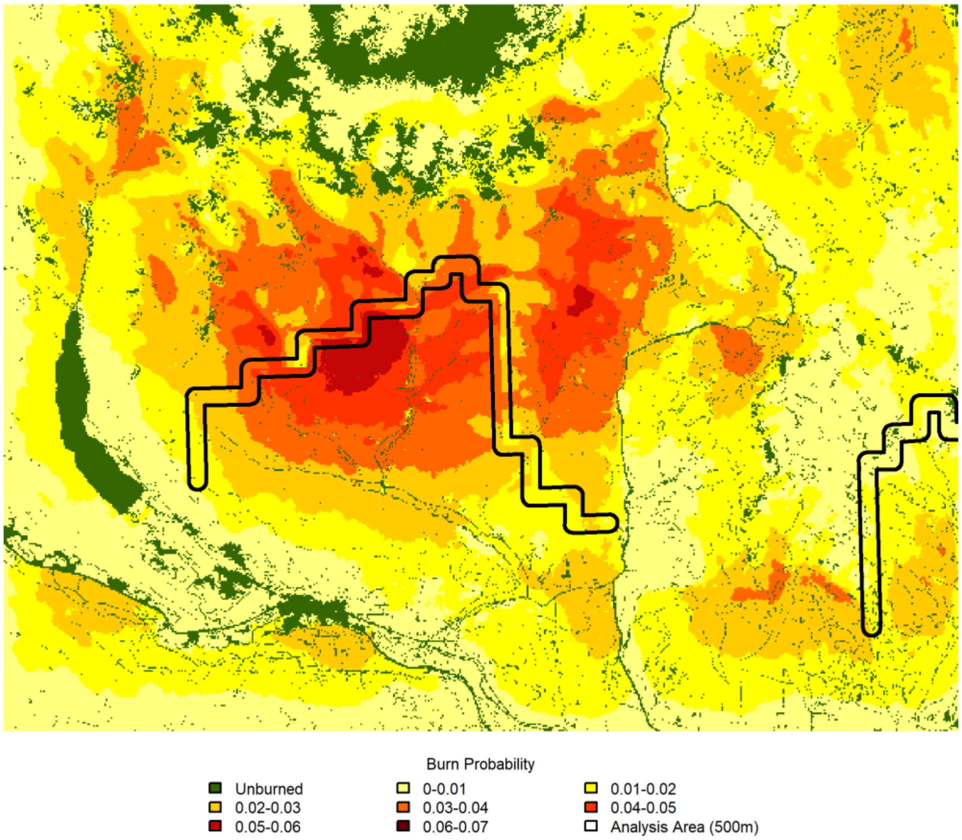
Reduction of 60% Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



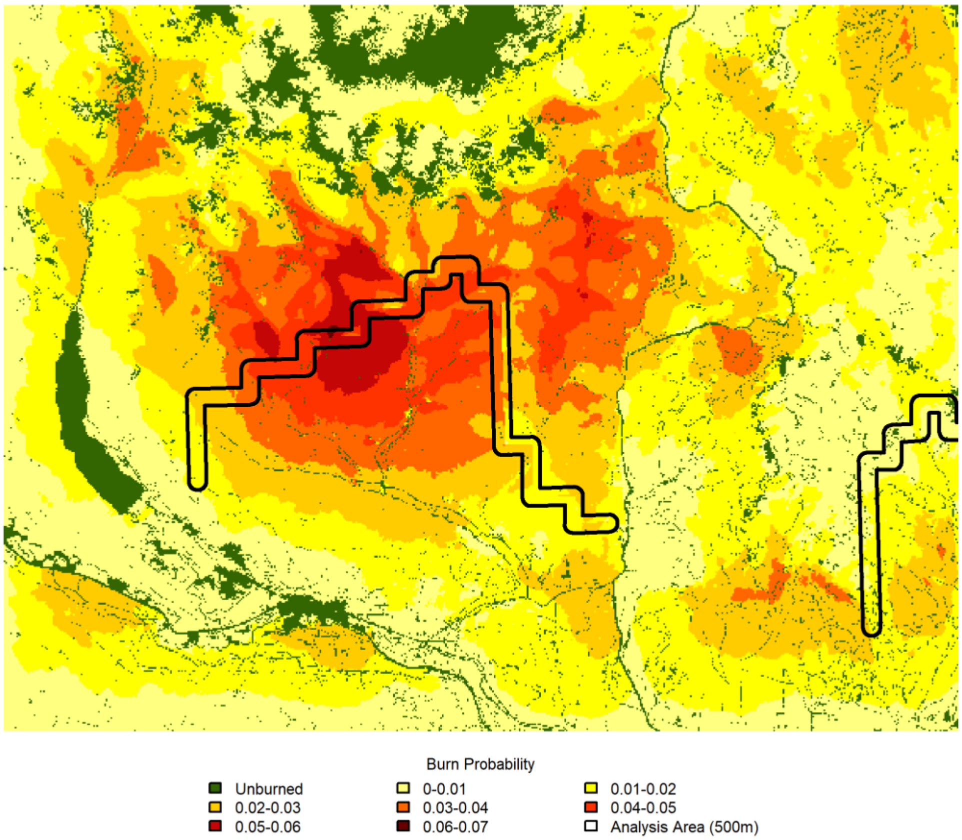
Reduction of 60% Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



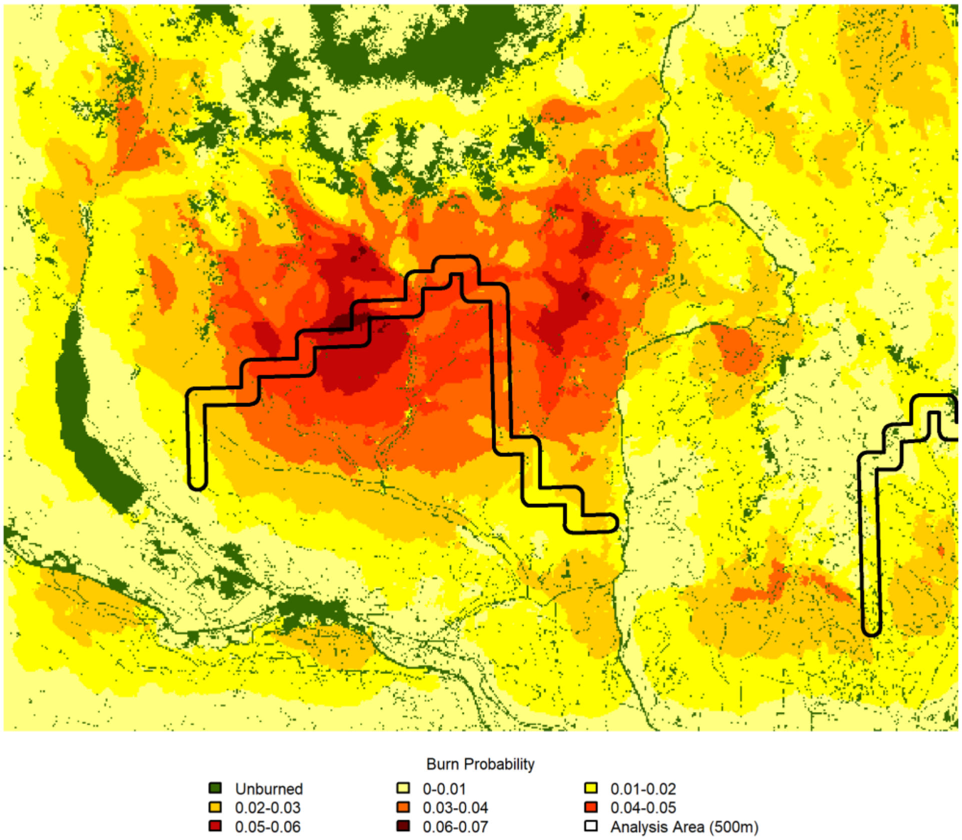
Reduction of 60% Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



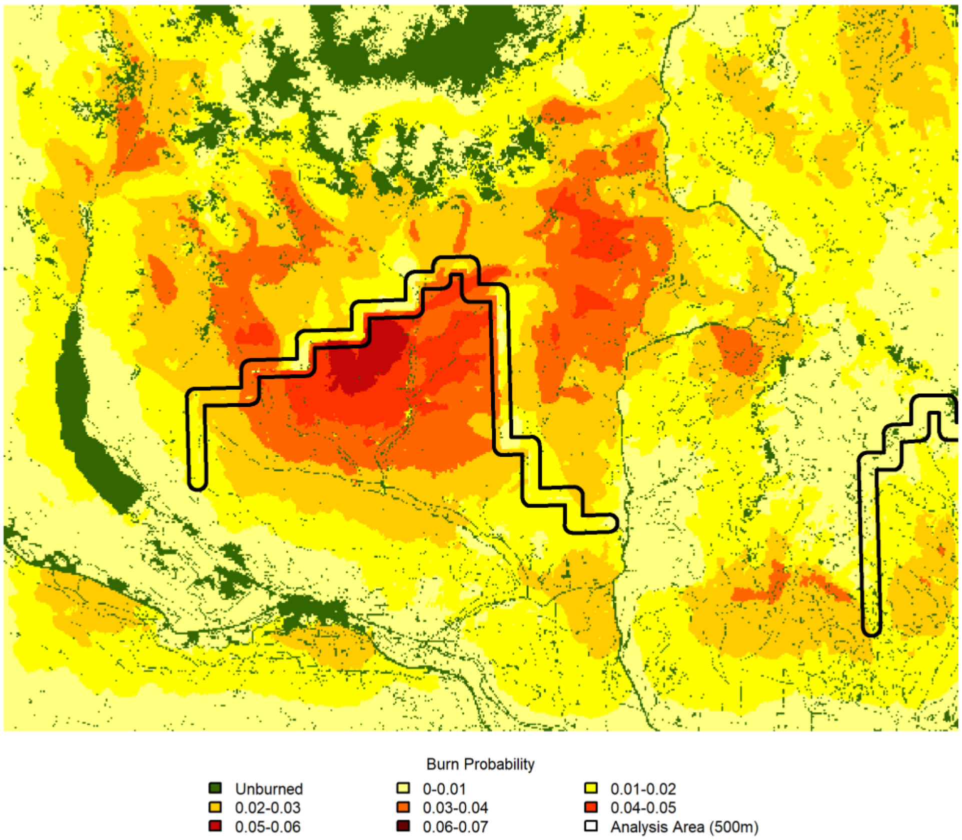
Reduction of 60% Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



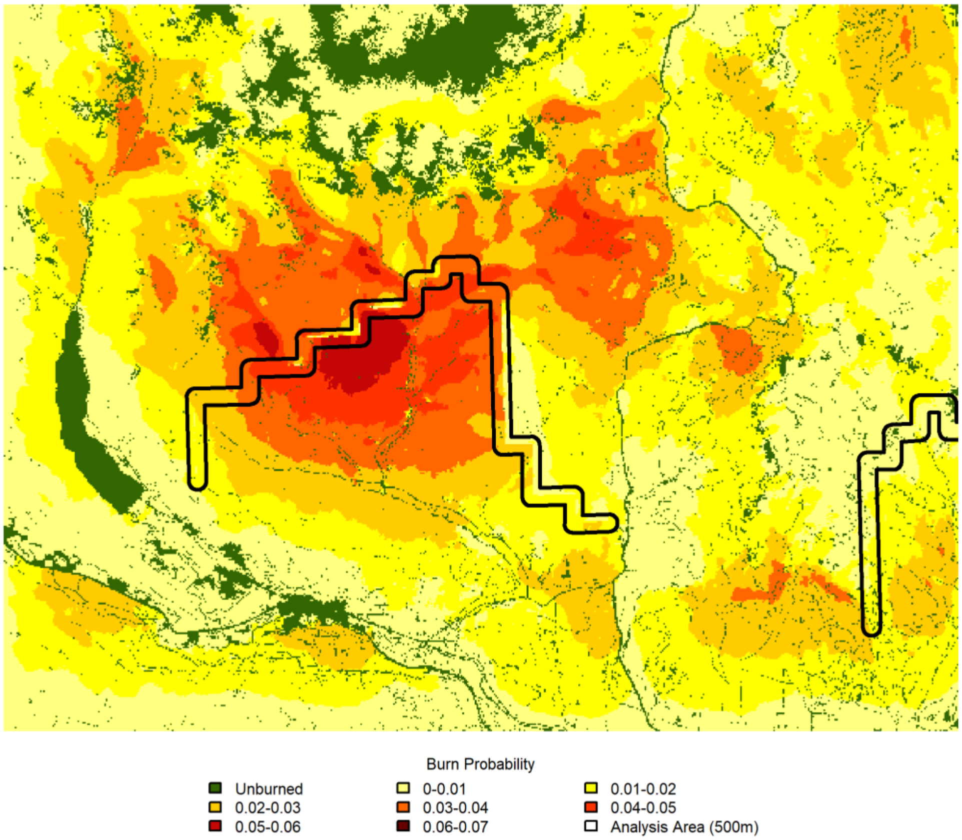
Reduction of 60% Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



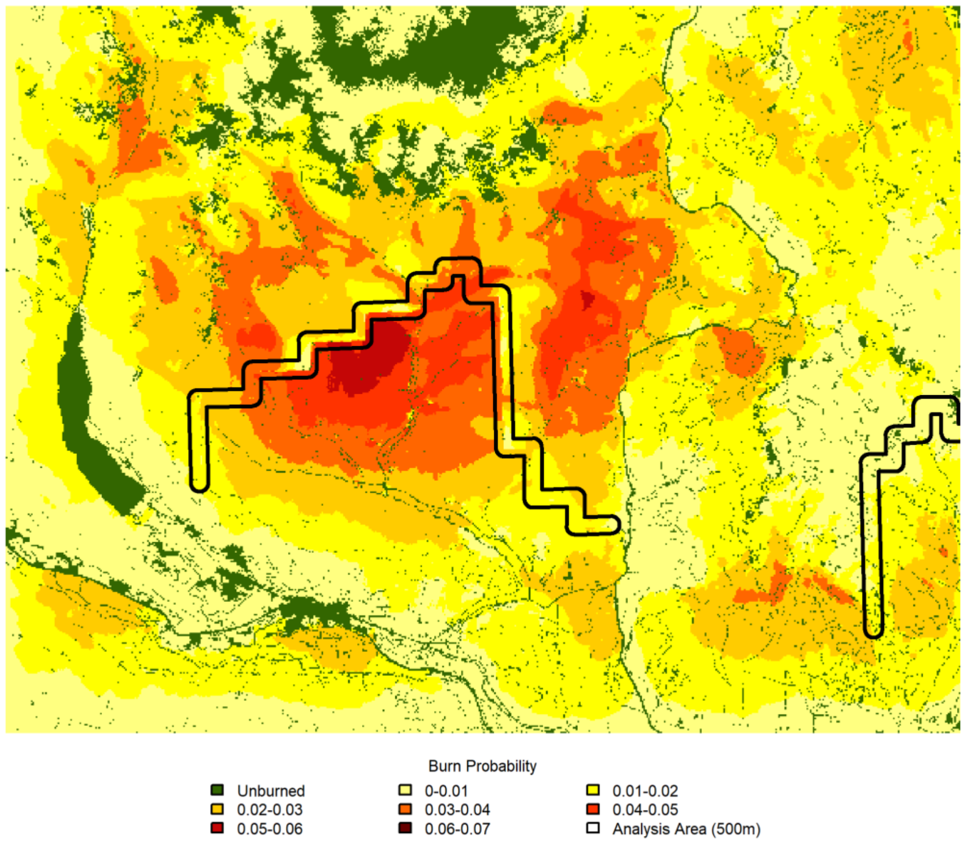
Reduction of 40% Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



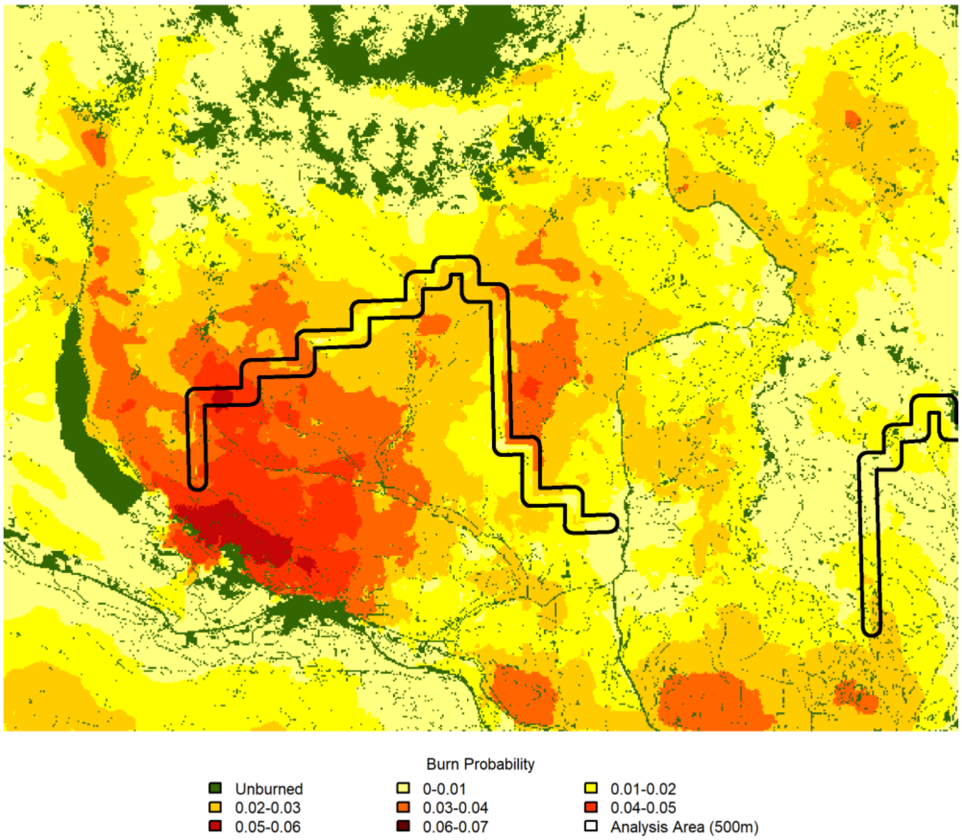
Reduction of 40% Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



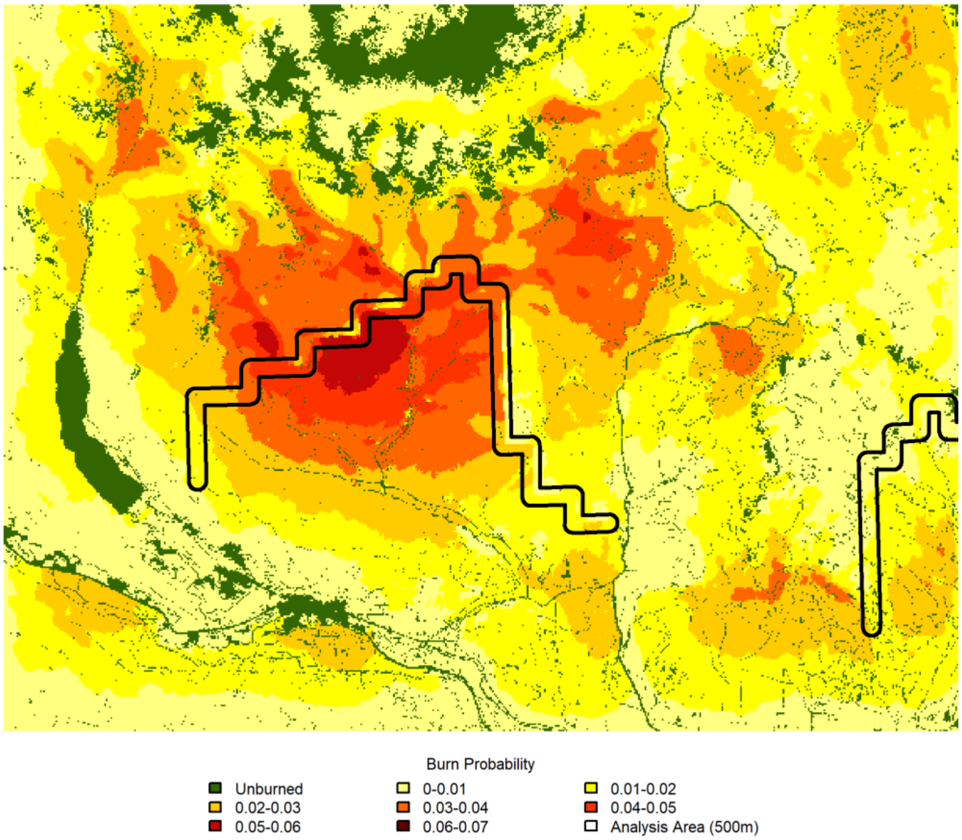
Reduction of 40% Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



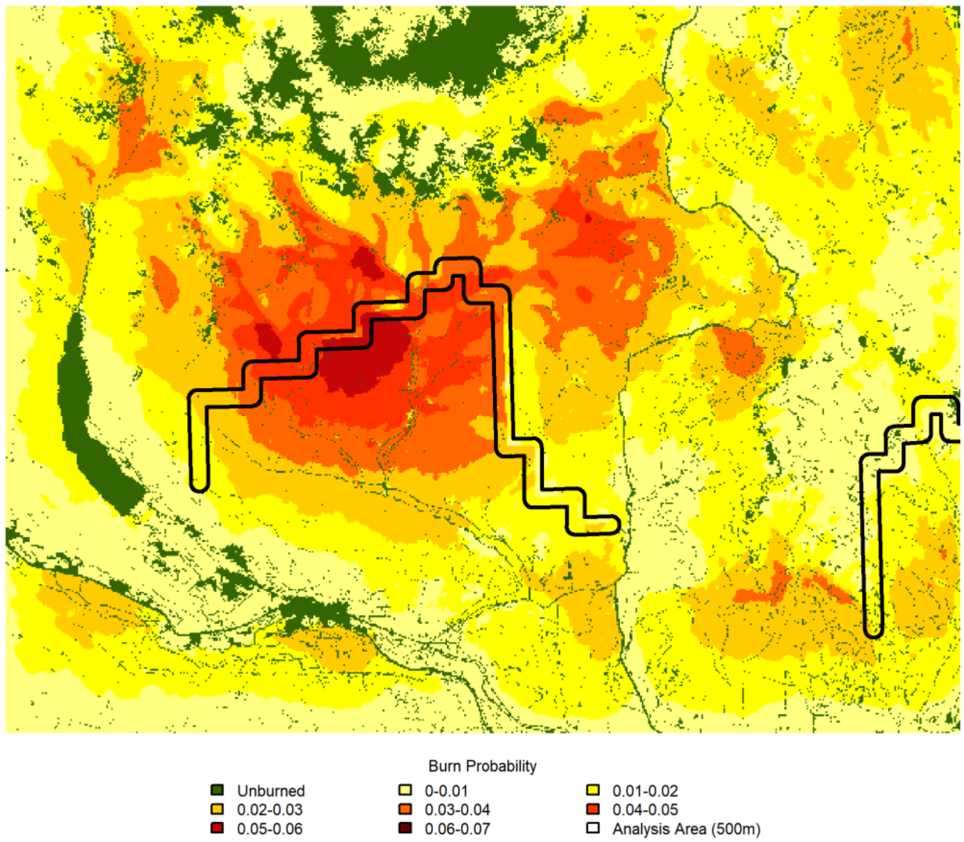
Reduction of 40% Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



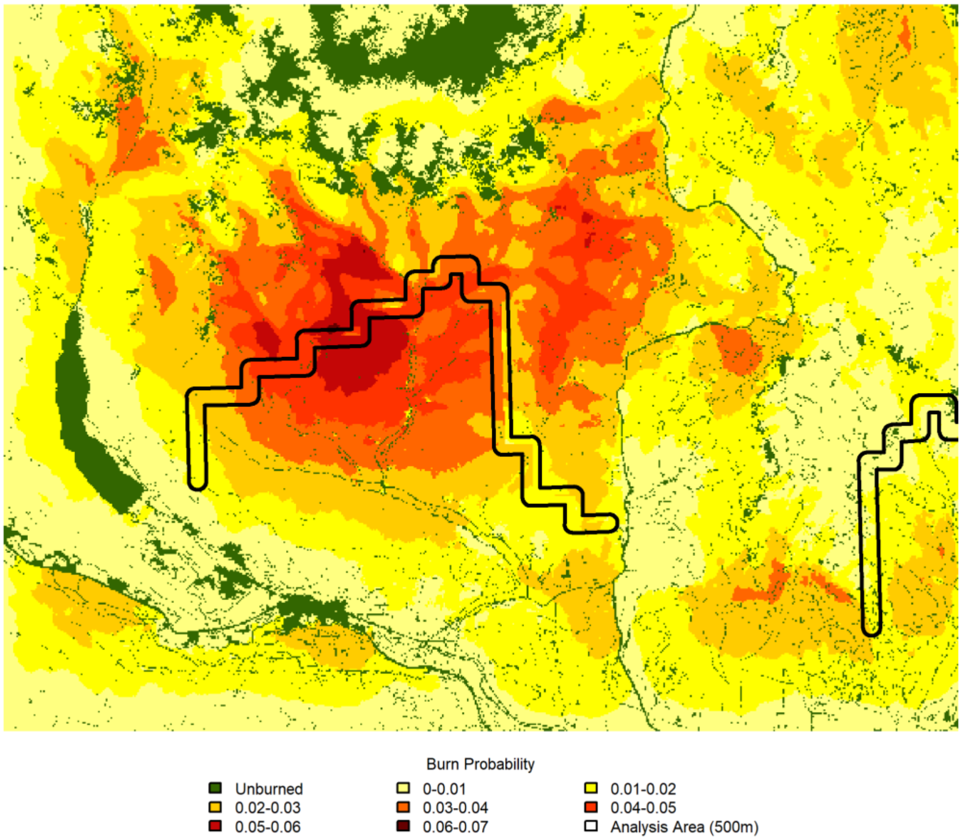
Reduction of 40% Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



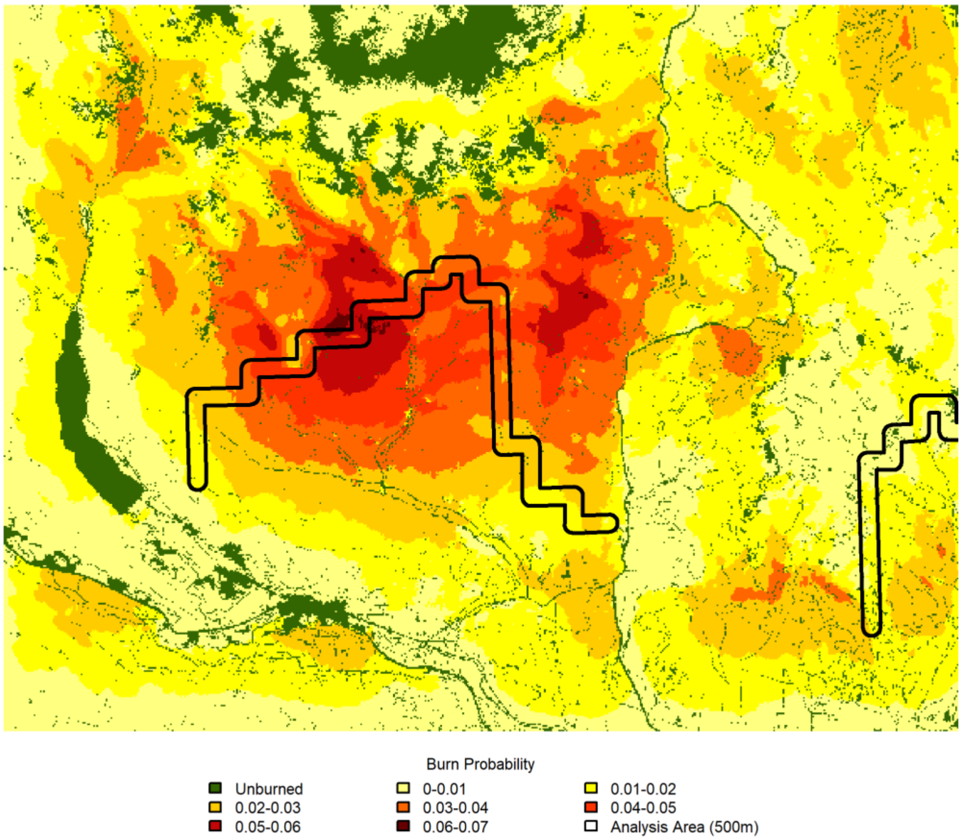
Reduction of 40% Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



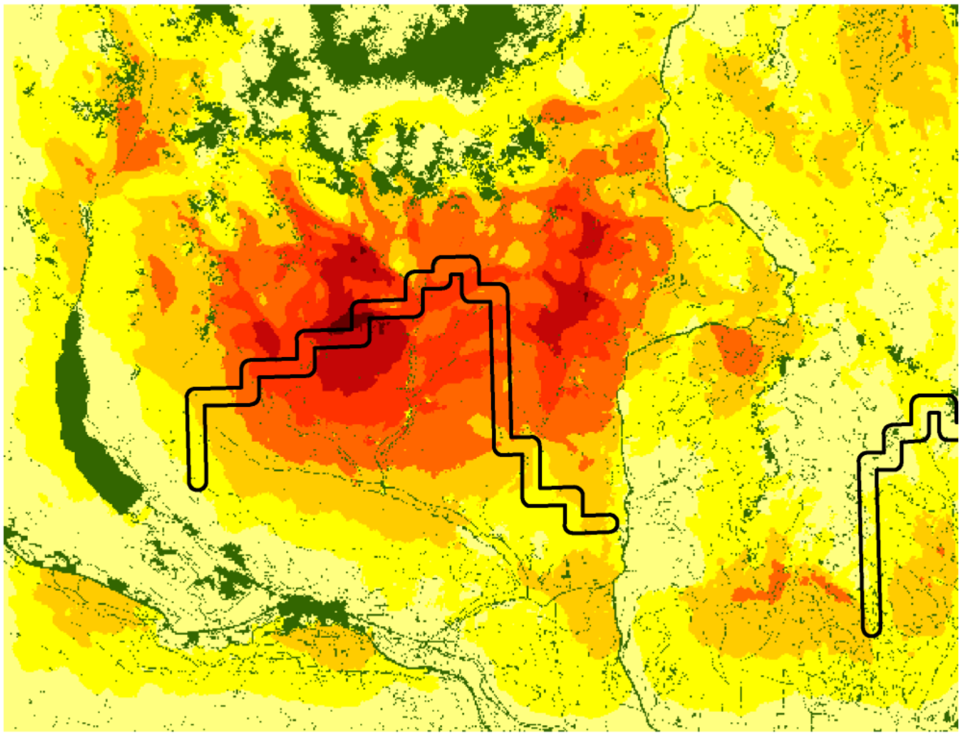
Reduction of 40% Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment

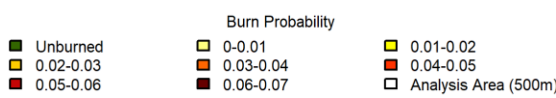


Reduction of 40% Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment

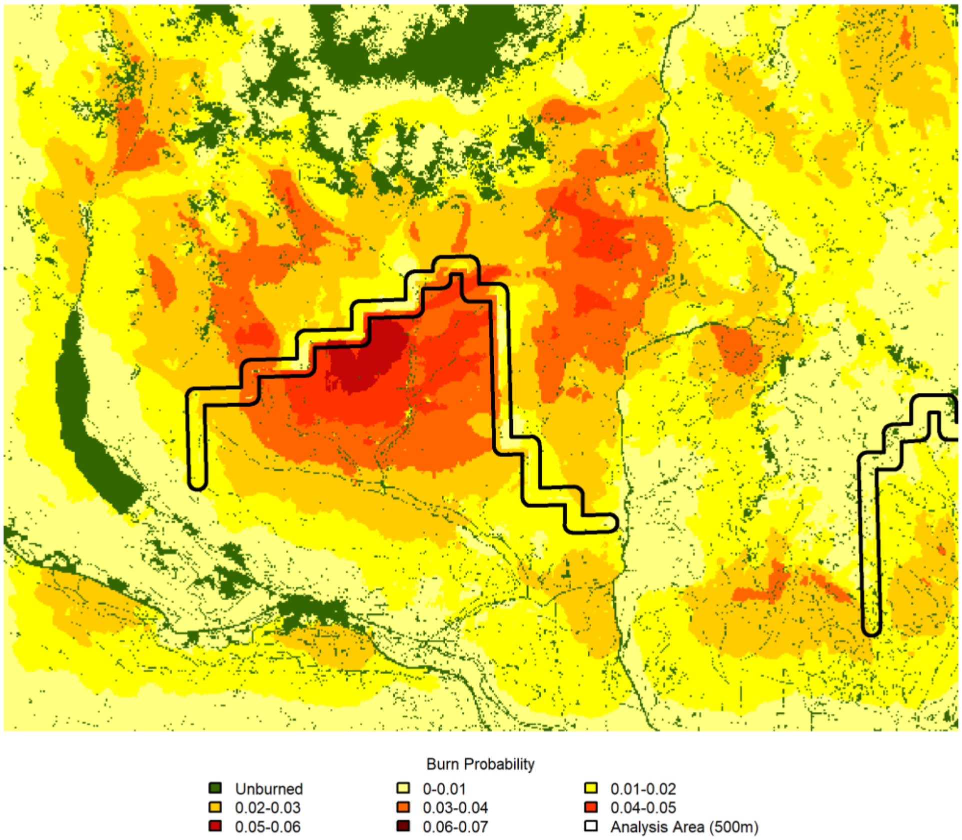


Reduction of 40% Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment

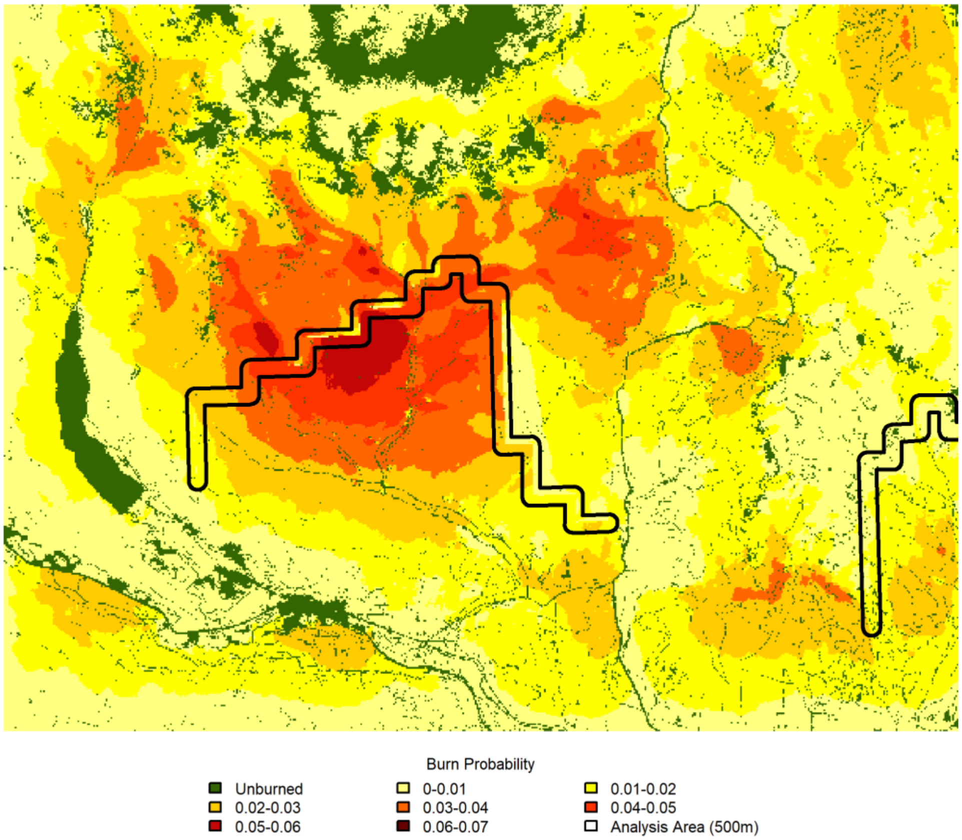




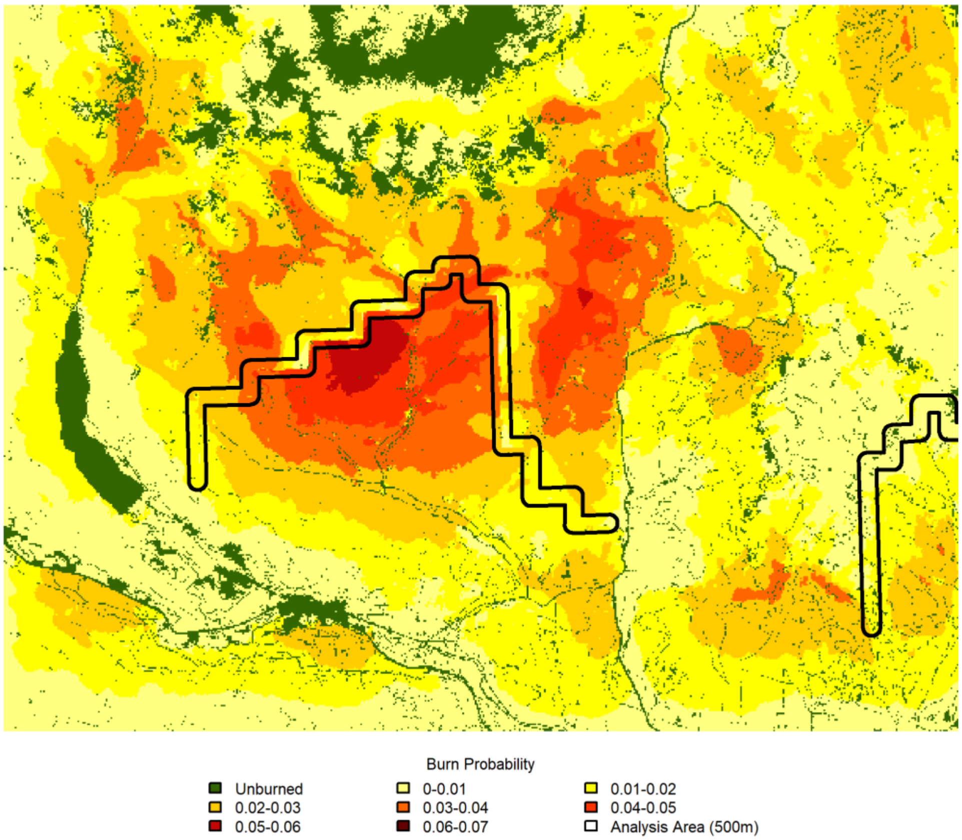
Reduction of 30% Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



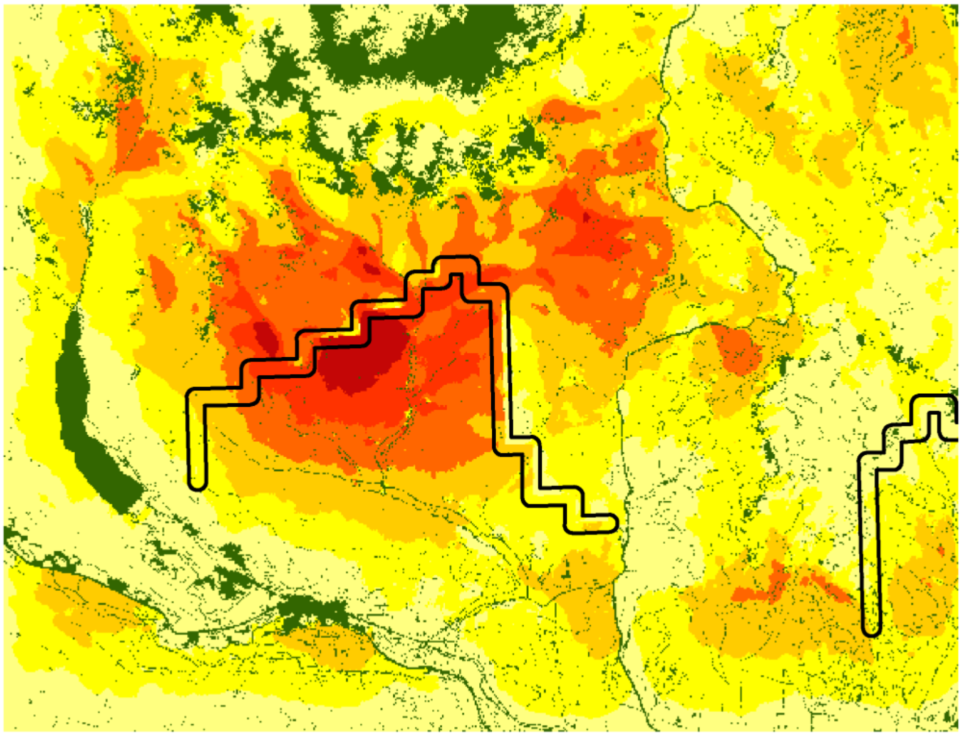
Reduction of 30% Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



Reduction of 30% Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



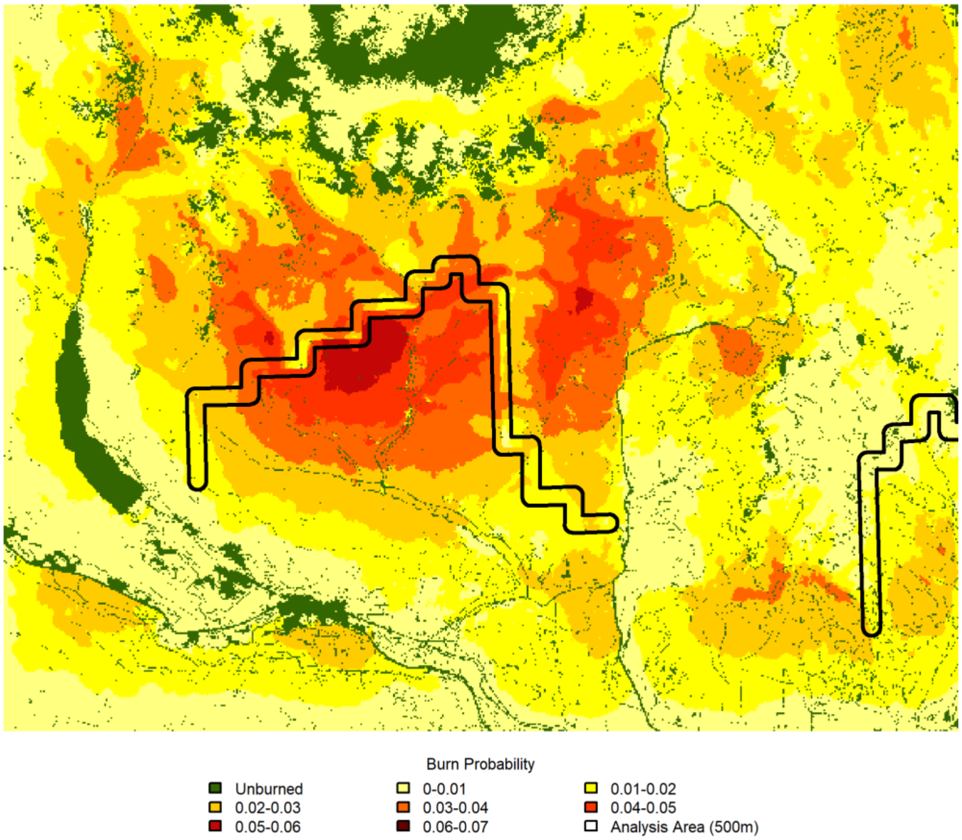
Reduction of 30% Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



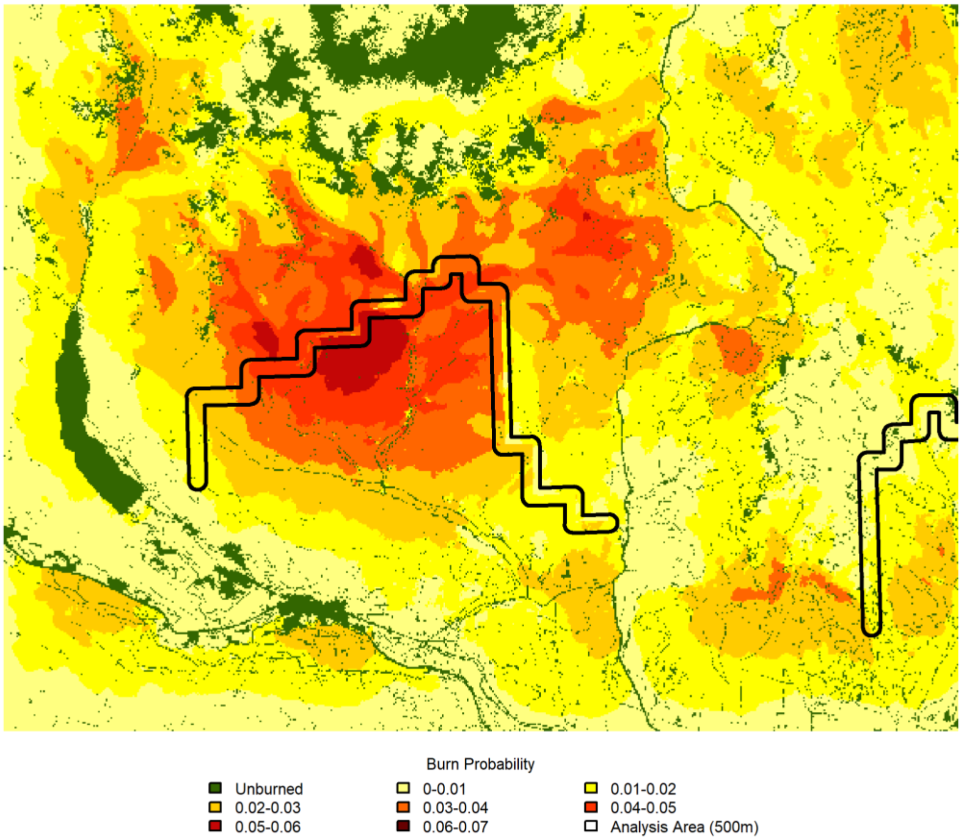
Burn Probability

Unburned | 0-0.01 | 0.01-0.02
0.02-0.03 | 0.03-0.04 | 0.04-0.05
0.05-0.06 | 0.06-0.07 | Analysis Area (500m)

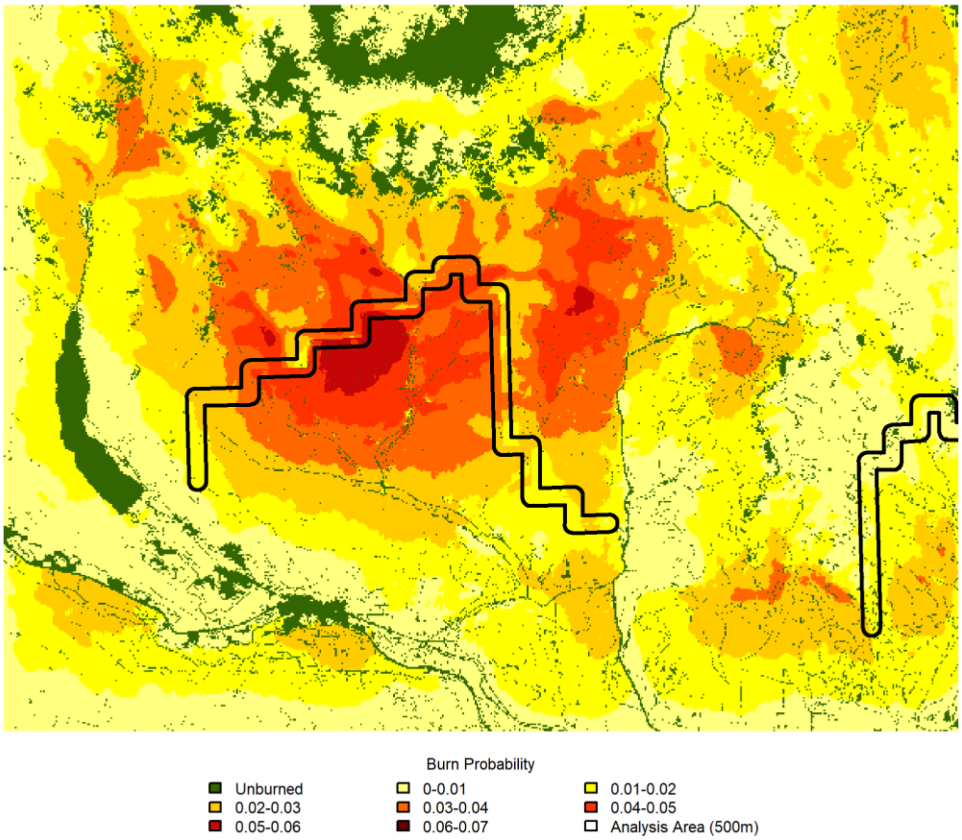
Reduction of 30% Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



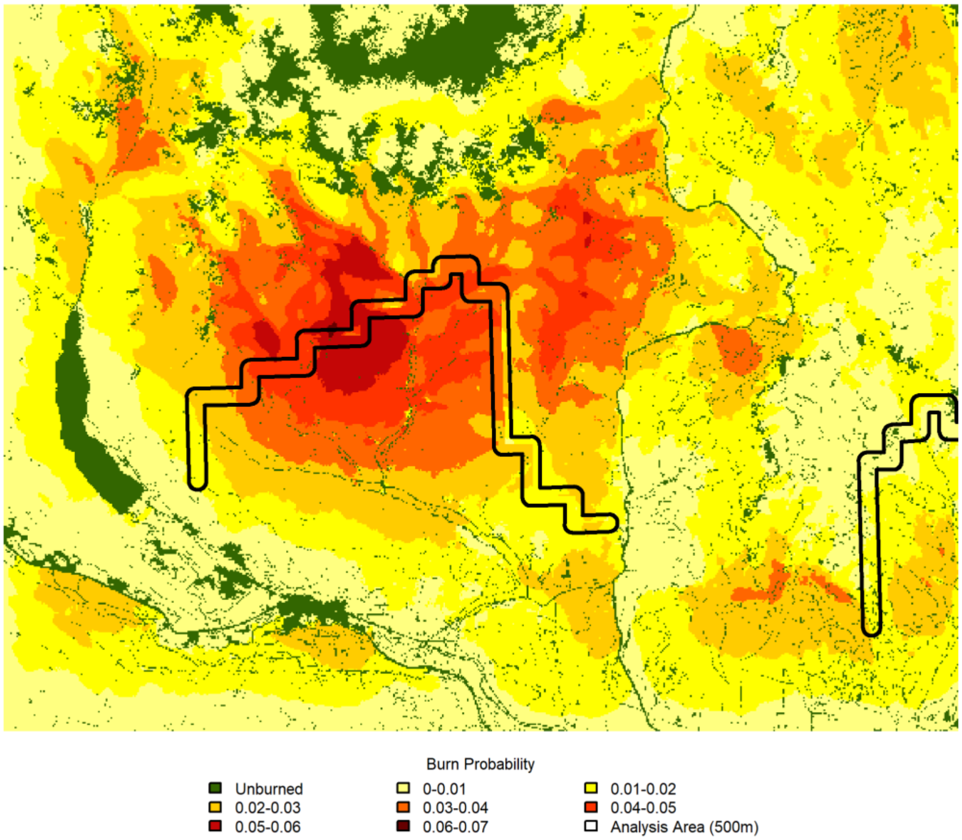
Reduction of 30% Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



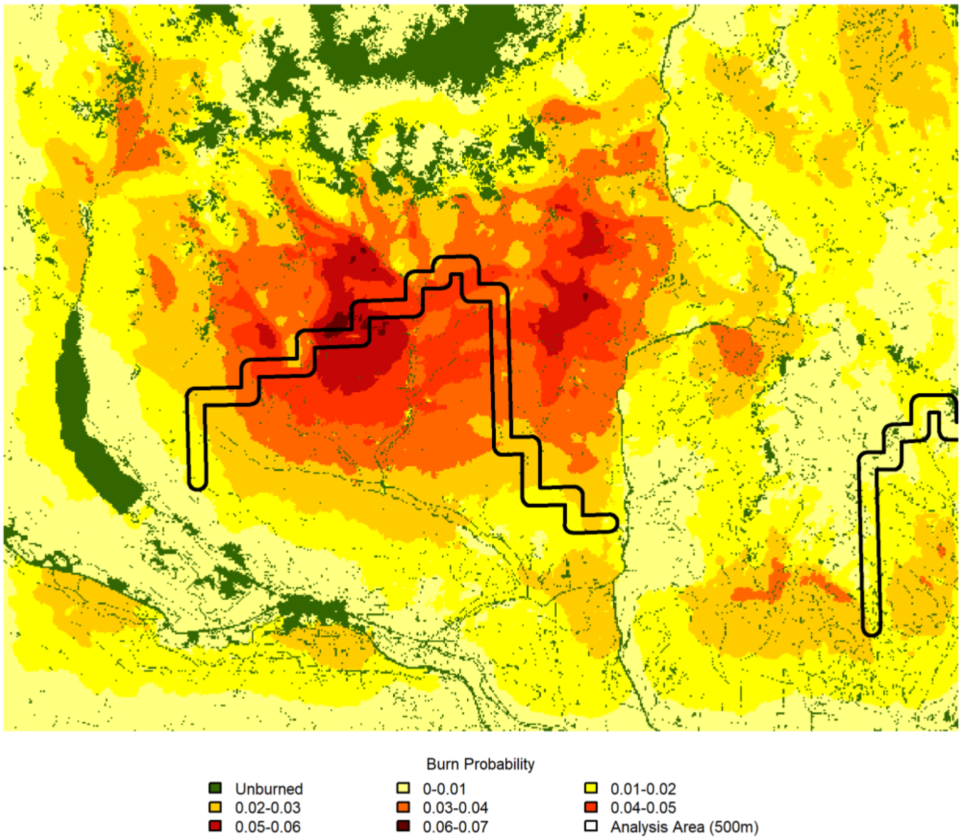
Reduction of 30% Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



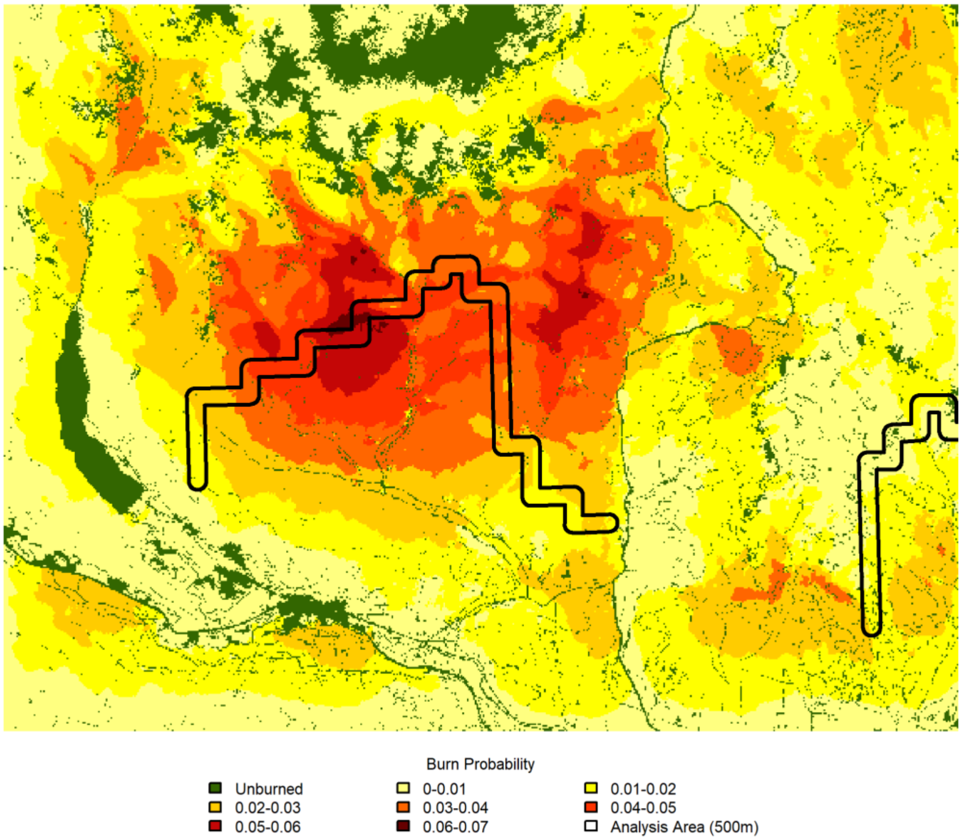
Reduction of 30% Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



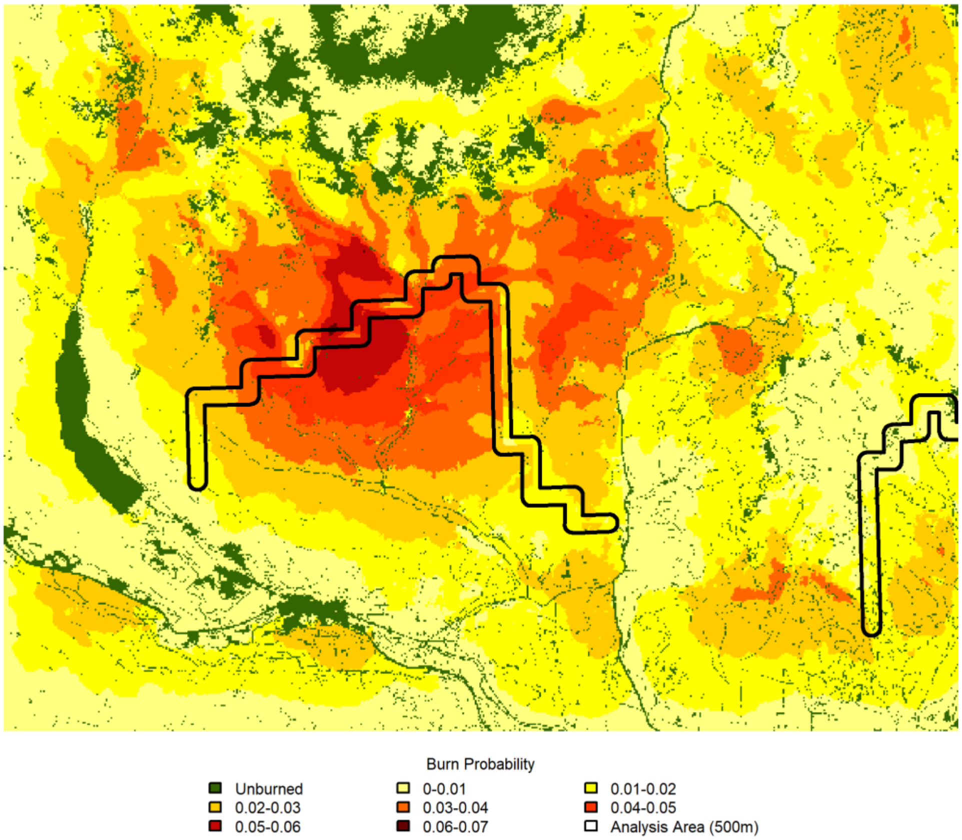
Reduction of 30% Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



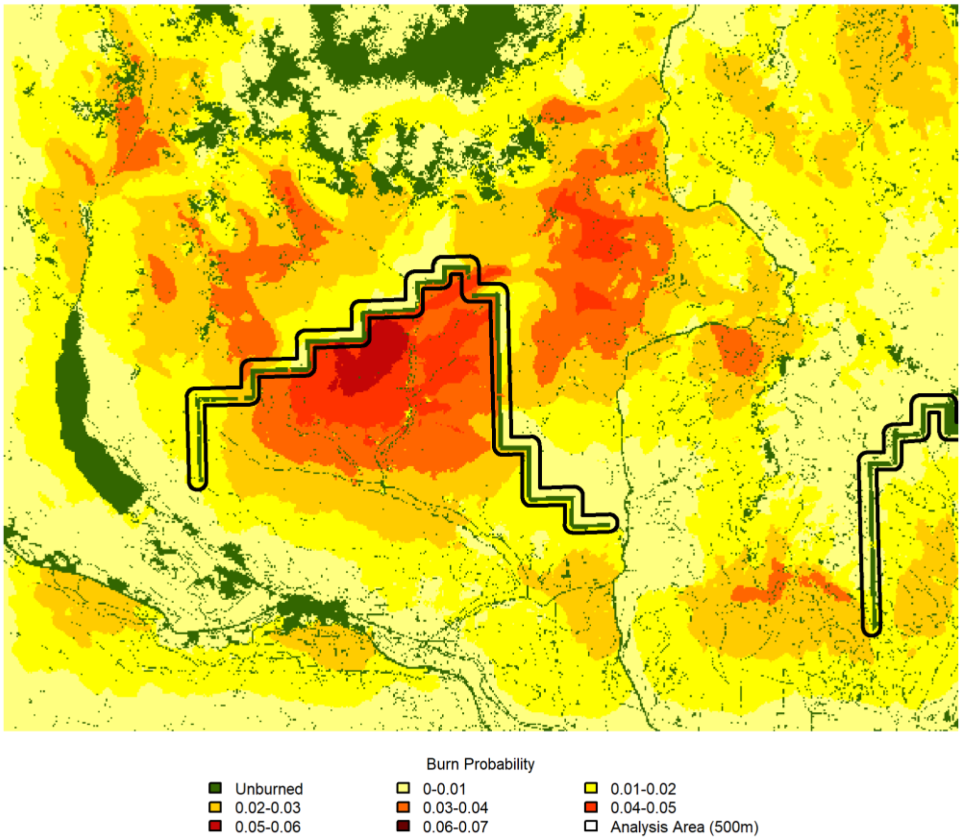
Reduction of 30% Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



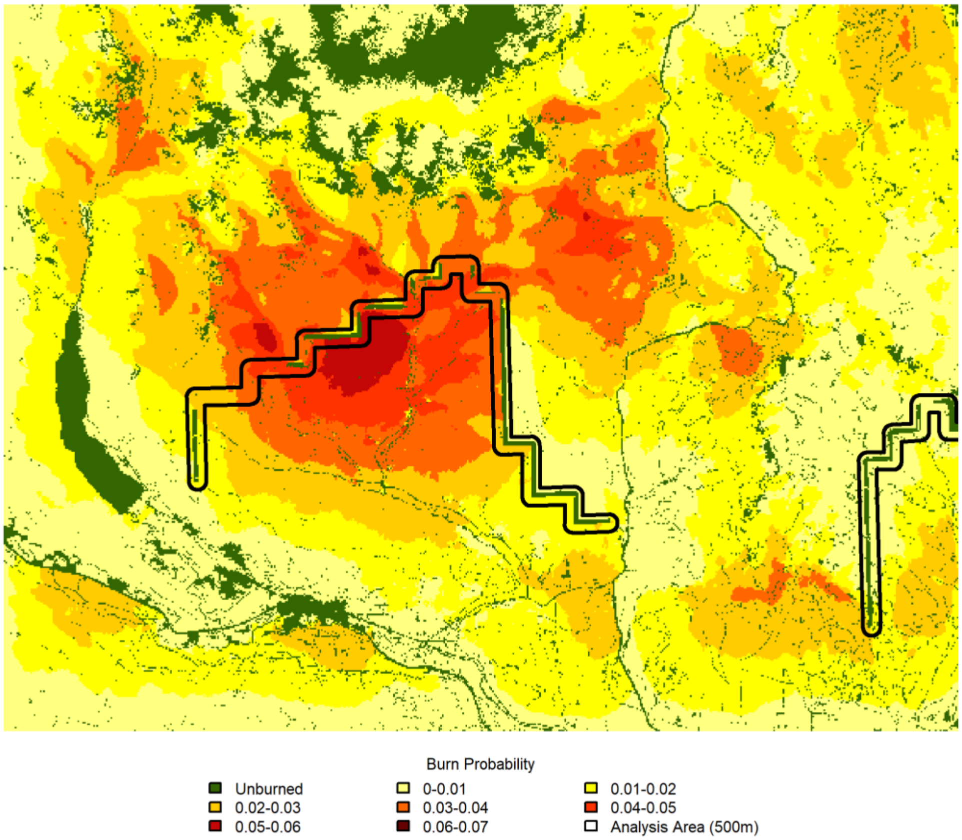
Reduction of 30% Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



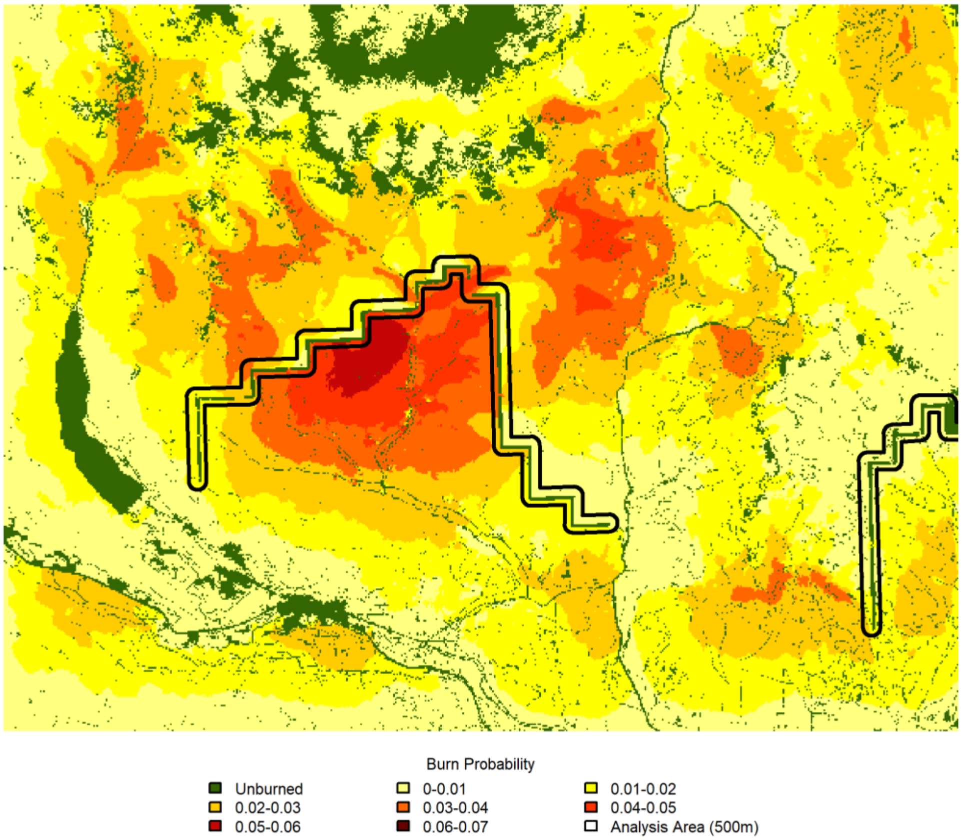
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



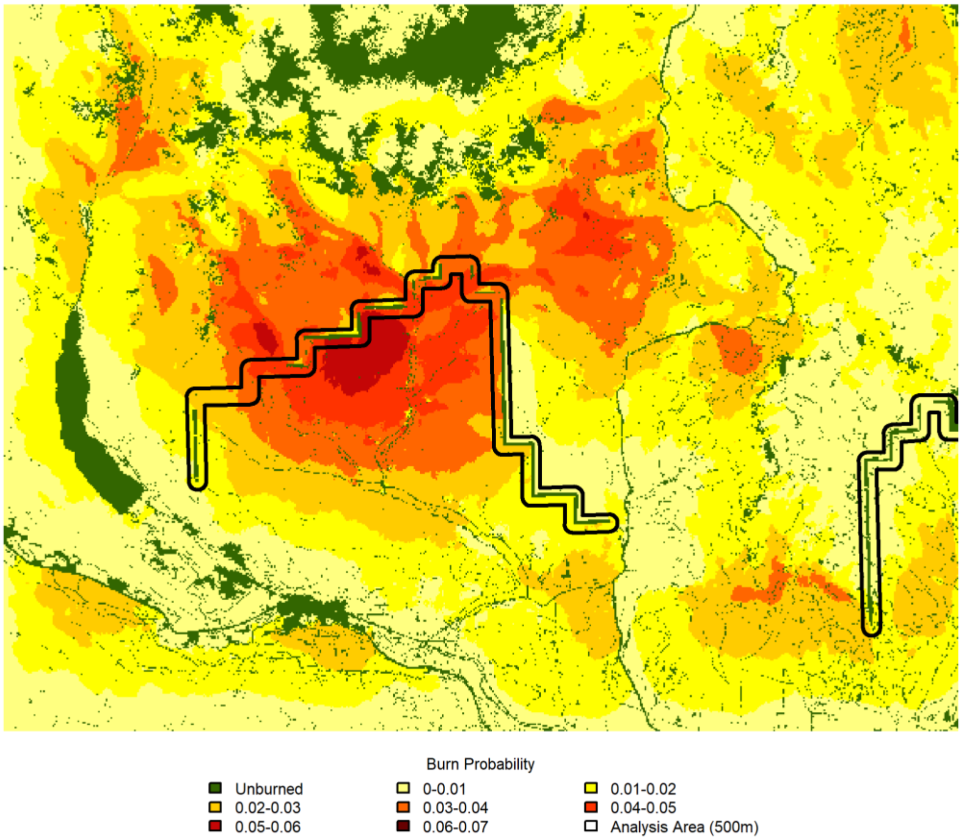
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



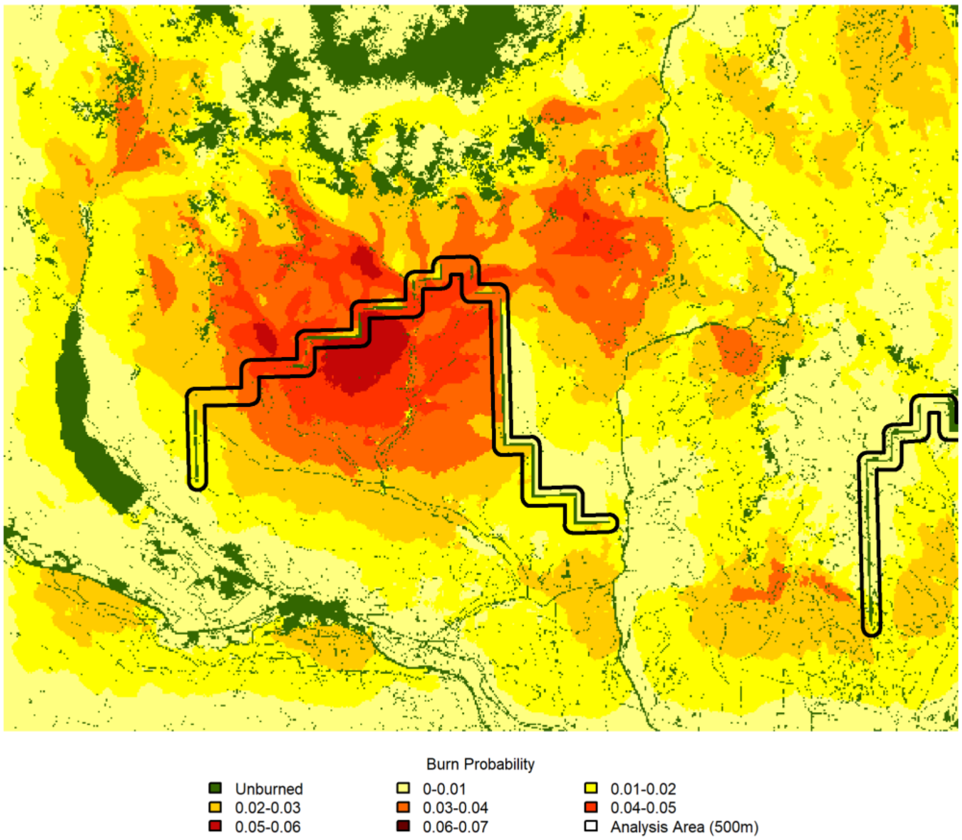
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



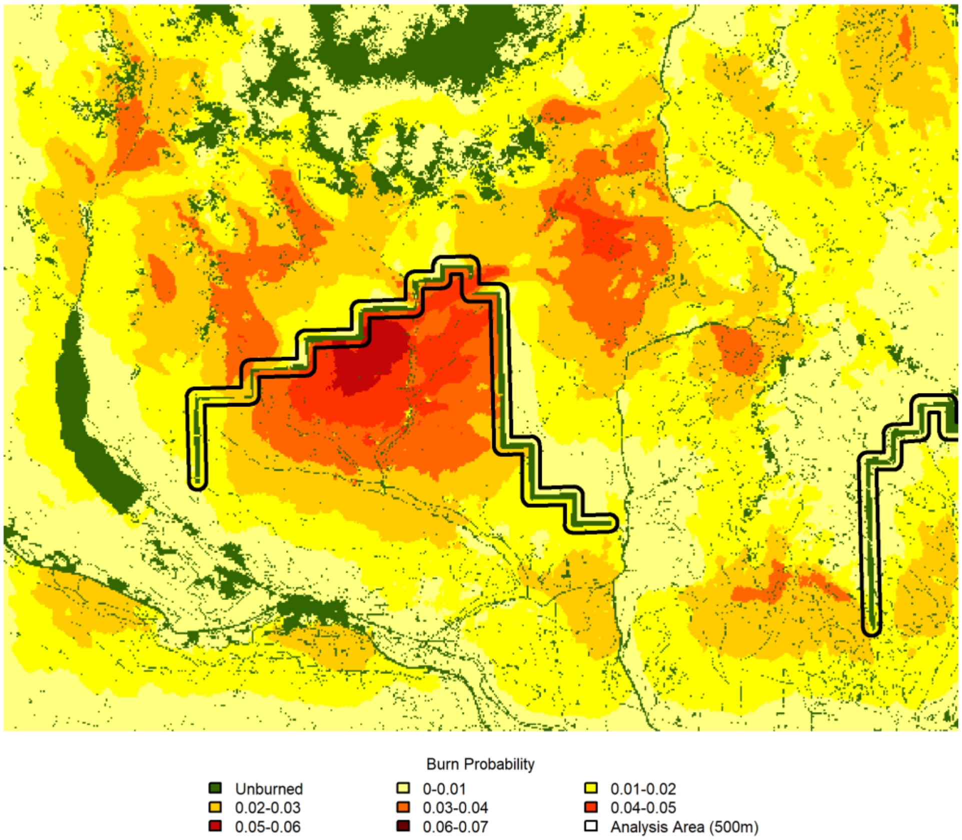
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



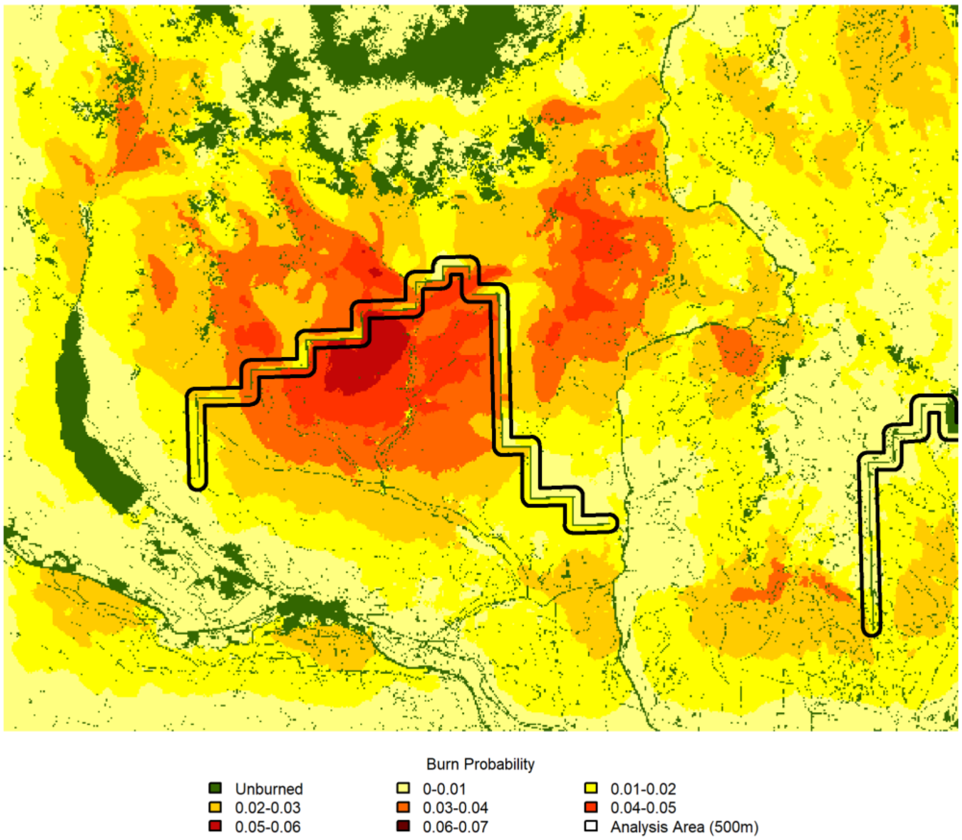
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



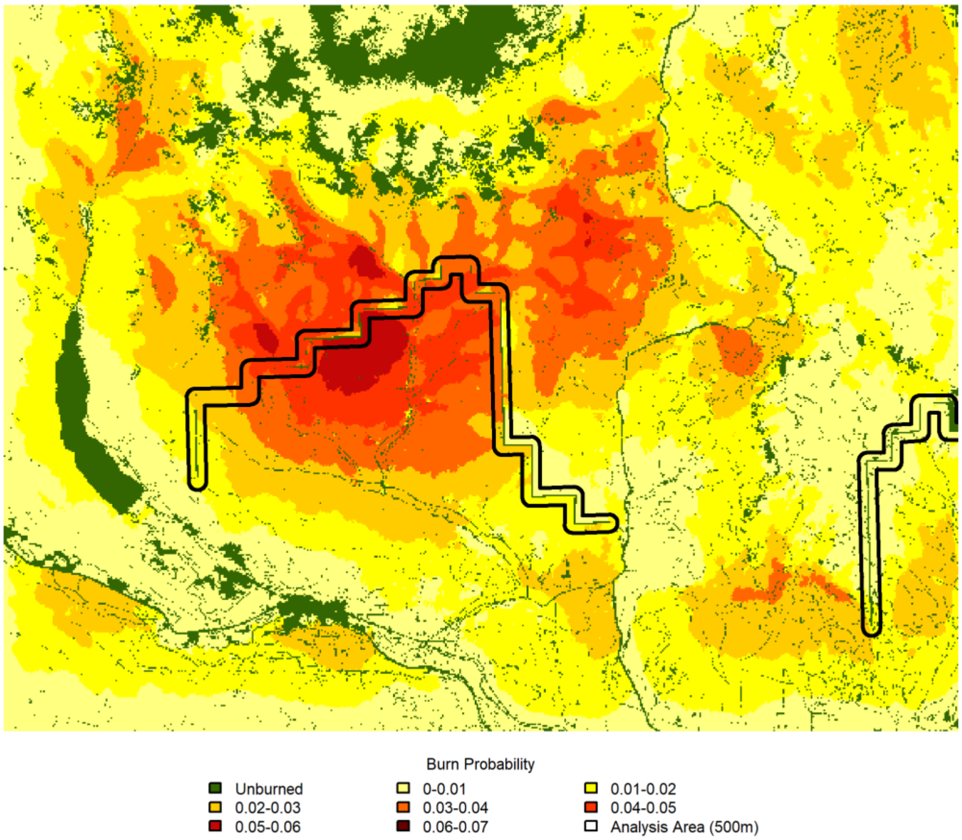
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Collaborative Treatment



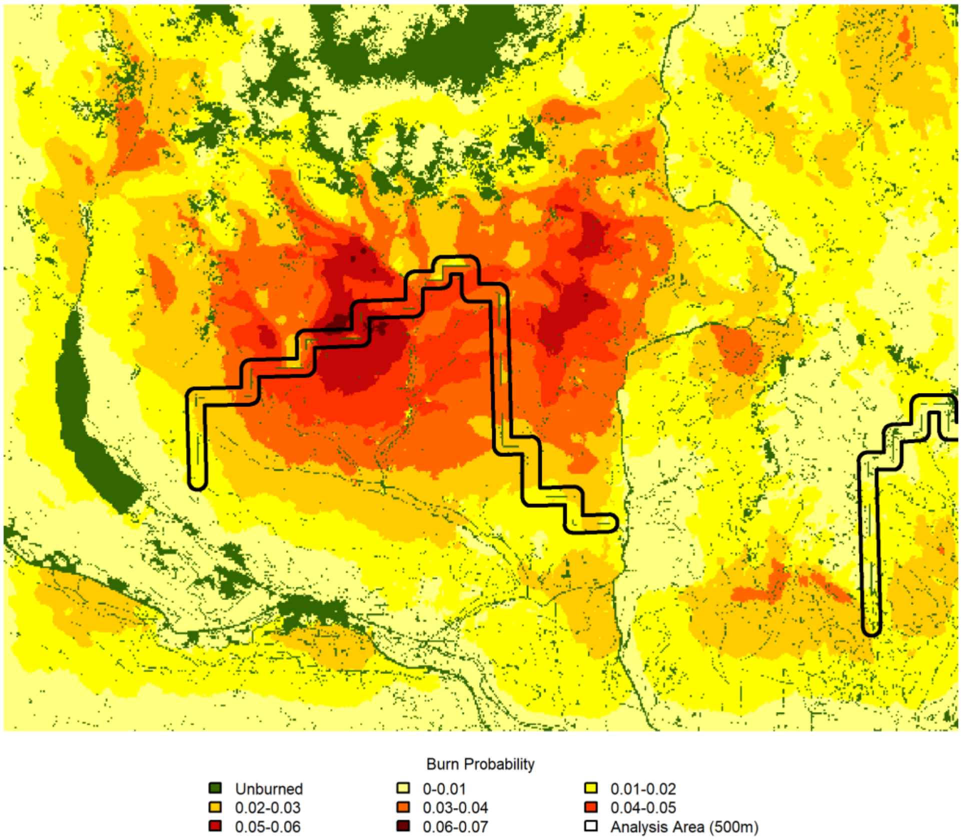
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



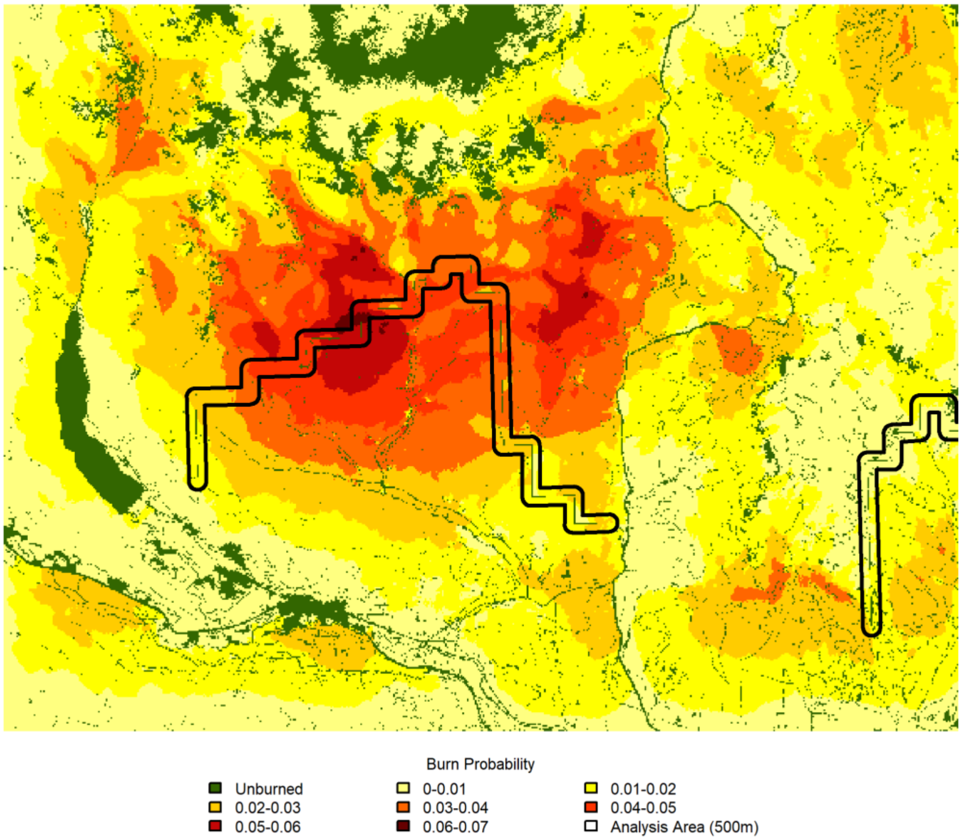
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment



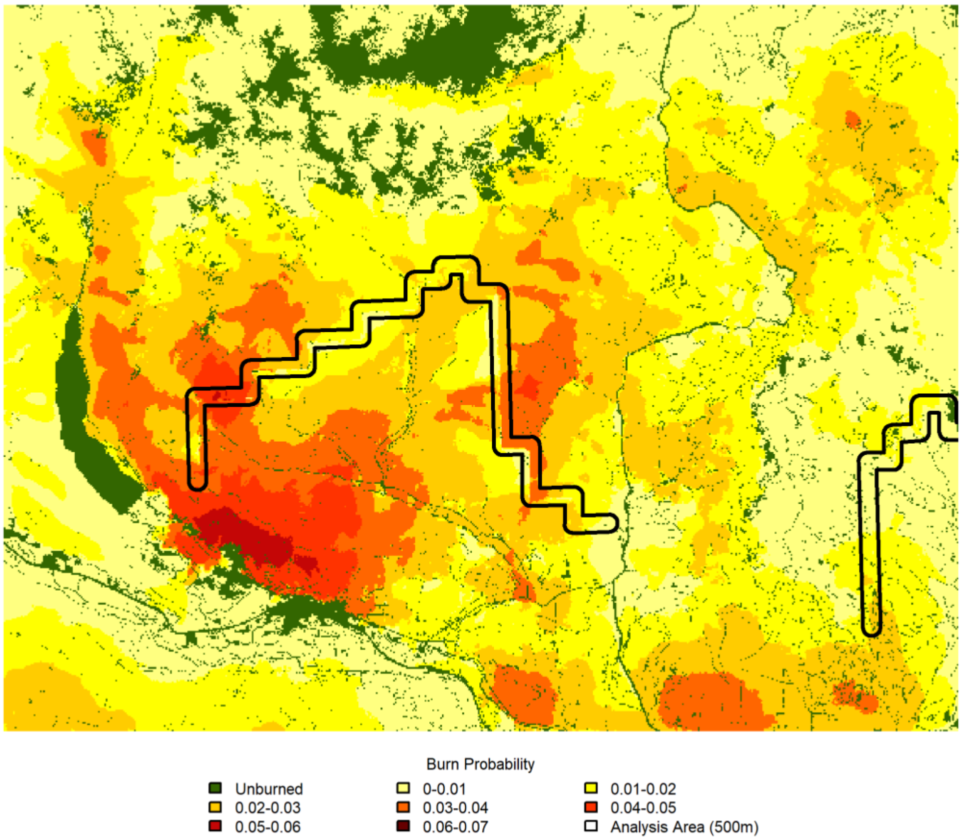
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment



Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Extreme Weather
Treatment Placement: Department of Natural Resources Treatment

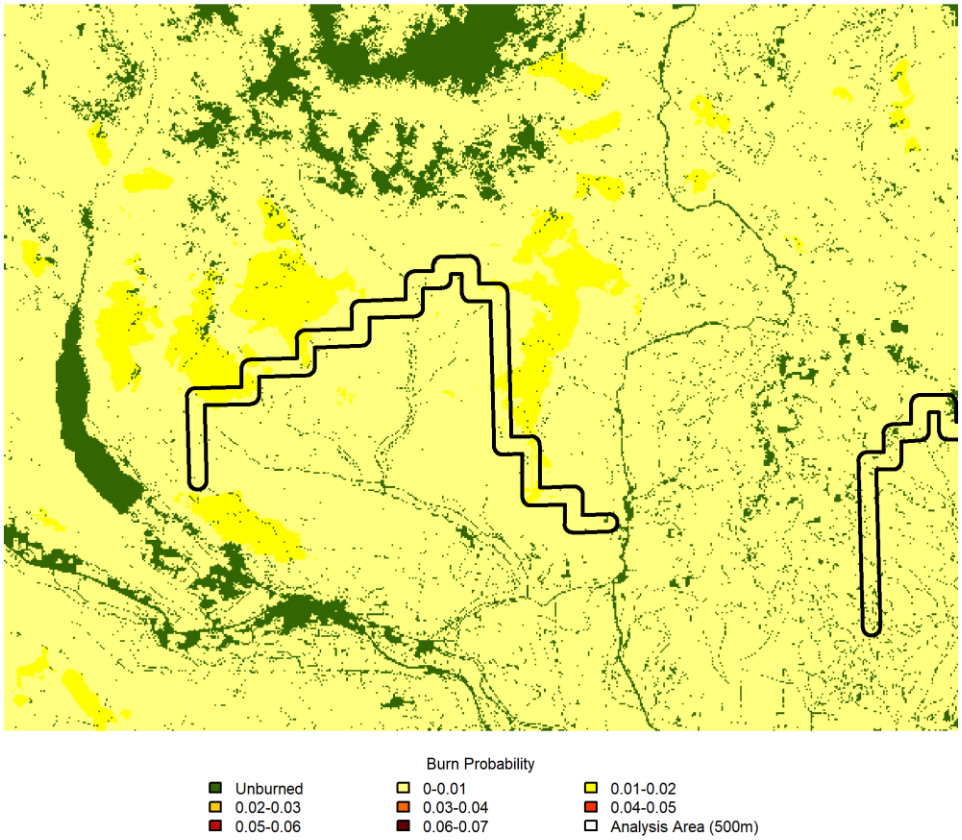


Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Extreme Weather
Treatment Placement: Forest Service Treatment

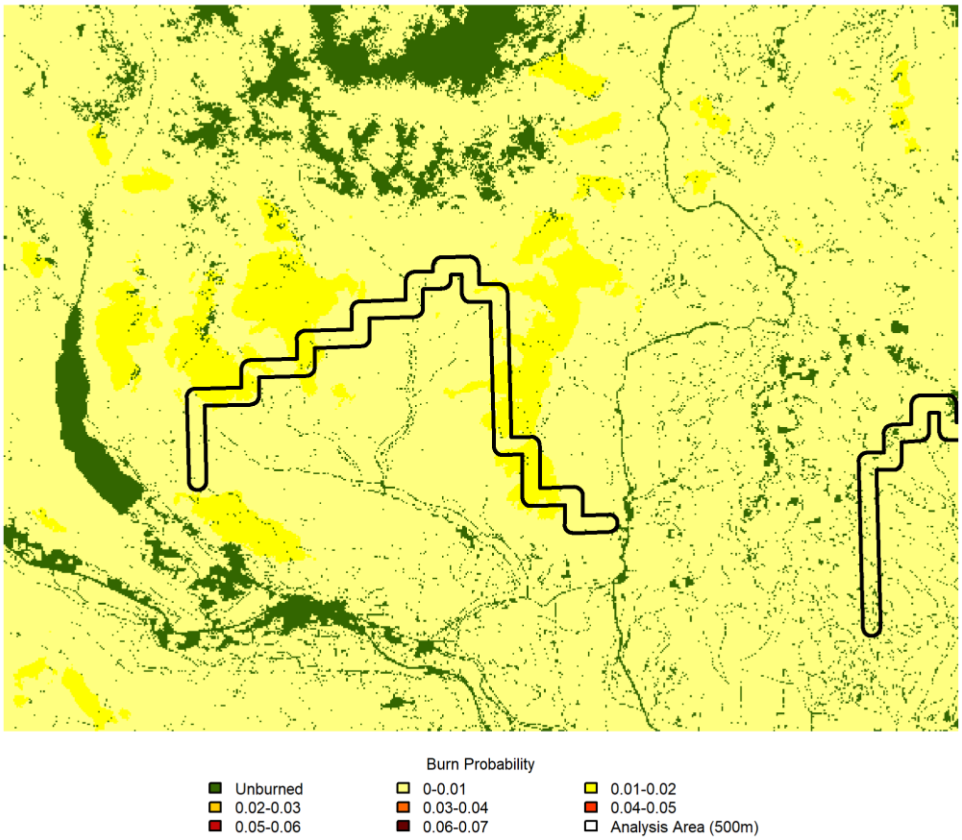


Jolly Mountain Weather Scenario

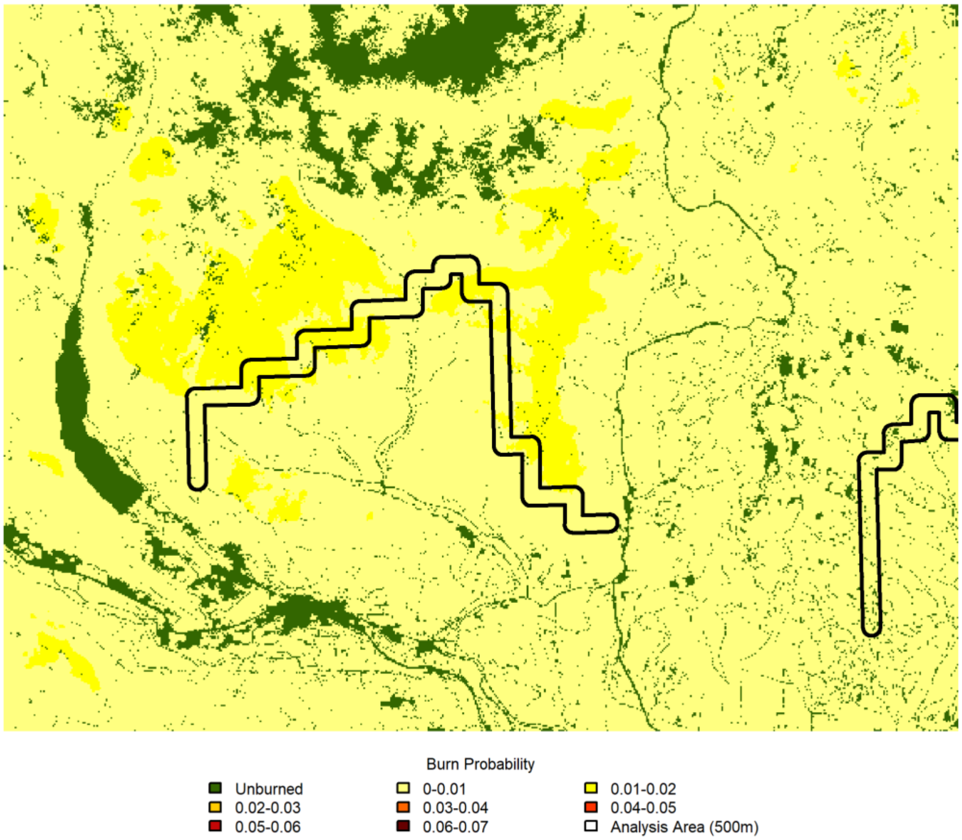
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



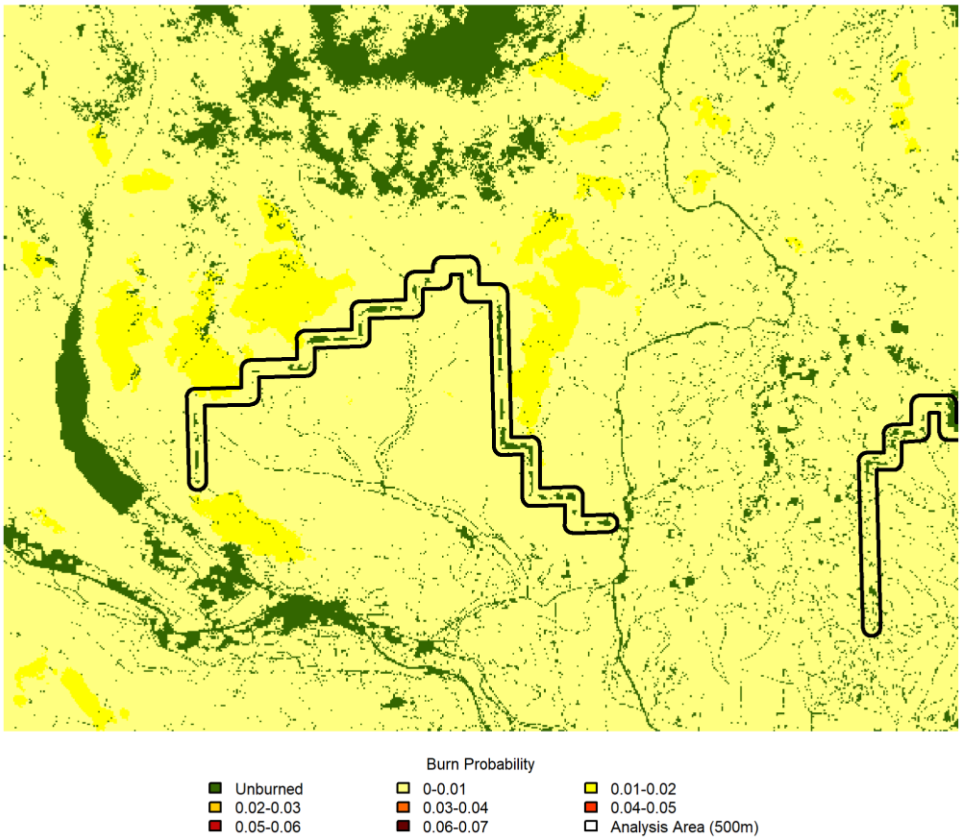
Untreated Simulations
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather



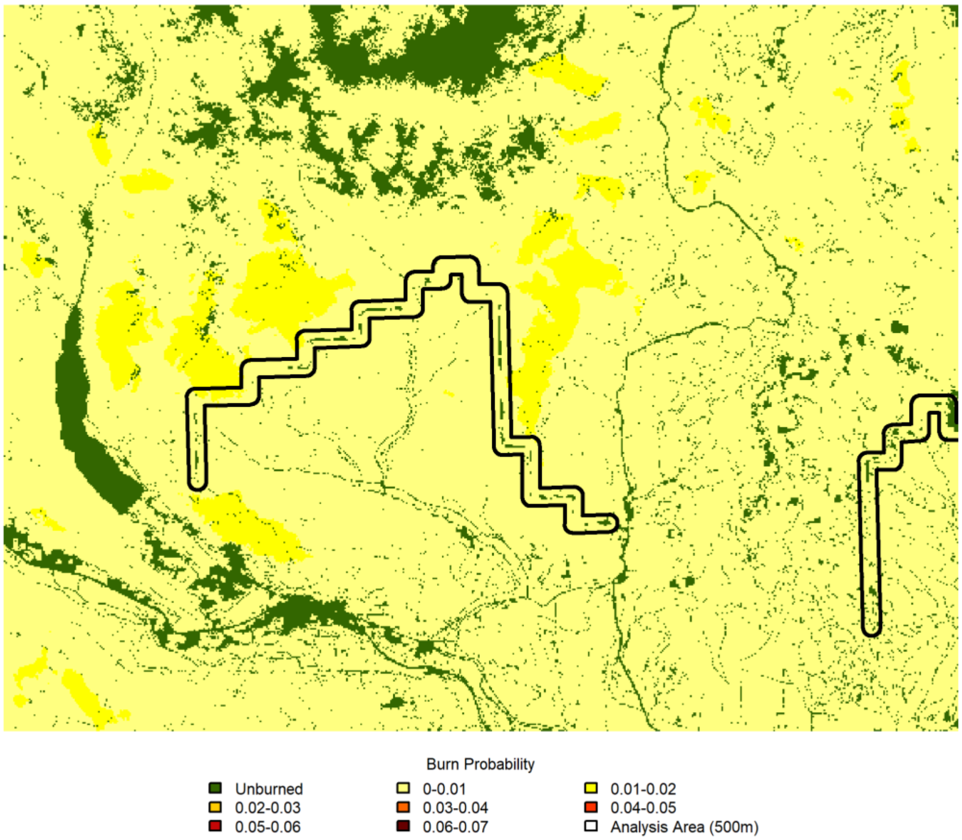
Untreated Simulations
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather



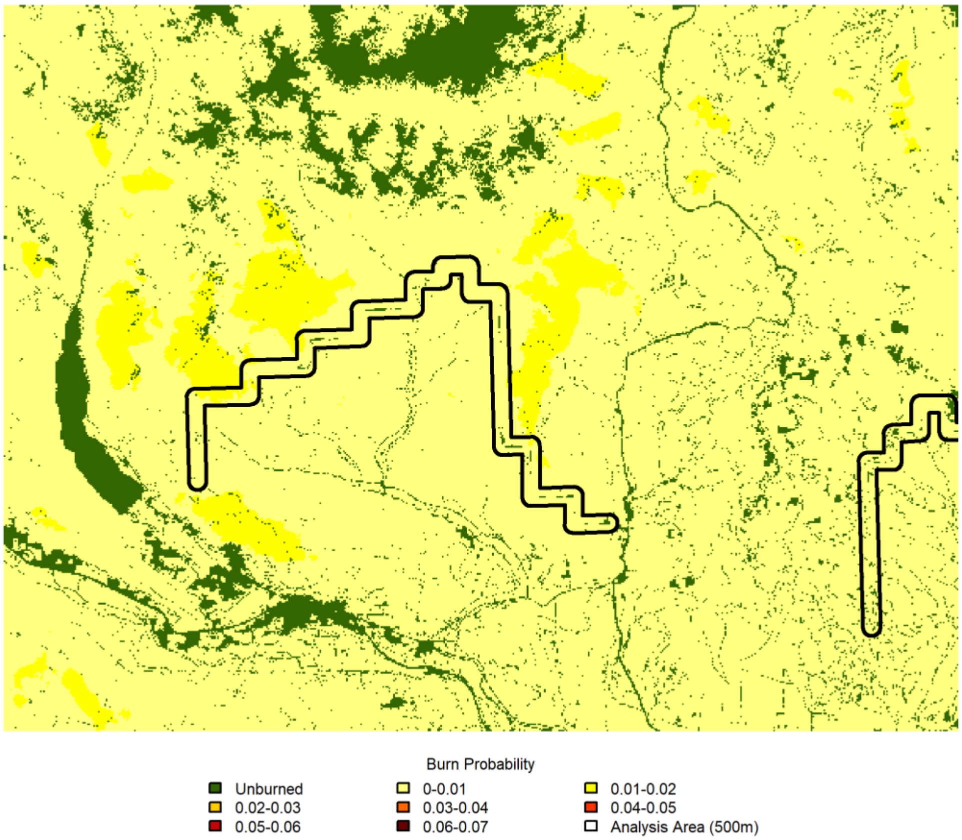
Reduction of 60% Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



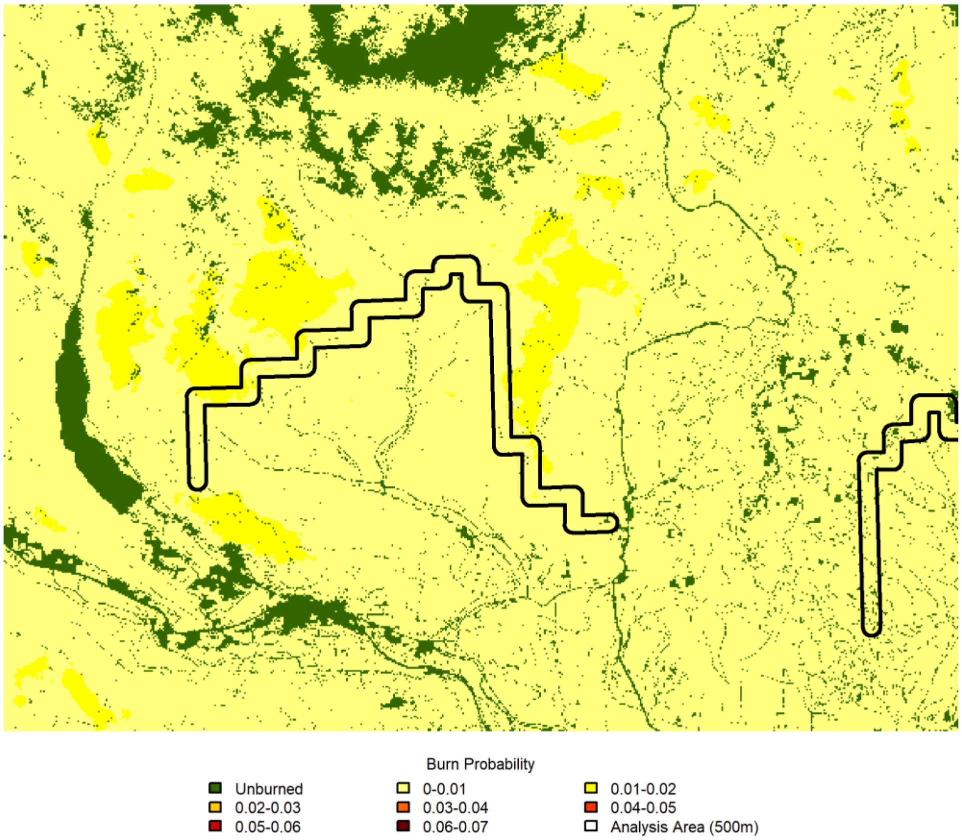
Reduction of 60% Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



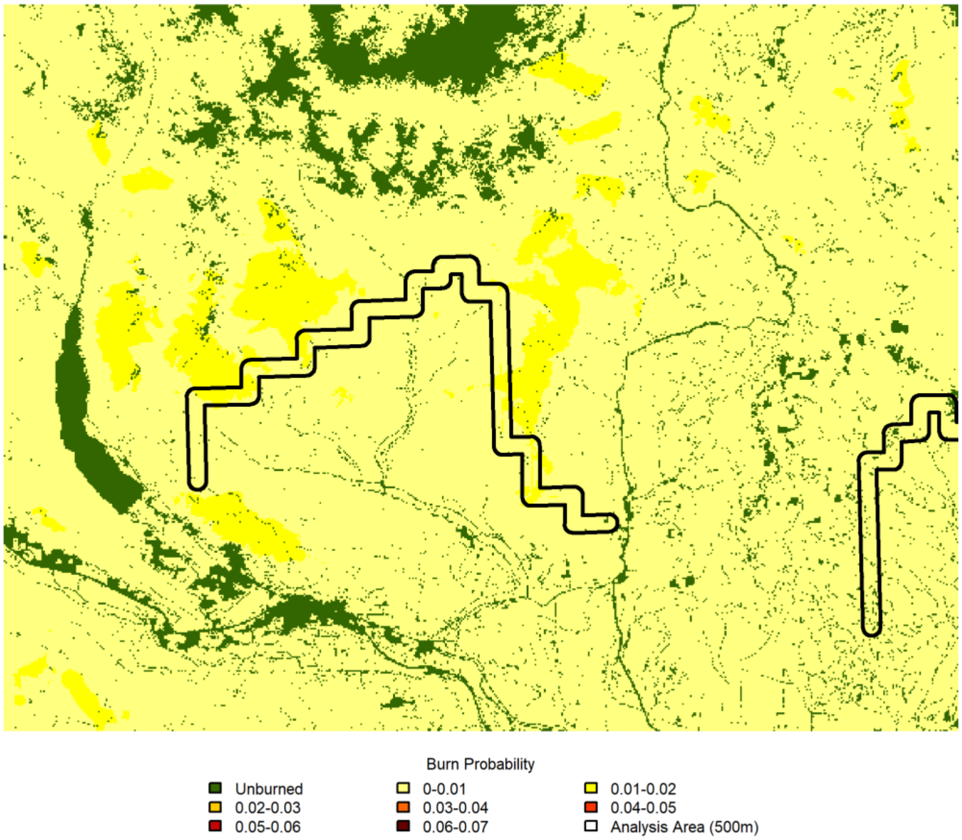
Reduction of 60% Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



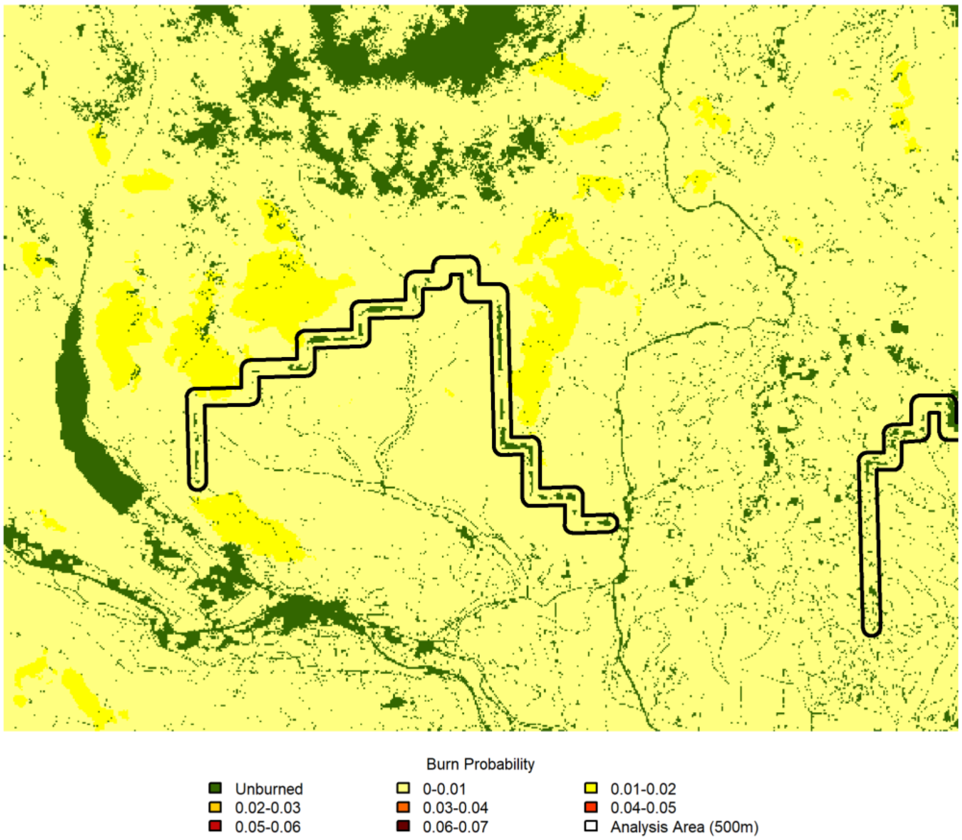
Reduction of 60% Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



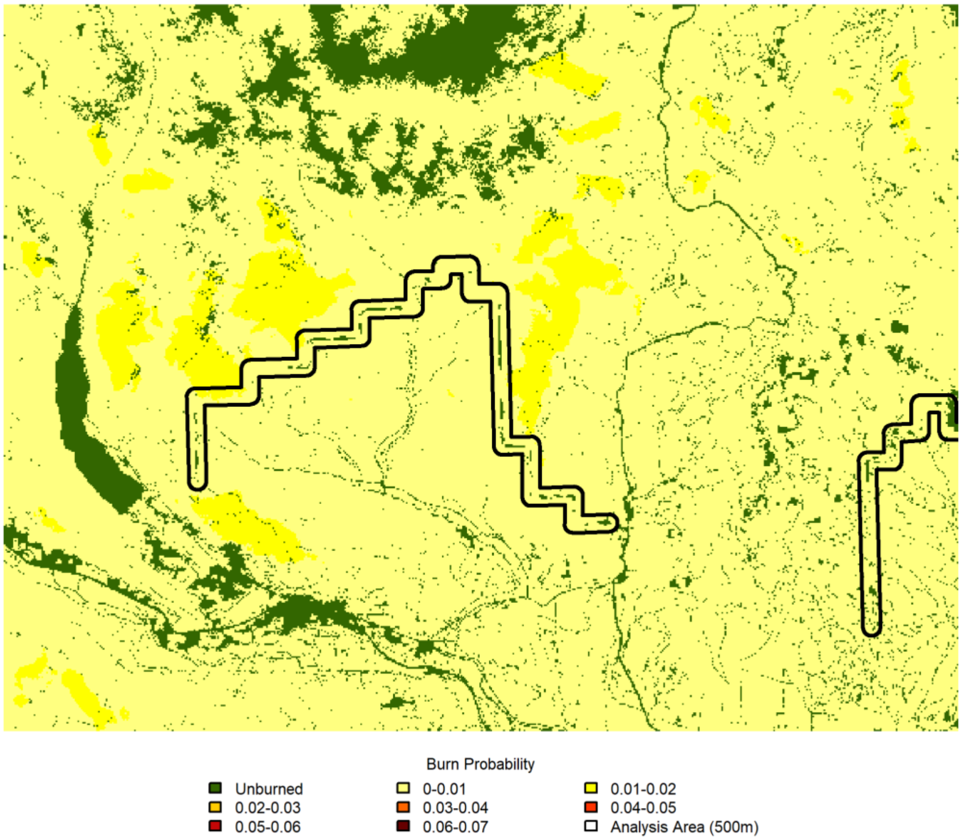
Reduction of 60% Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



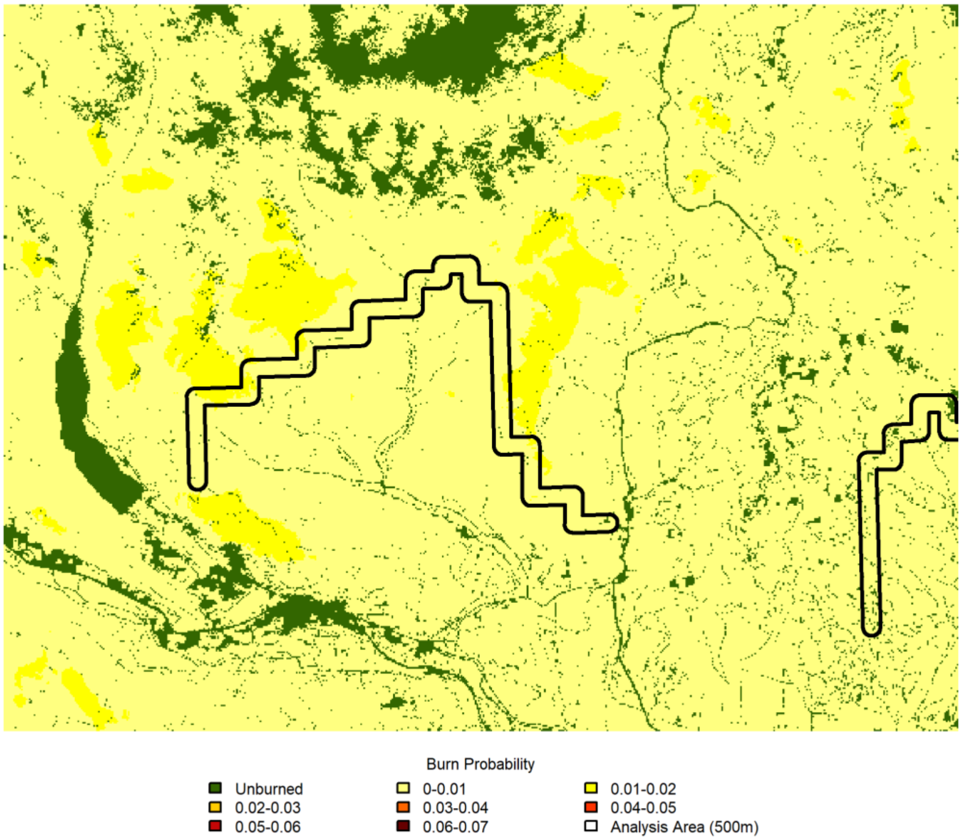
Reduction of 40% Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



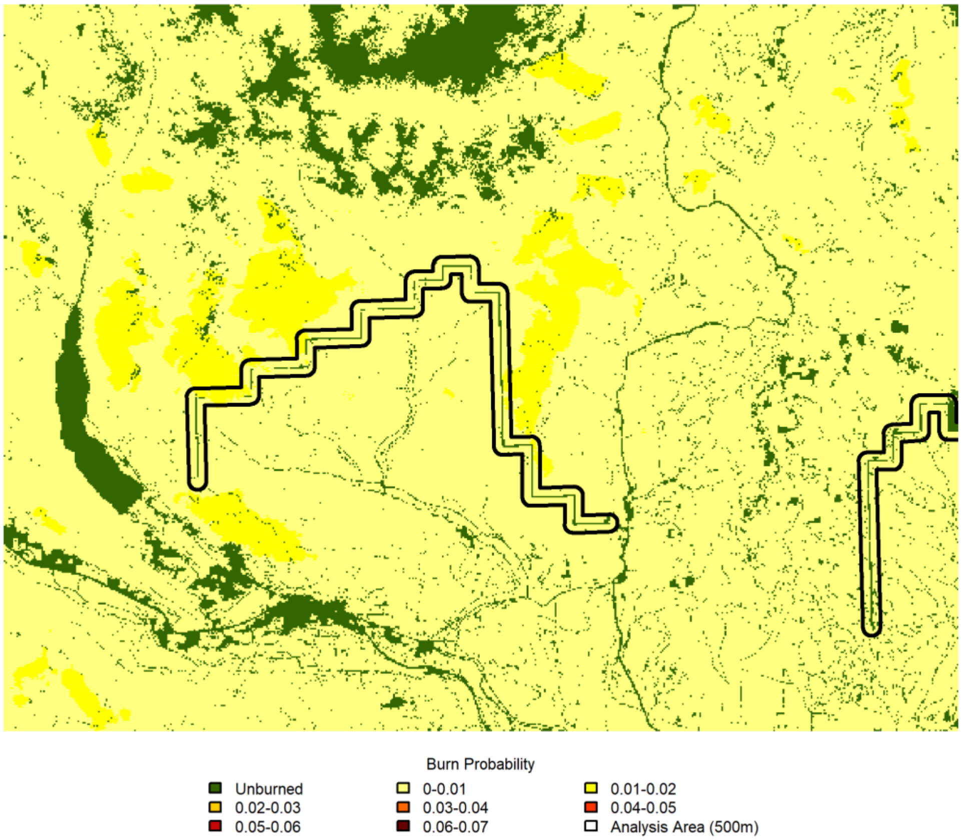
Reduction of 40% Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



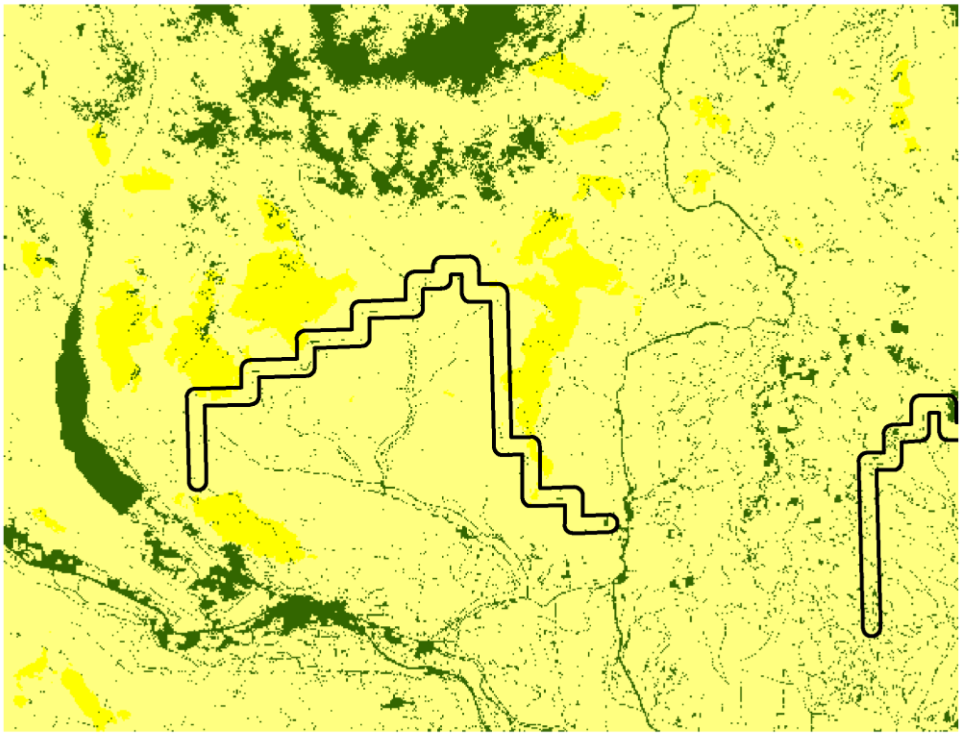
Reduction of 30% Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment

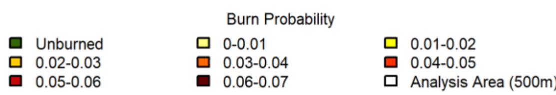


Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment

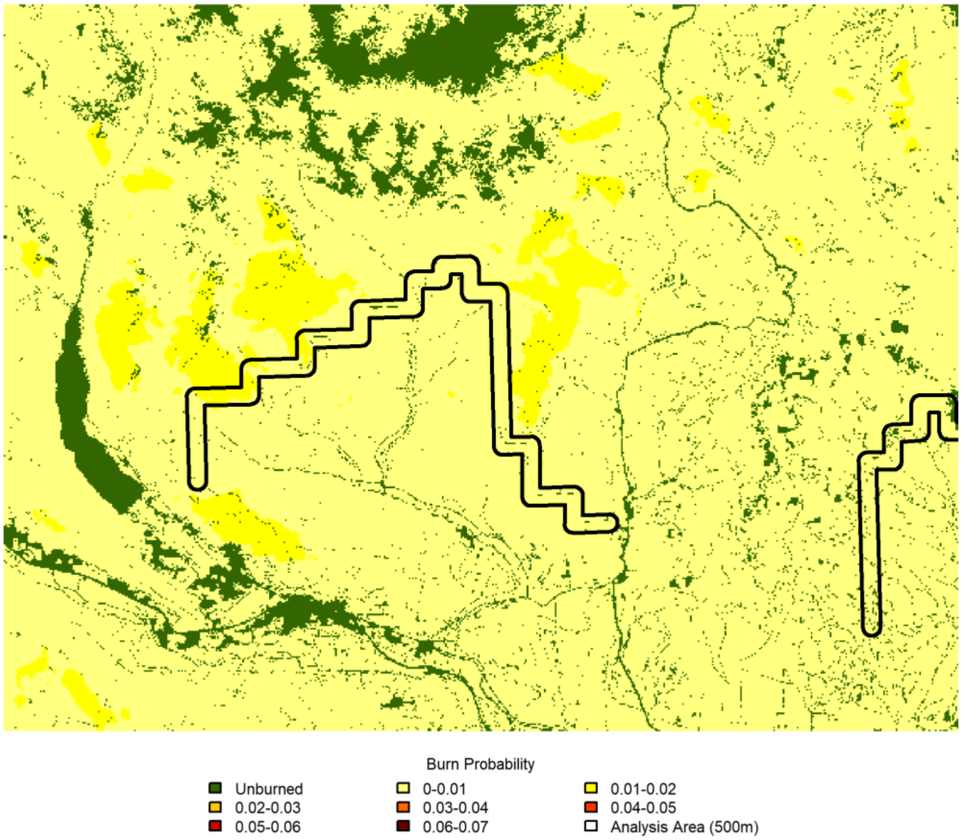


Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment

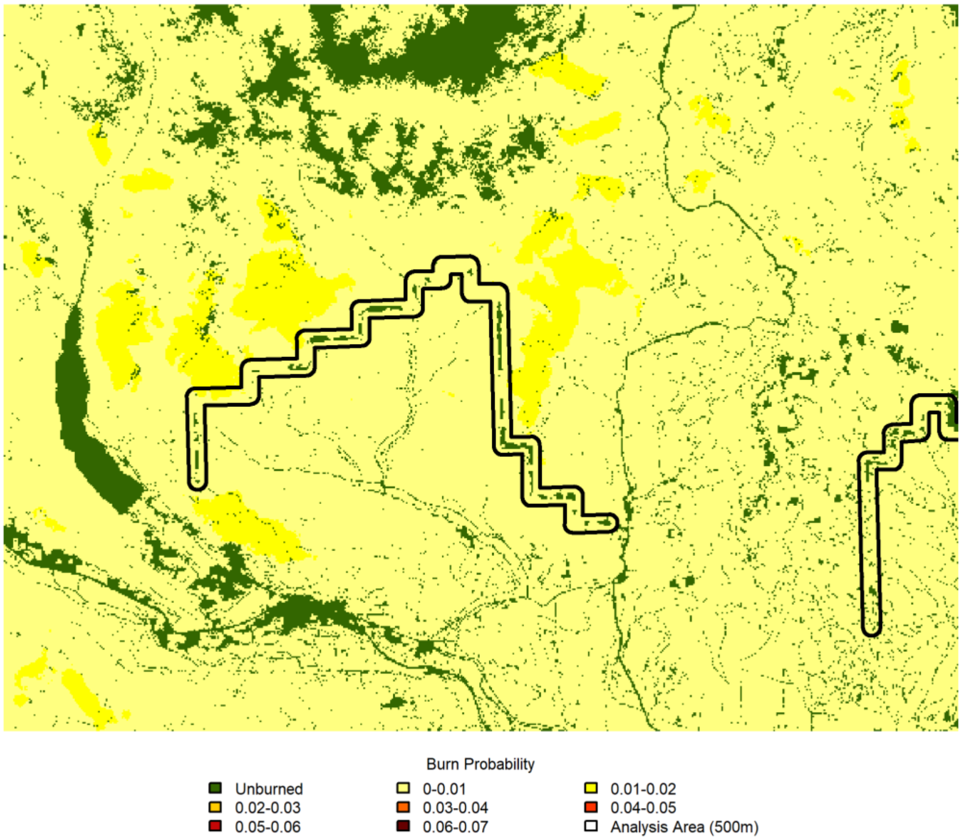




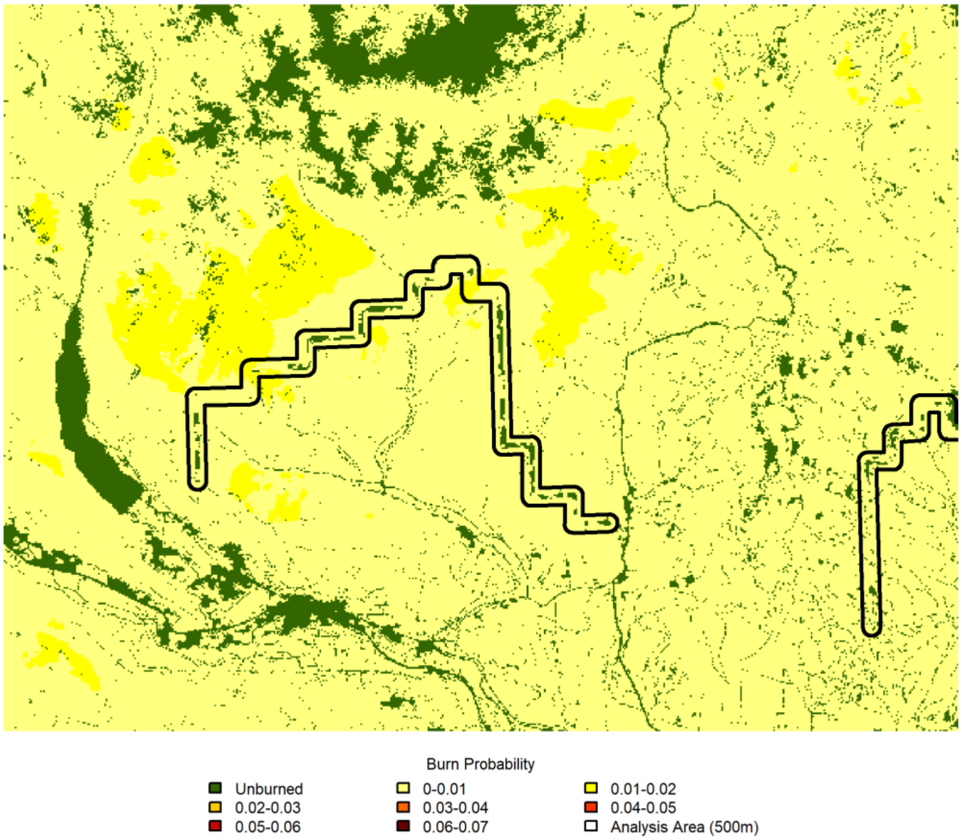
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



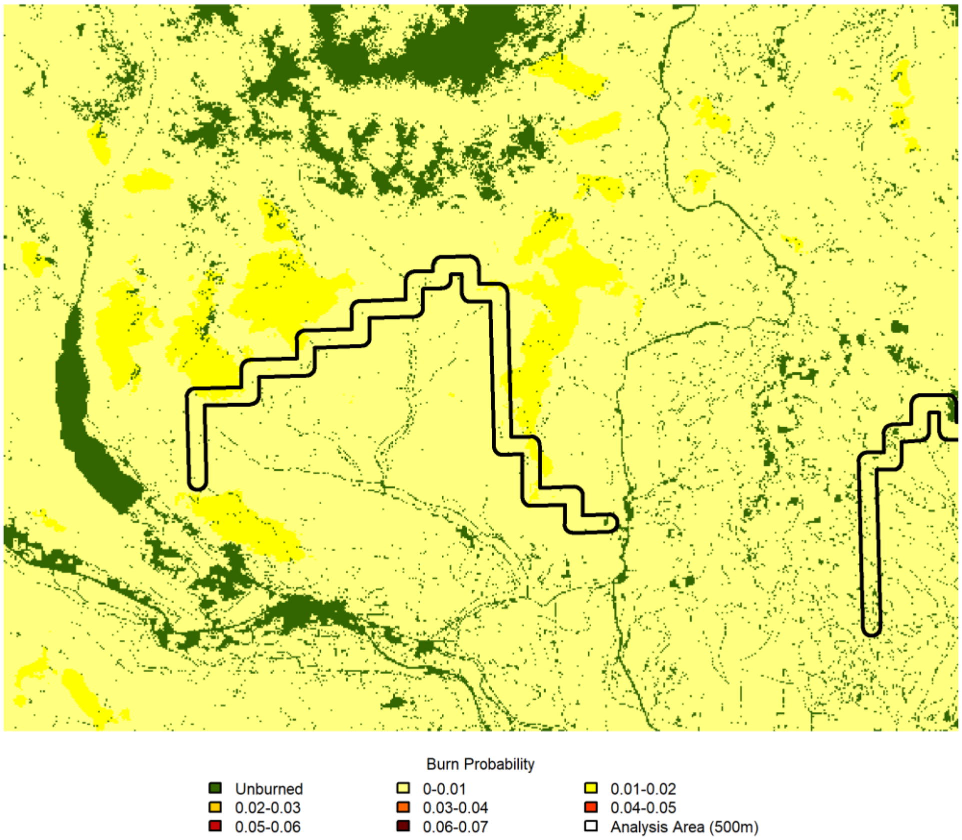
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



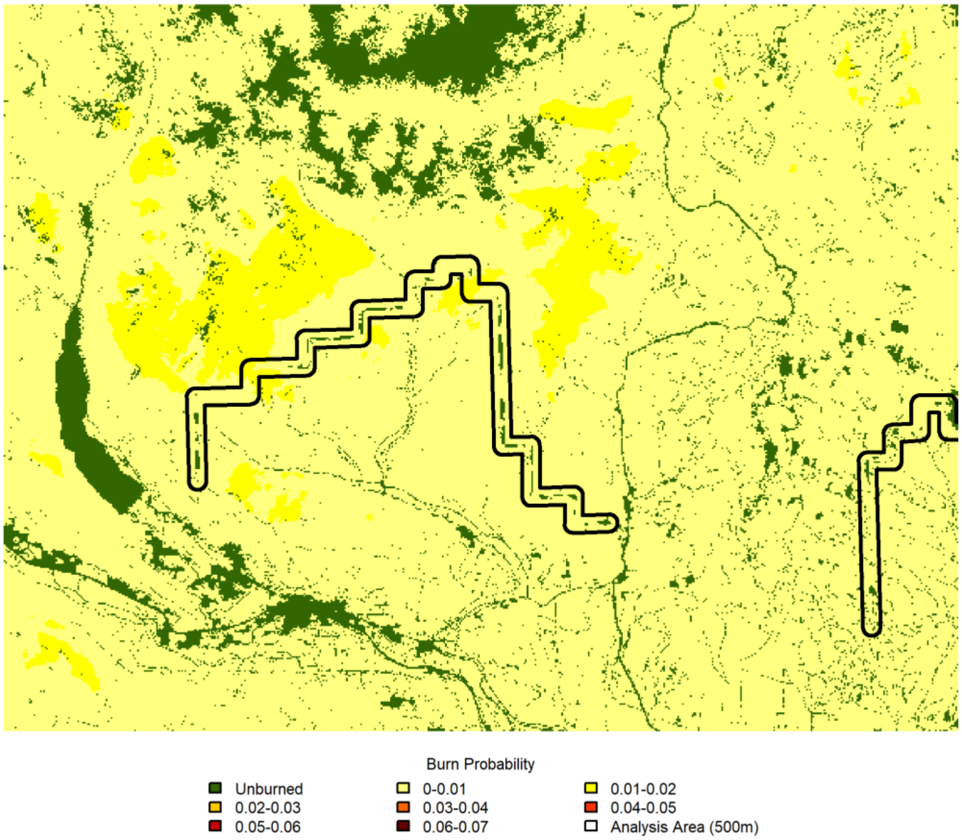
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



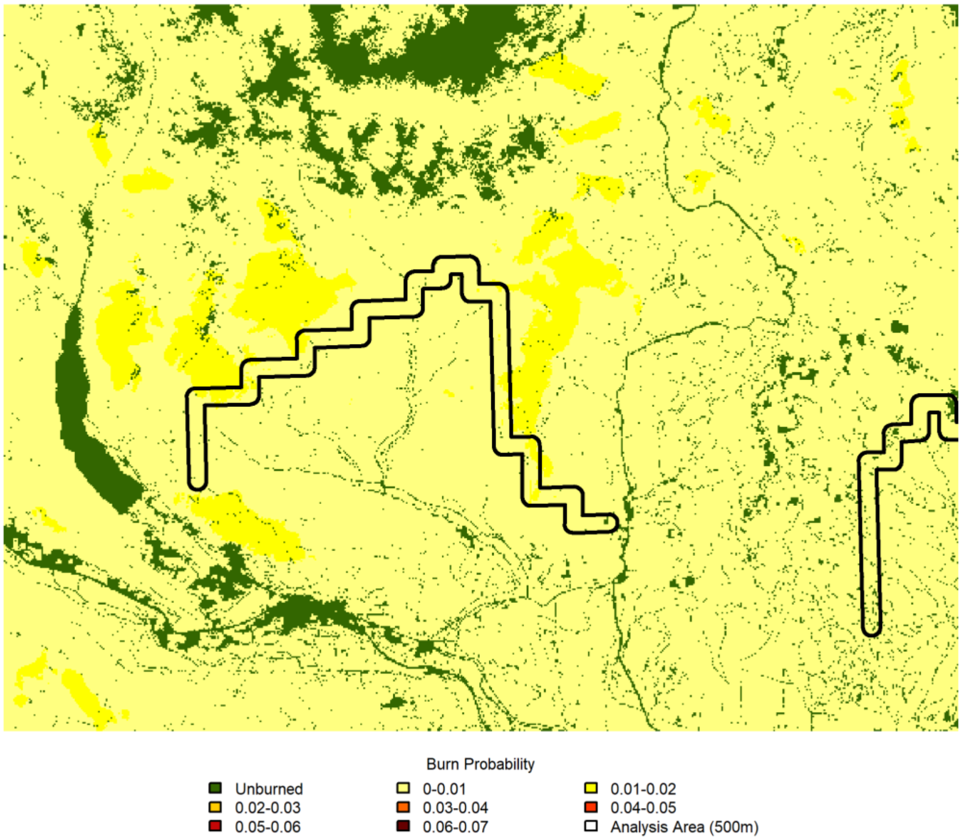
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



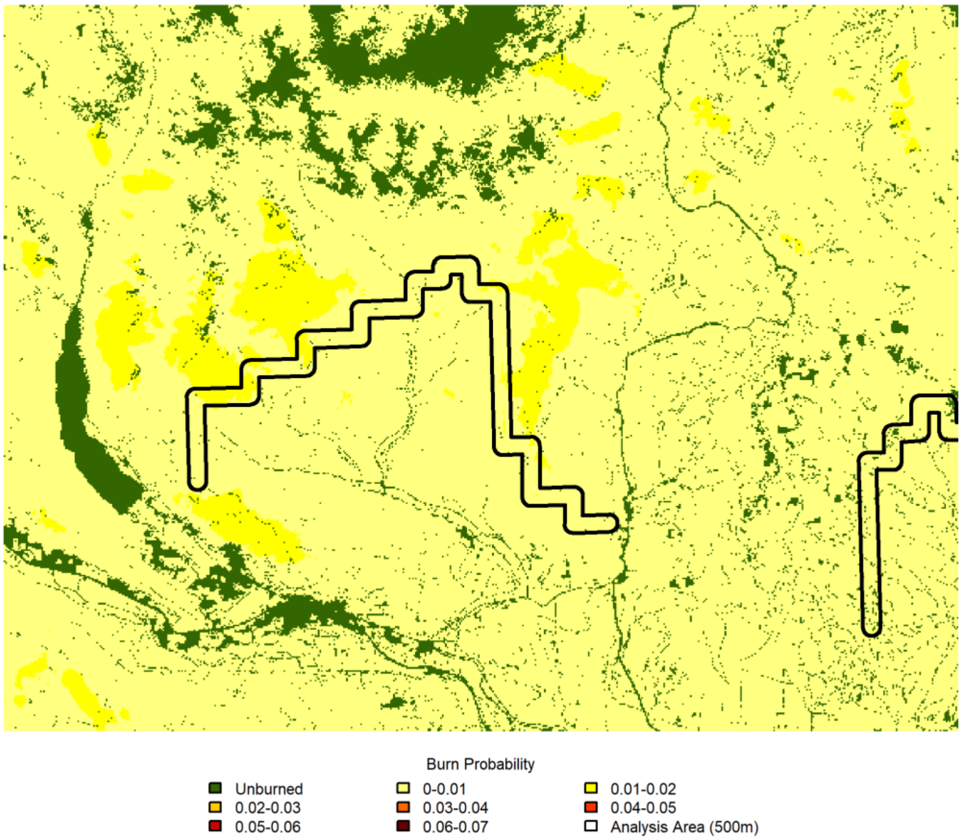
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



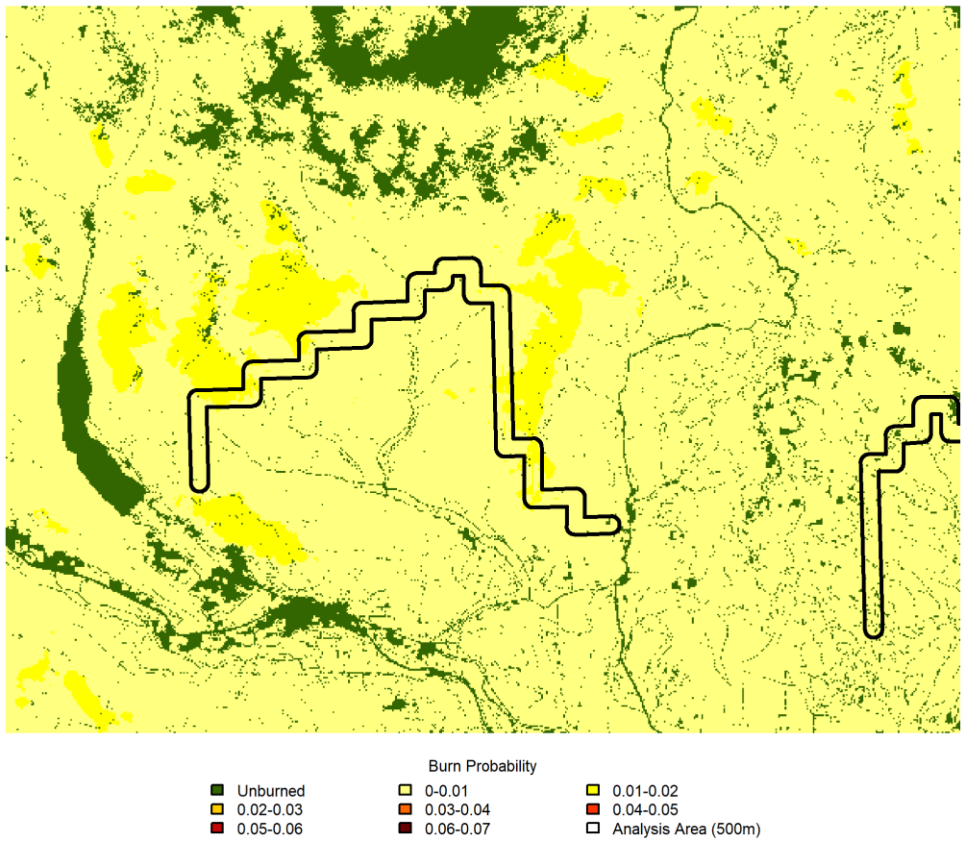
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



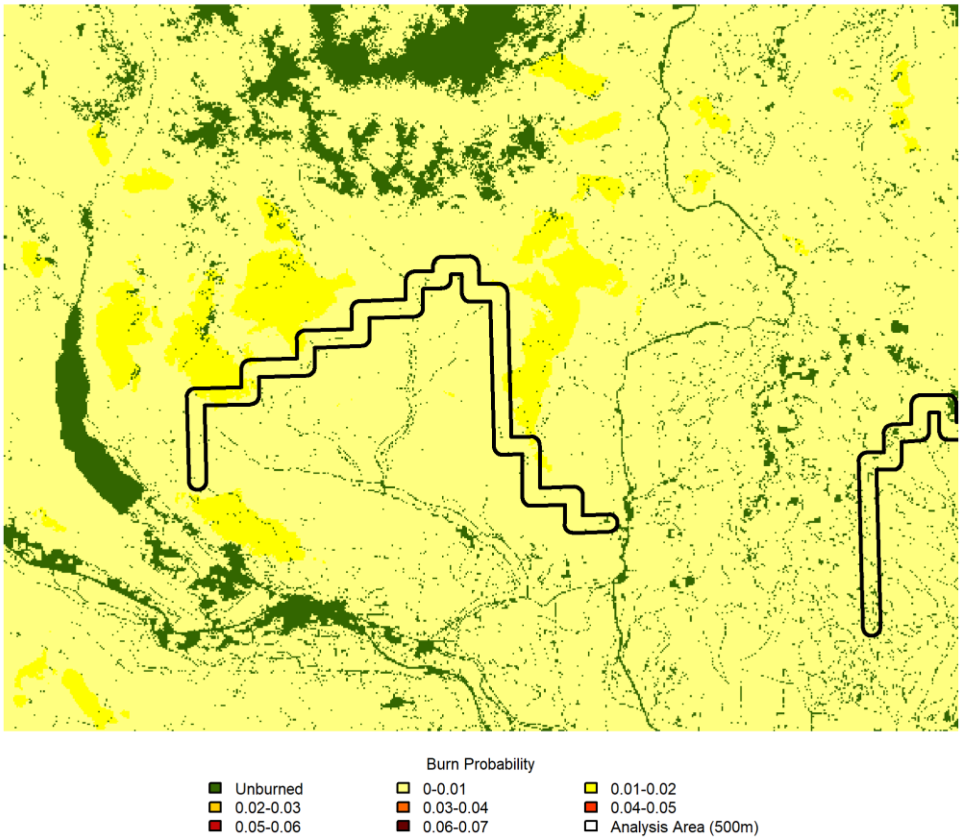
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



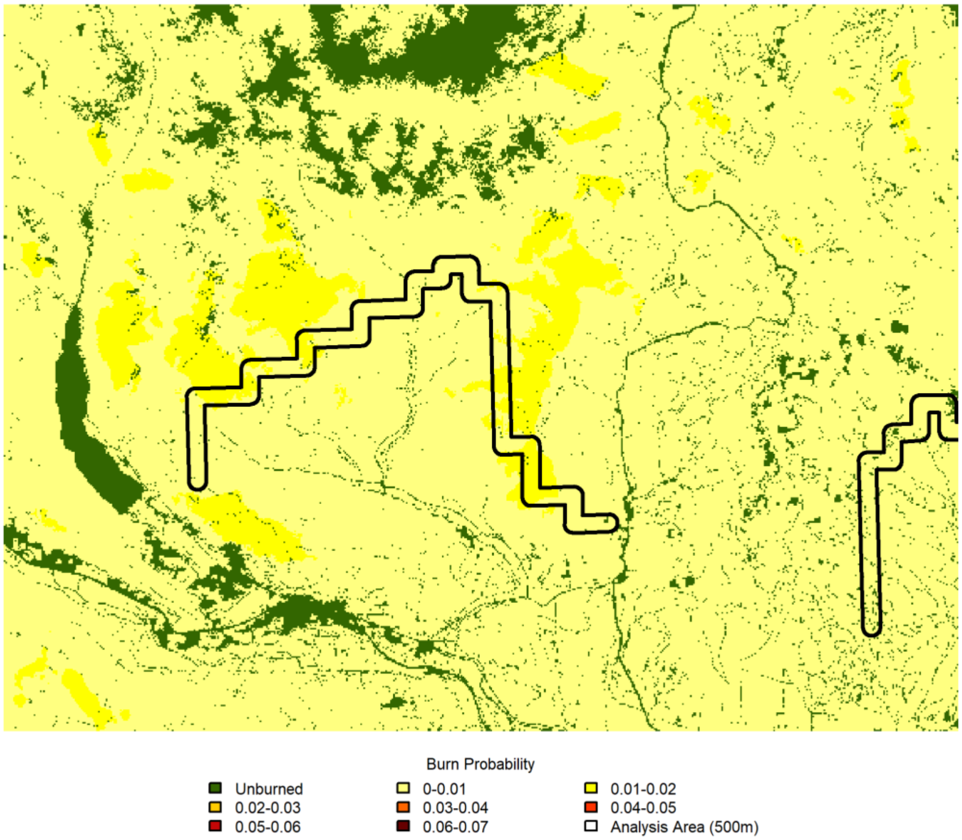
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



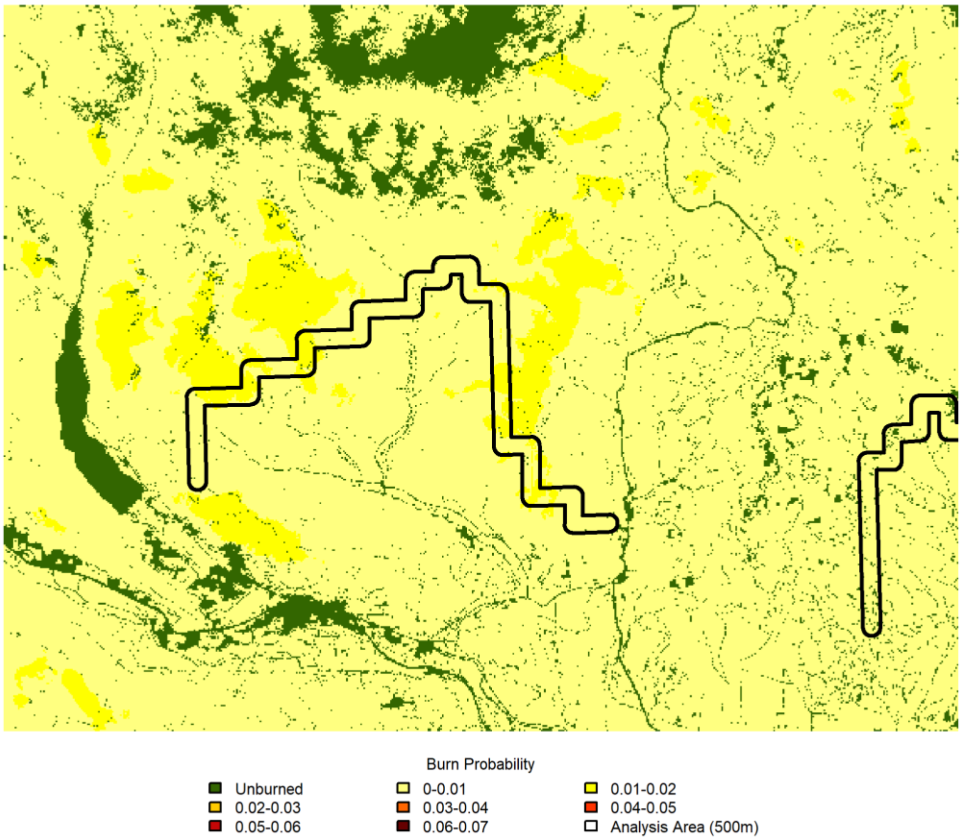
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



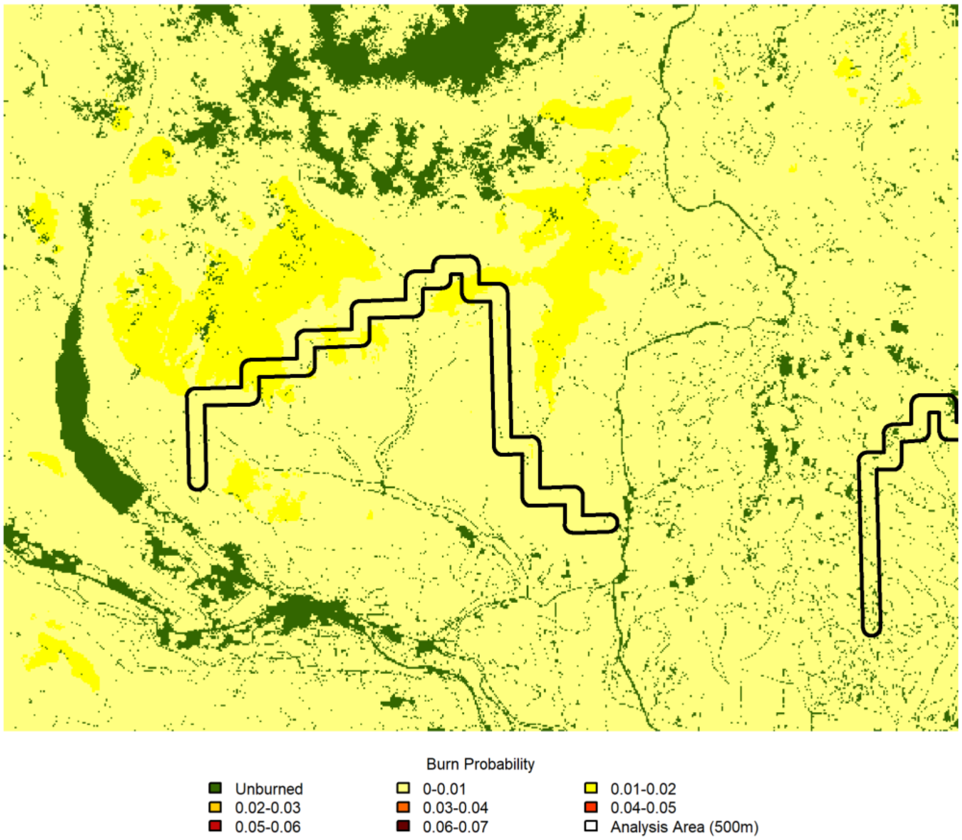
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



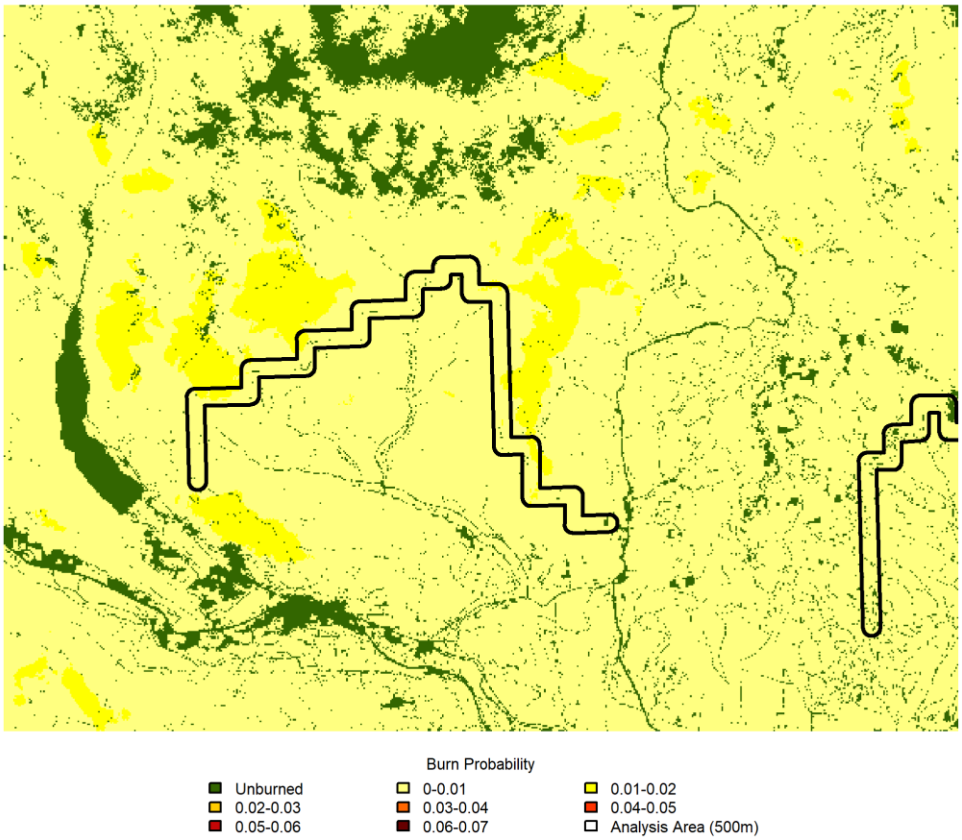
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



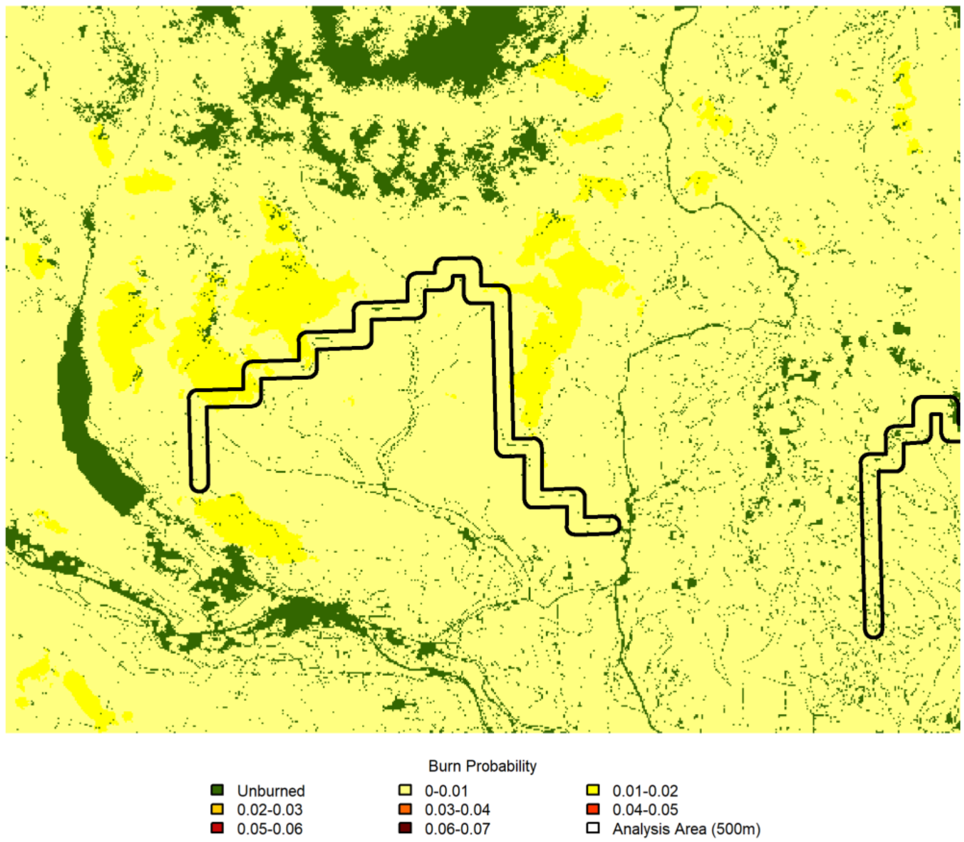
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



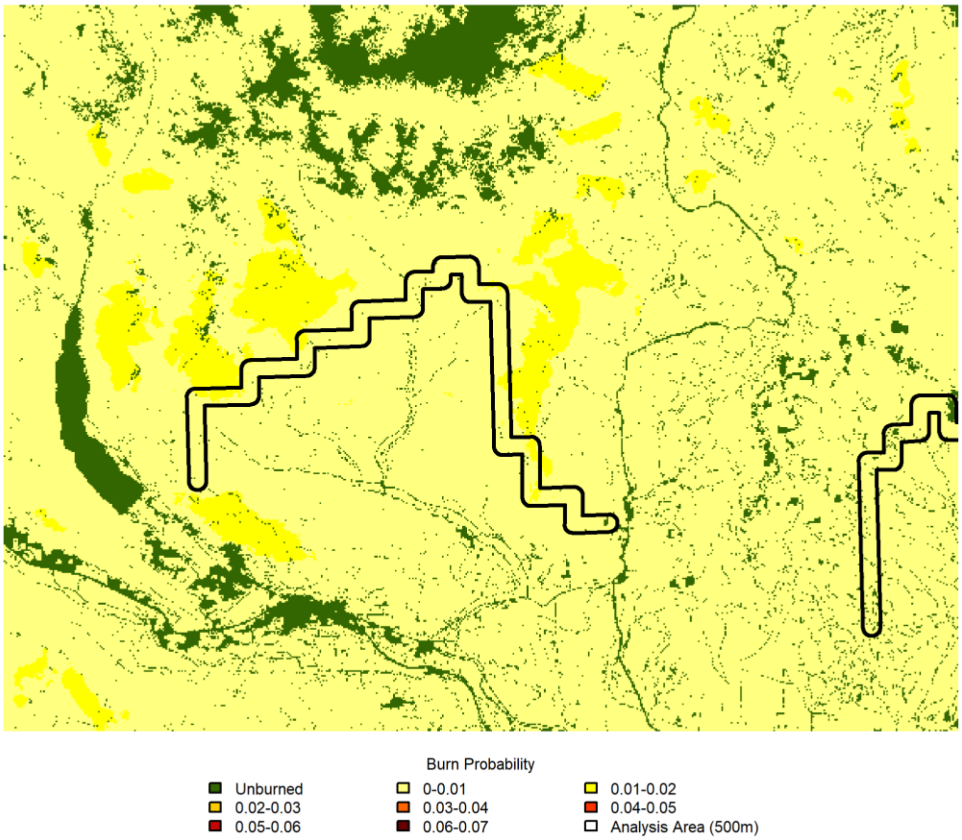
Reduction of 60% Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



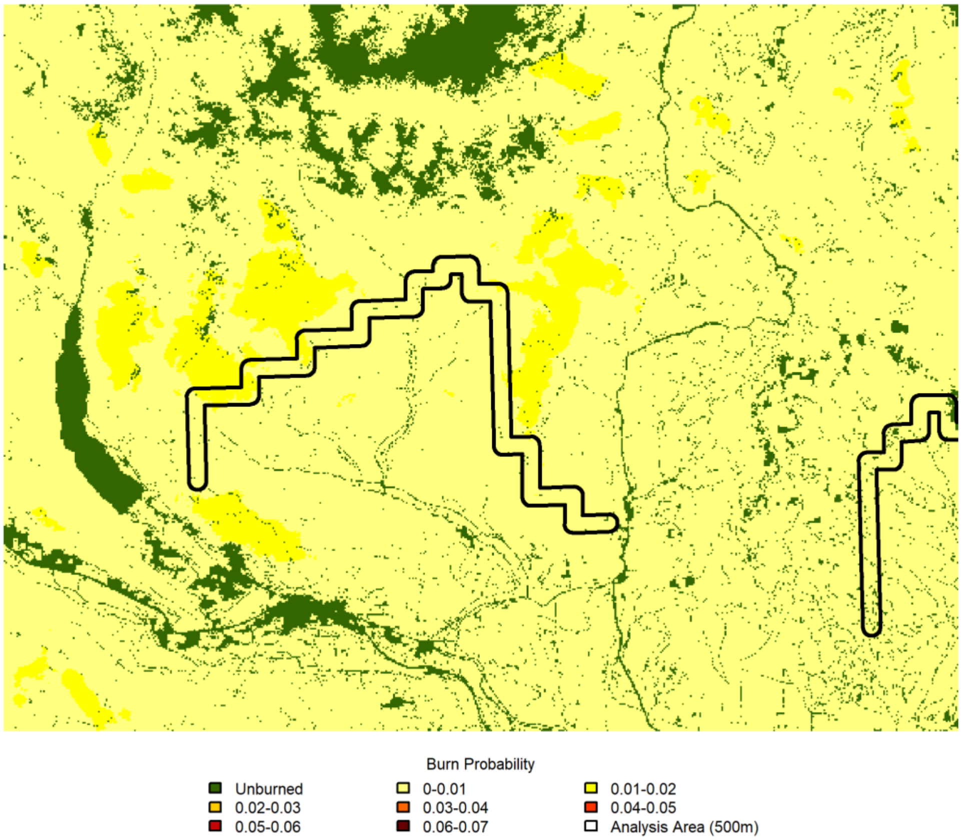
Reduction of 60% Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



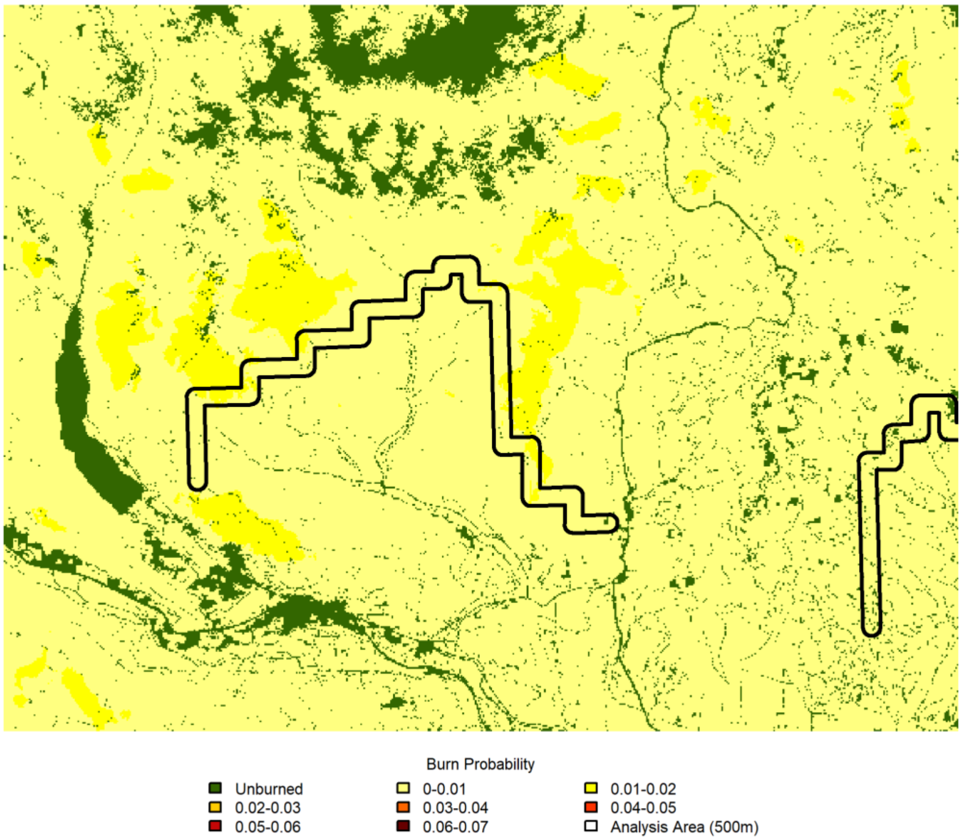
Reduction of 60% Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



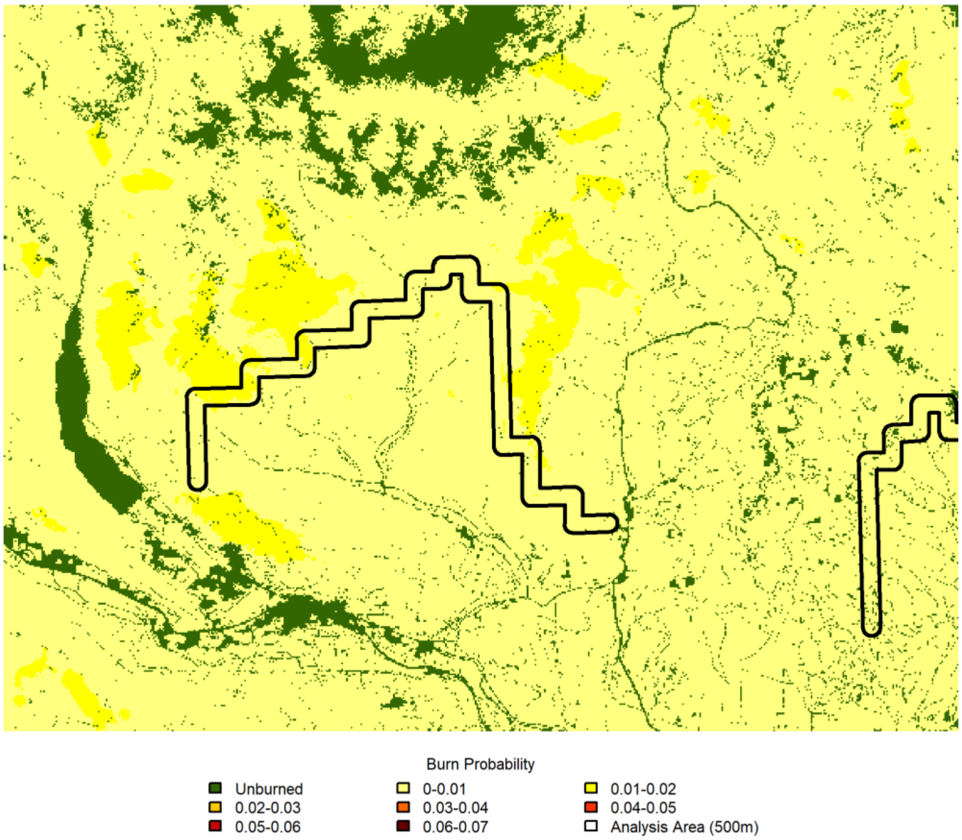
Reduction of 60% Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



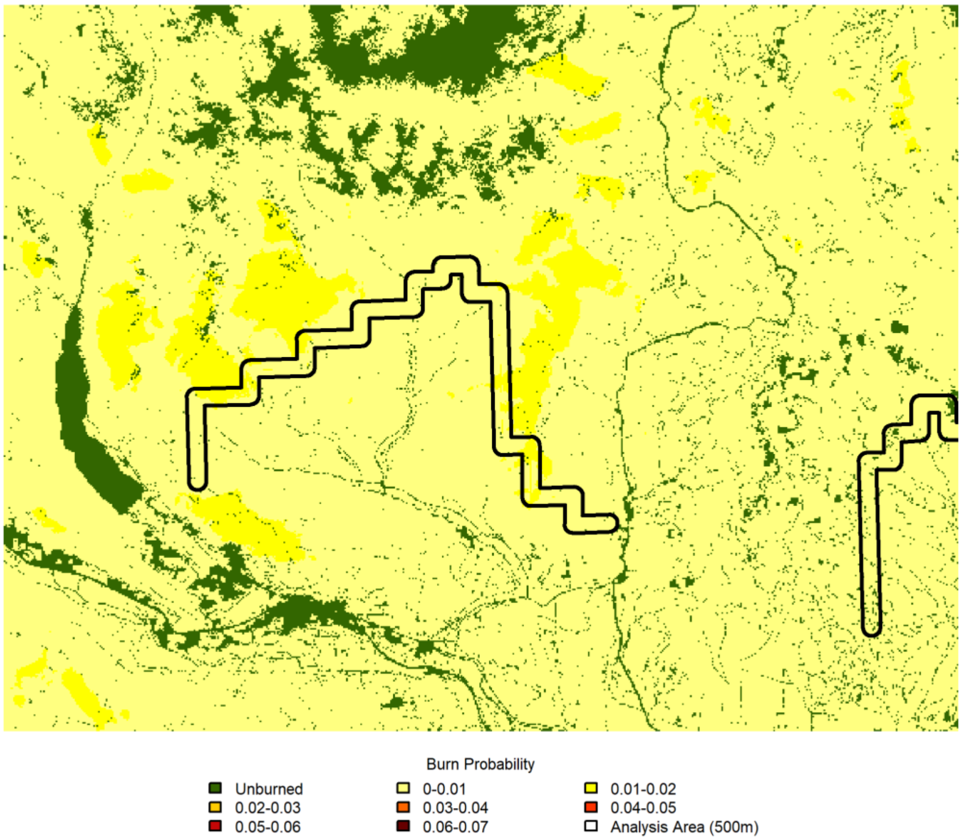
Reduction of 60% Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



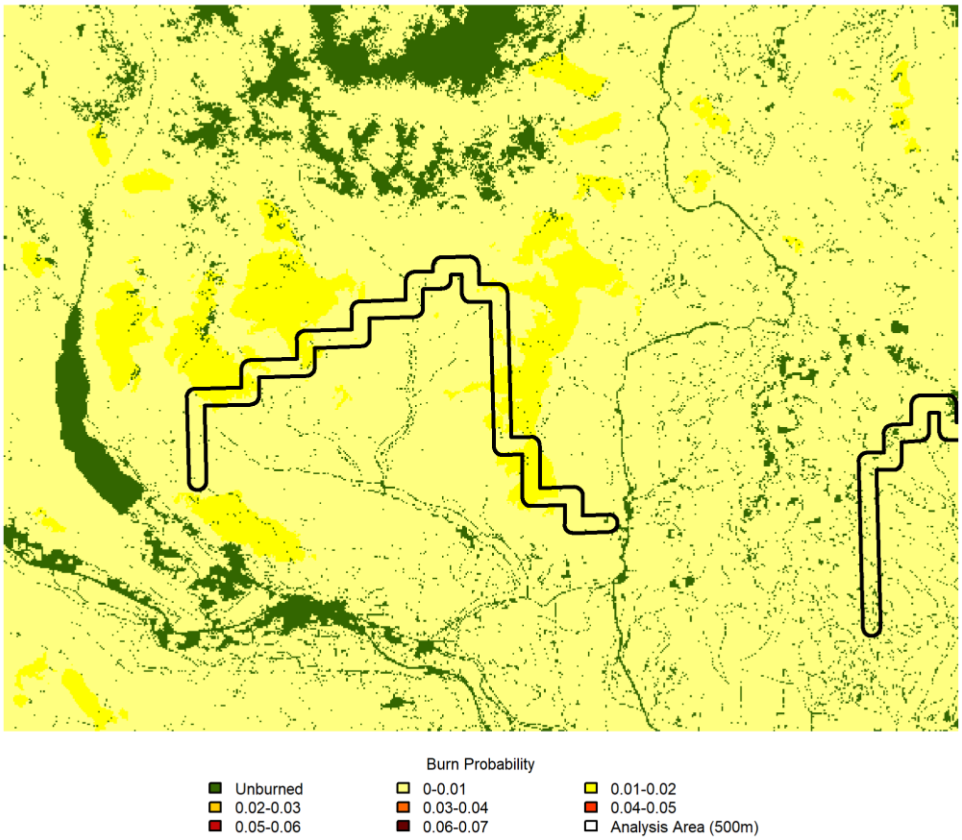
Reduction of 60% Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



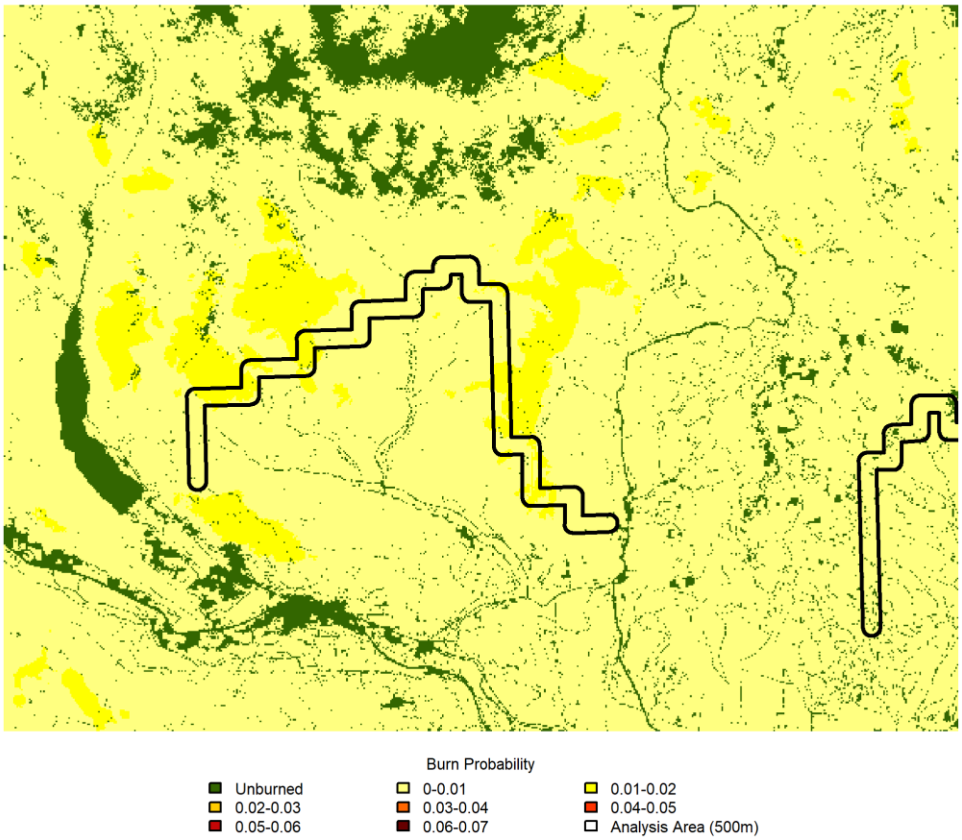
Reduction of 60% Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



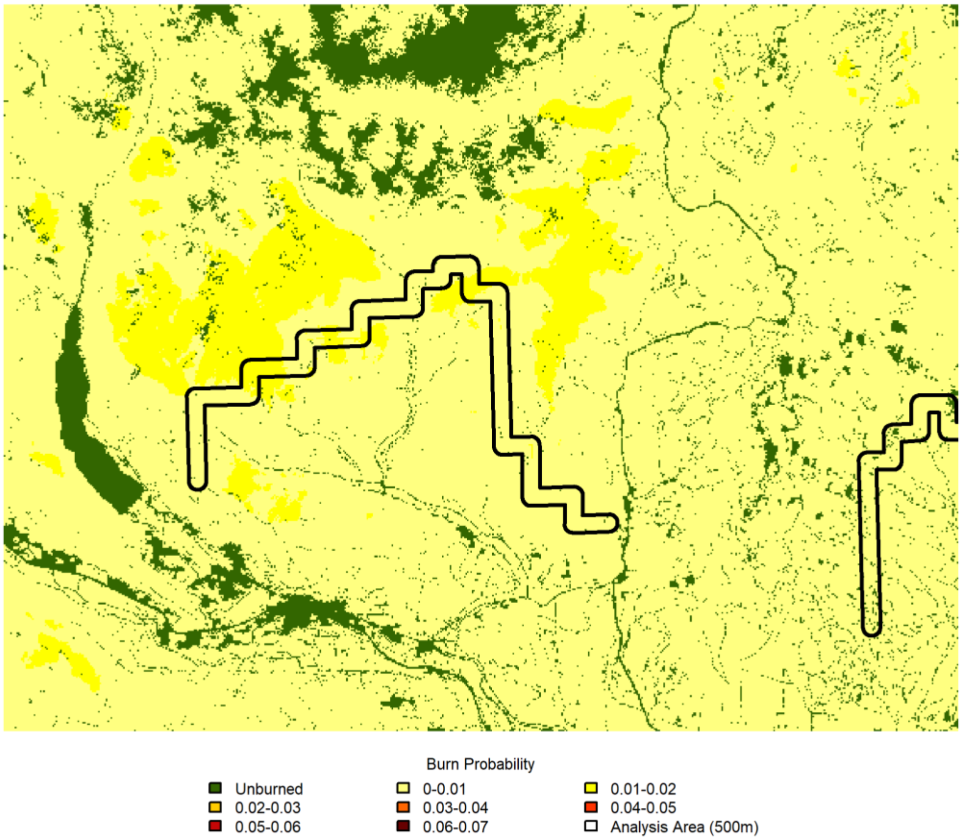
Reduction of 60% Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



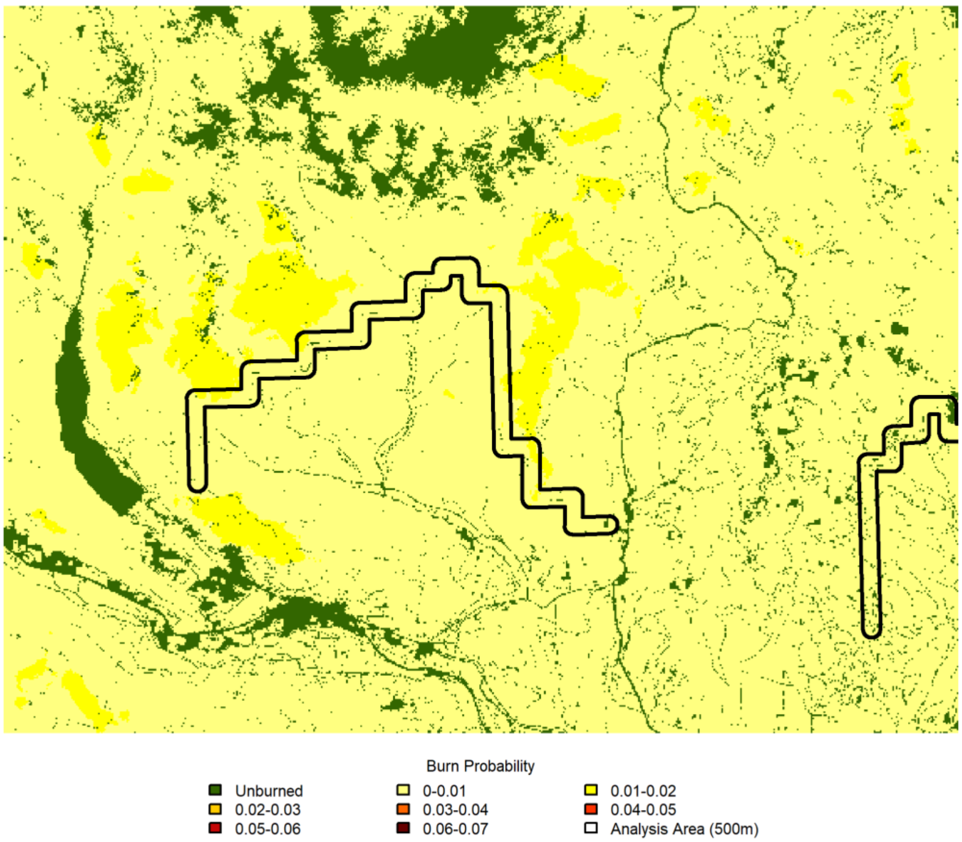
Reduction of 60% Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



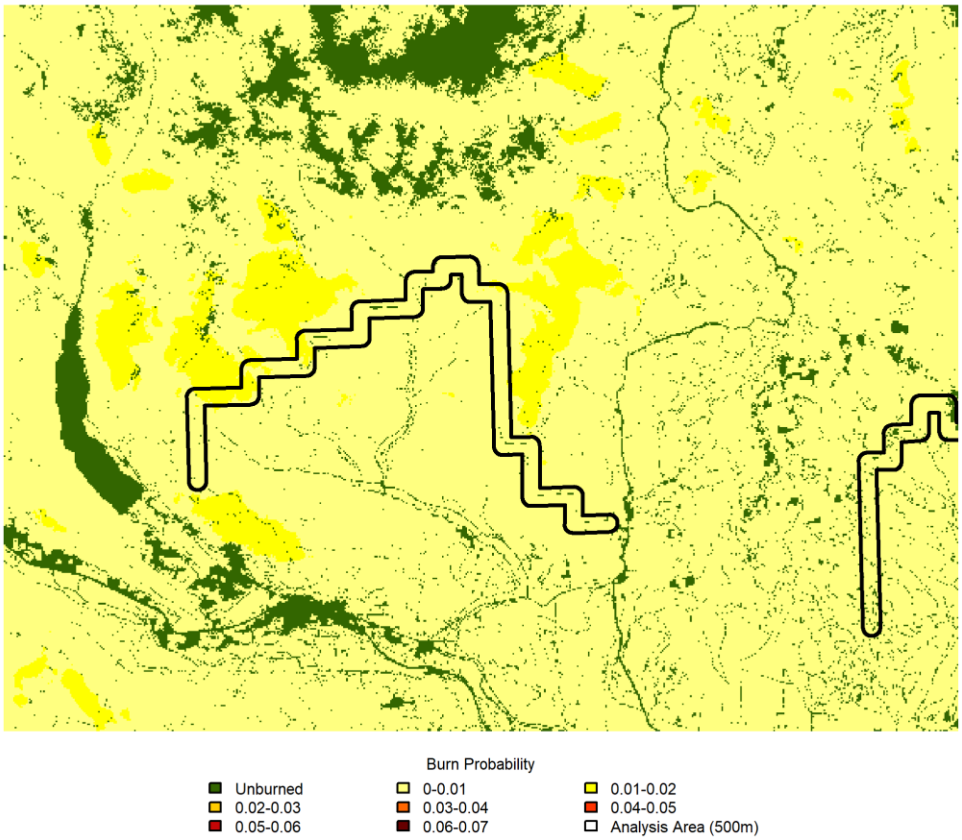
Reduction of 60% Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



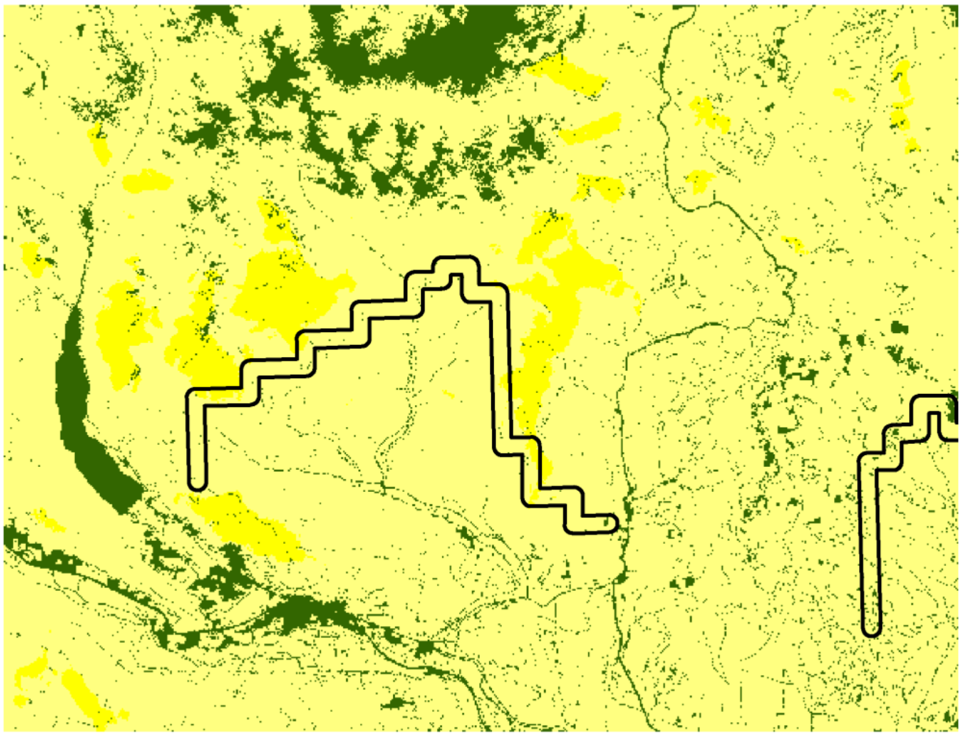
Reduction of 40% Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



Reduction of 40% Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



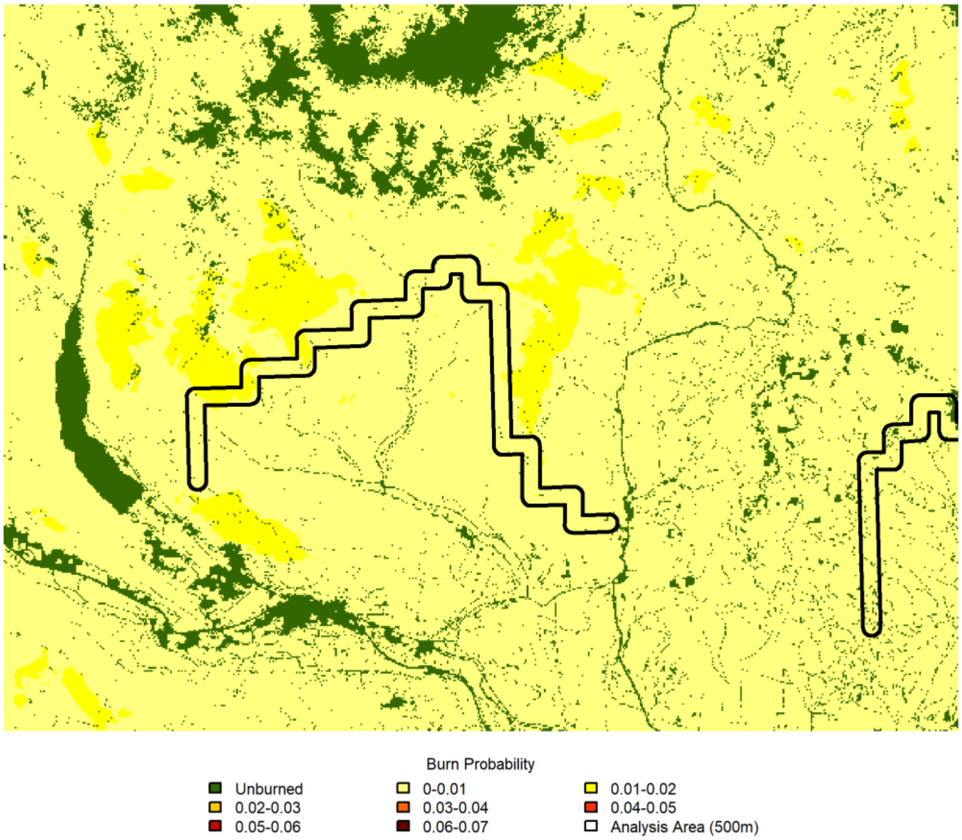
Reduction of 40% Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



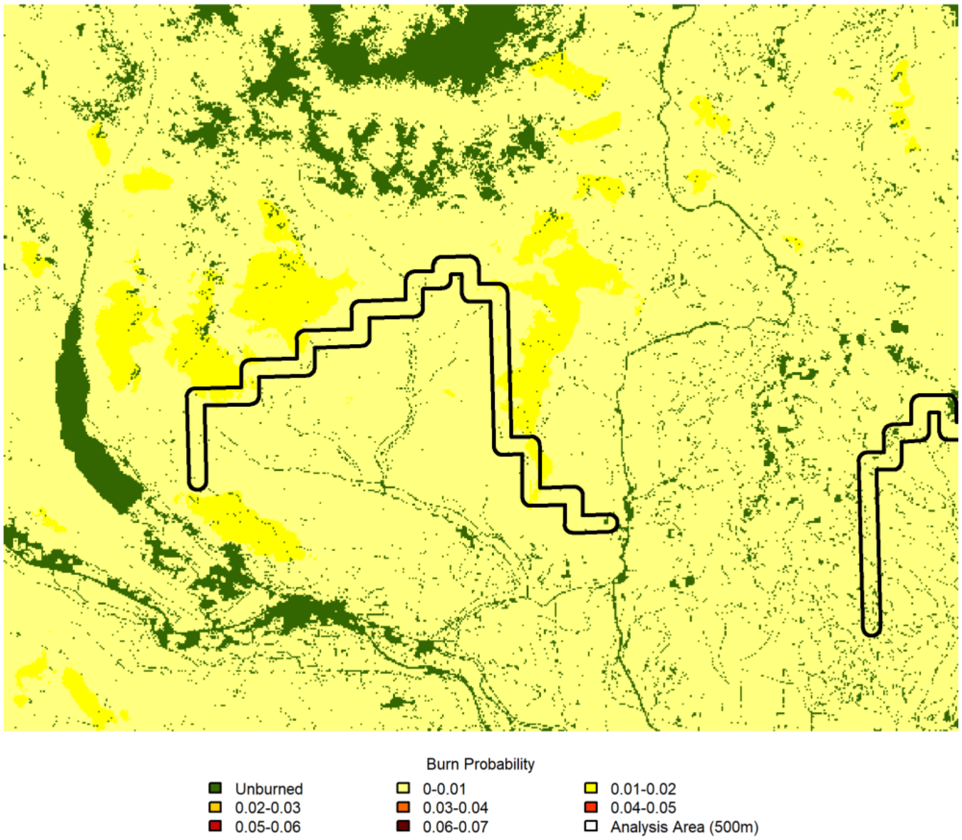
Burn Probability

Unburned	0-0.01	0.01-0.02
0.02-0.03	0.03-0.04	0.04-0.05
0.05-0.06	0.06-0.07	Analysis Area (500m)

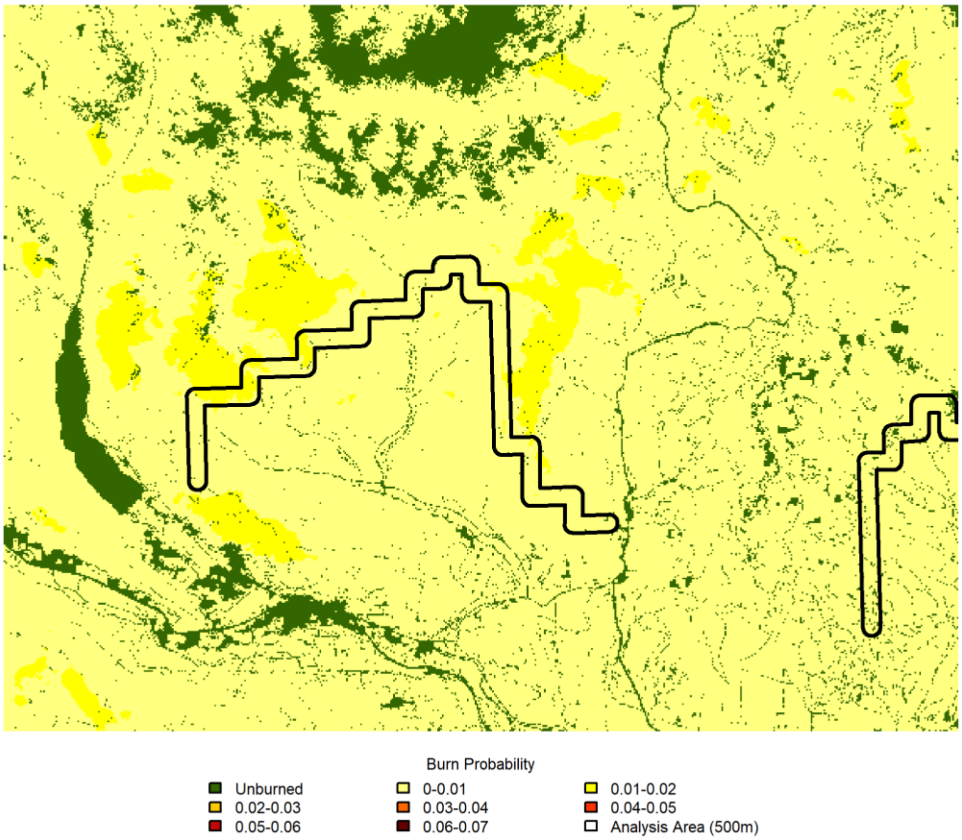
Reduction of 40% Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



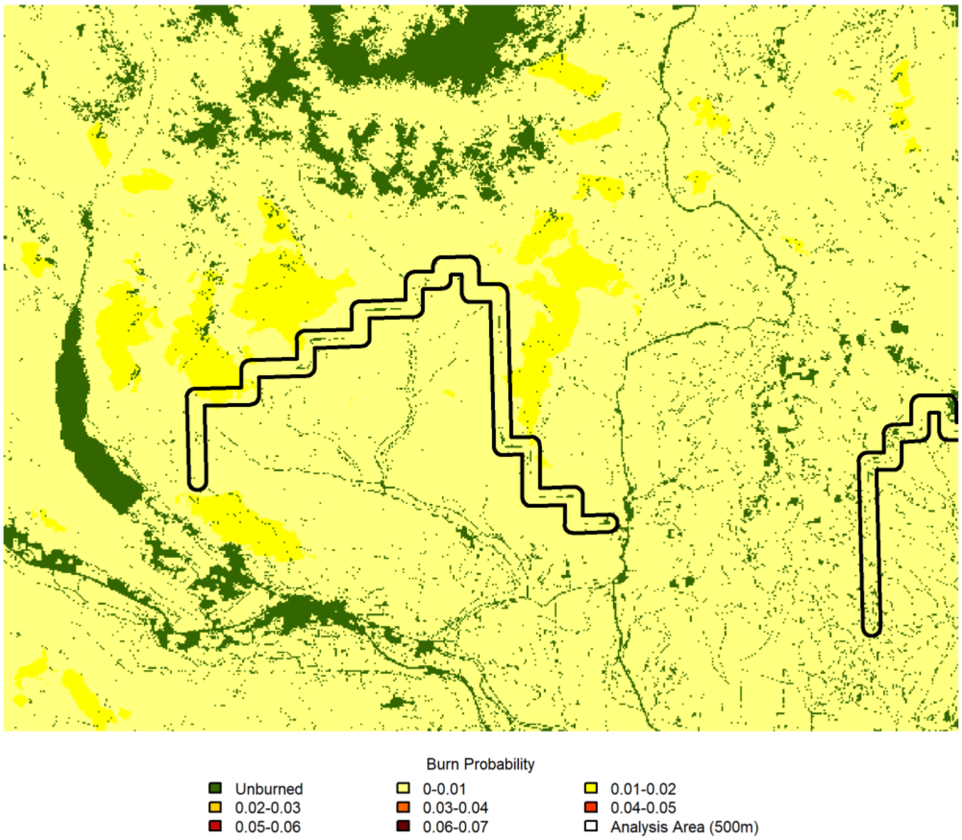
Reduction of 40% Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



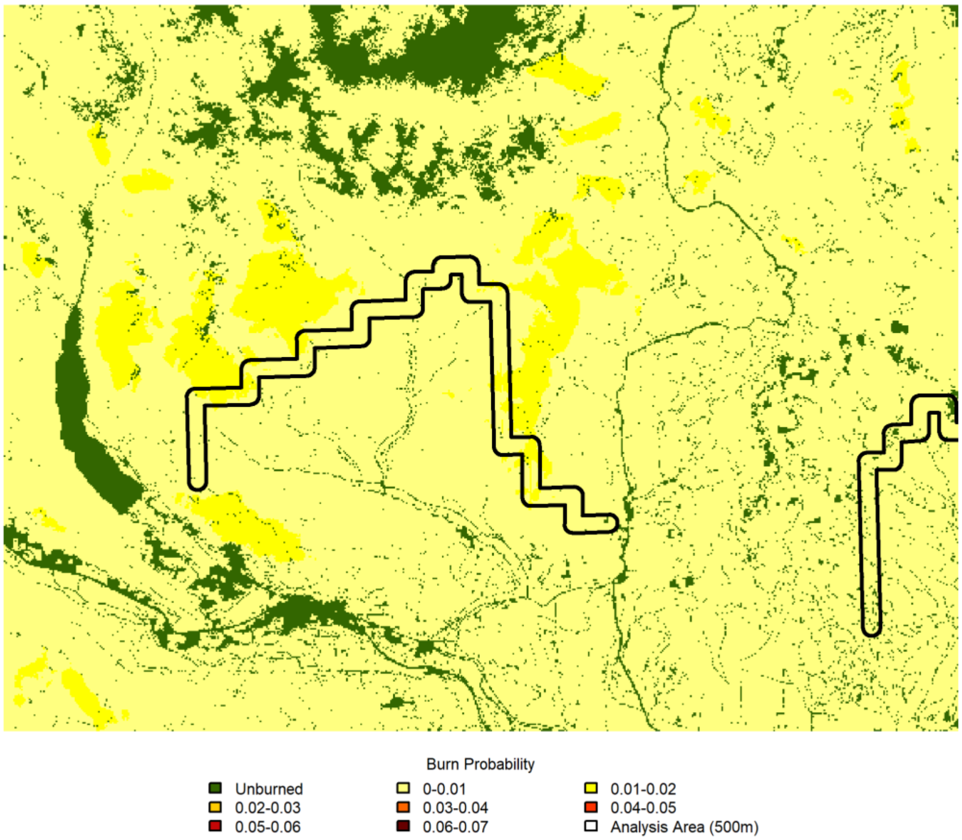
Reduction of 40% Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



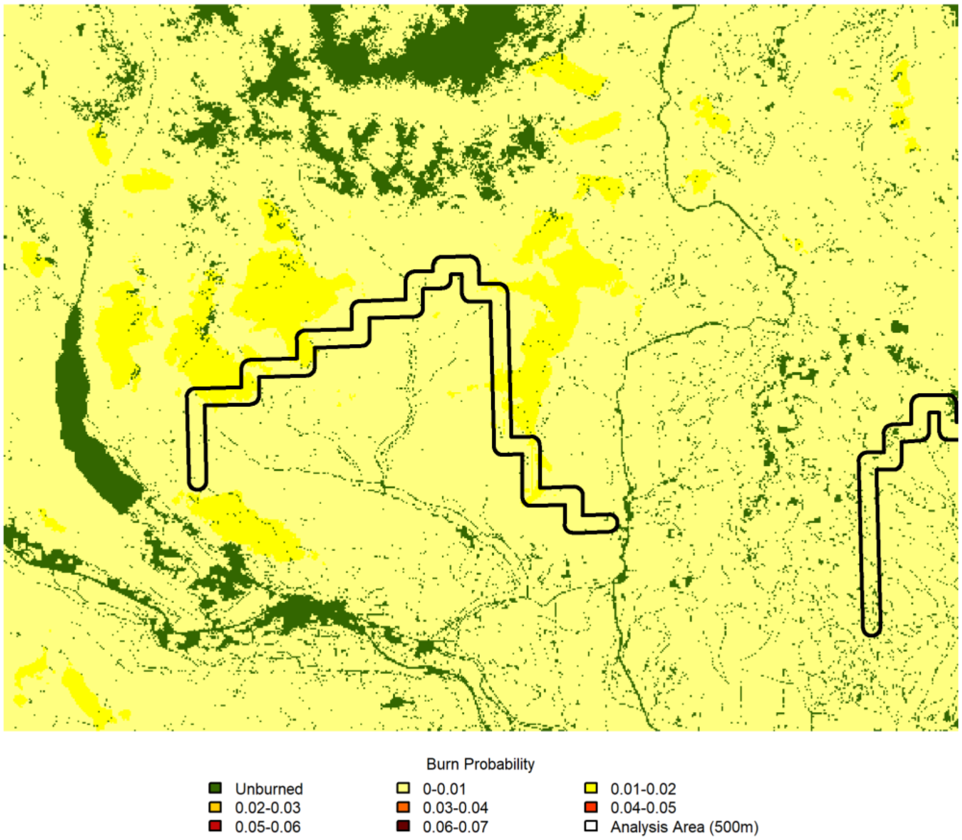
Reduction of 40% Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



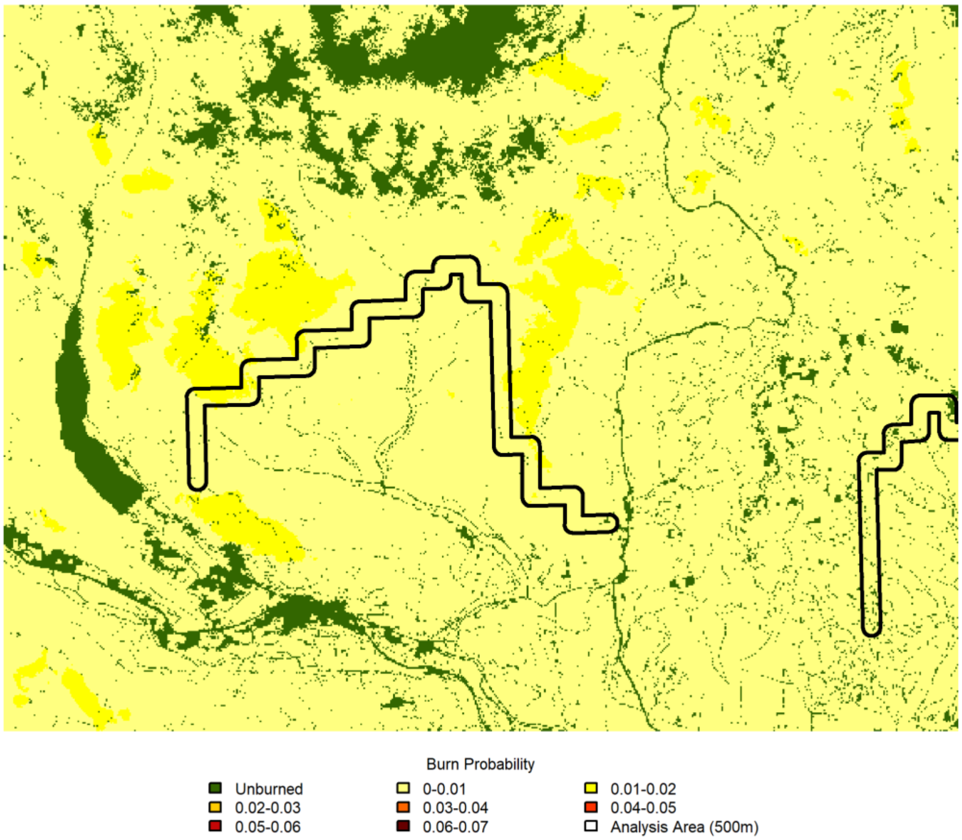
Reduction of 40% Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



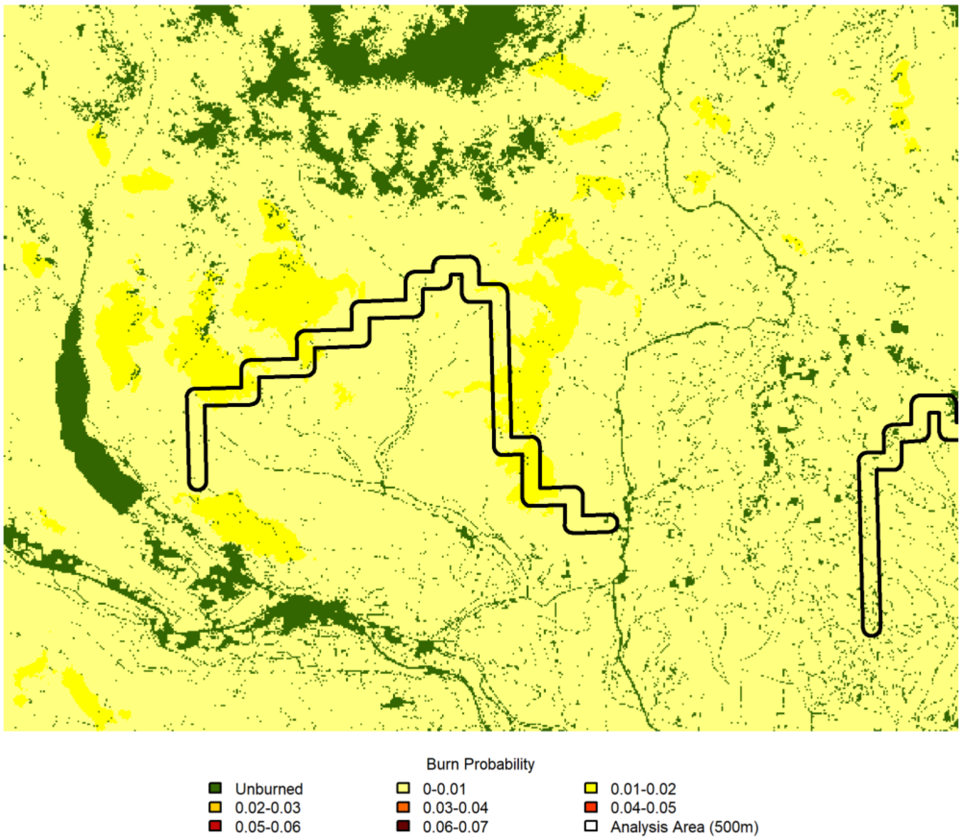
Reduction of 40% Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



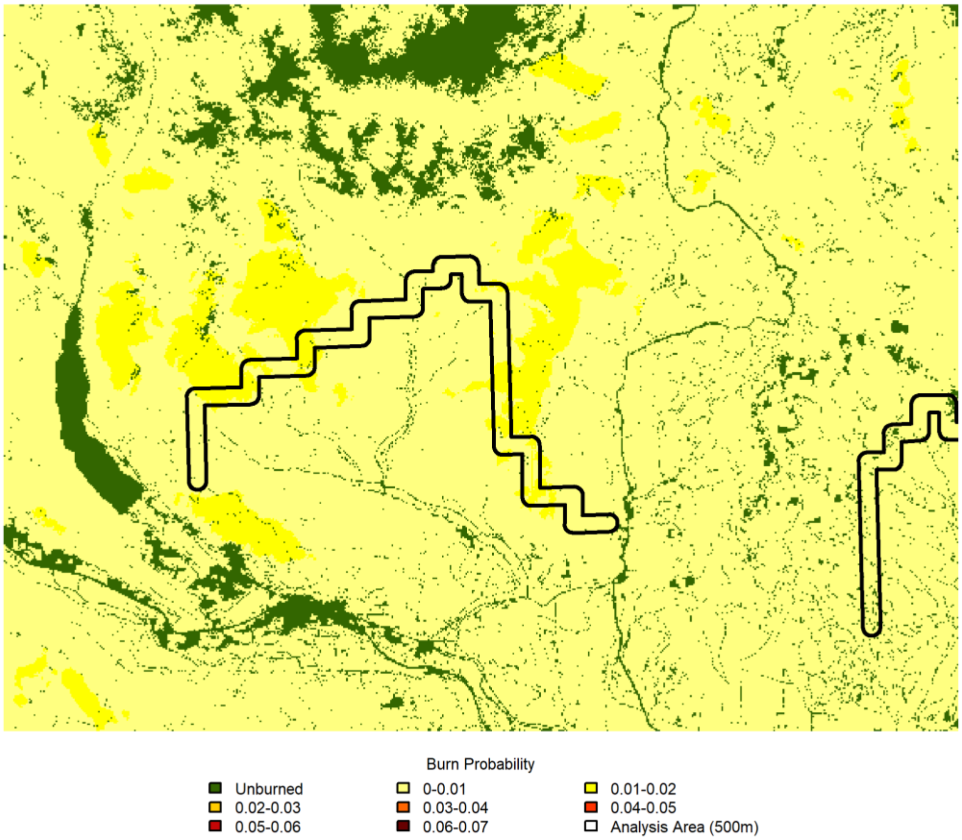
Reduction of 40% Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



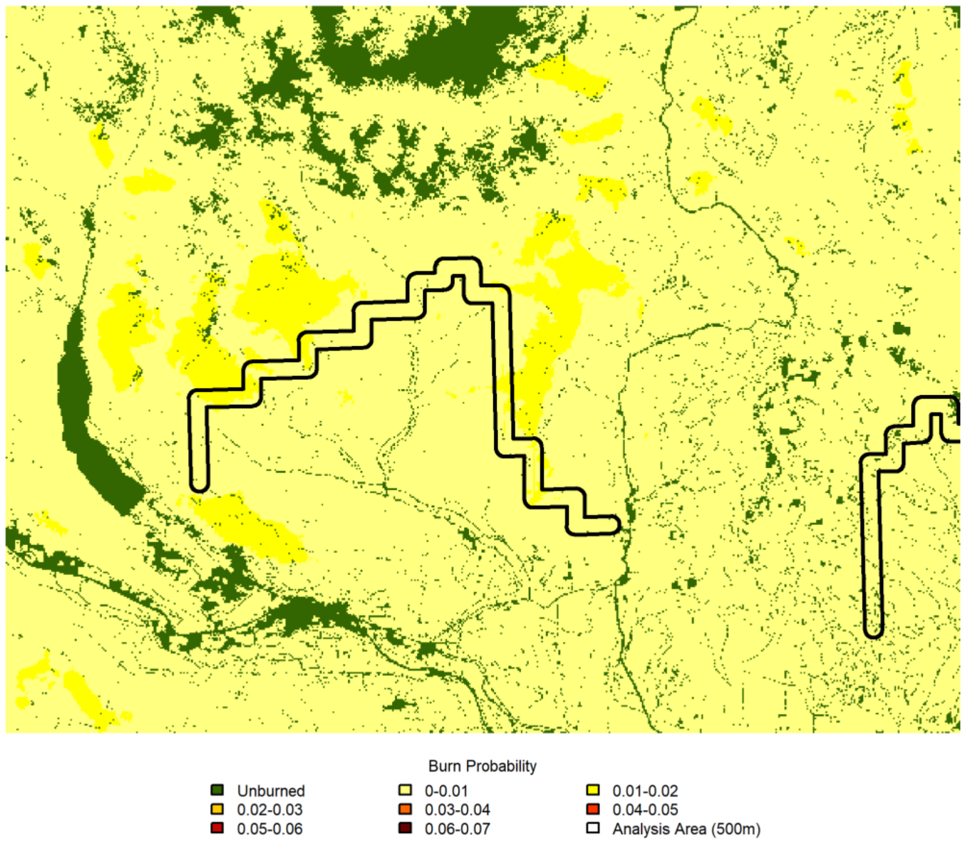
Reduction of 40% Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



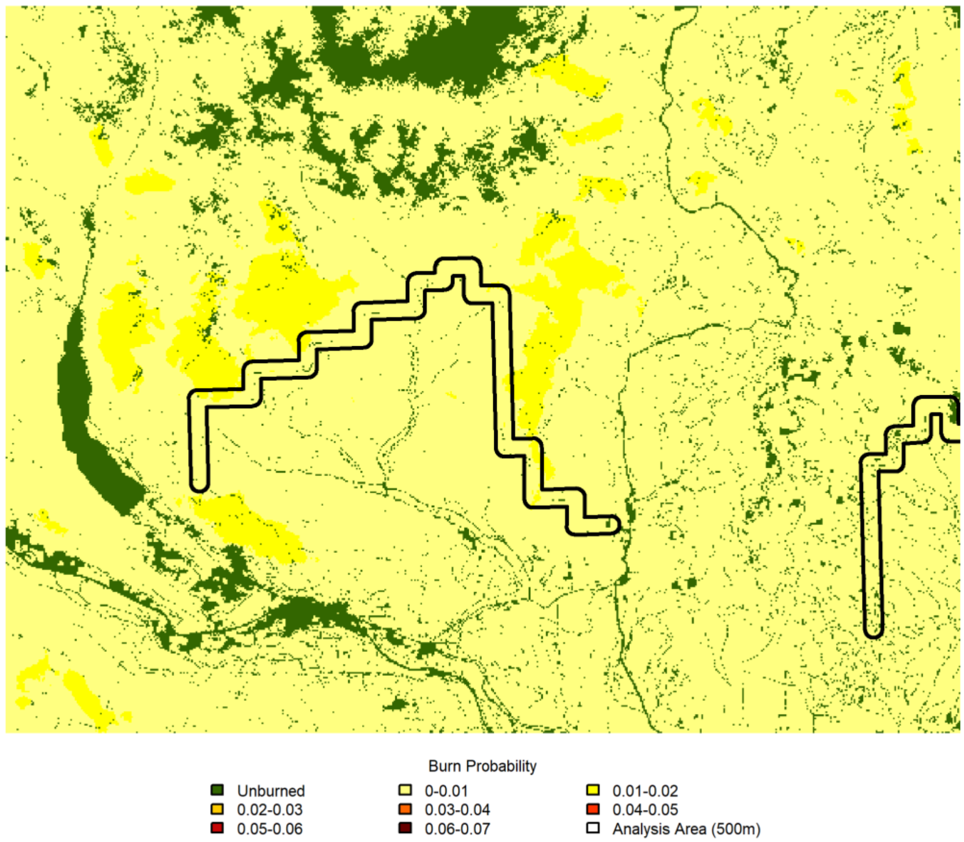
Reduction of 40% Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



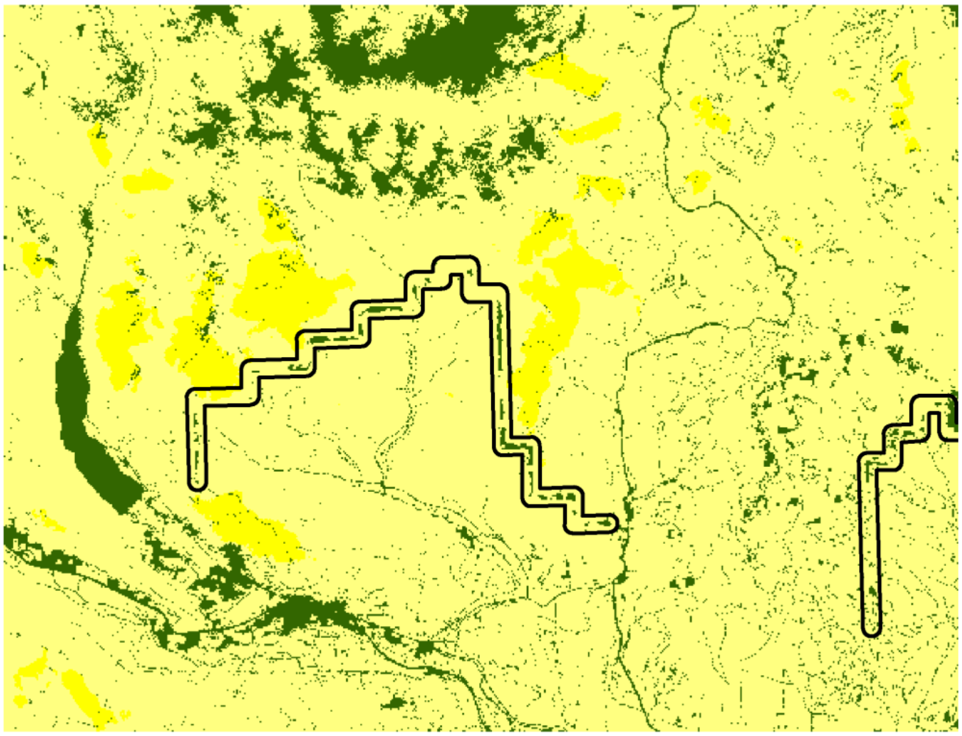
Reduction of 40% Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



Reduction of 30% Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



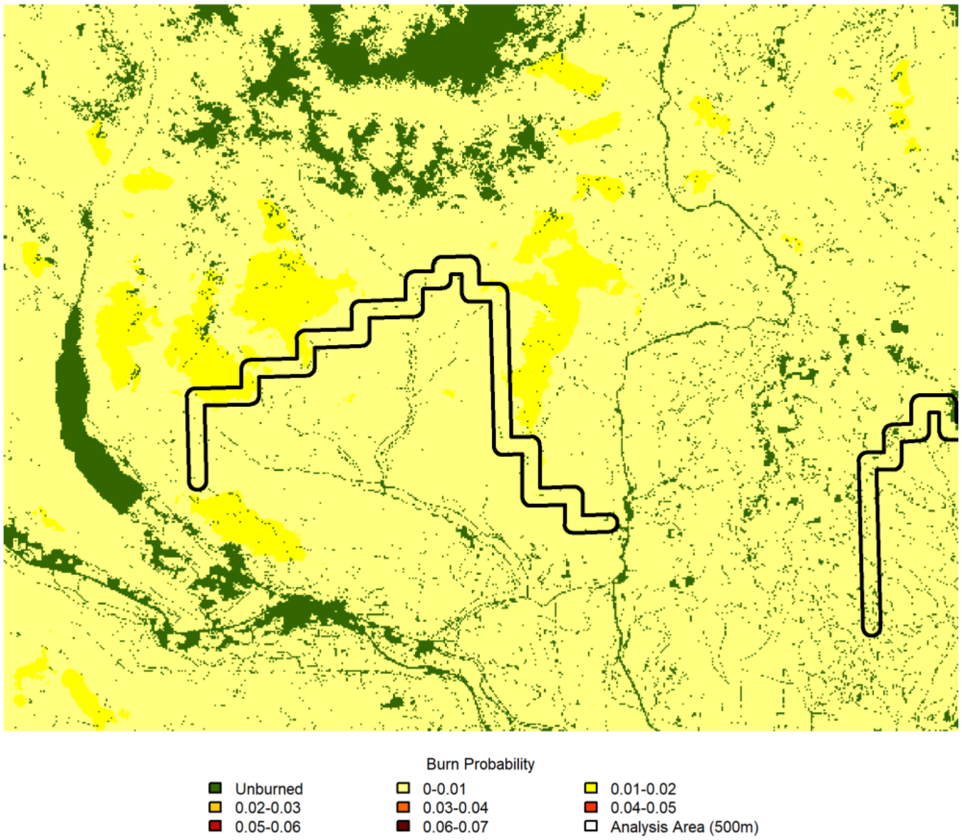
Reduction of 30% Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



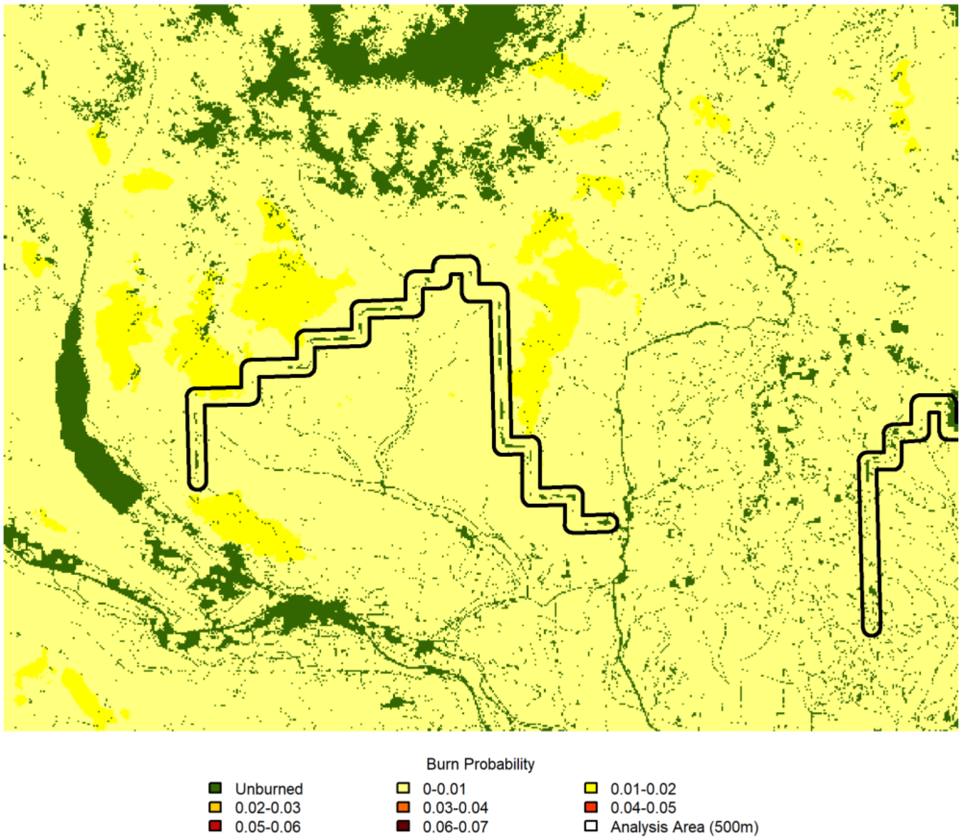
Burn Probability

Unburned	0-0.01	0.01-0.02
0.02-0.03	0.03-0.04	0.04-0.05
0.05-0.06	0.06-0.07	Analysis Area (500m)

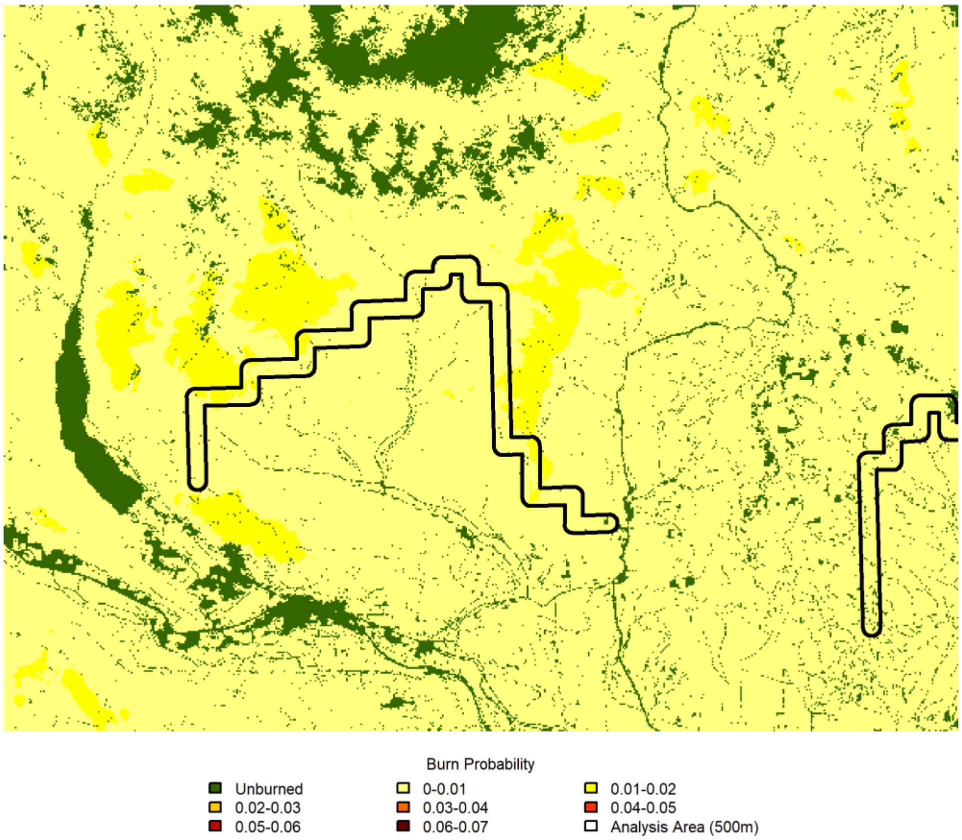
Reduction of 30% Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



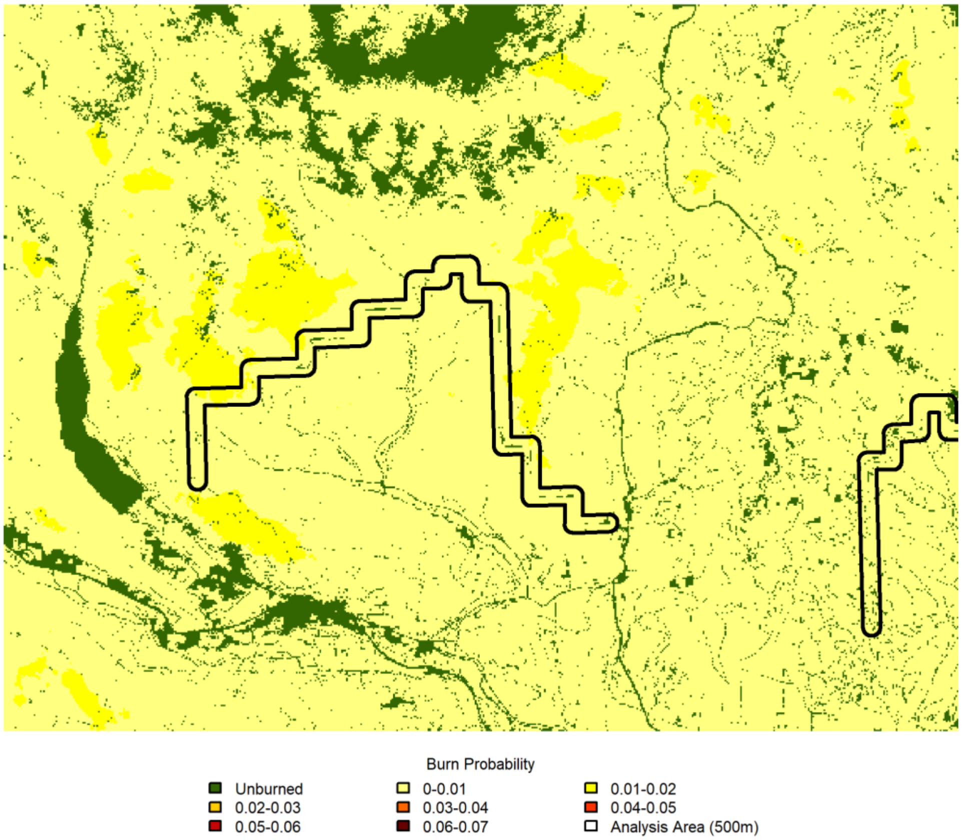
Reduction of 30% Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



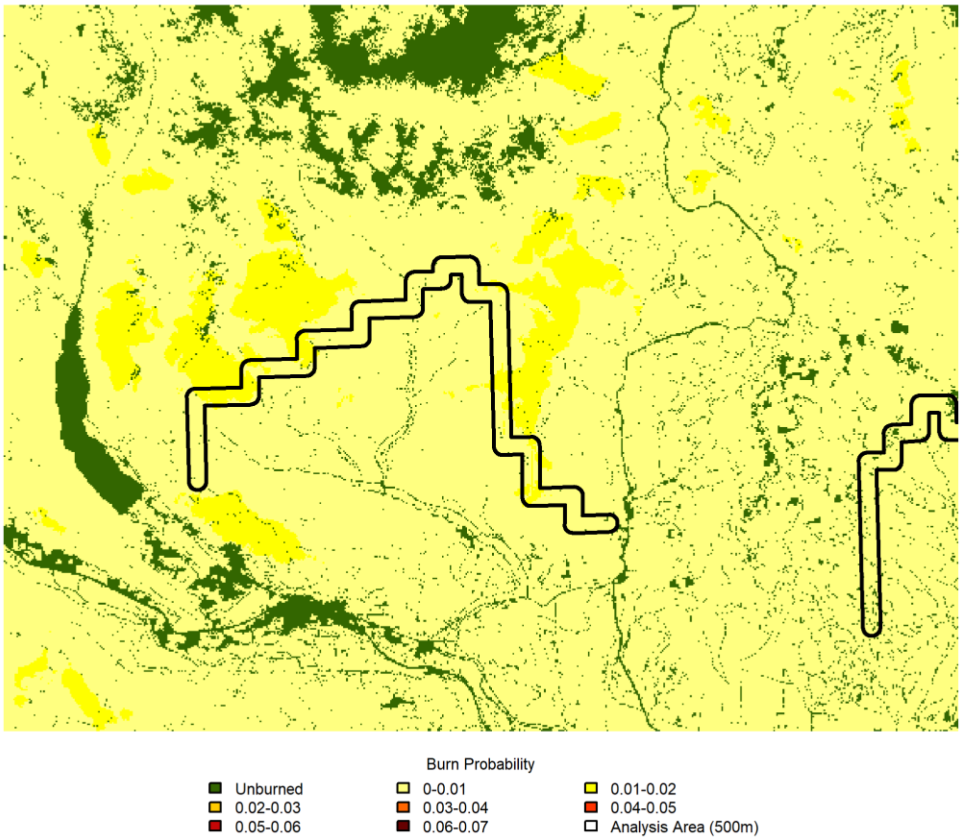
Reduction of 30% Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



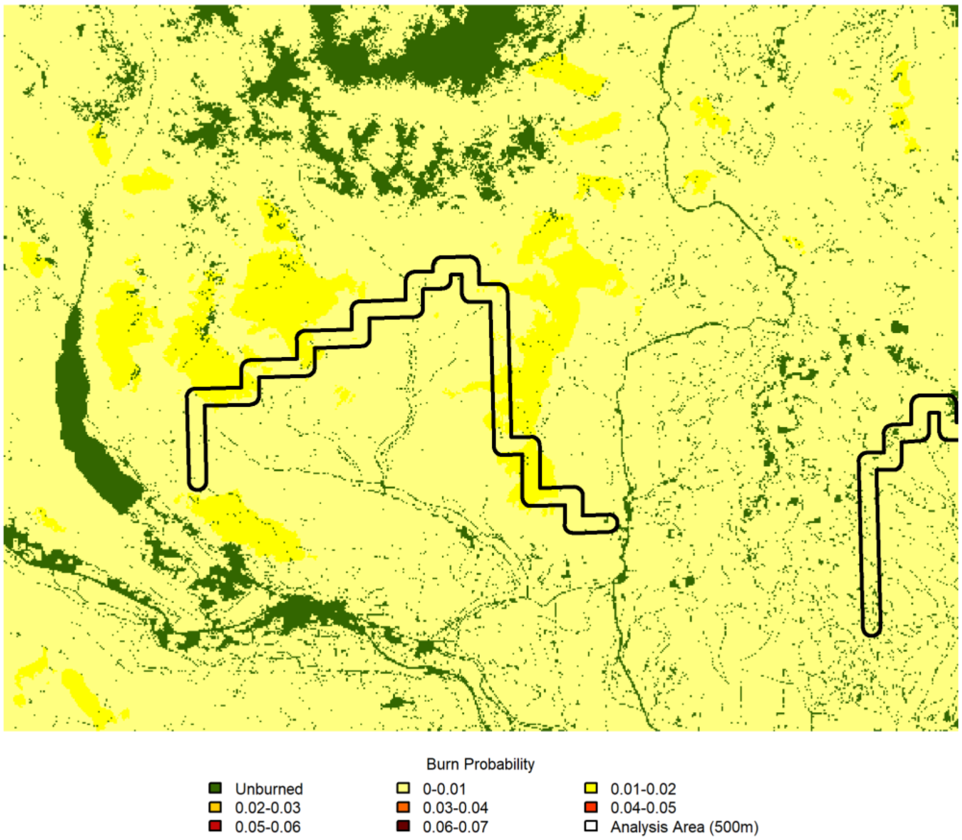
Reduction of 30% Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



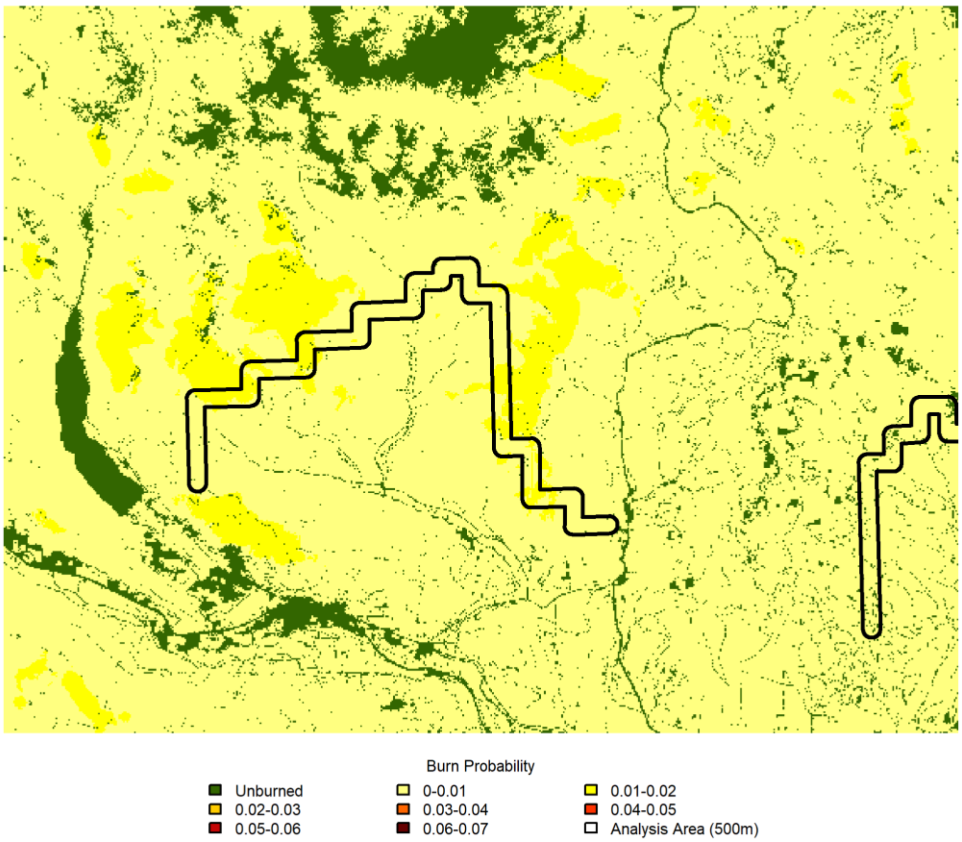
Reduction of 30% Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



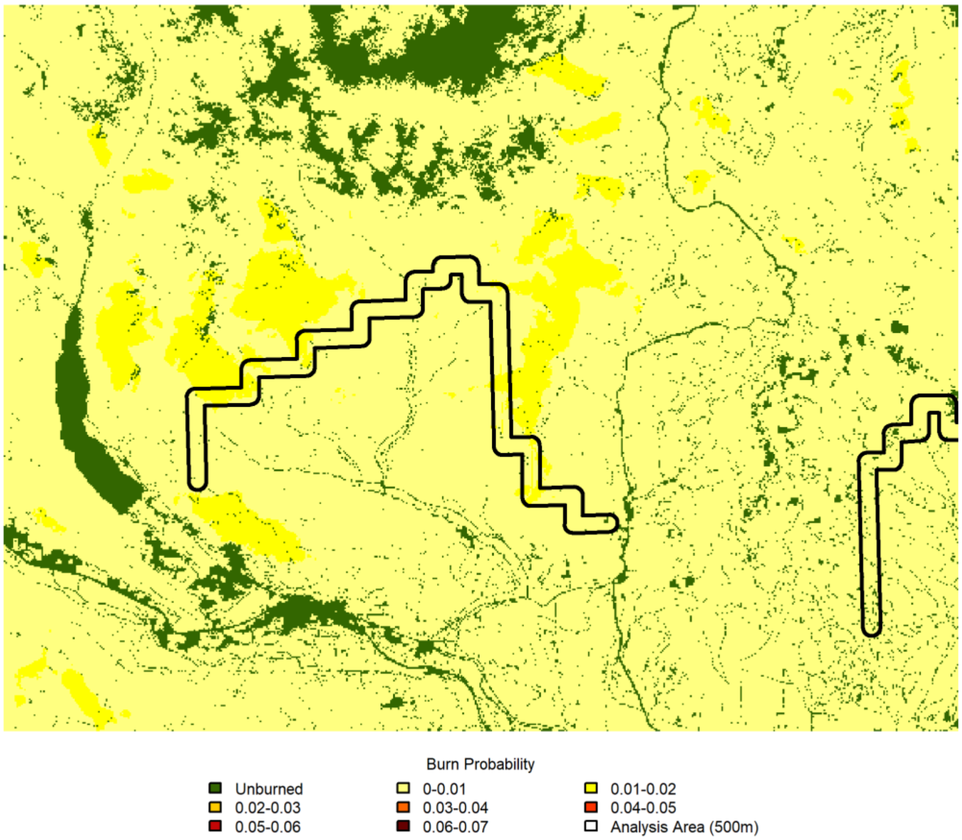
Reduction of 30% Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



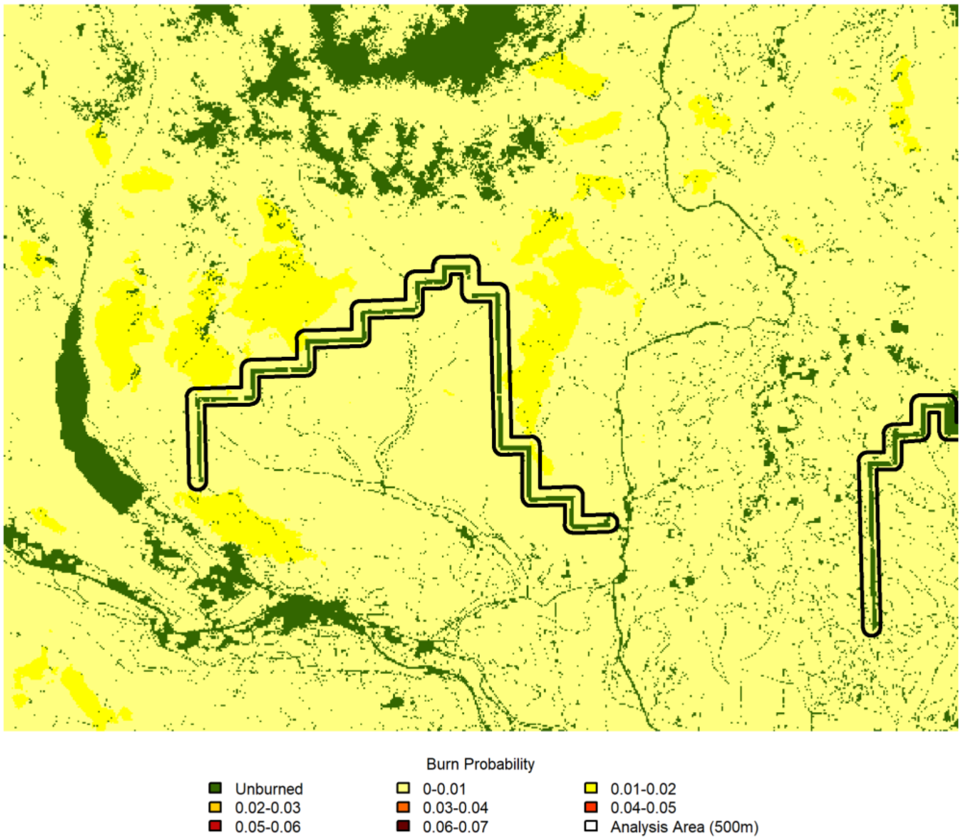
Reduction of 30% Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



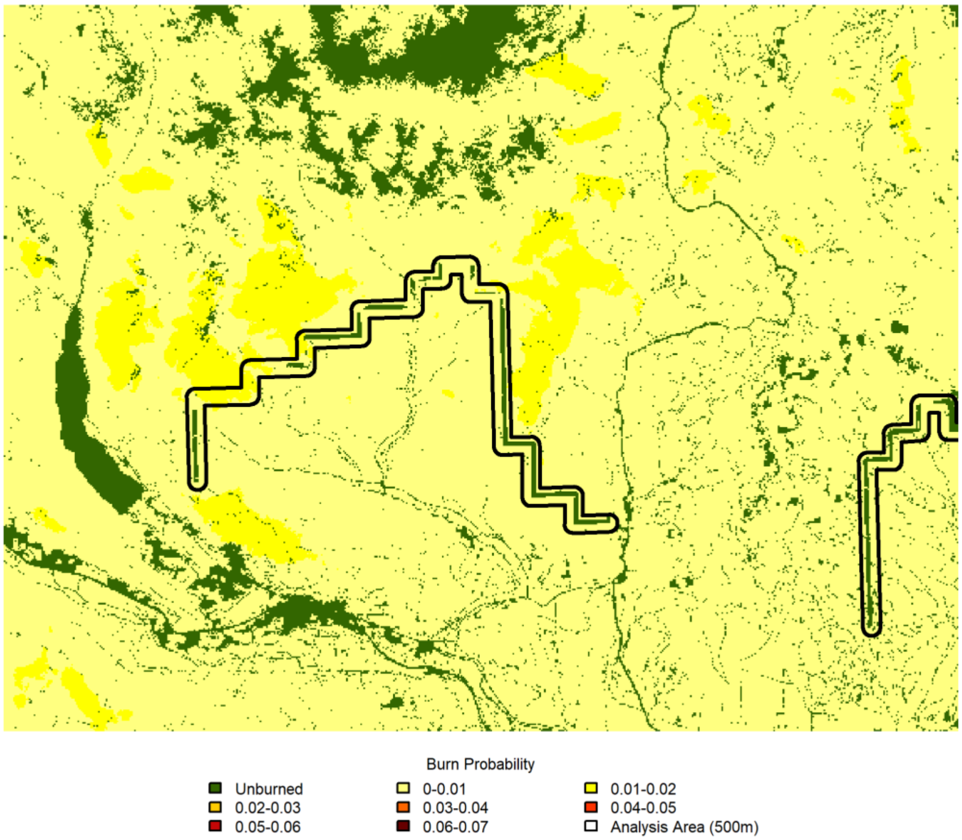
Reduction of 30% Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



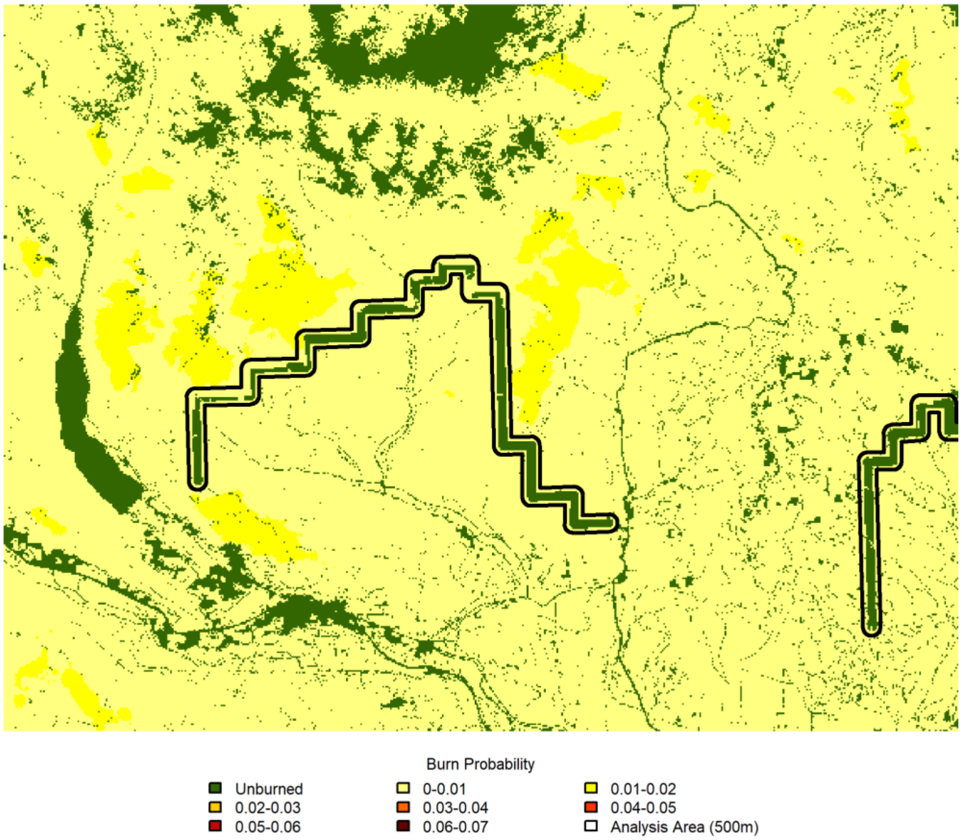
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



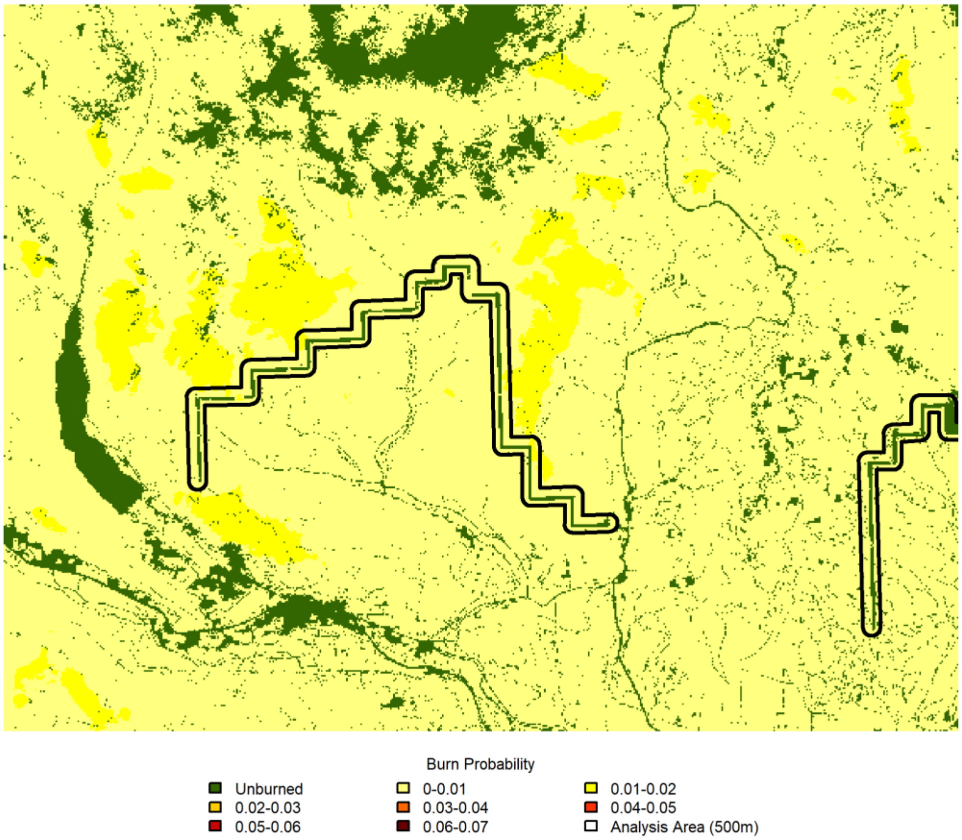
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



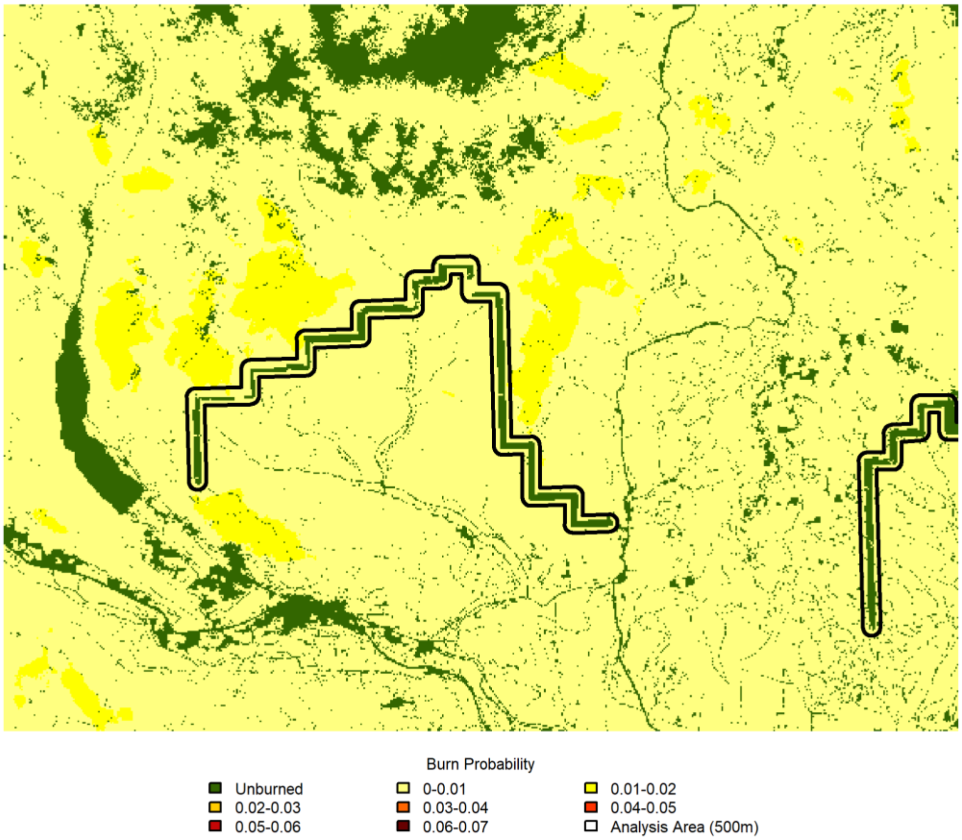
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



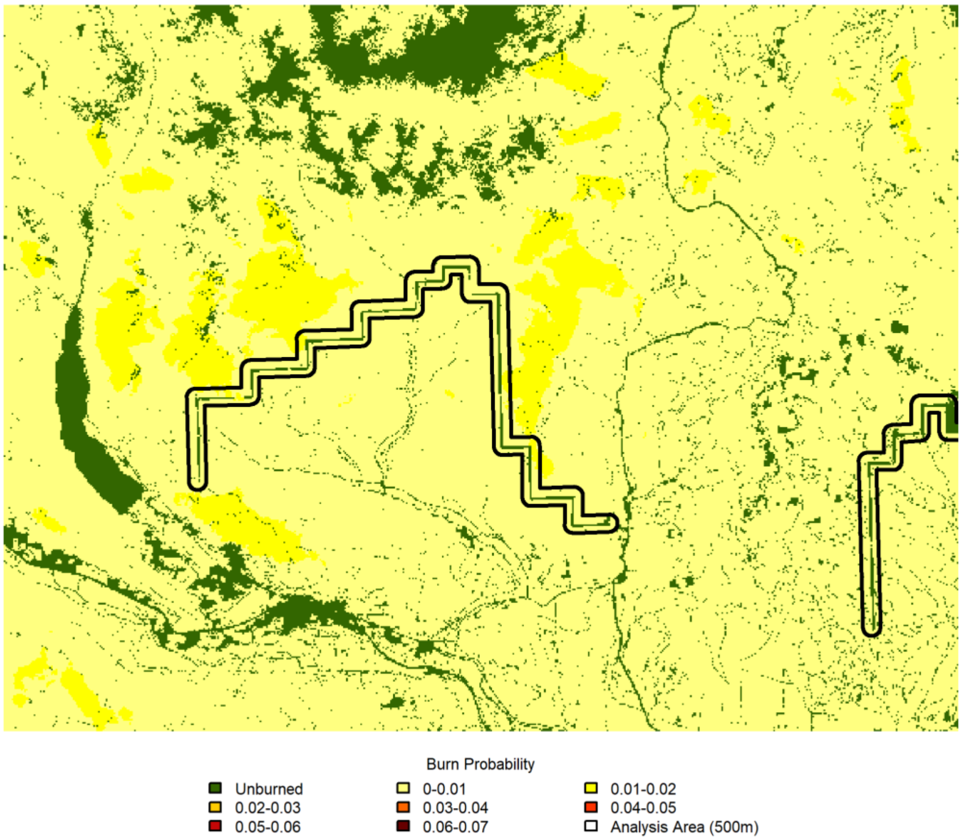
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



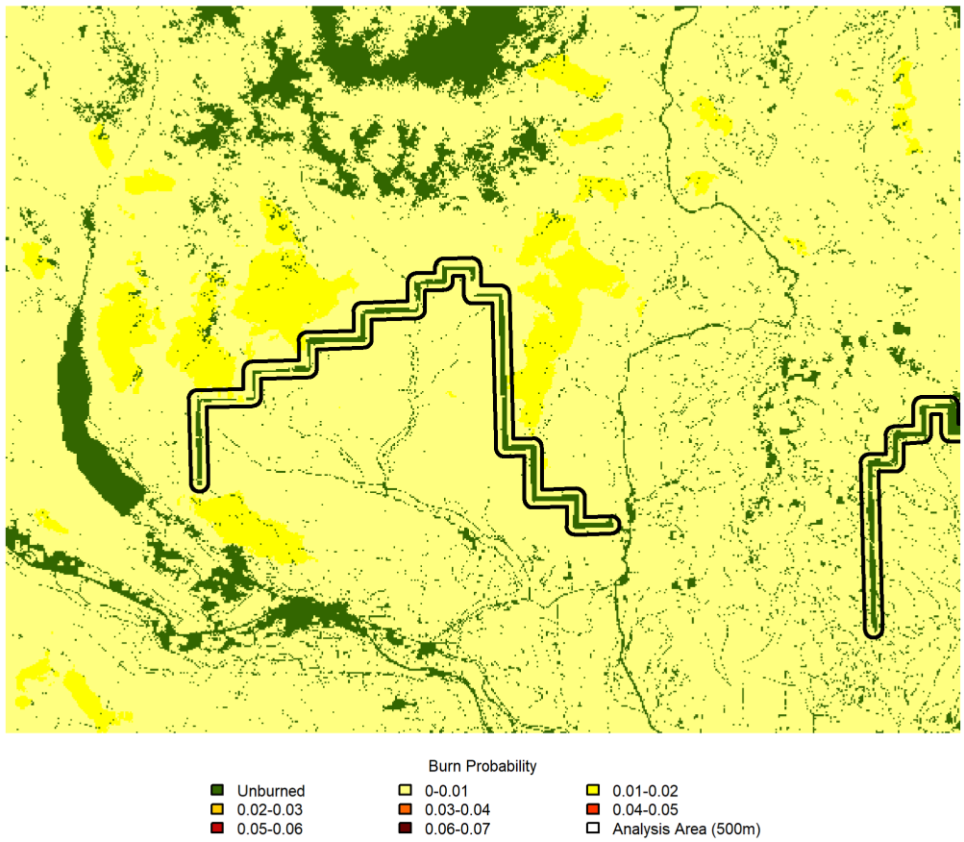
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



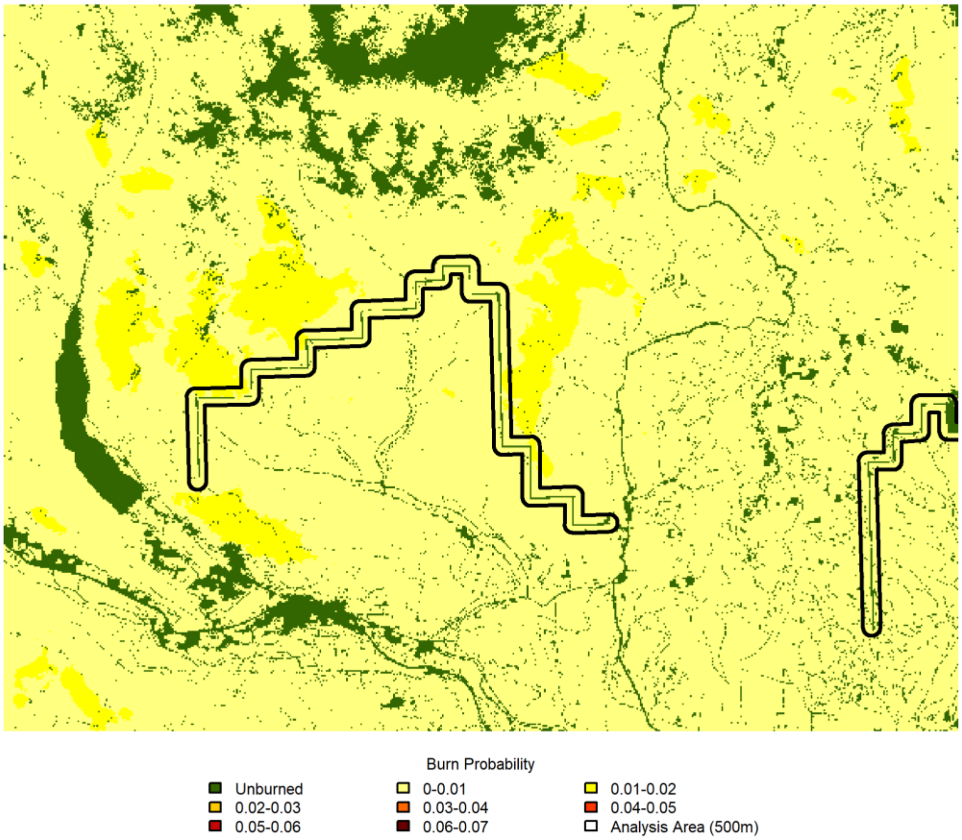
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



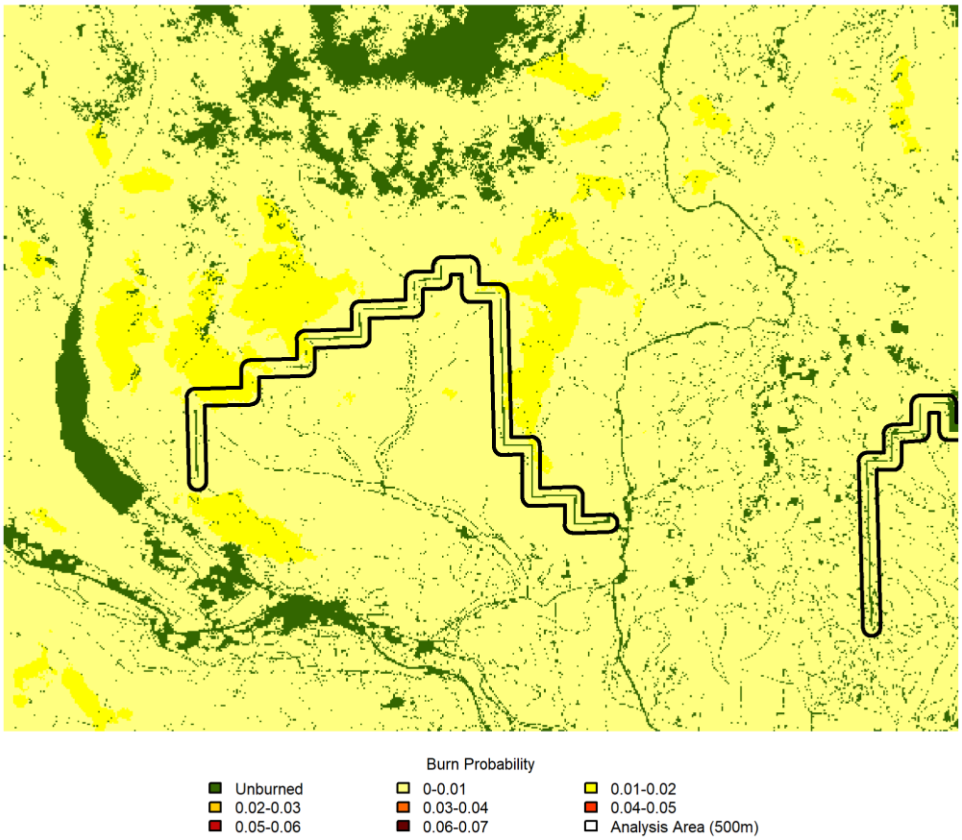
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



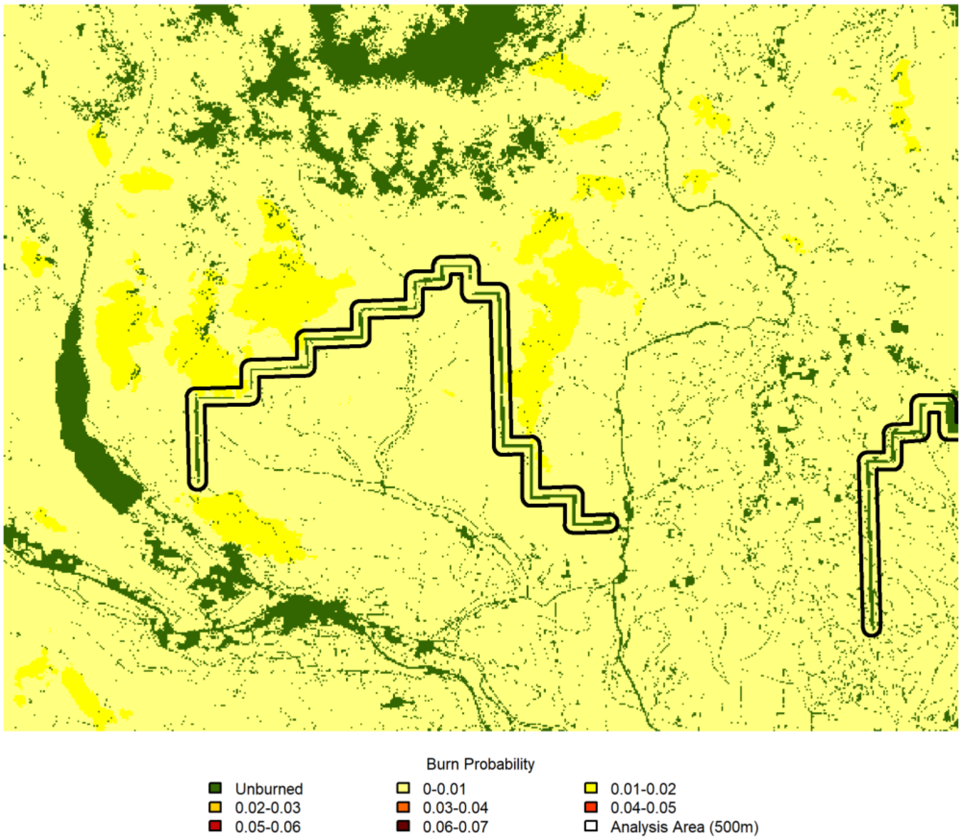
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



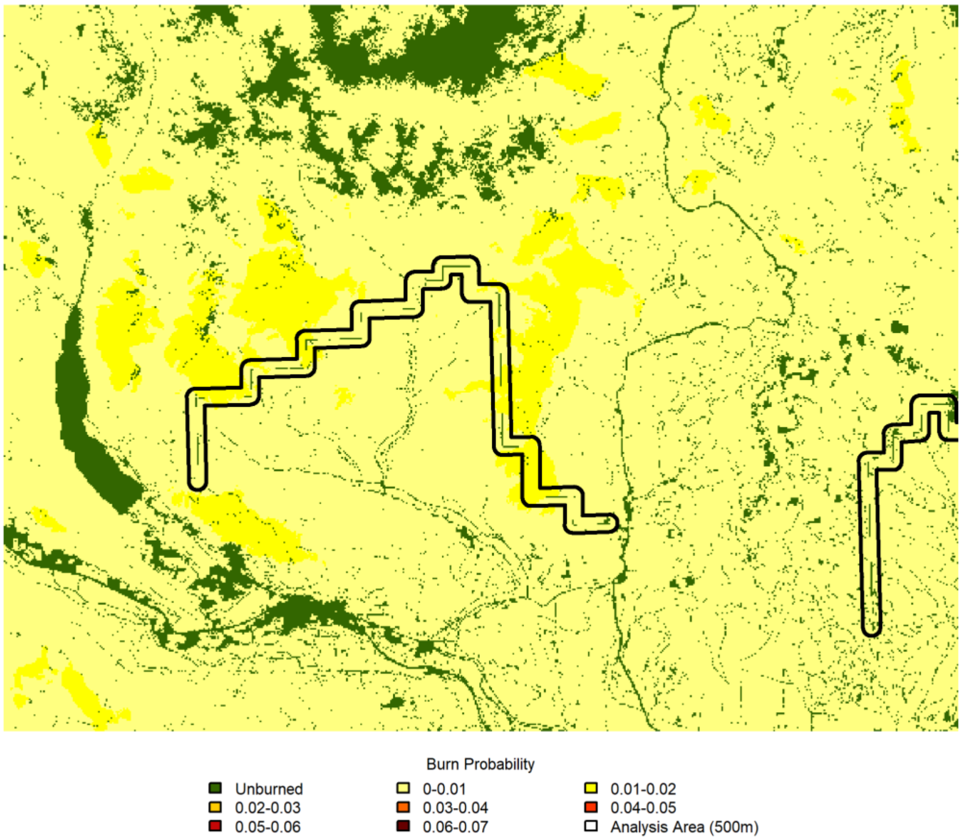
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



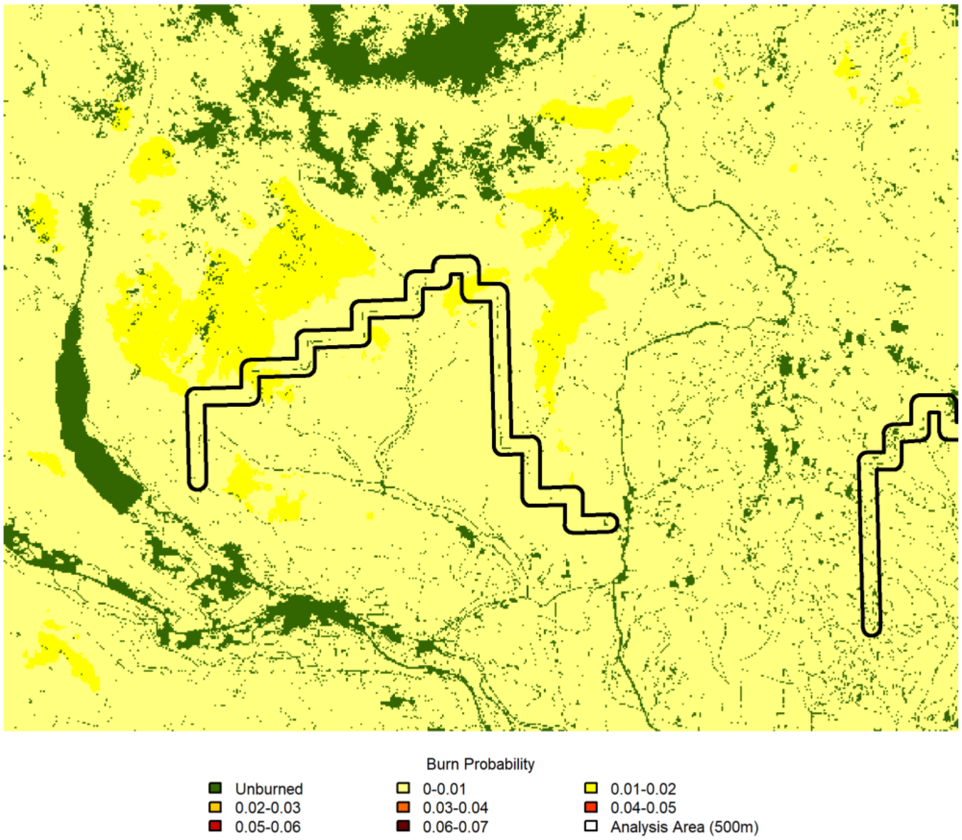
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



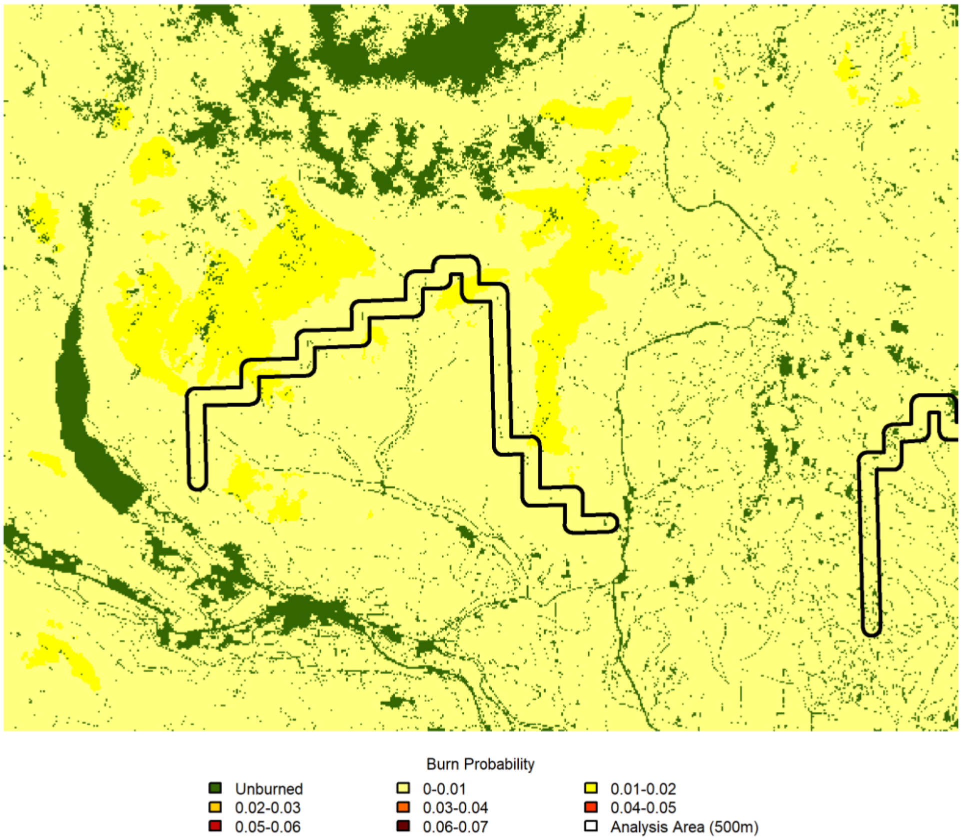
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



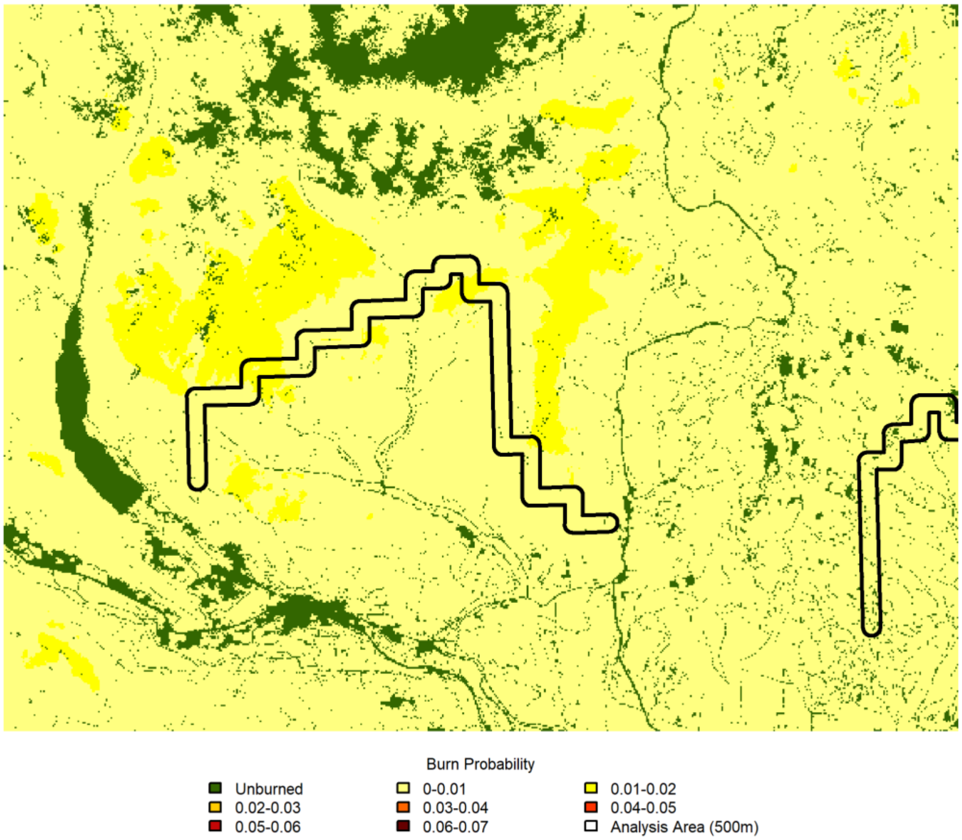
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



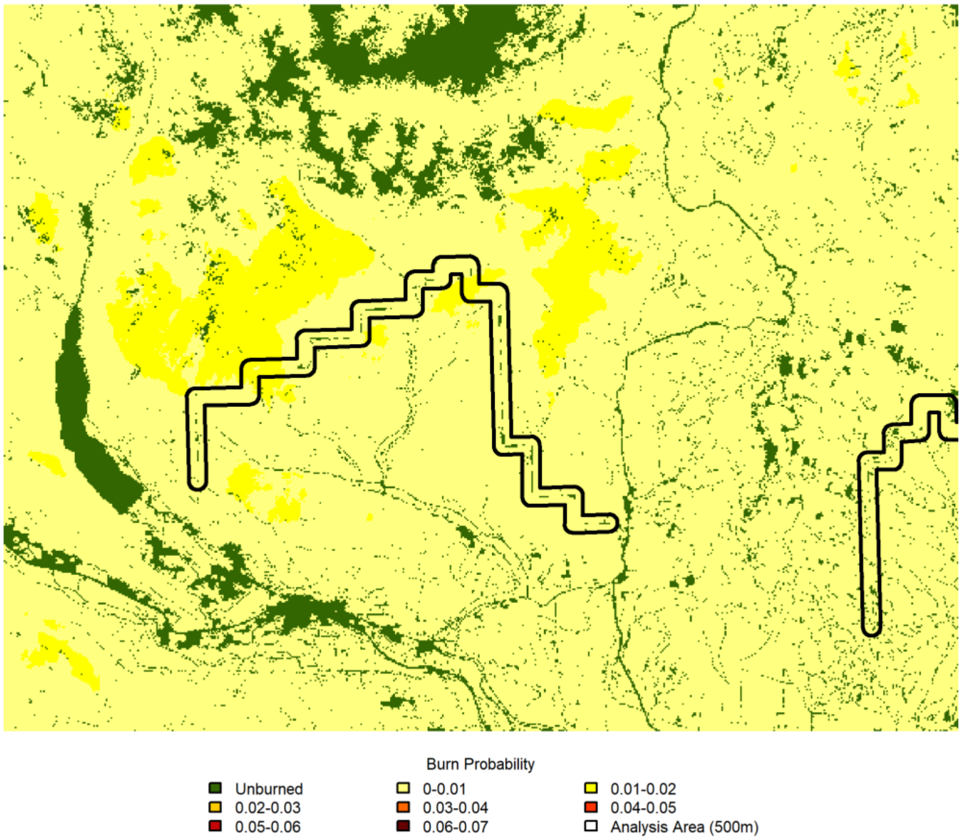
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



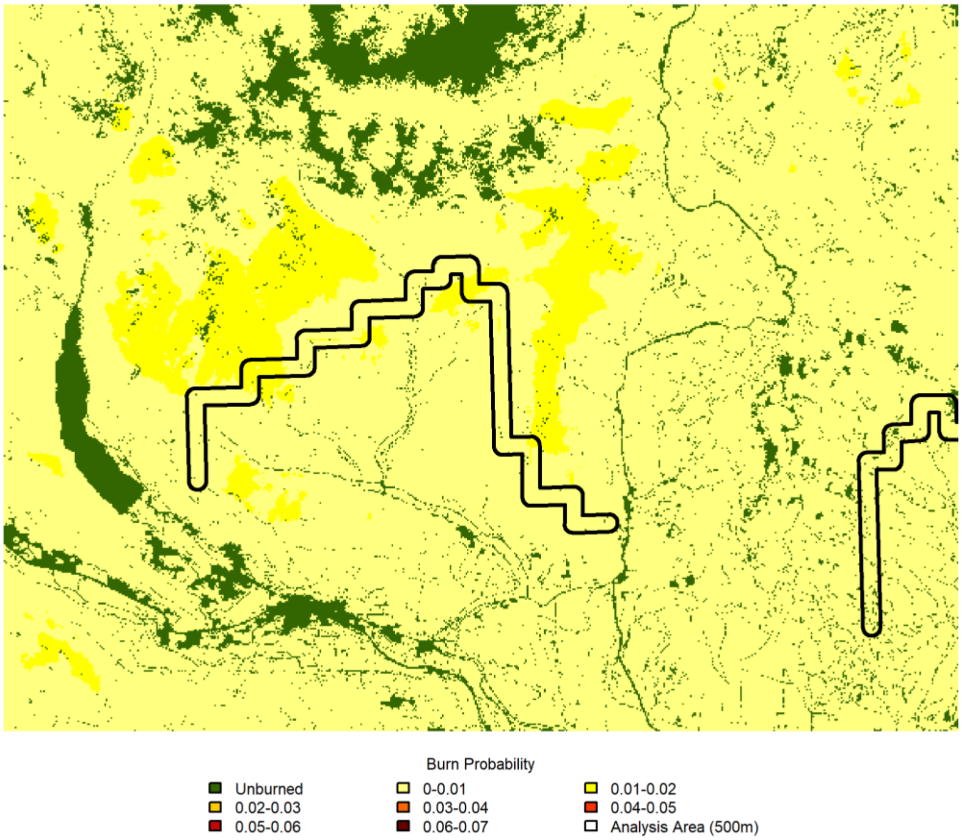
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



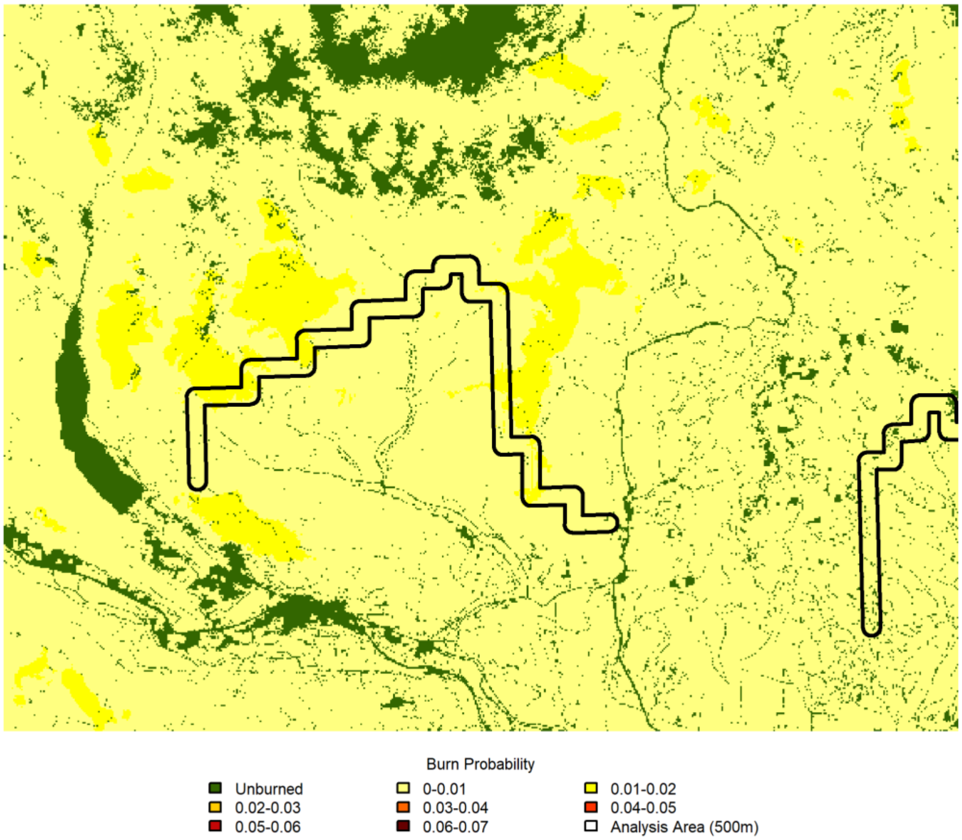
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



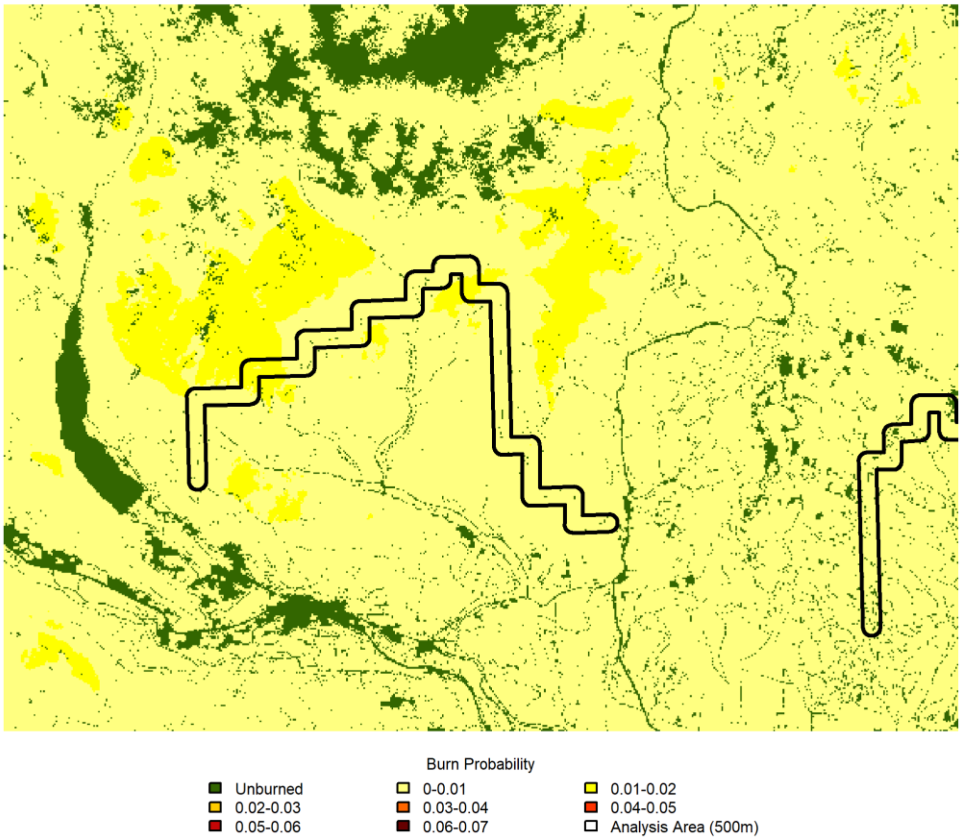
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



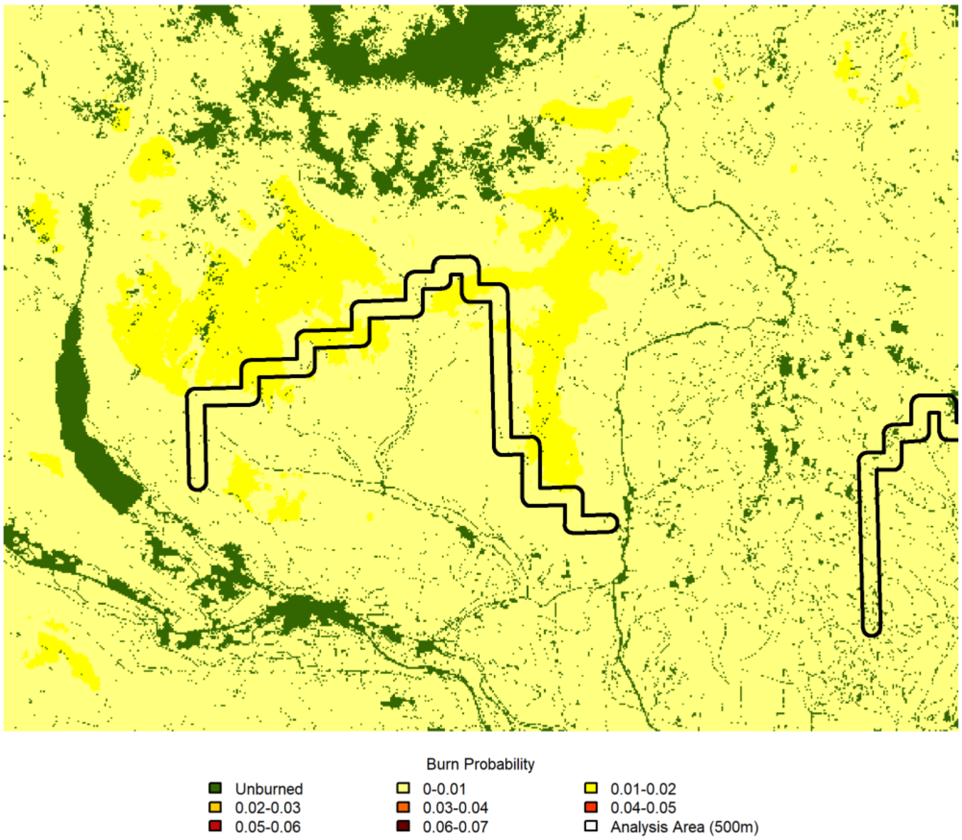
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



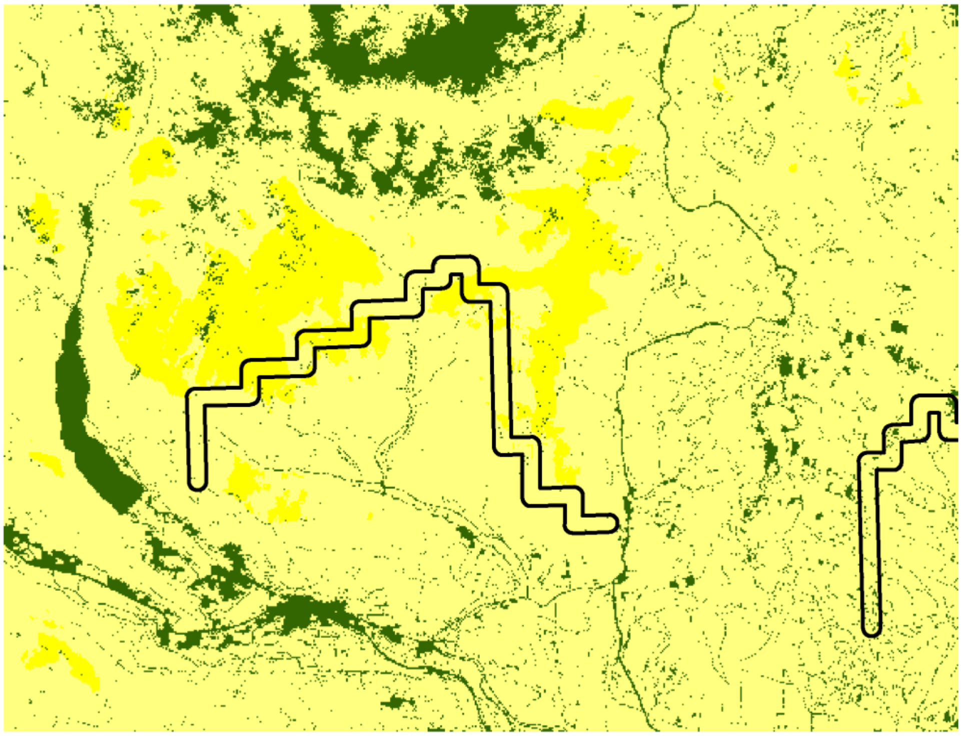
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



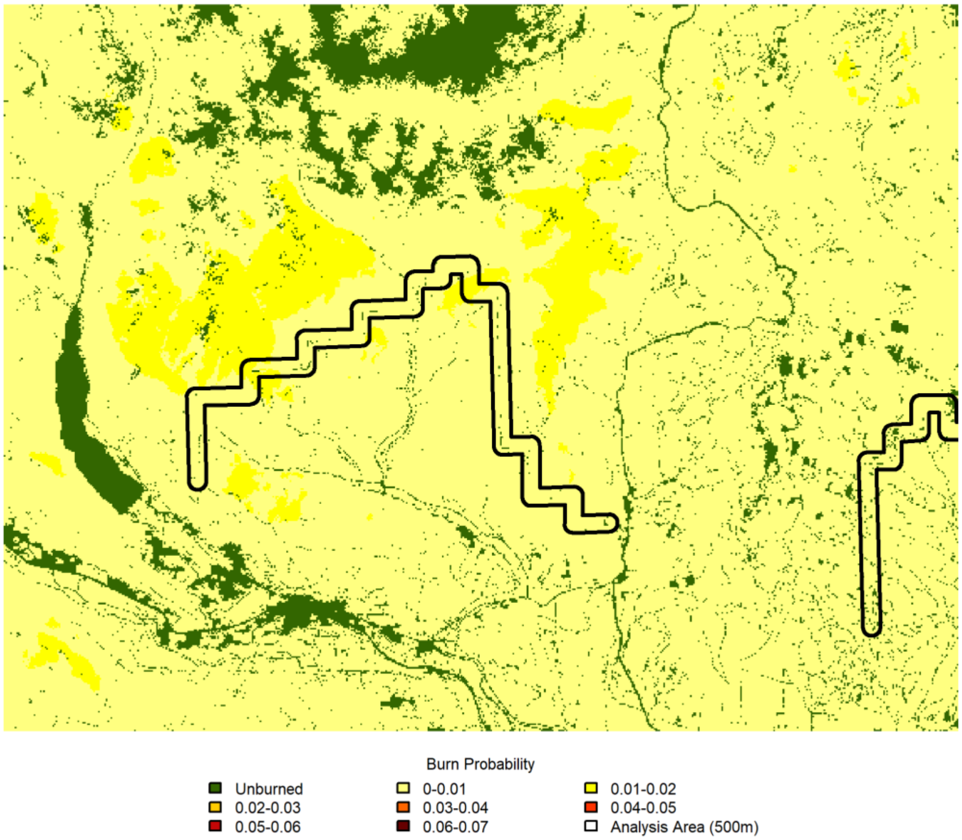
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



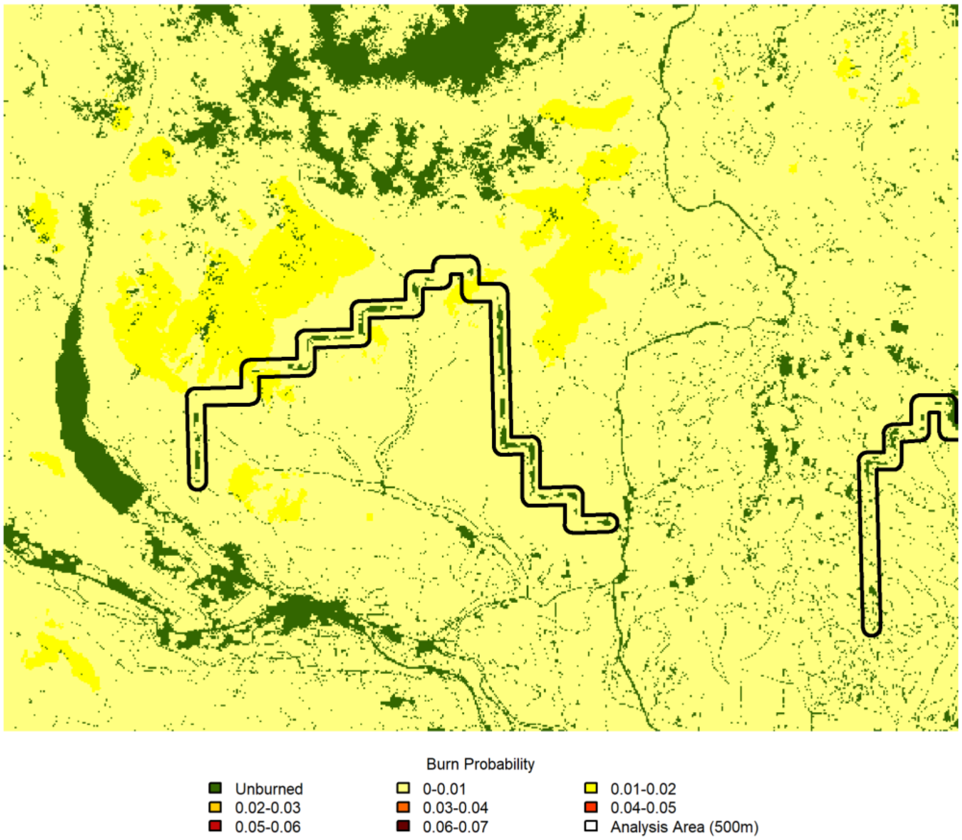
Burn Probability

Unburned	0-0.01	0.01-0.02
0.02-0.03	0.03-0.04	0.04-0.05
0.05-0.06	0.06-0.07	Analysis Area (500m)

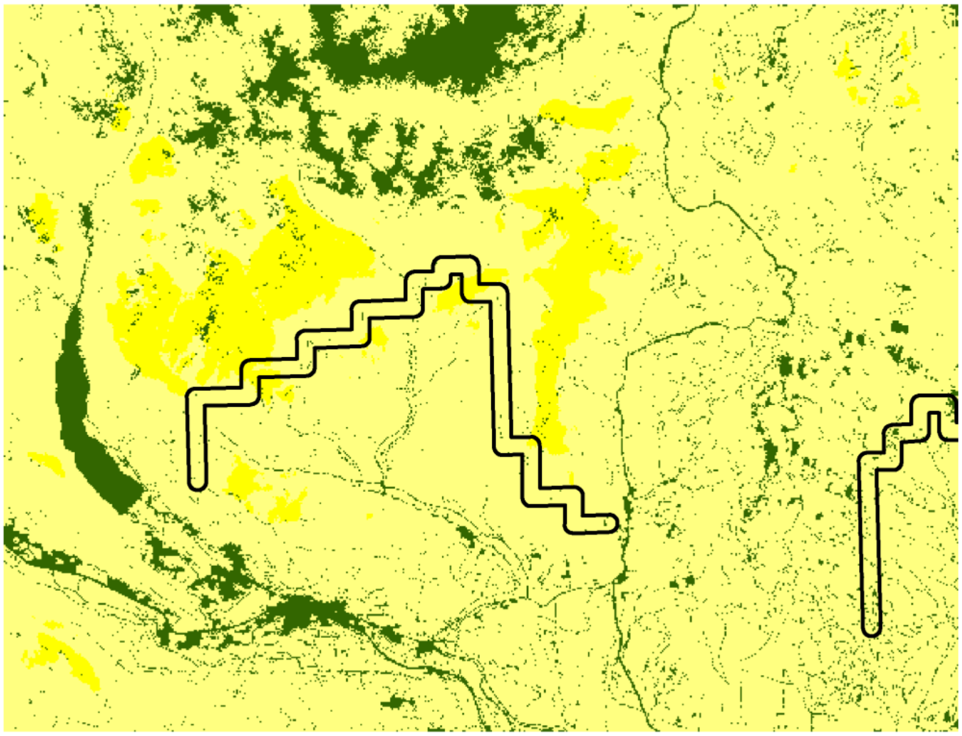
Reduction of 60% Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



Reduction of 60% Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



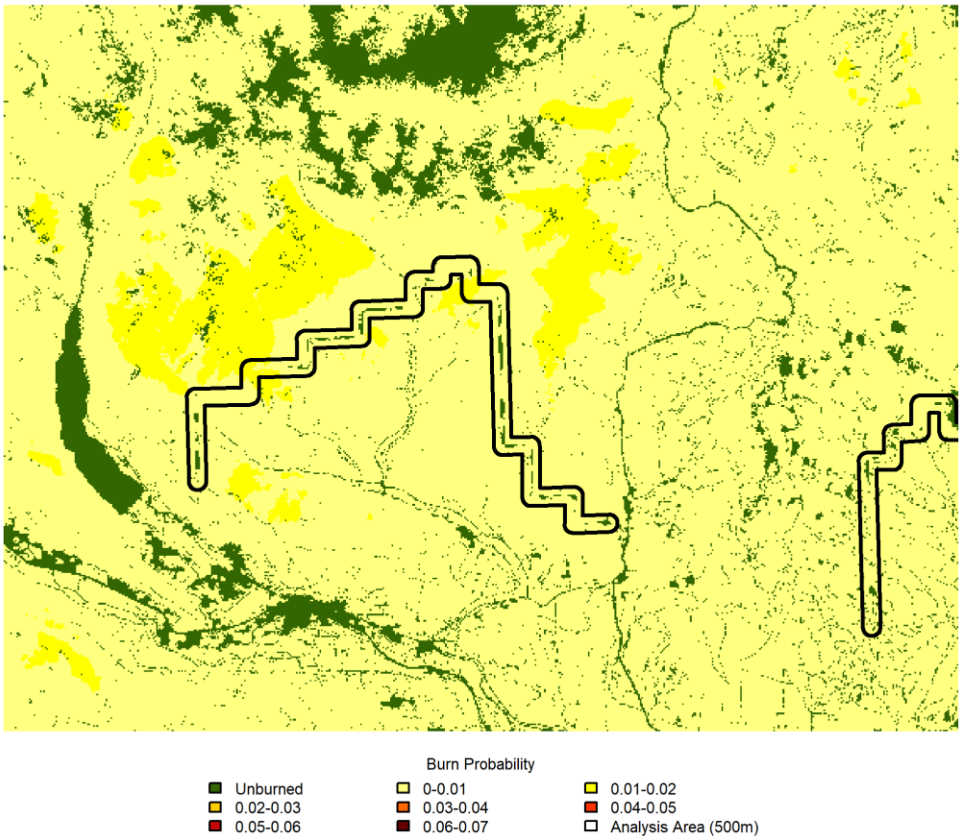
Reduction of 60% Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



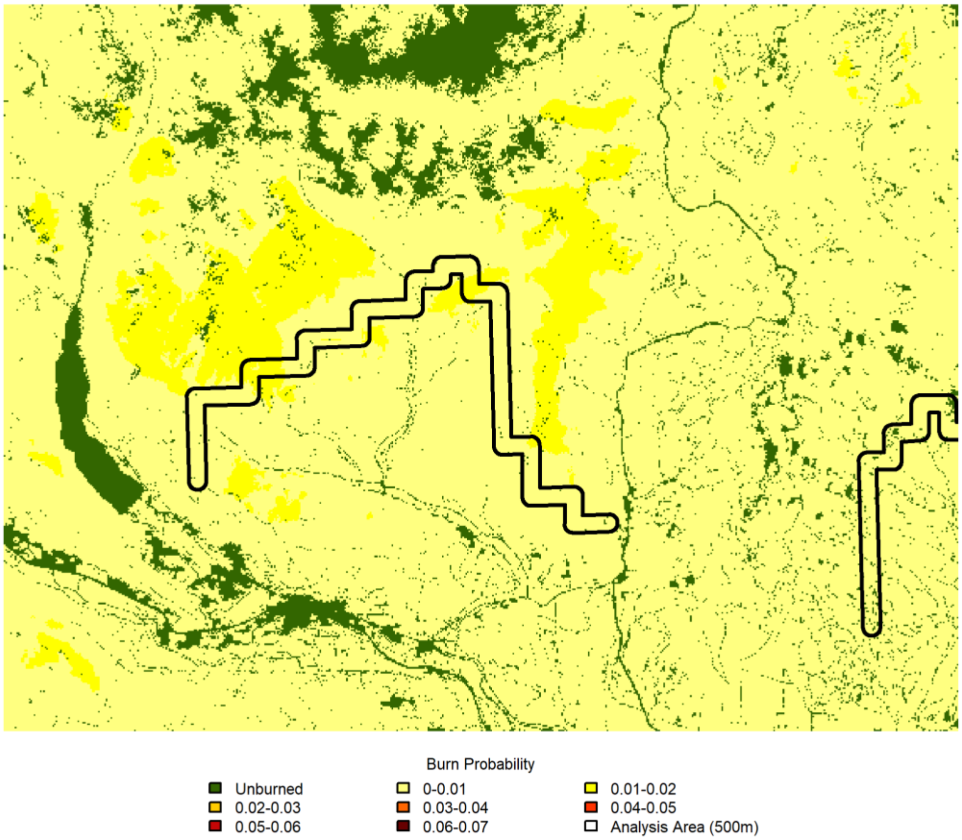
Burn Probability

Unburned
0-0.01
0.01-0.02
0.02-0.03
0.03-0.04
0.04-0.05
0.05-0.06
0.06-0.07
Analysis Area (500m)

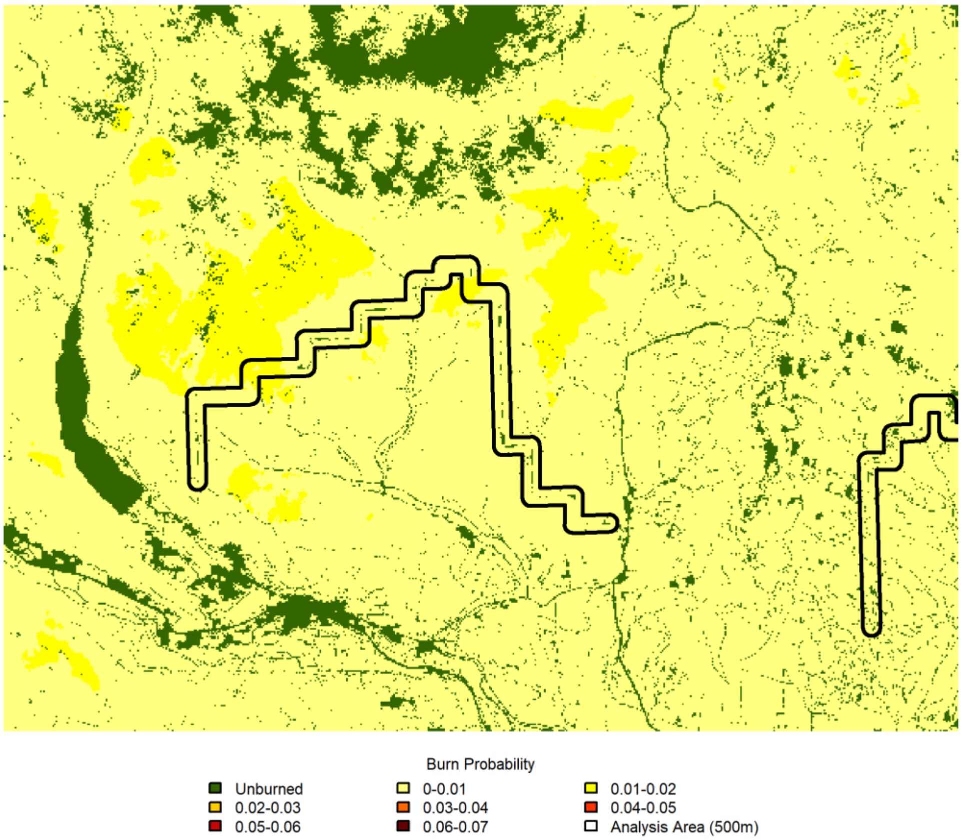
Reduction of 60% Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



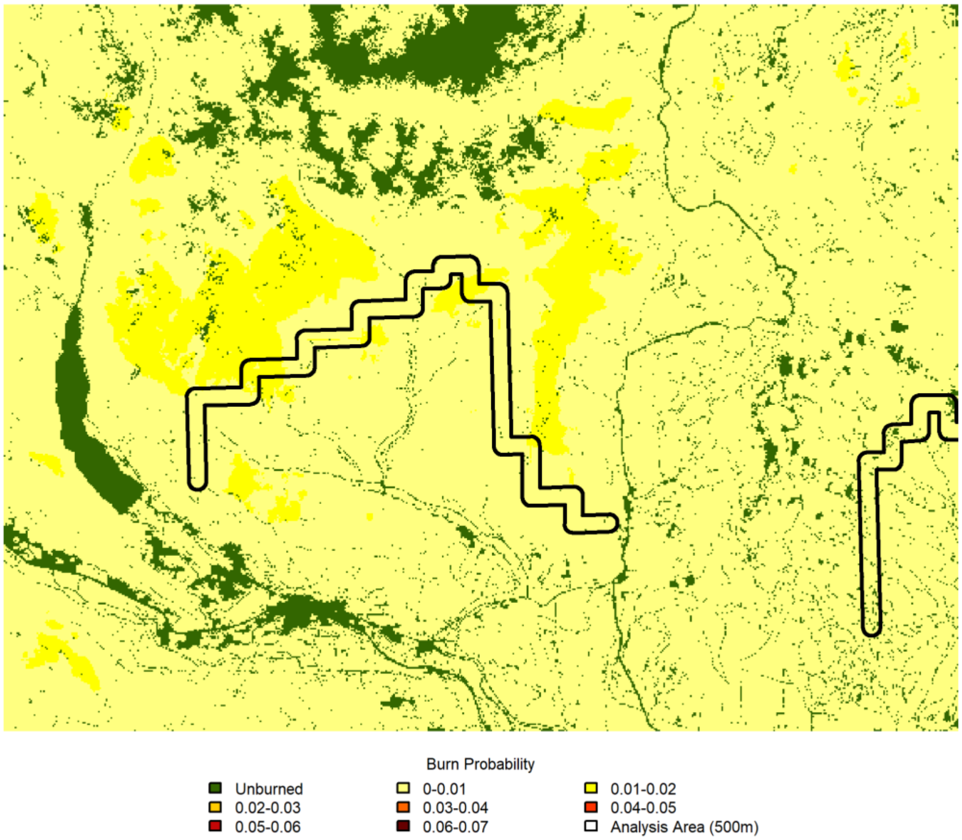
Reduction of 60% Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



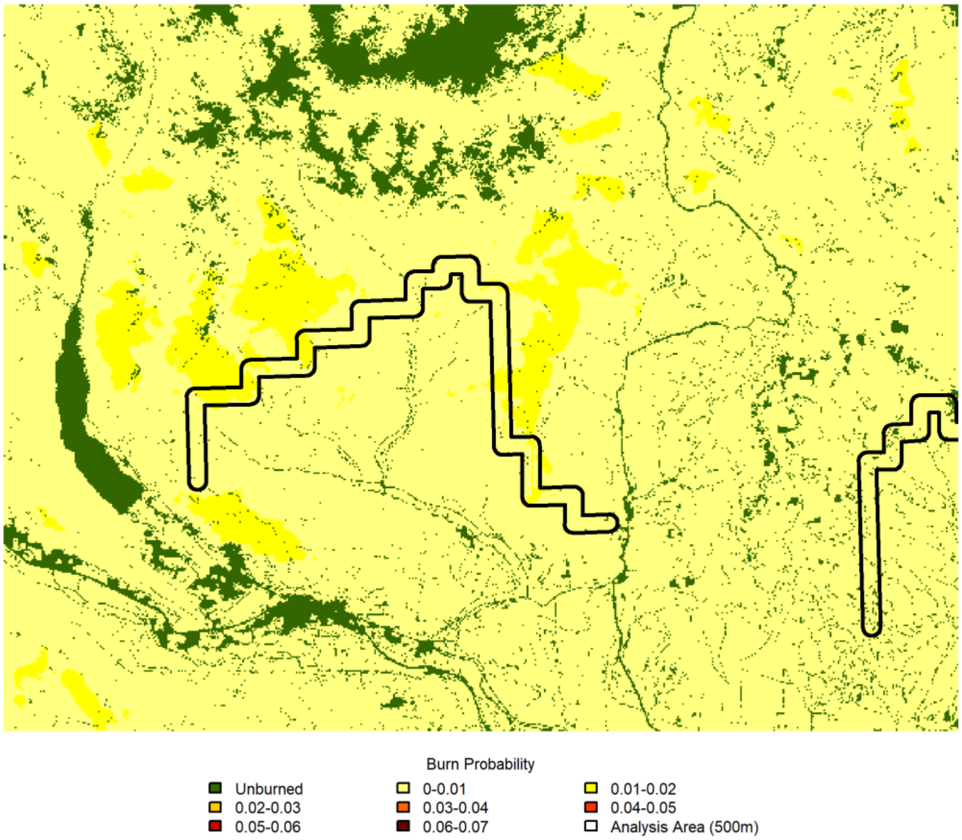
Reduction of 60% Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



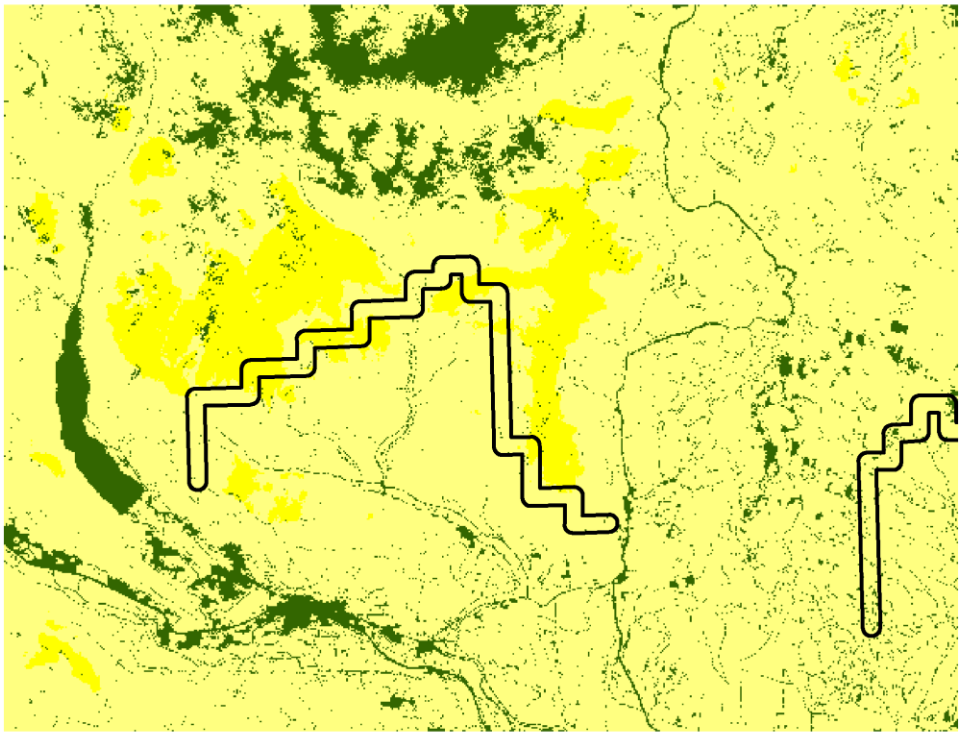
Reduction of 60% Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



Reduction of 60% Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



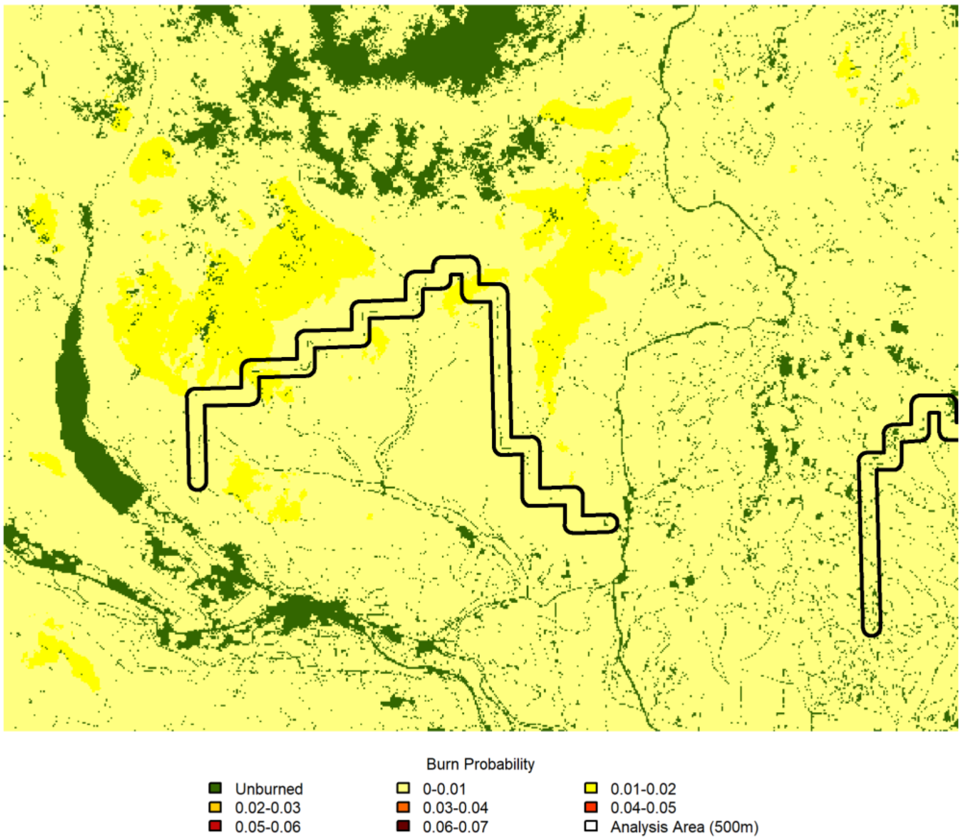
Reduction of 60% Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



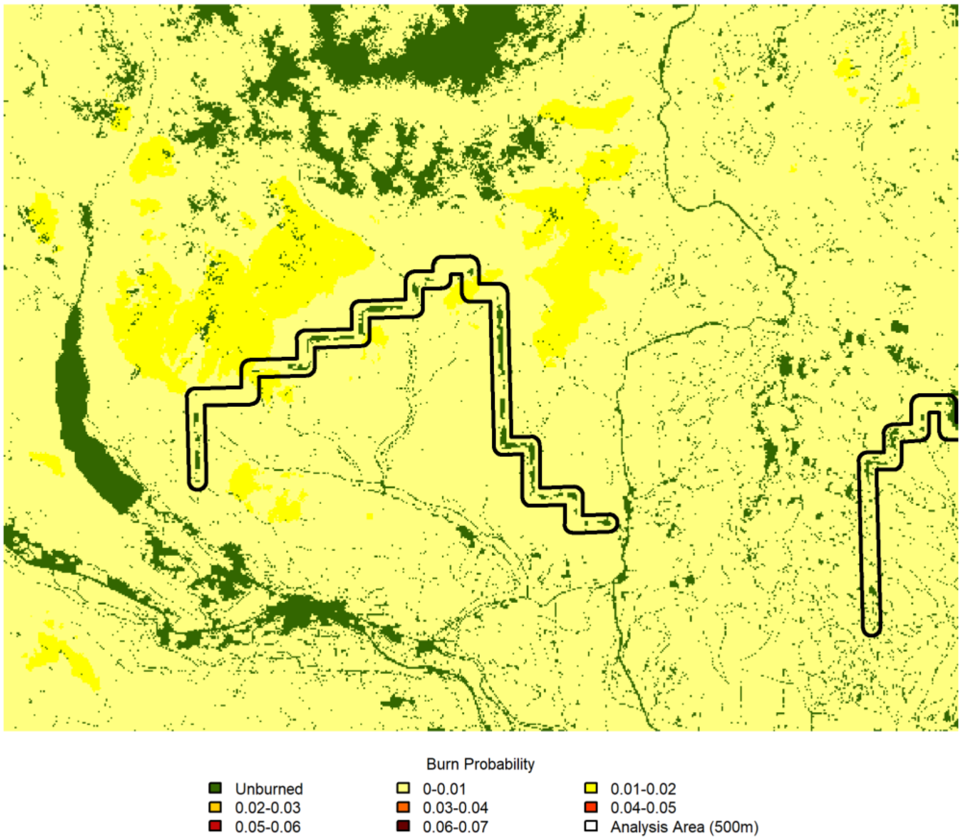
Burn Probability

Unburned	0-0.01	0.01-0.02
0.02-0.03	0.03-0.04	0.04-0.05
0.05-0.06	0.06-0.07	Analysis Area (500m)

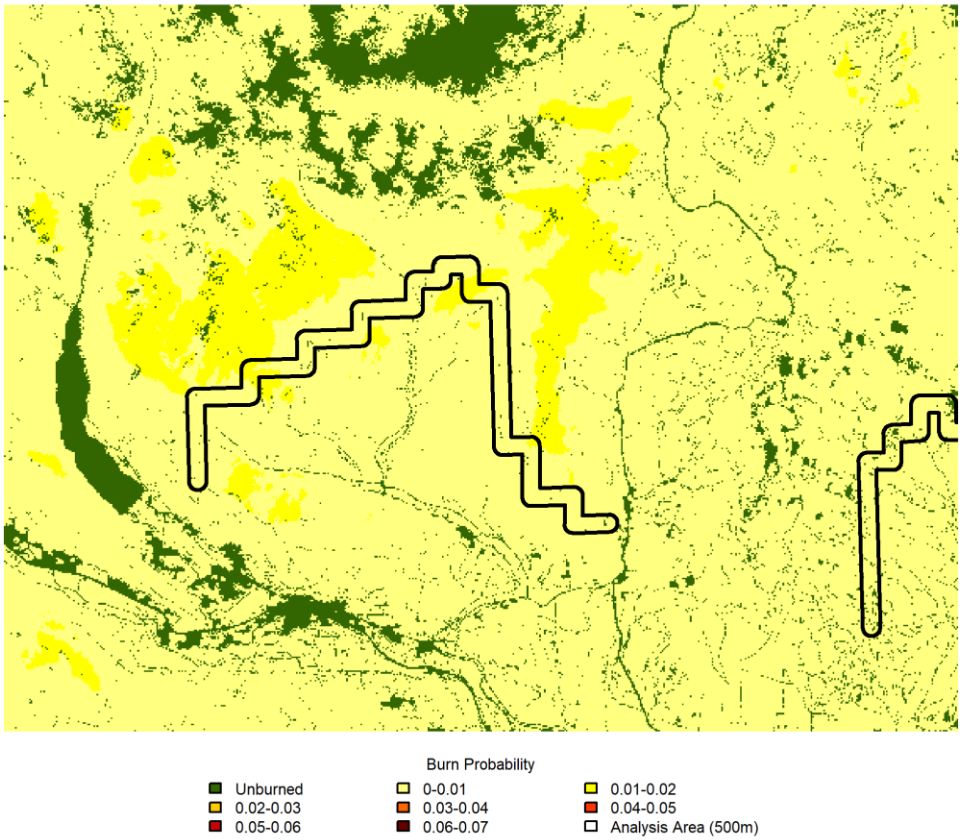
Reduction of 40% Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



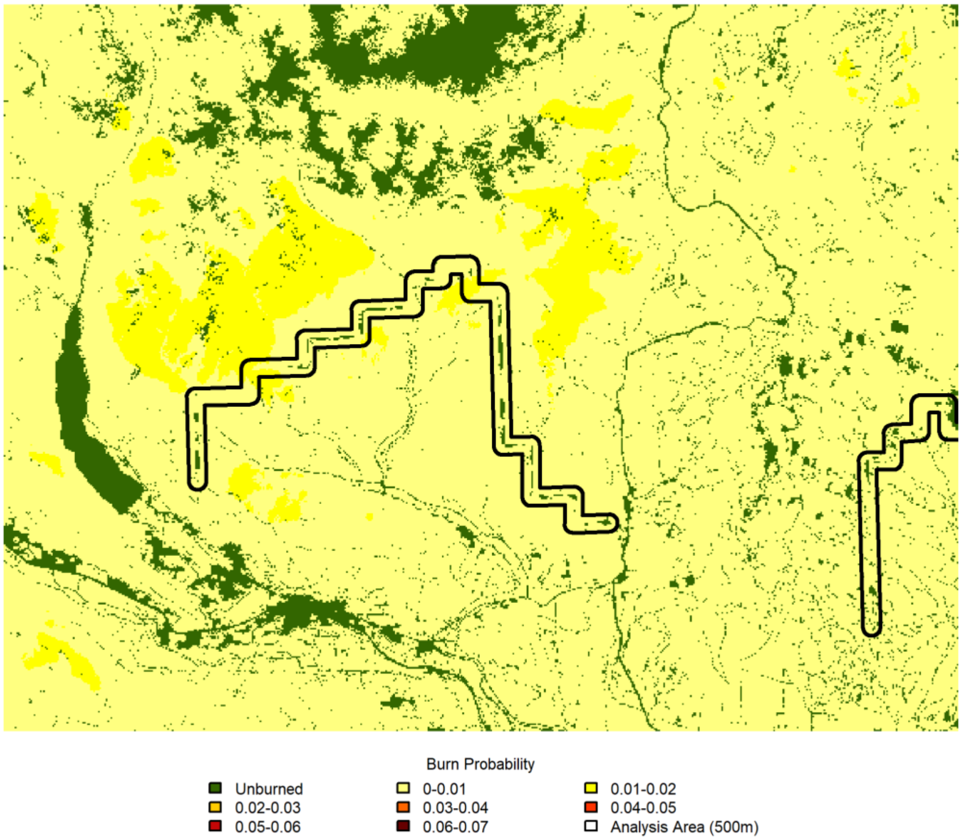
Reduction of 40% Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



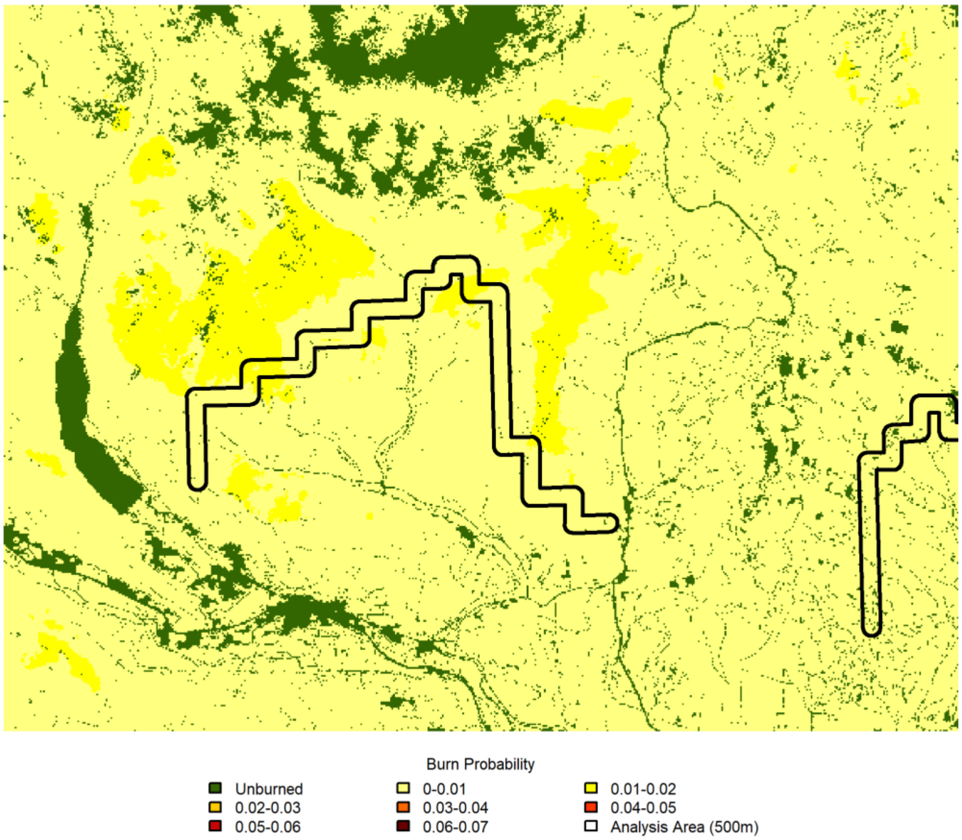
Reduction of 40% Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



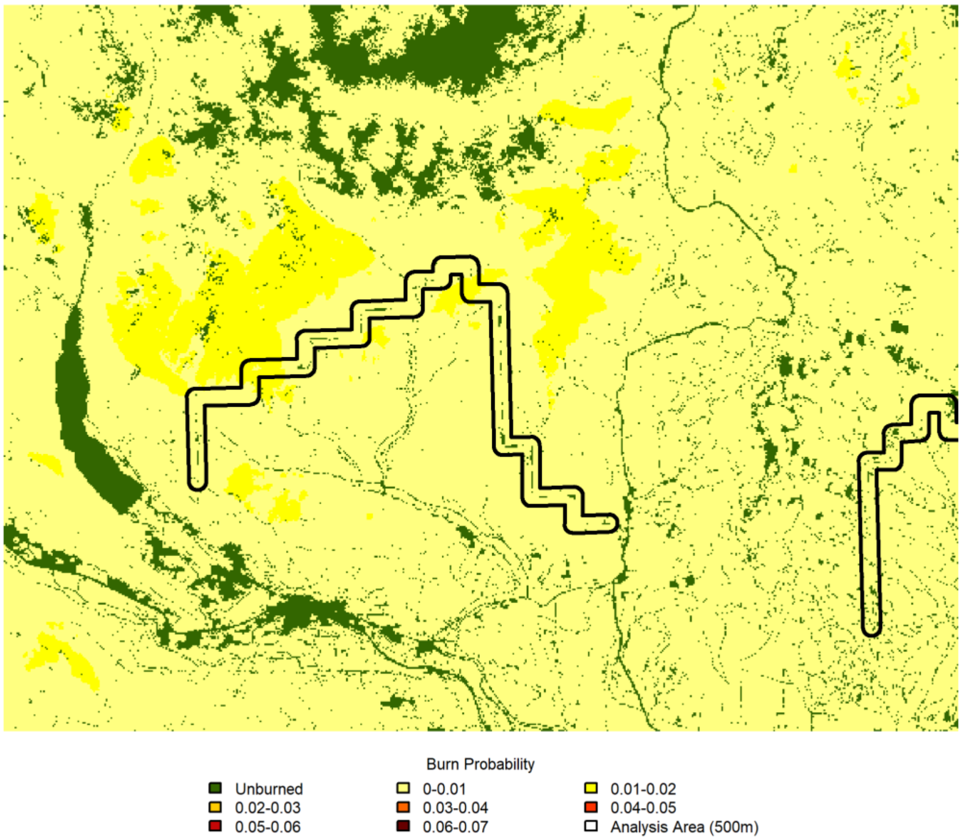
Reduction of 40% Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



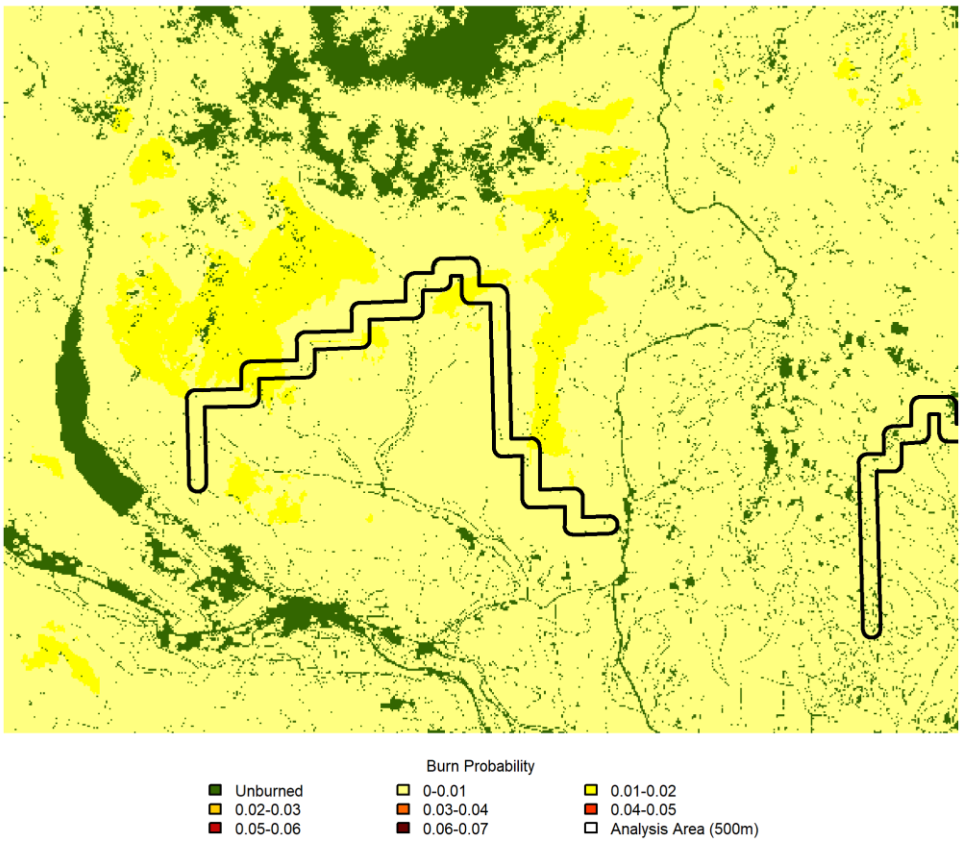
Reduction of 40% Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



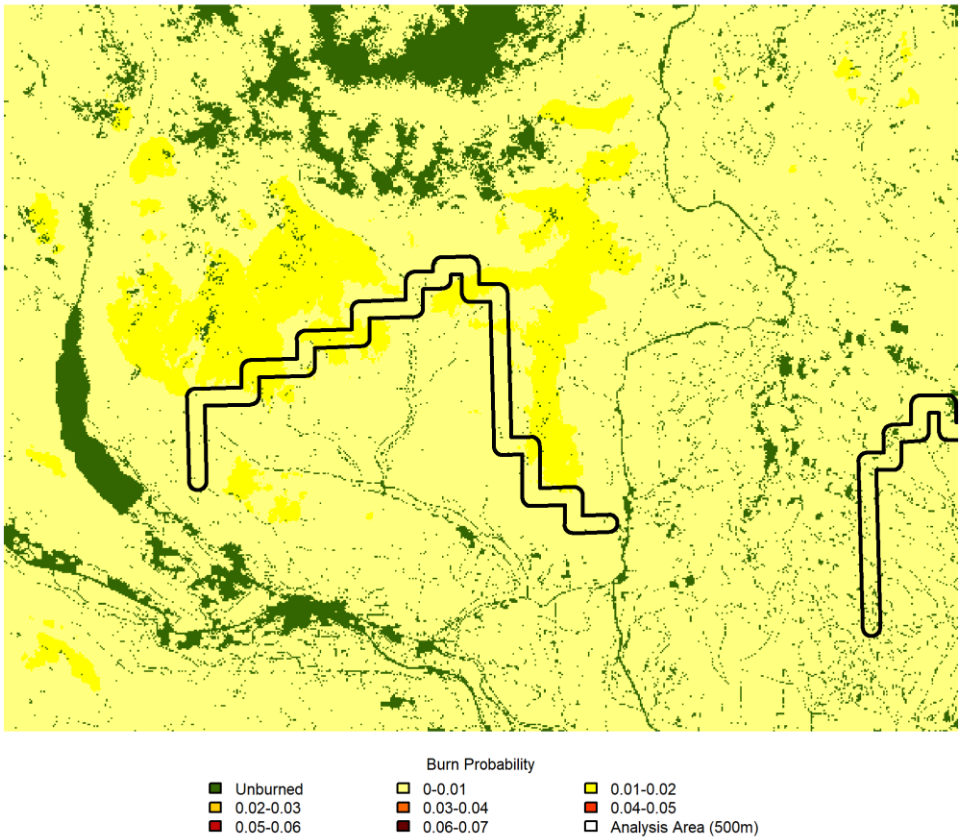
Reduction of 40% Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



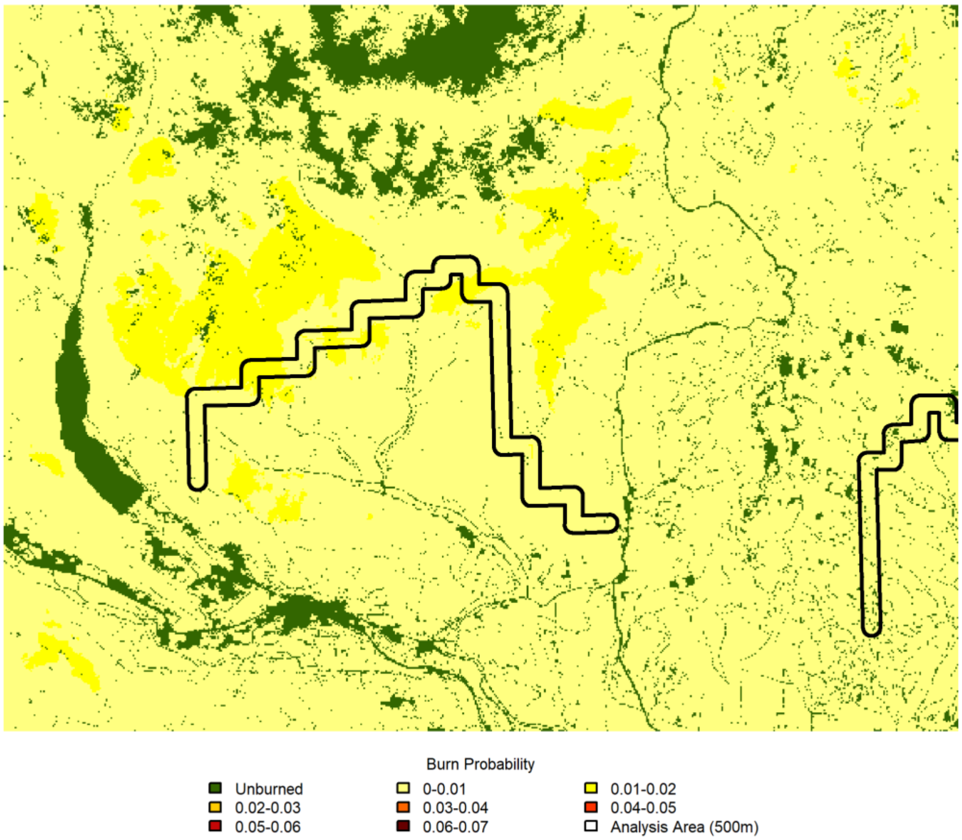
Reduction of 40% Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



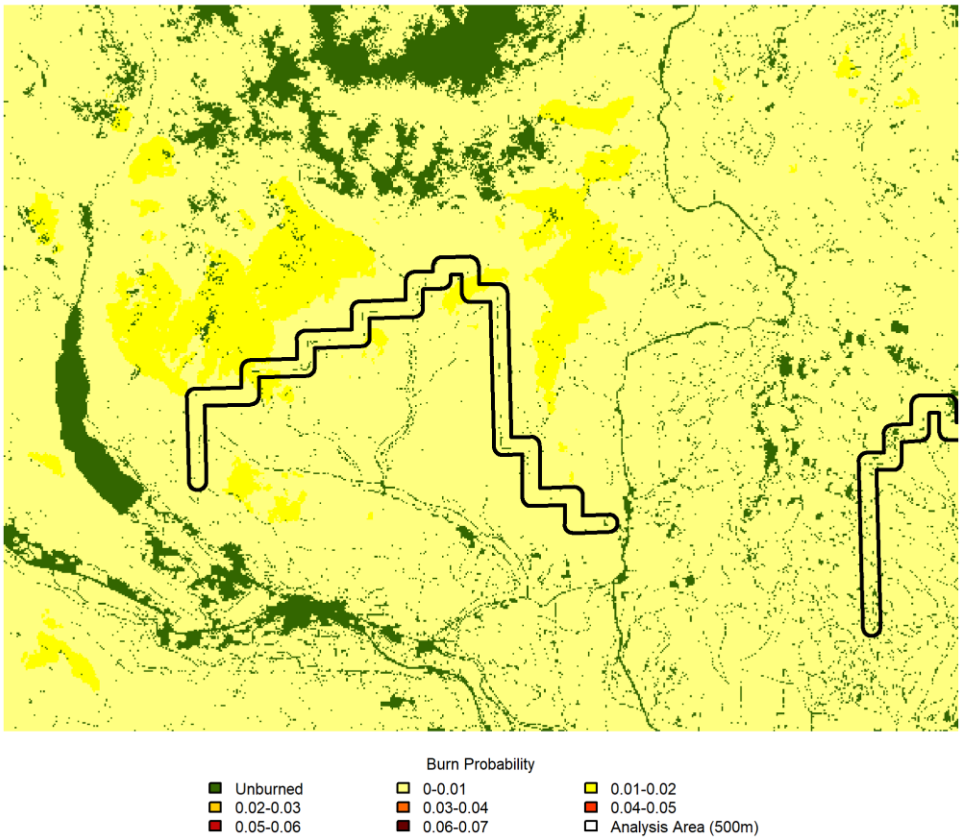
Reduction of 40% Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



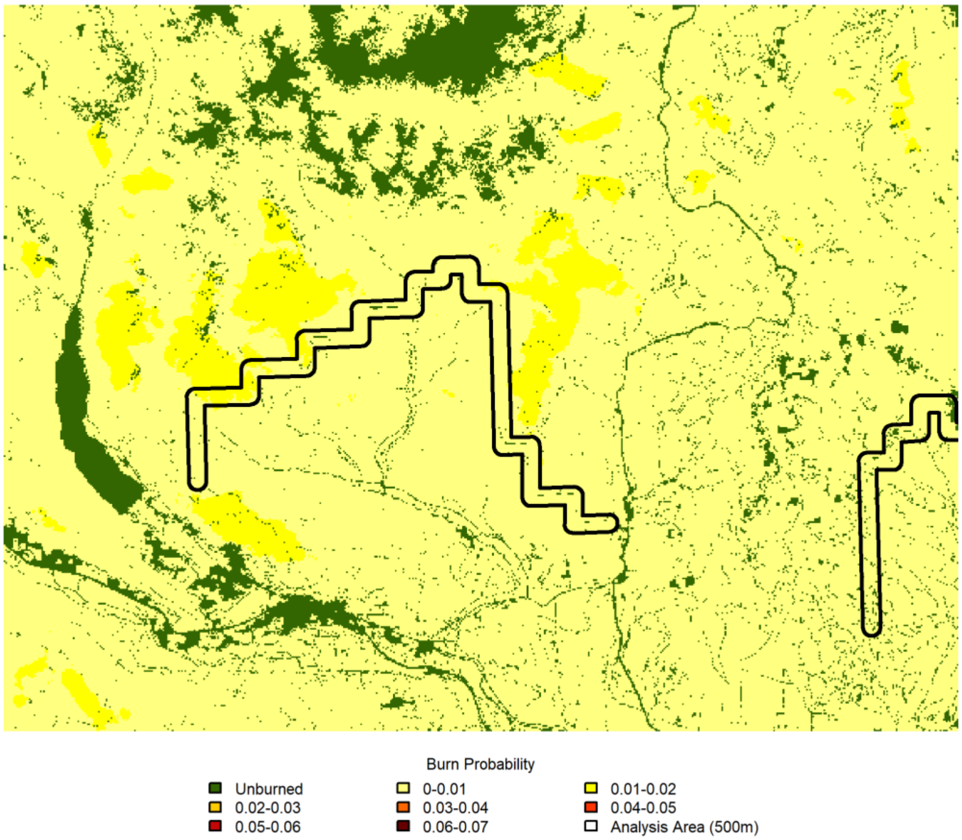
Reduction of 40% Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



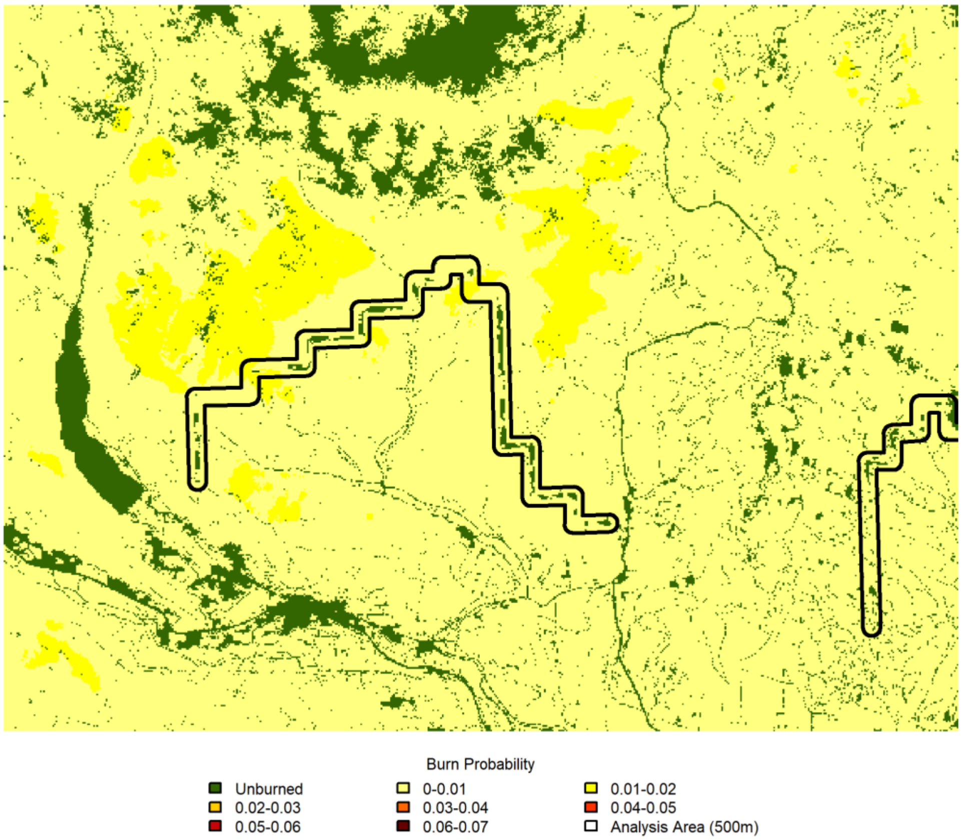
Reduction of 30% Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



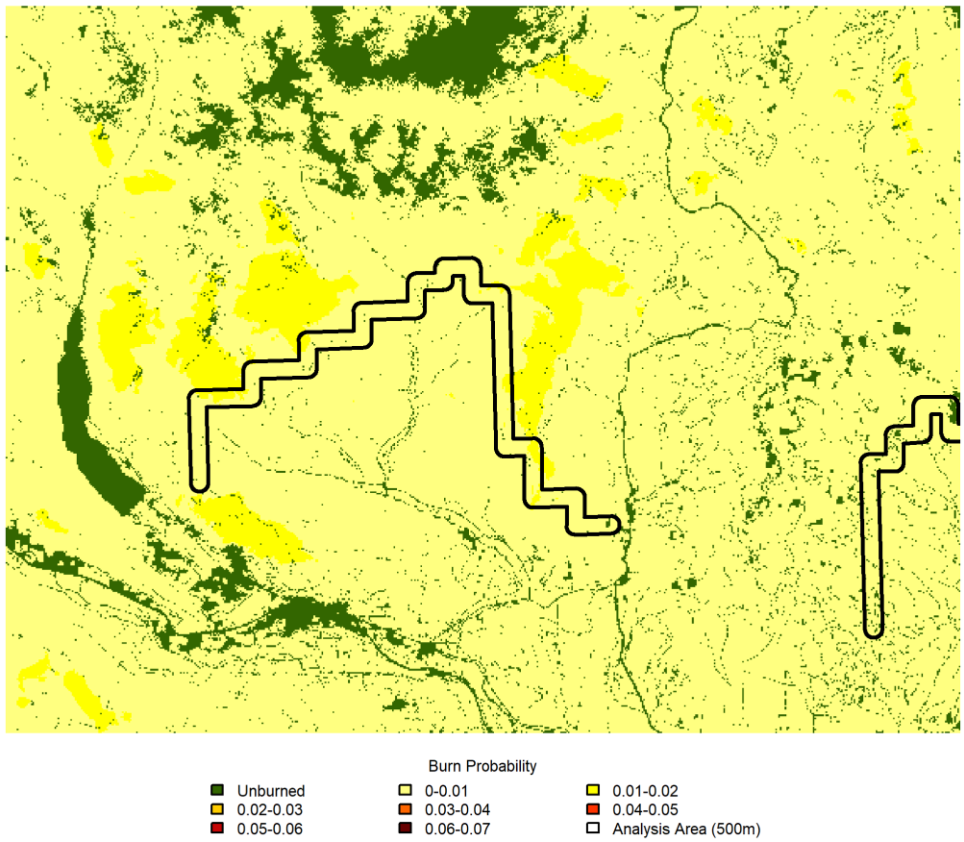
Reduction of 30% Simulations
Treatment Width per Entity: 250 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



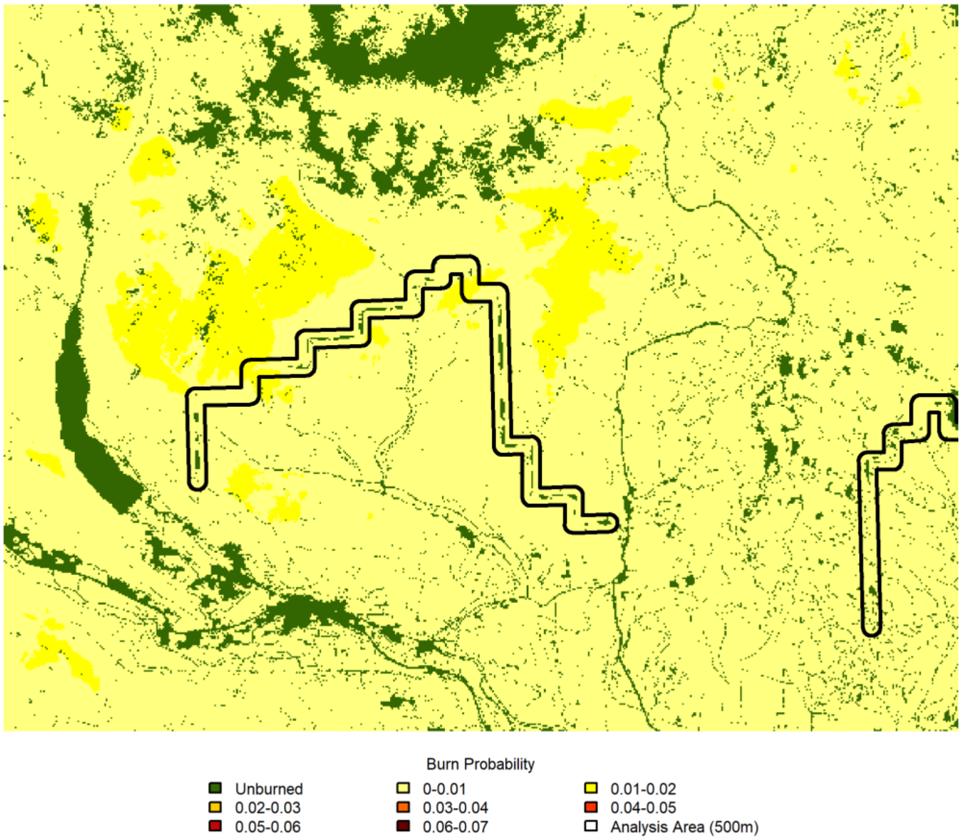
Reduction of 30% Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



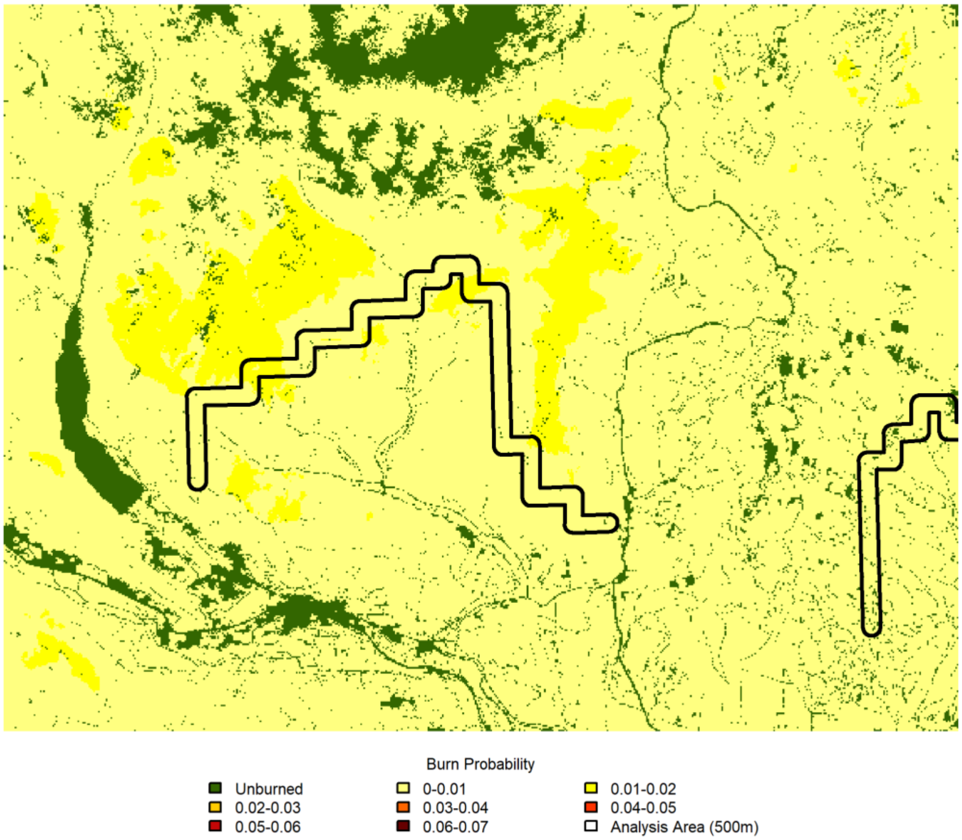
Reduction of 30% Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



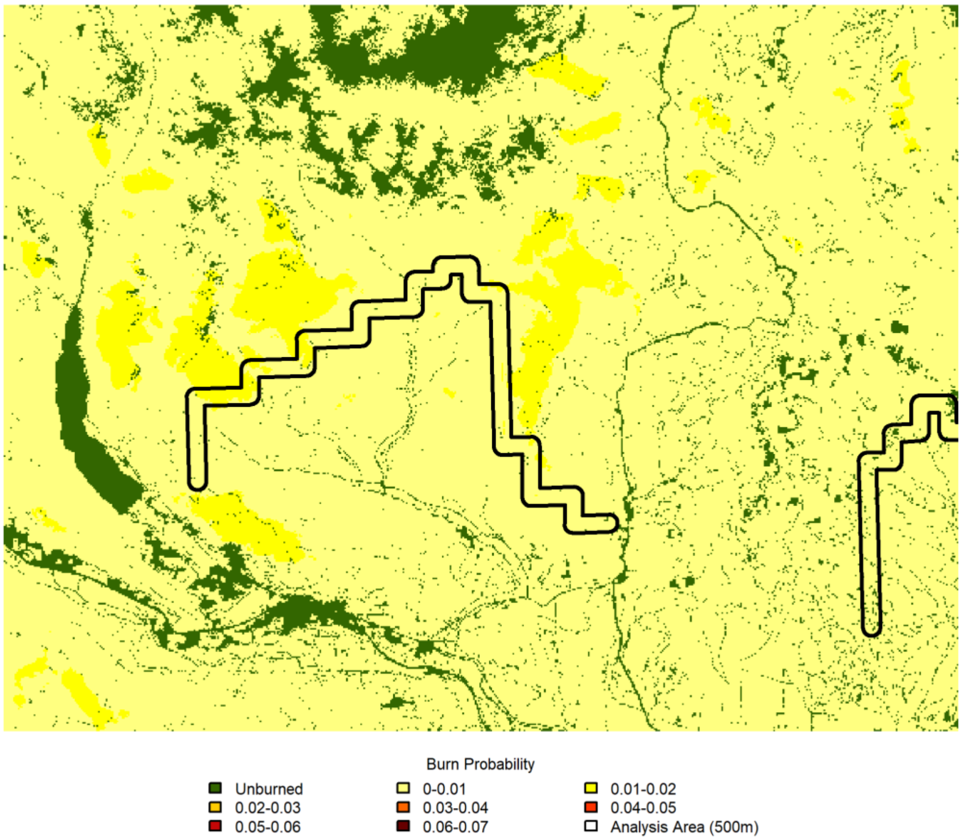
Reduction of 30% Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



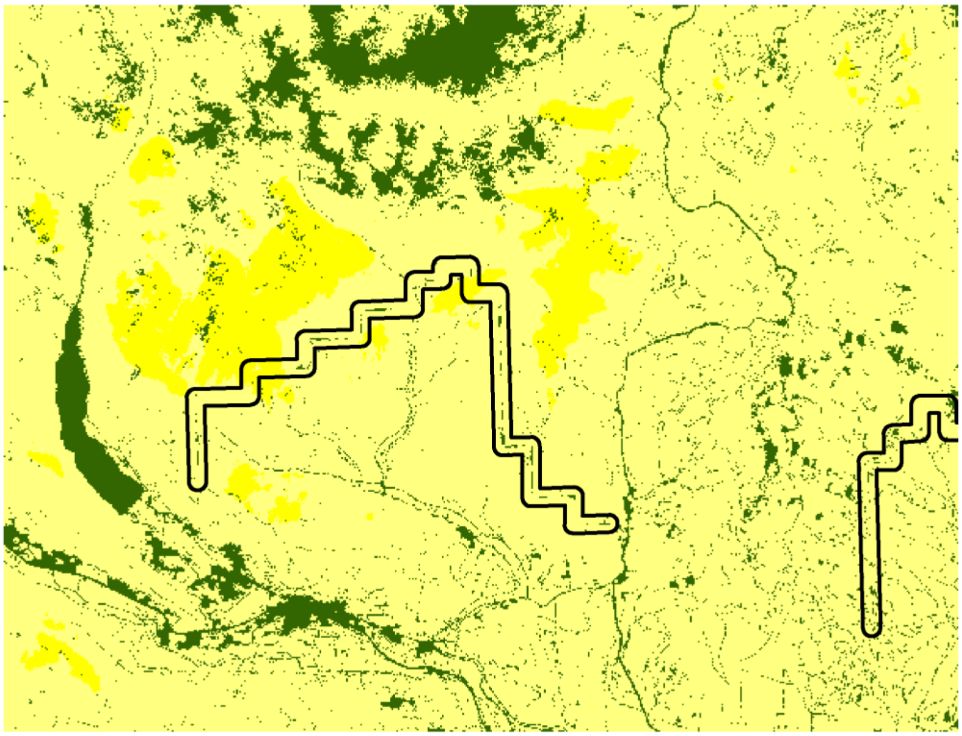
Reduction of 30% Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



Reduction of 30% Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



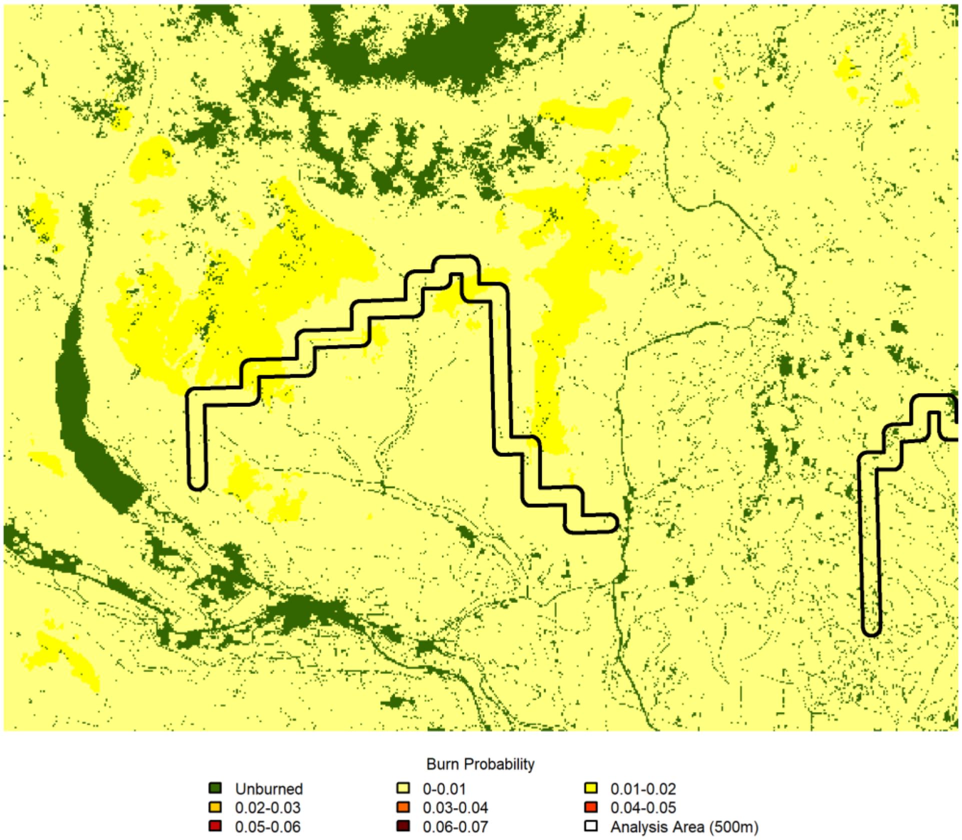
Reduction of 30% Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



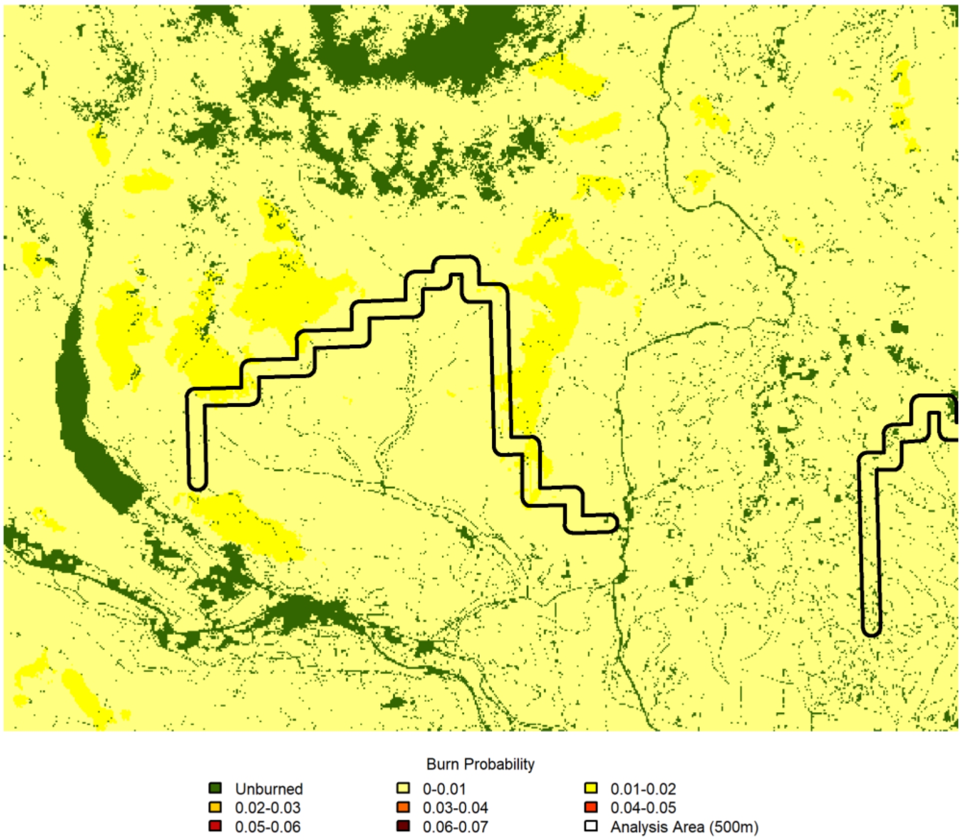
Burn Probability

Unburned	0-0.01	0.01-0.02
0.02-0.03	0.03-0.04	0.04-0.05
0.05-0.06	0.06-0.07	Analysis Area (500m)

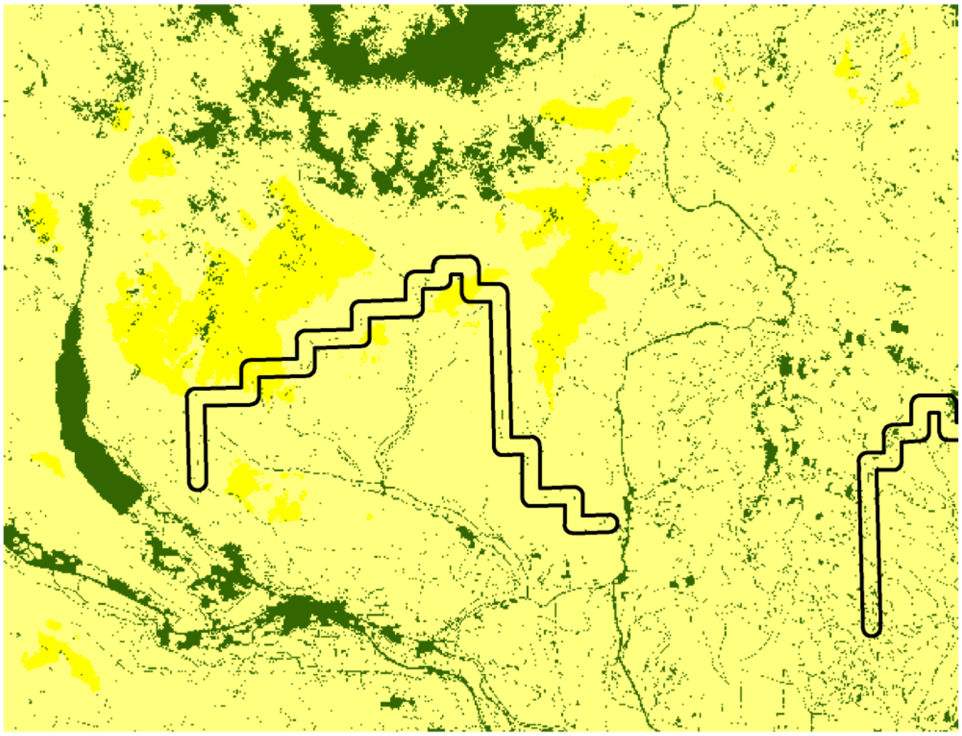
Reduction of 30% Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



Reduction of 30% Simulations
Treatment Width per Entity: 100 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



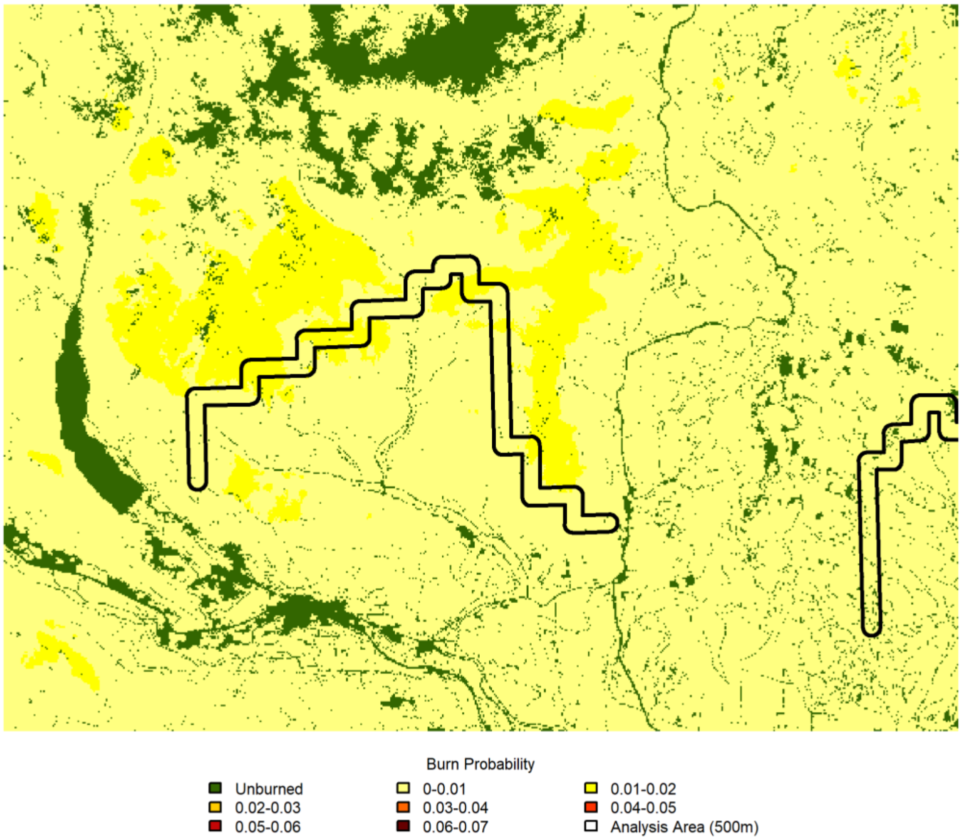
Reduction of 30% Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



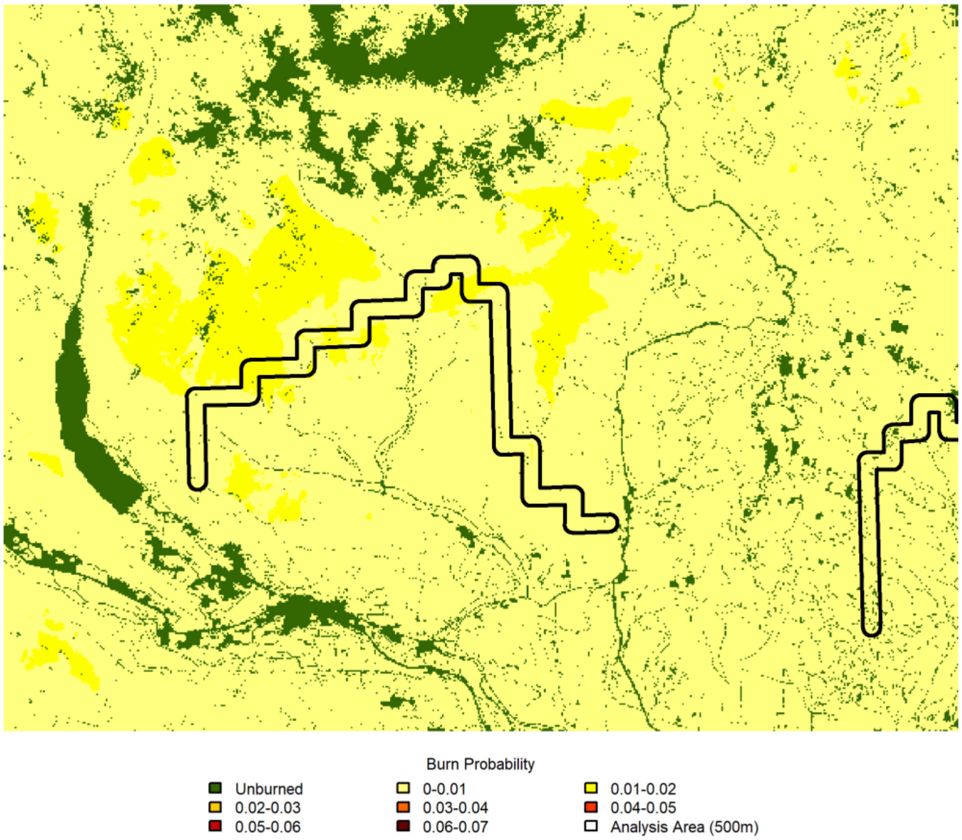
Burn Probability

Unburned
0-0.01
0.01-0.02
0.02-0.03
0.03-0.04
0.04-0.05
0.05-0.06
0.06-0.07
Analysis Area (500m)

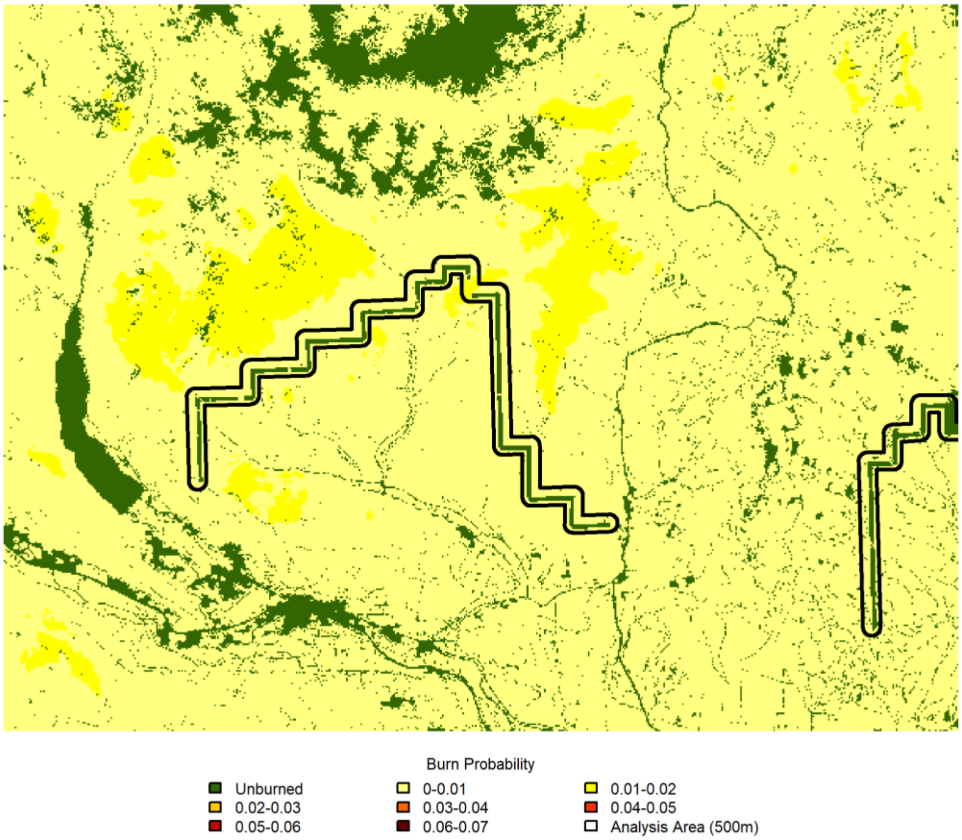
Reduction of 30% Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



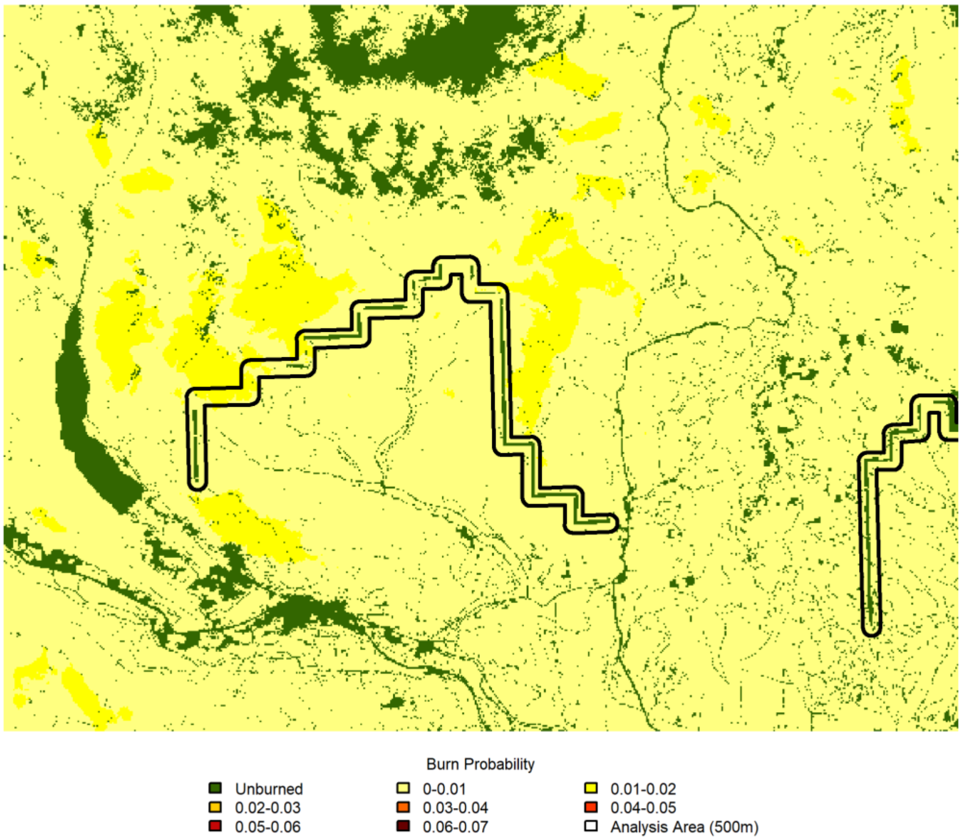
Reduction of 30% Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



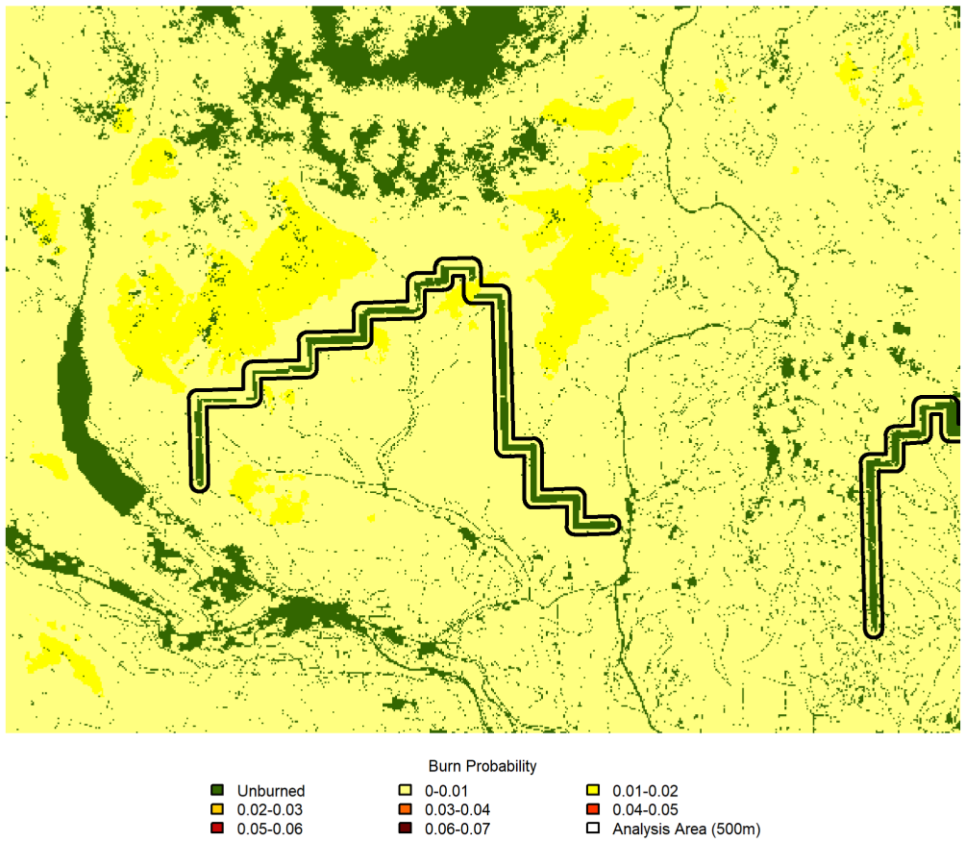
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



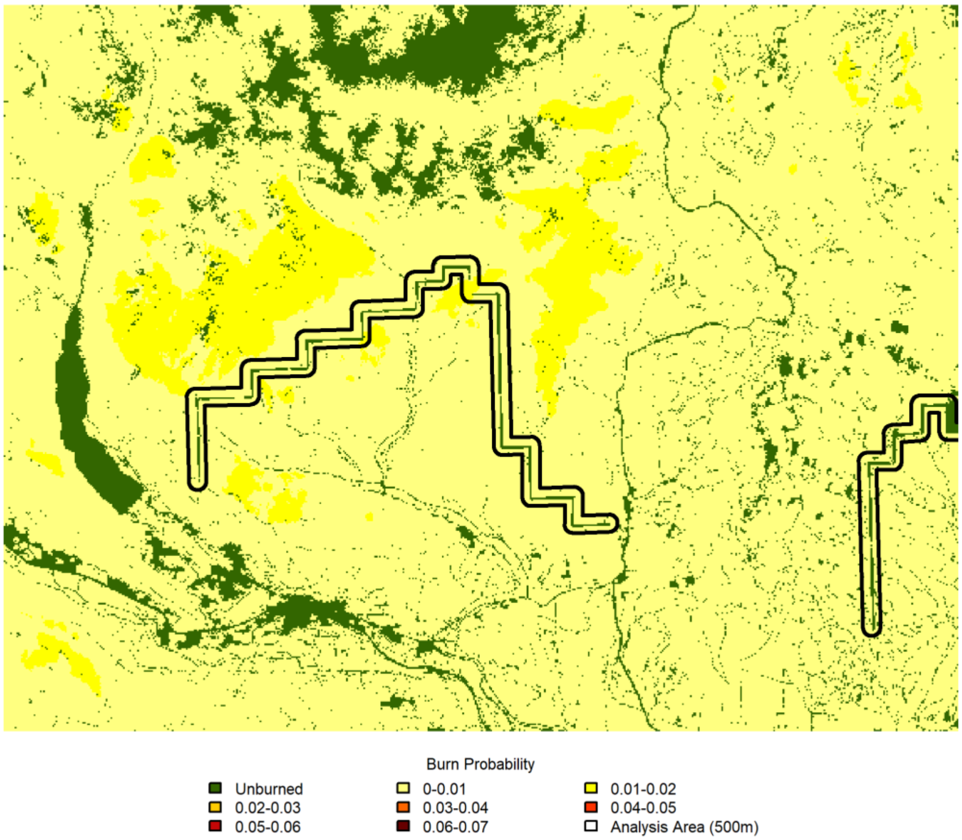
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



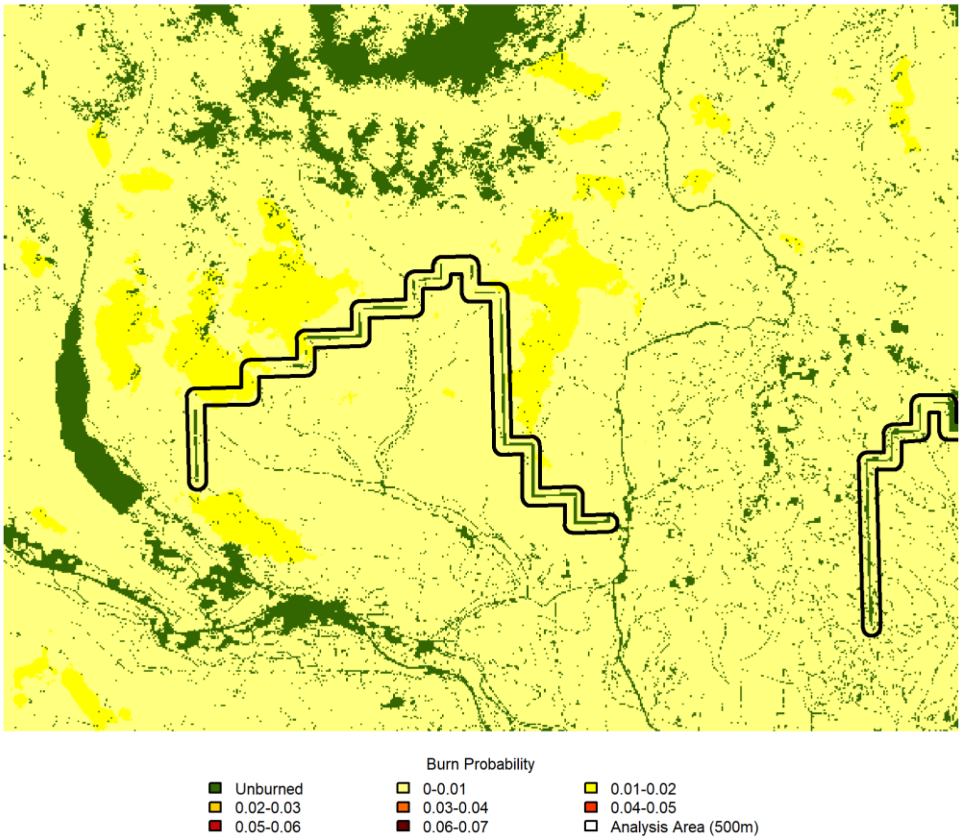
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



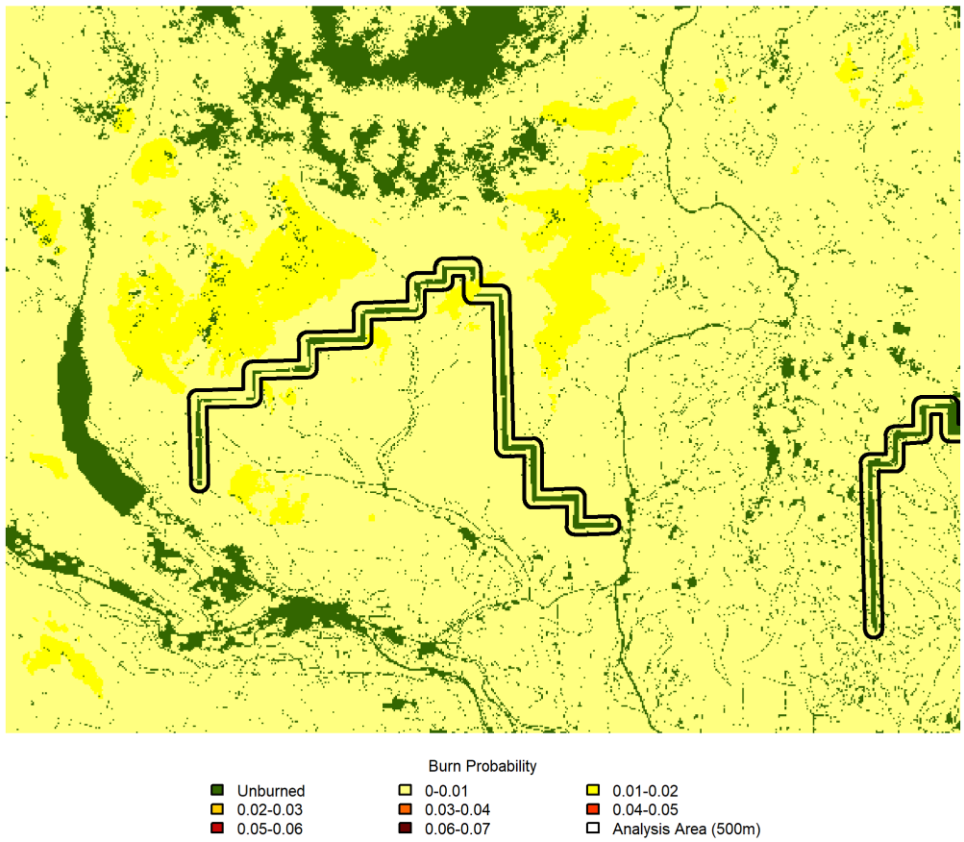
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



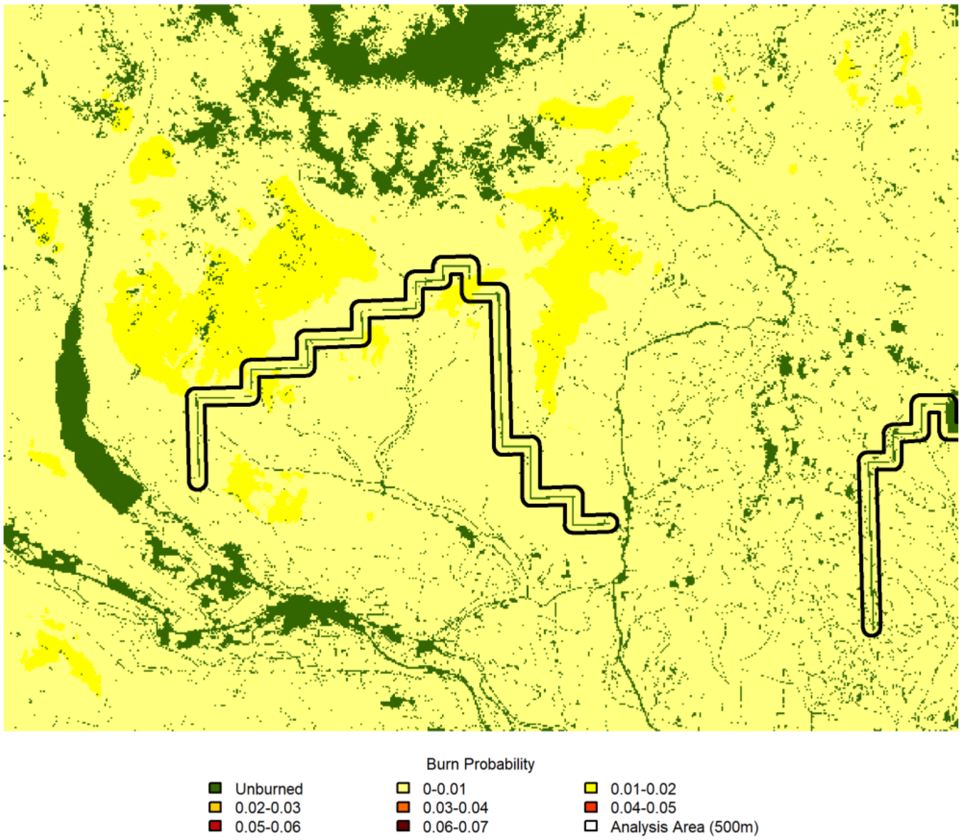
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



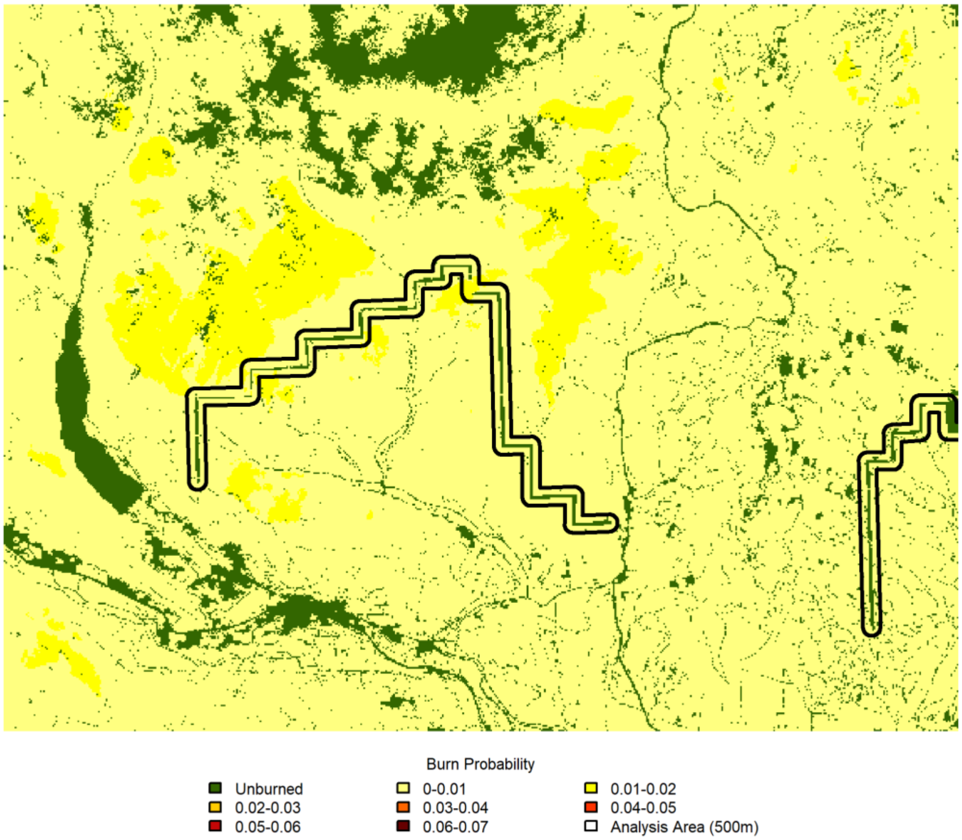
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



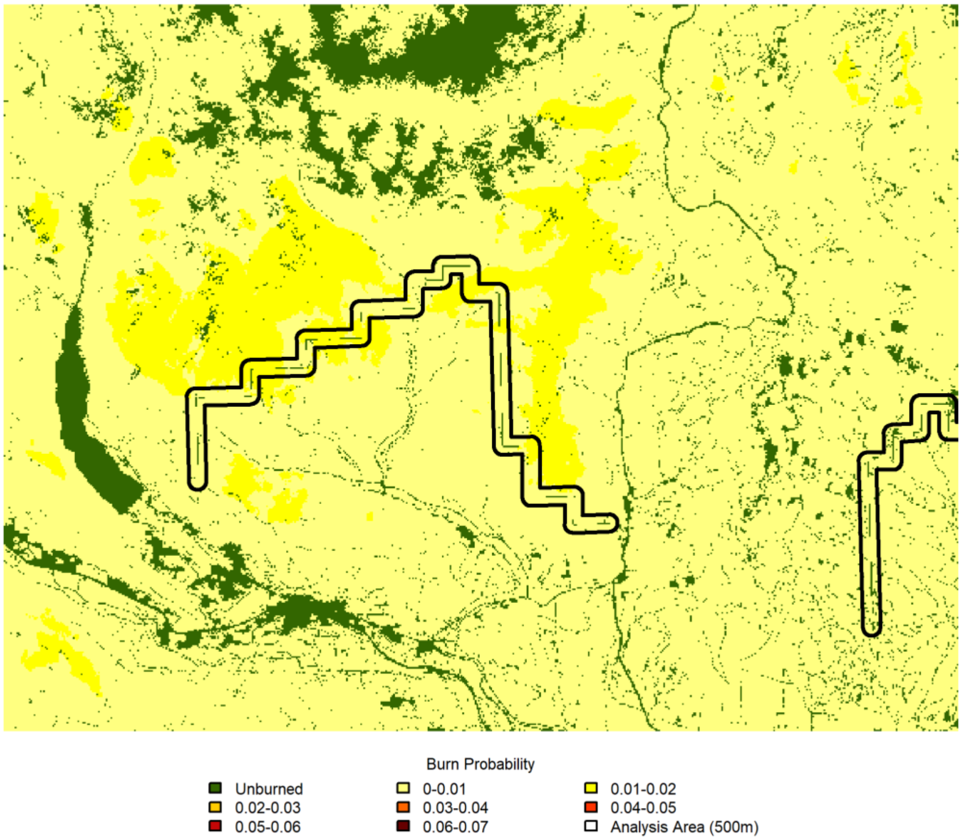
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



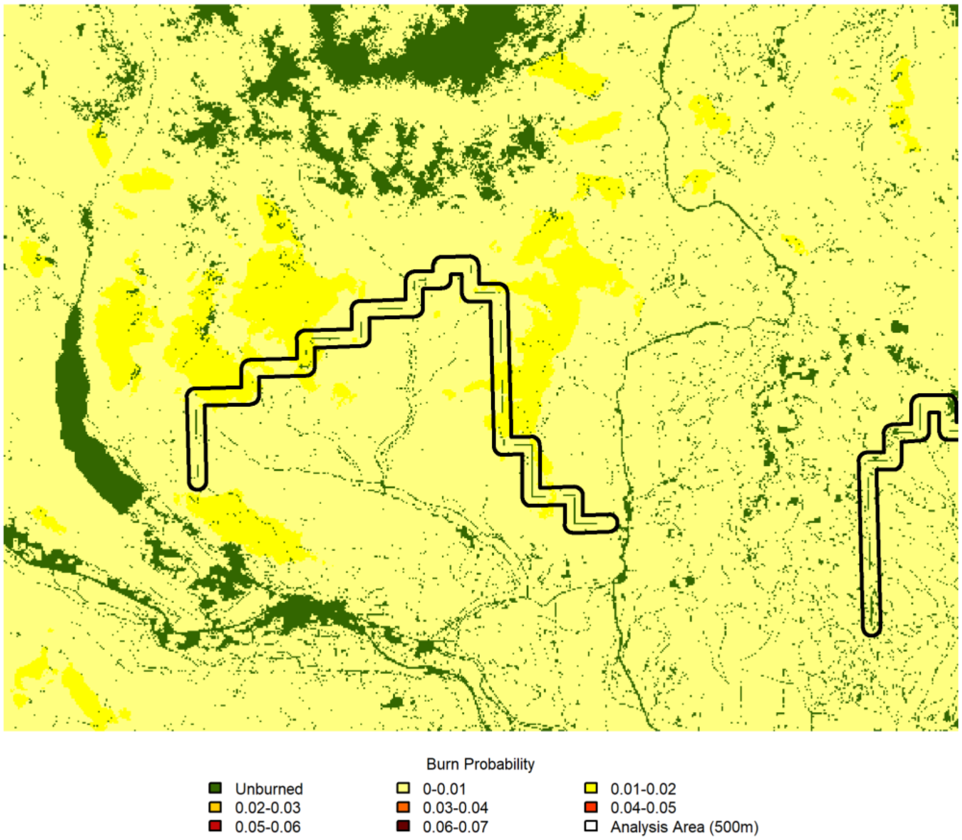
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



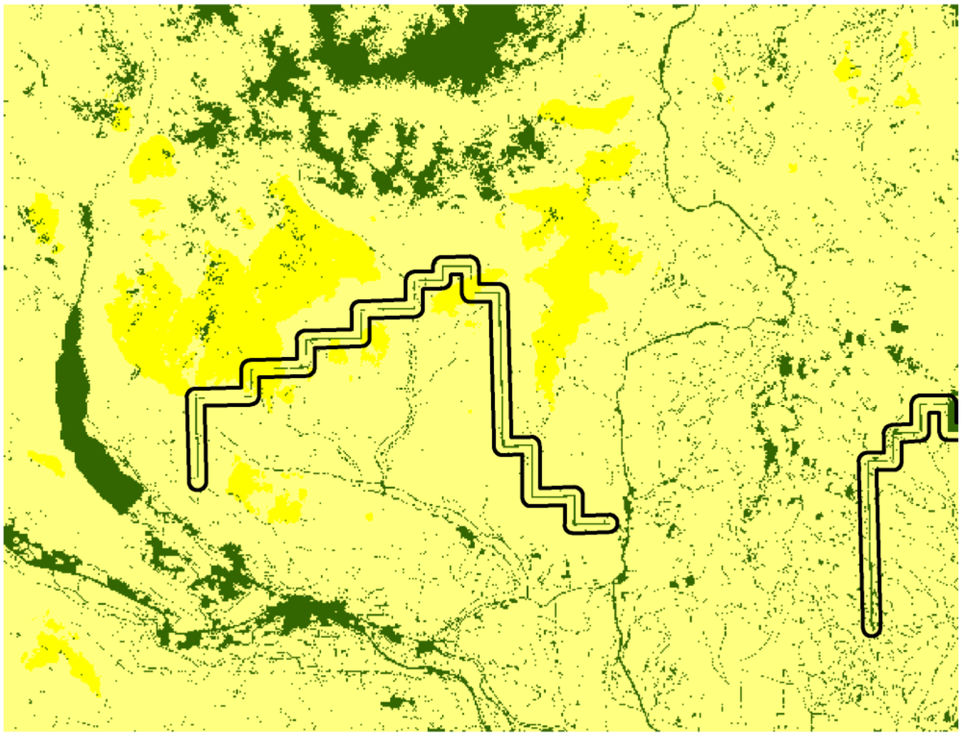
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



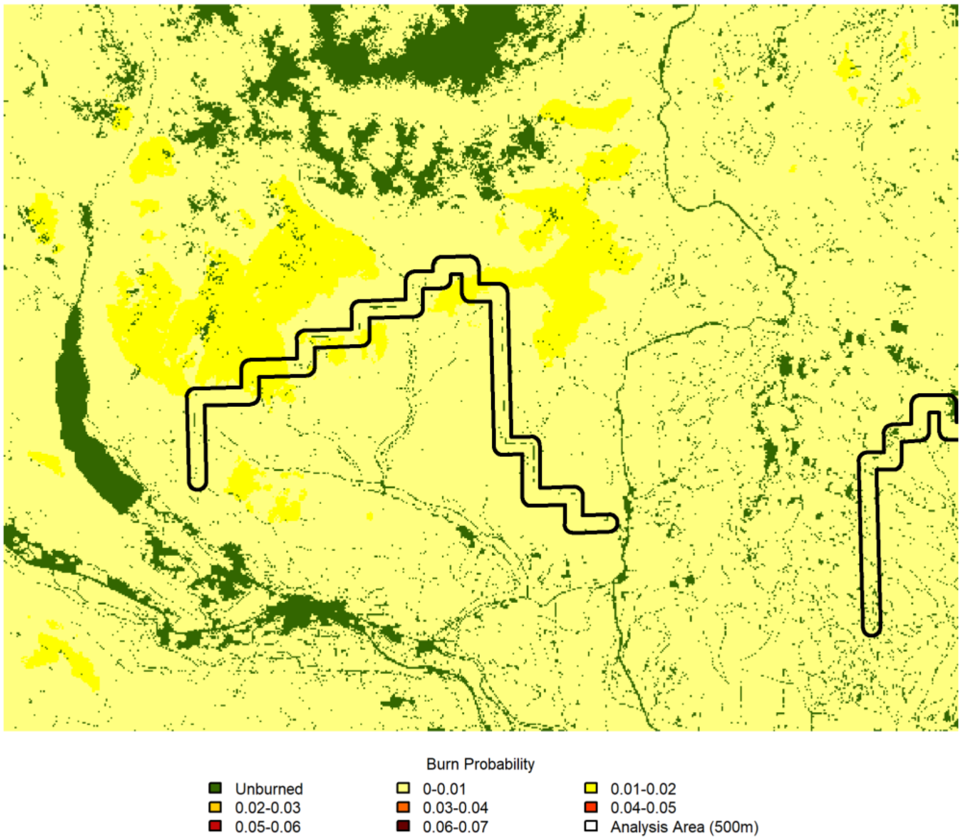
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



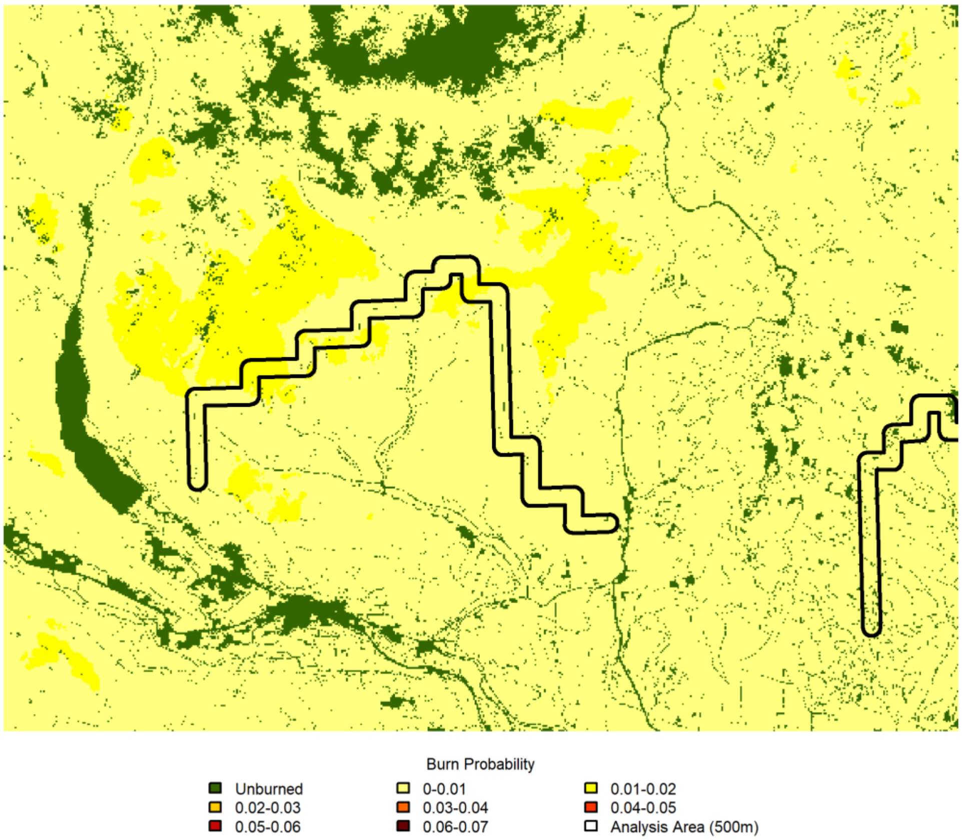
Burn Probability

Unburned	0-0.01	0.01-0.02
0.02-0.03	0.03-0.04	0.04-0.05
0.05-0.06	0.06-0.07	Analysis Area (500m)

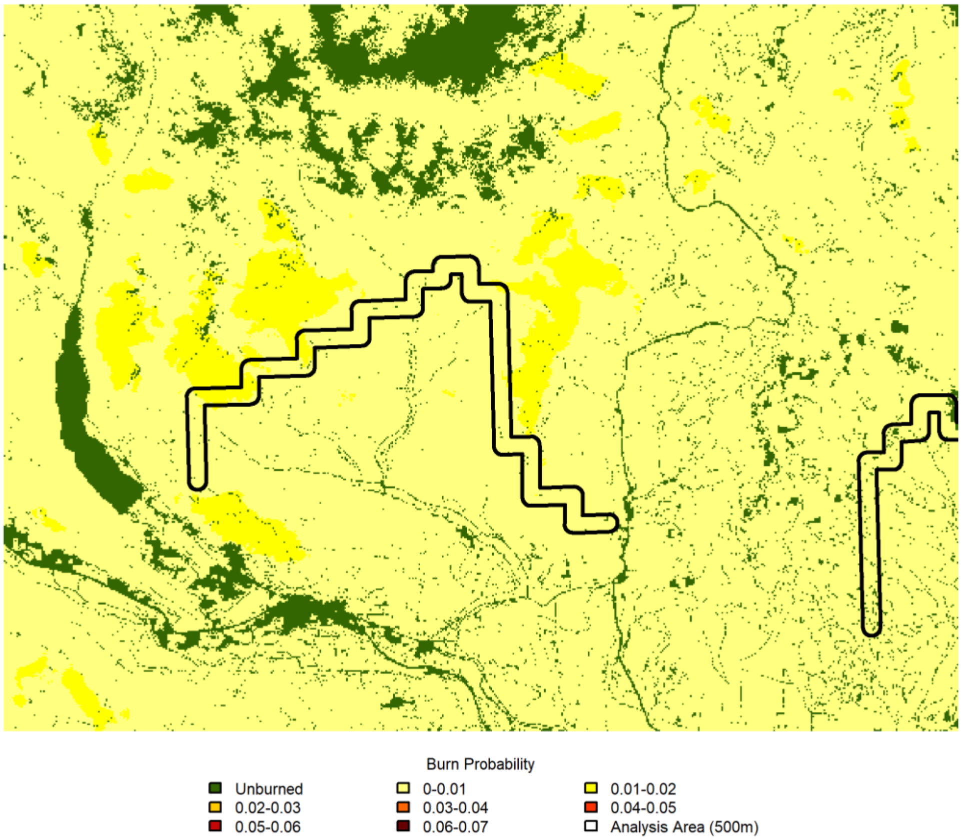
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



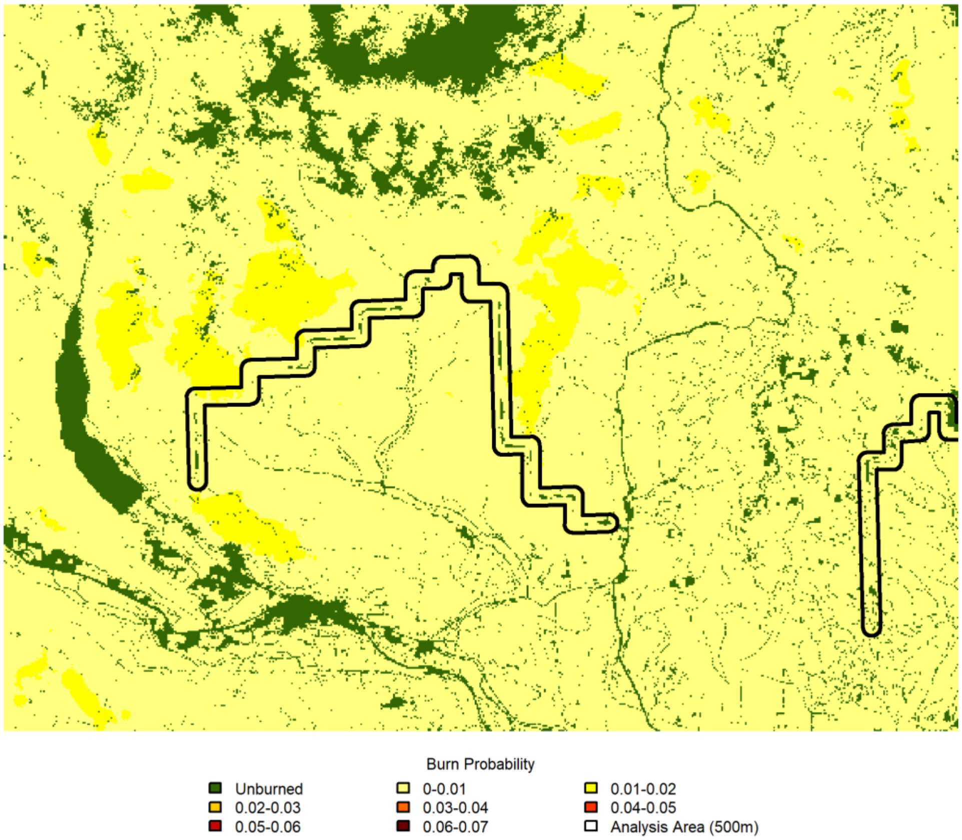
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



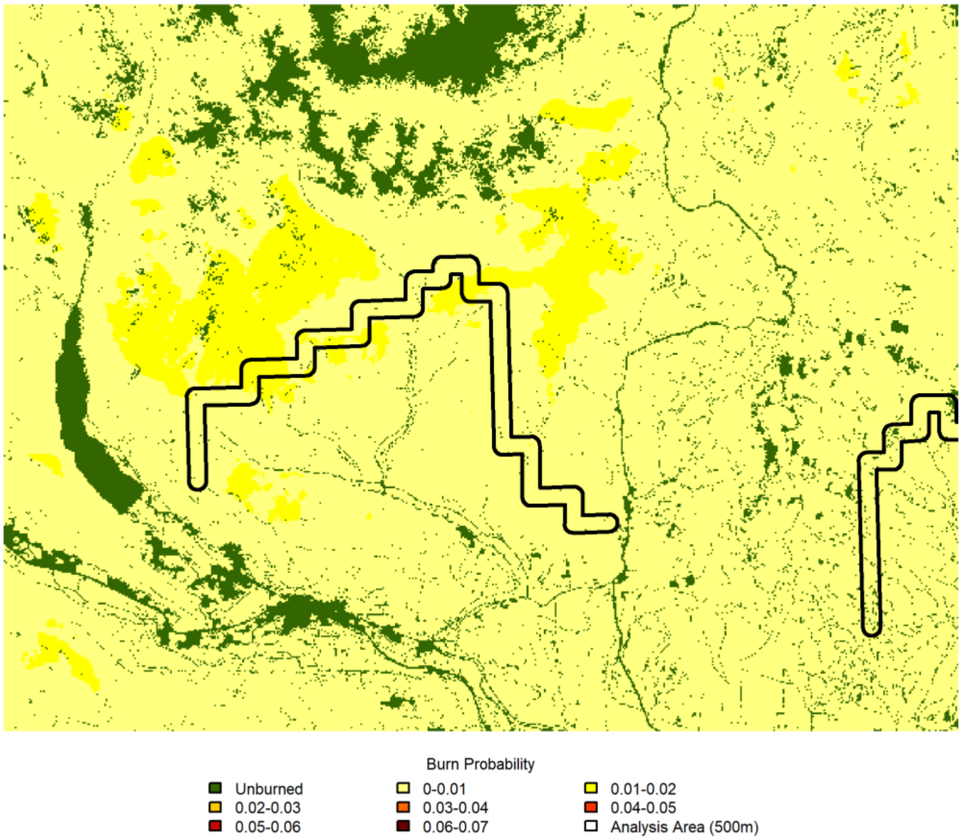
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



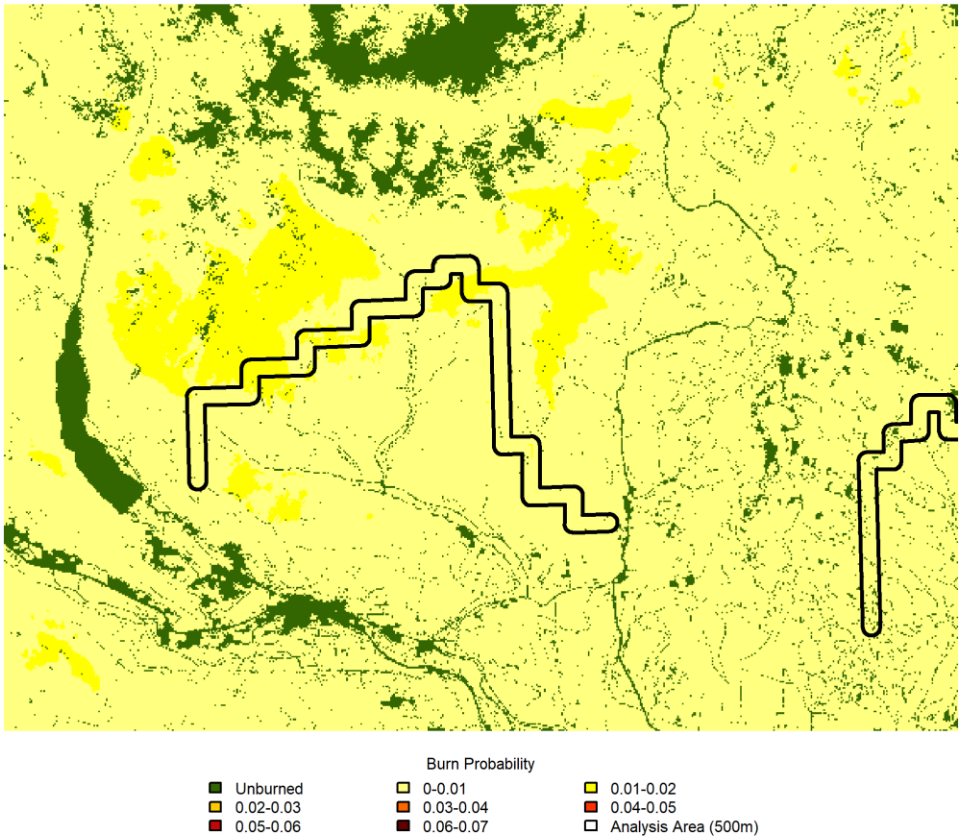
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



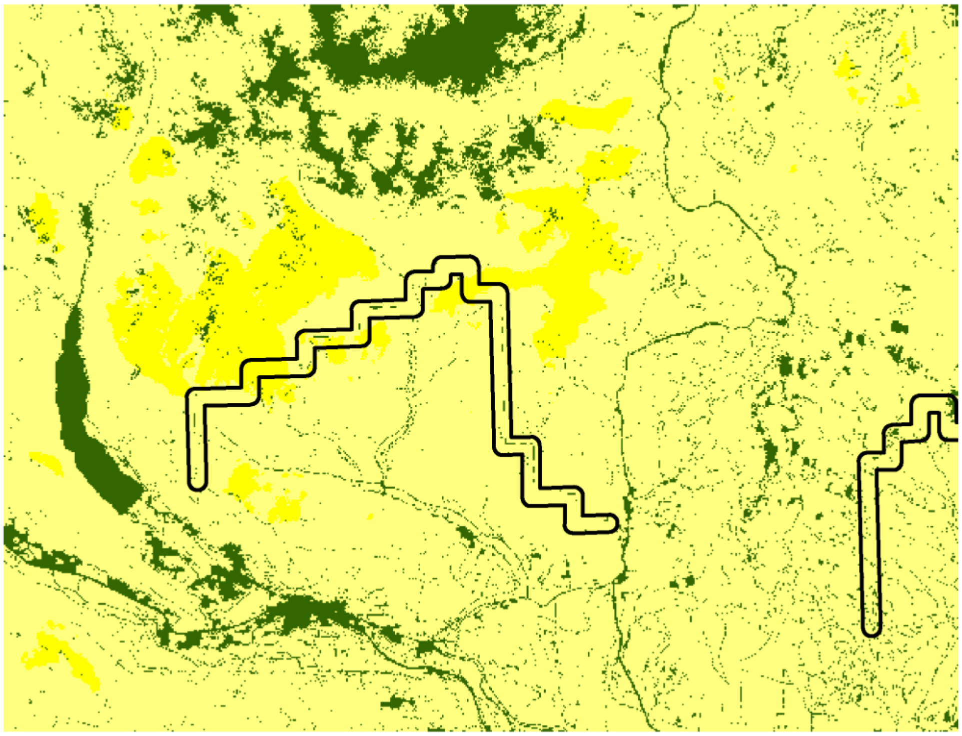
Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



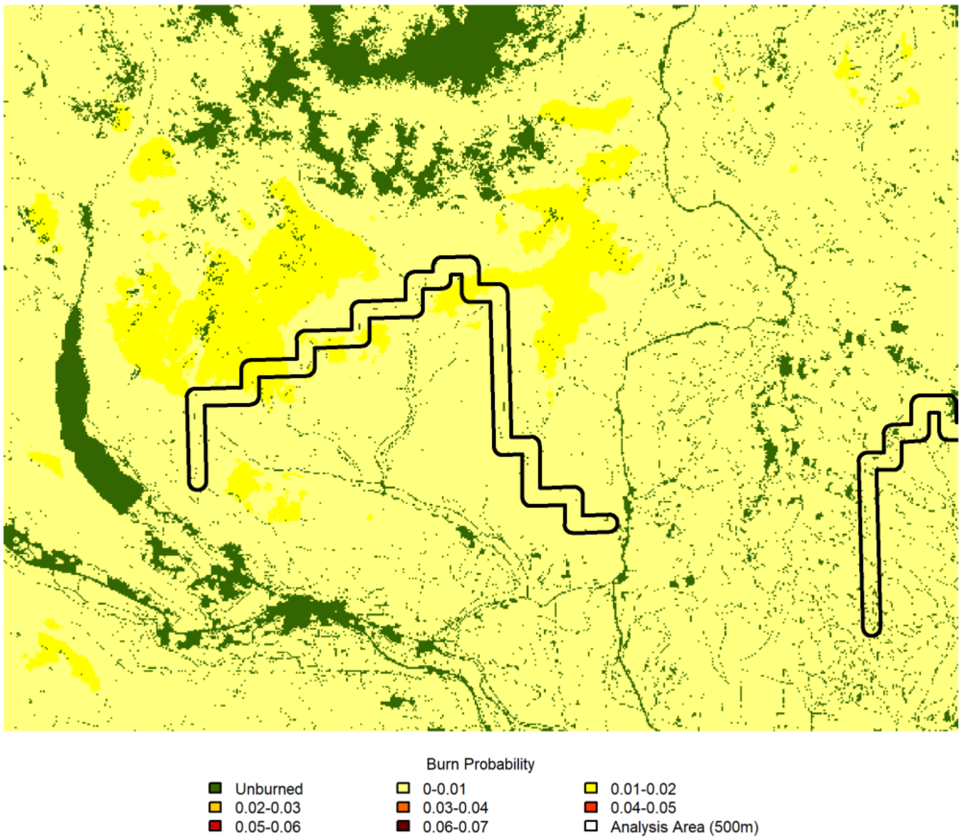
Reduction of 60% Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



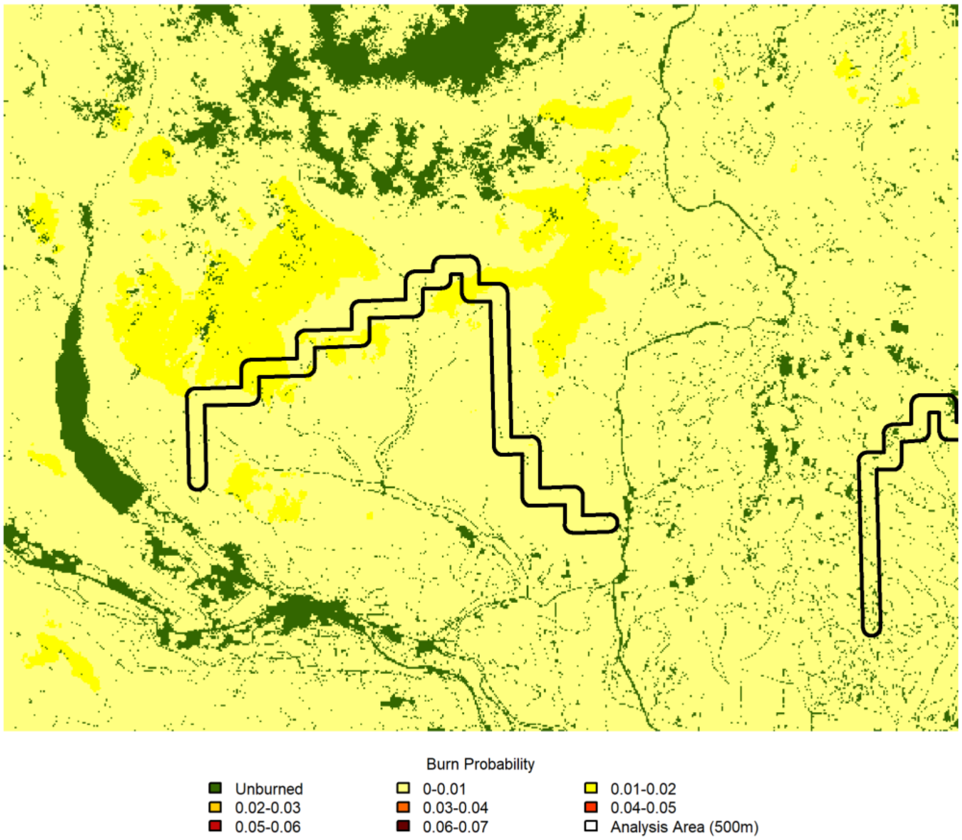
Burn Probability

Unburned	0-0.01	0.01-0.02
0.02-0.03	0.03-0.04	0.04-0.05
0.05-0.06	0.06-0.07	Analysis Area (500m)

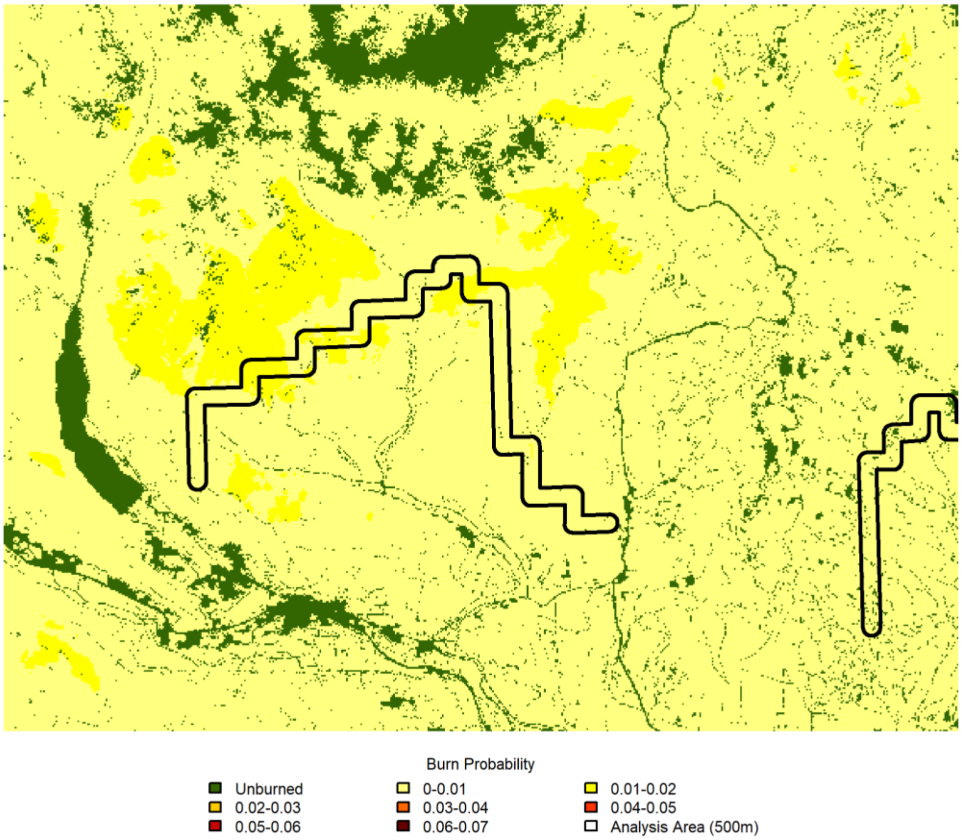
Reduction of 60% Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



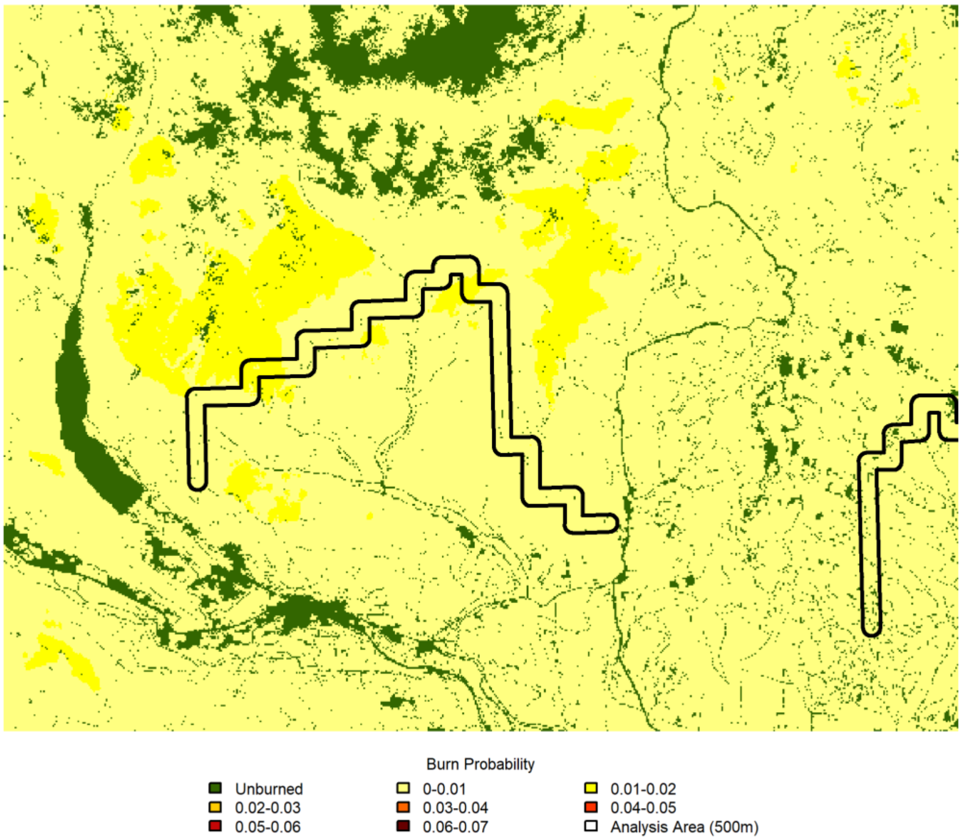
Reduction of 60% Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



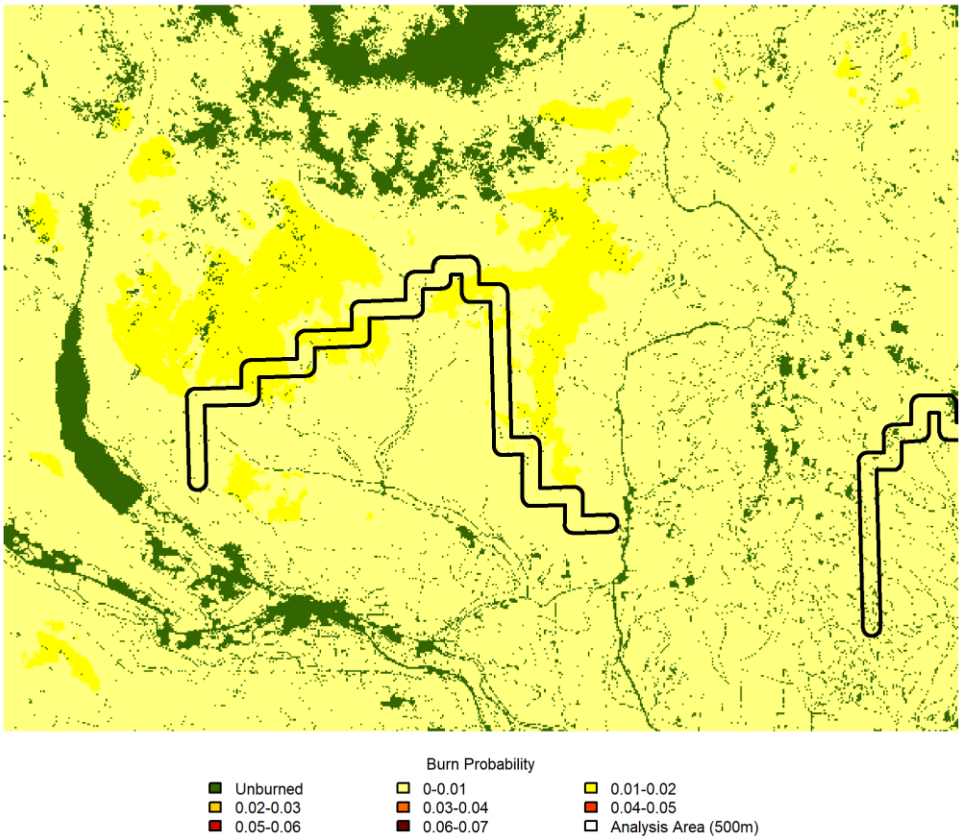
Reduction of 60% Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



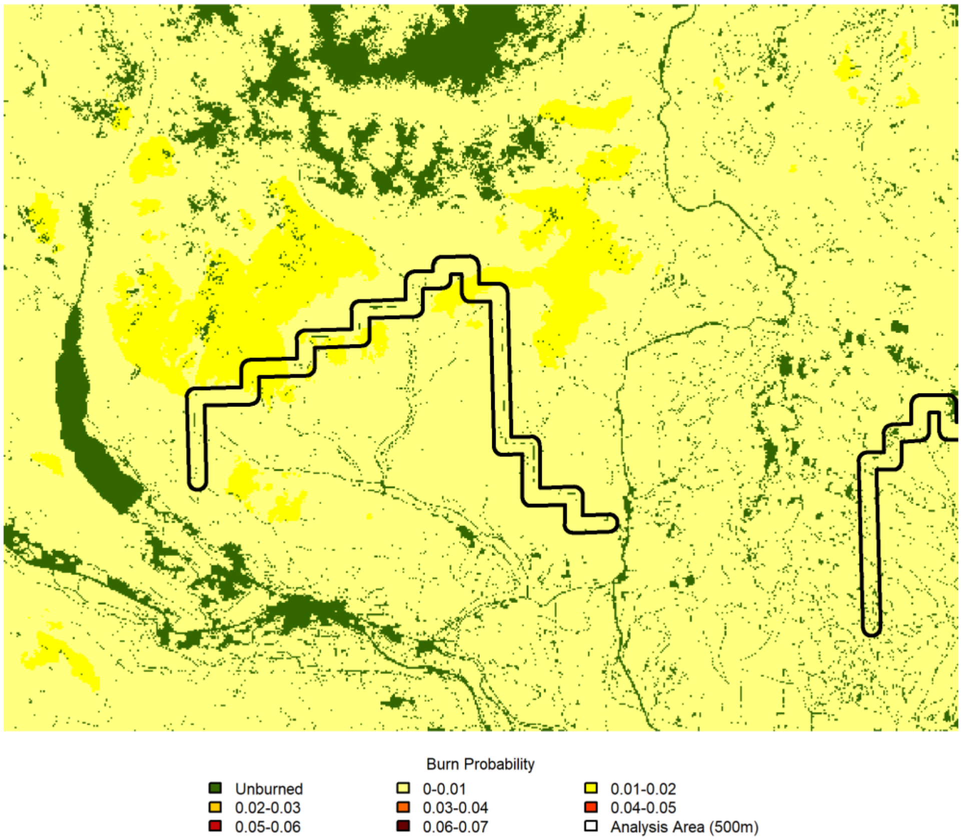
Reduction of 60% Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



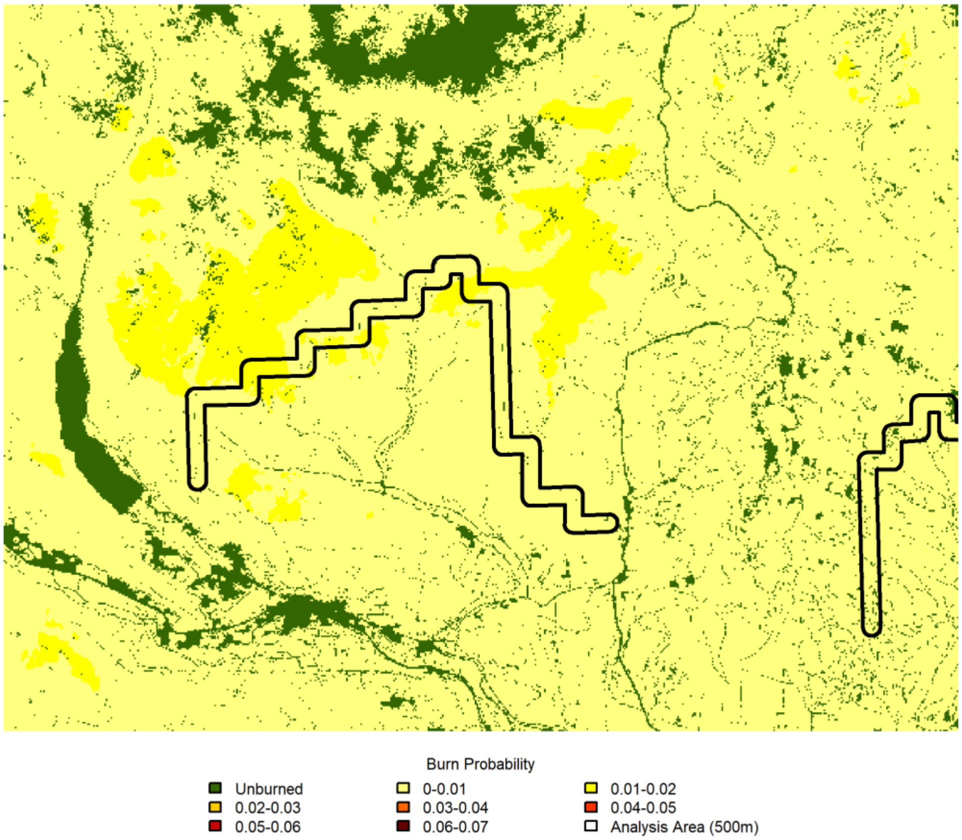
Reduction of 60% Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



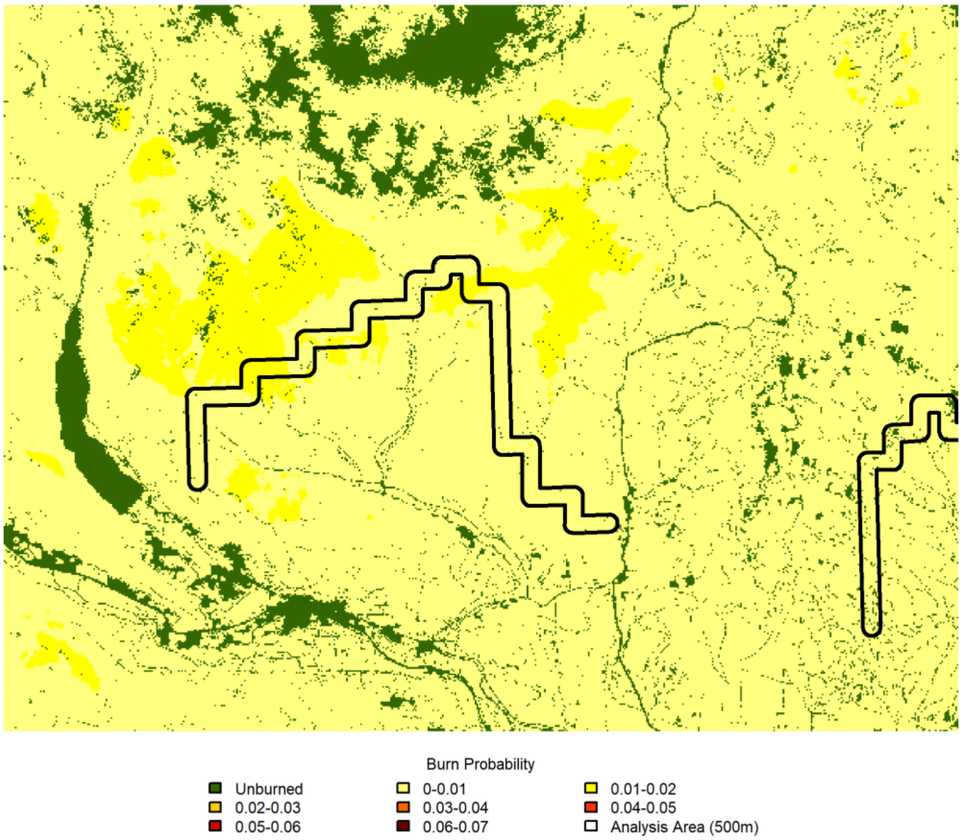
Reduction of 40% Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



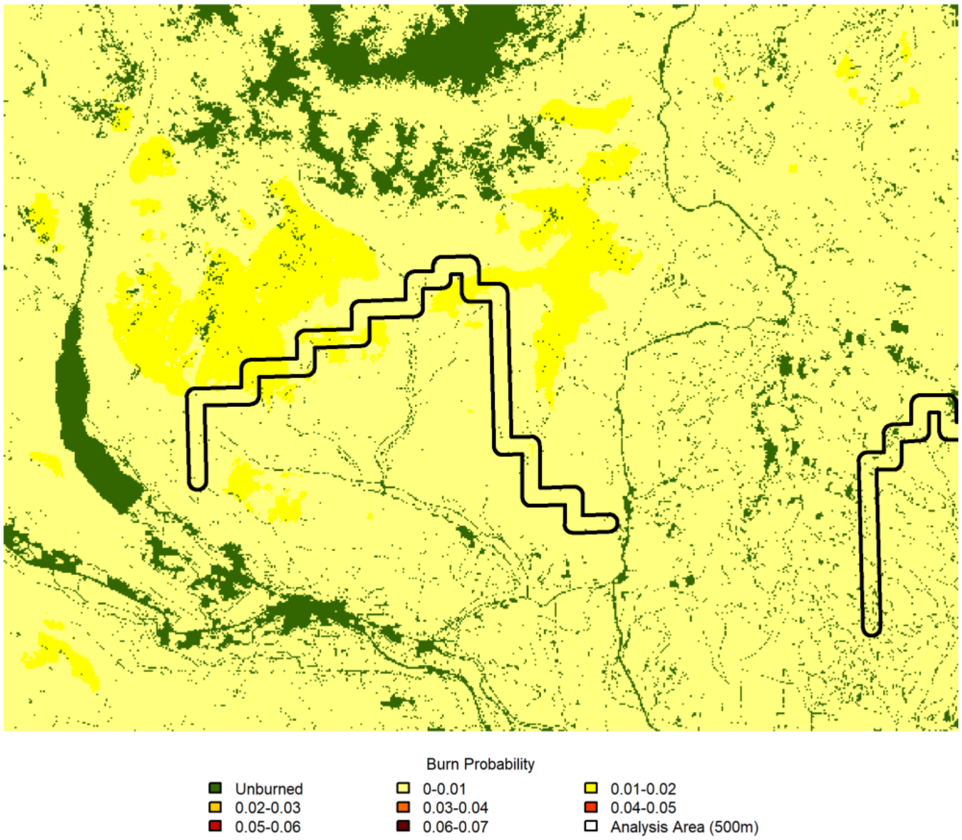
Reduction of 40% Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



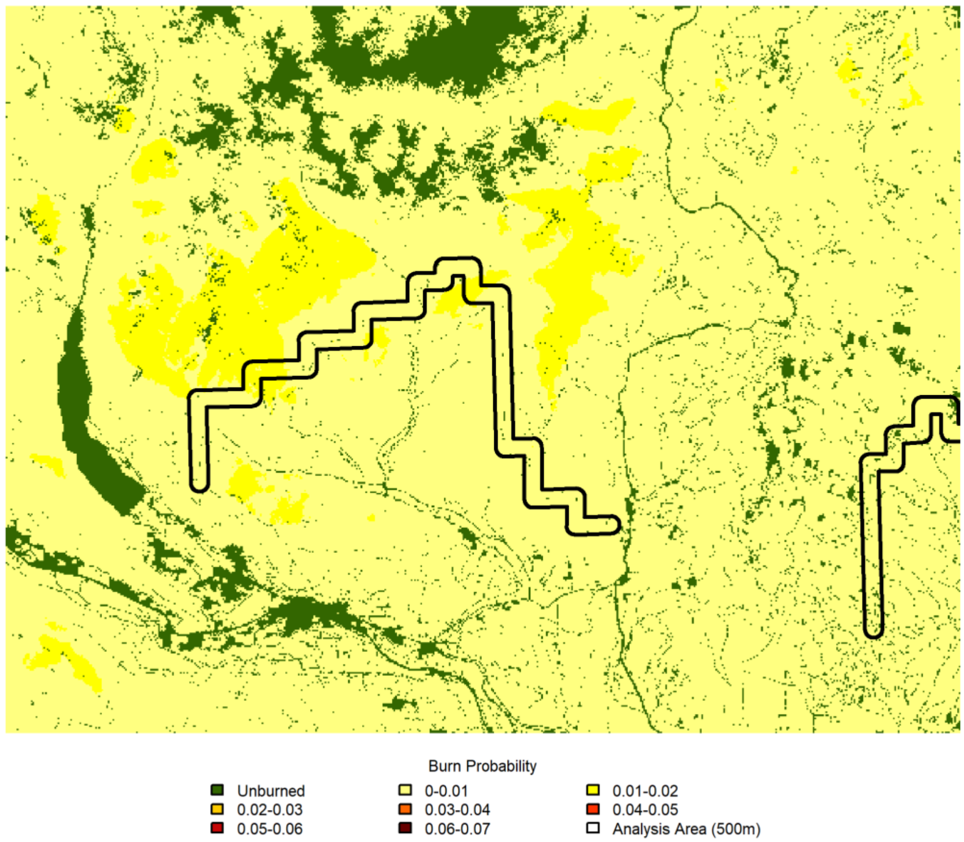
Reduction of 40% Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



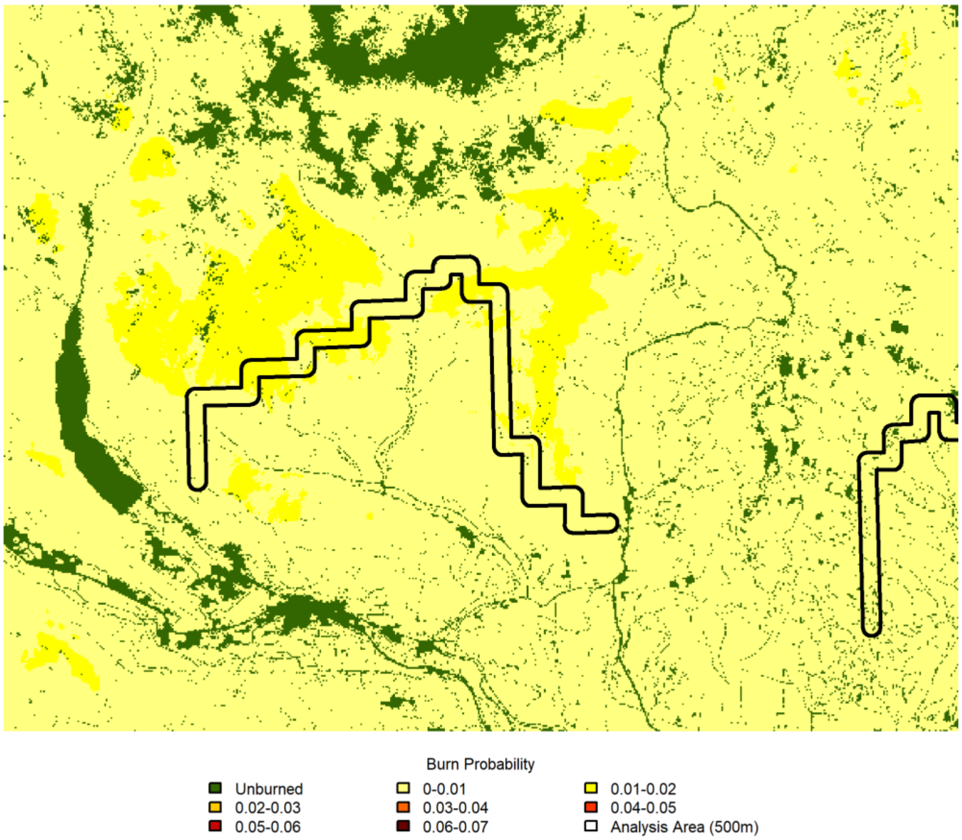
Reduction of 40% Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



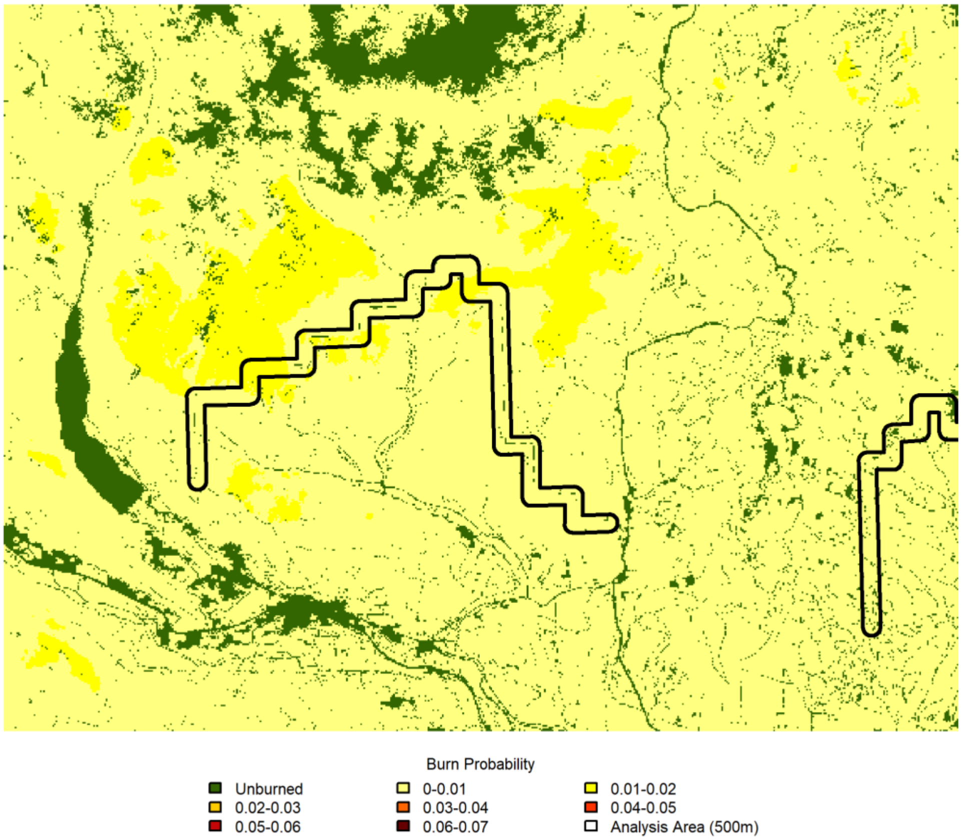
Reduction of 40% Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



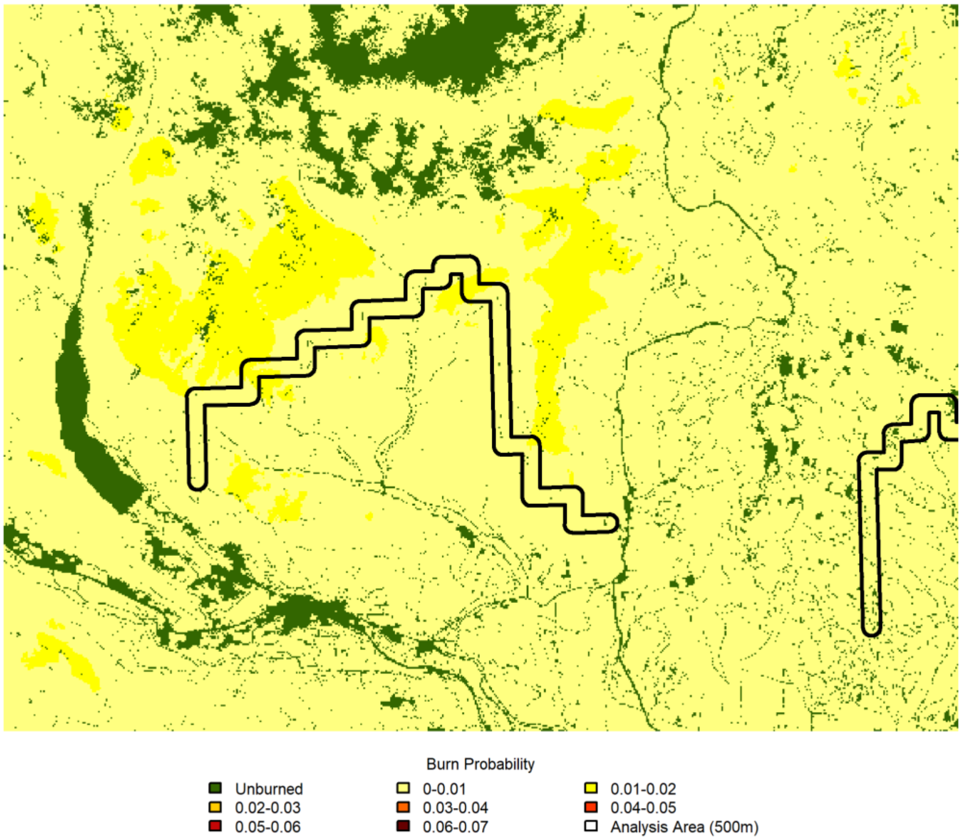
Reduction of 40% Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



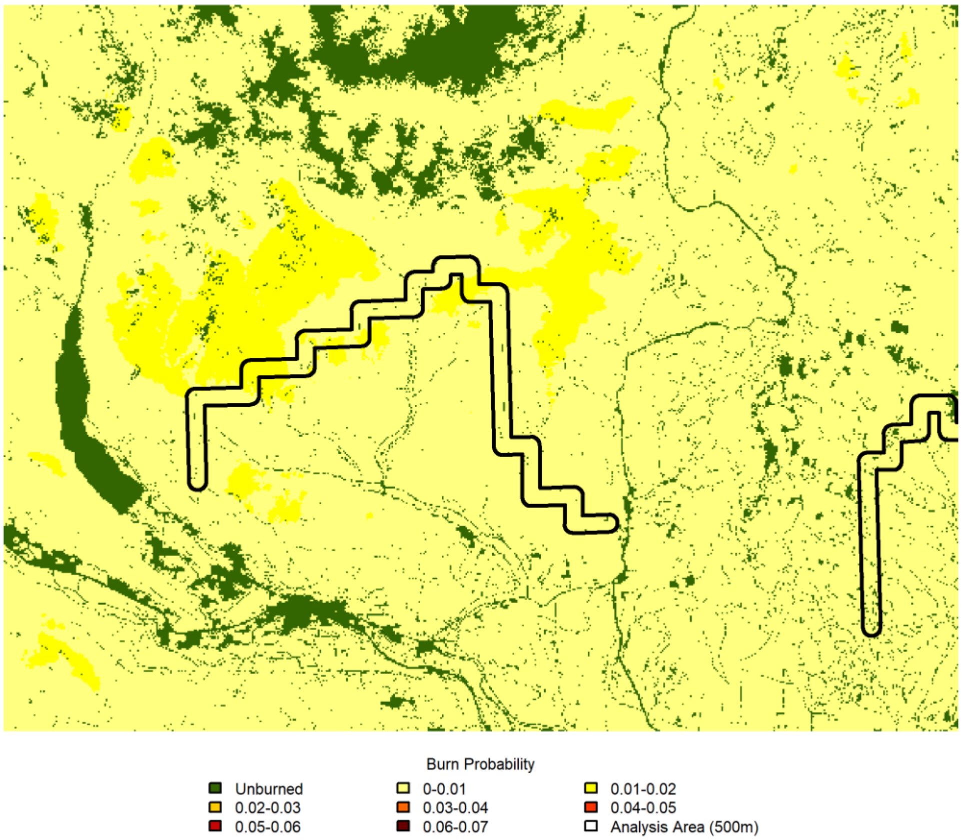
Reduction of 30% Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



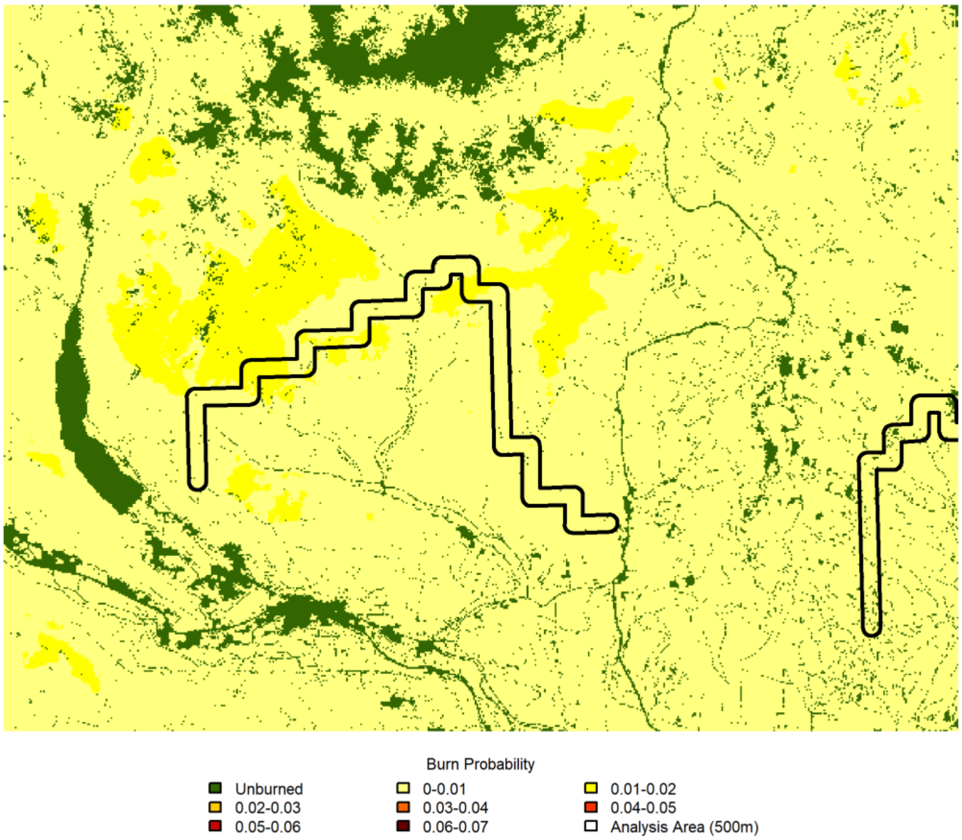
Reduction of 30% Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



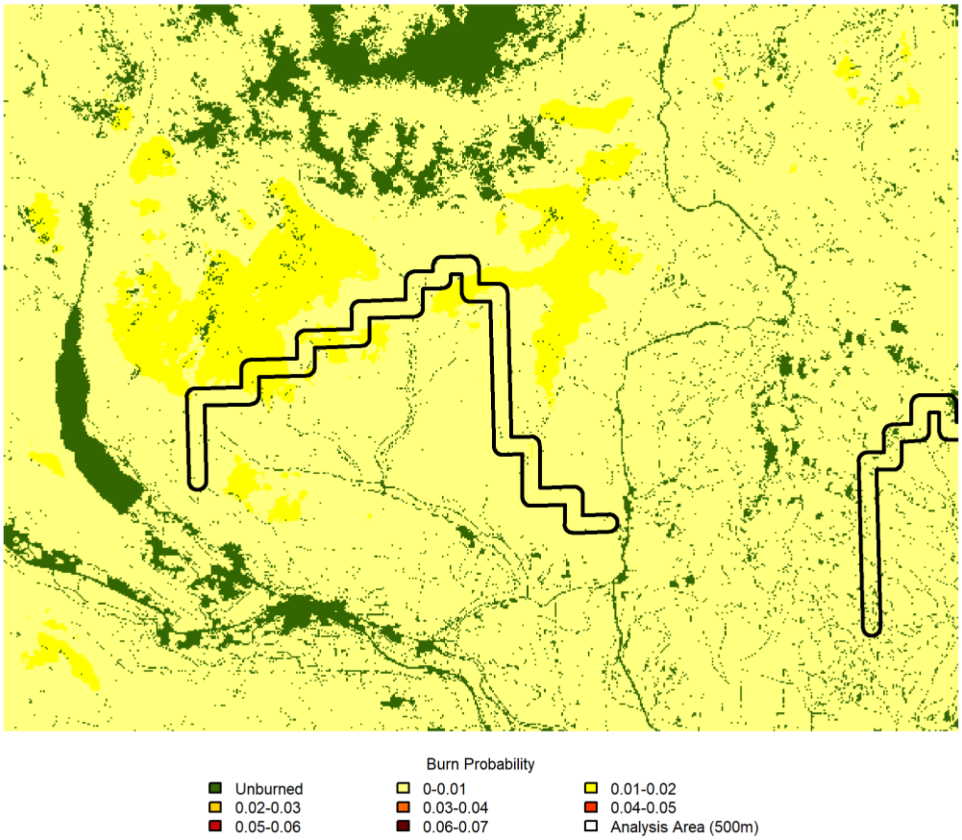
Reduction of 30% Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



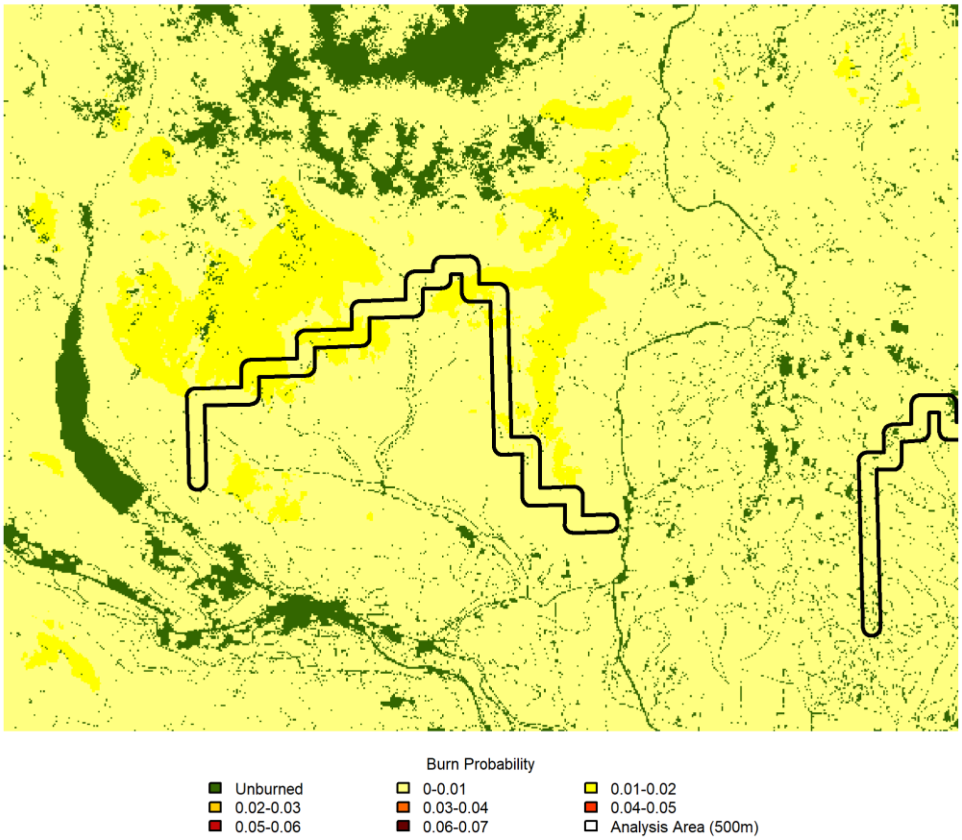
Reduction of 30% Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



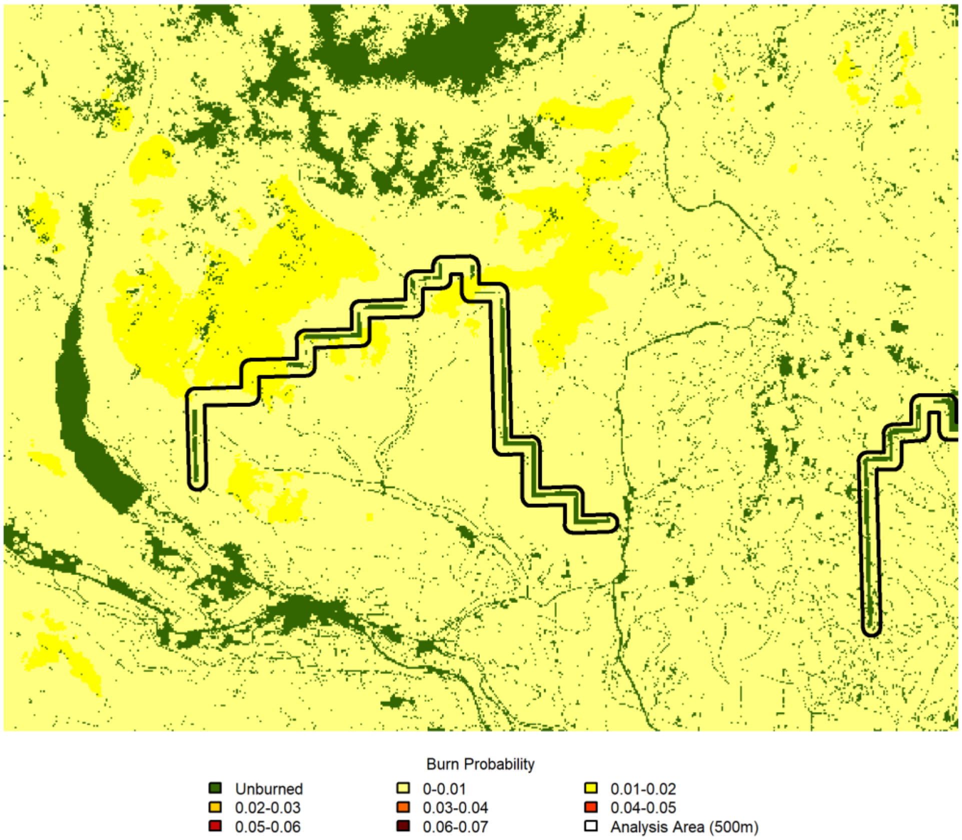
Reduction of 30% Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



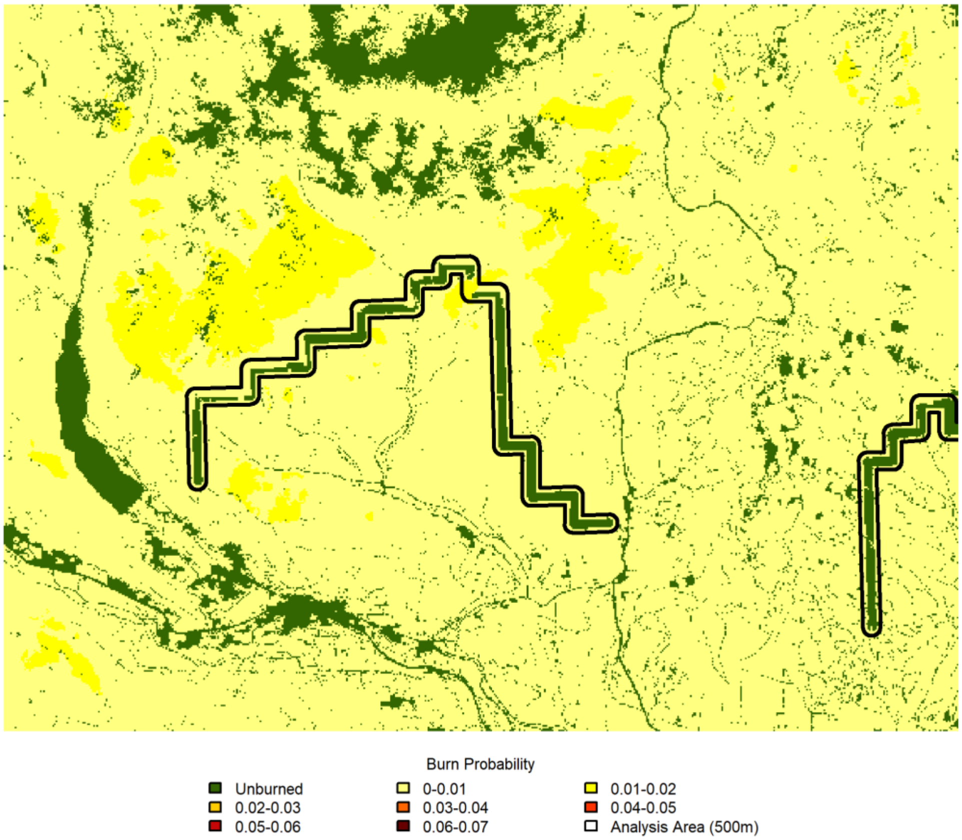
Reduction of 30% Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



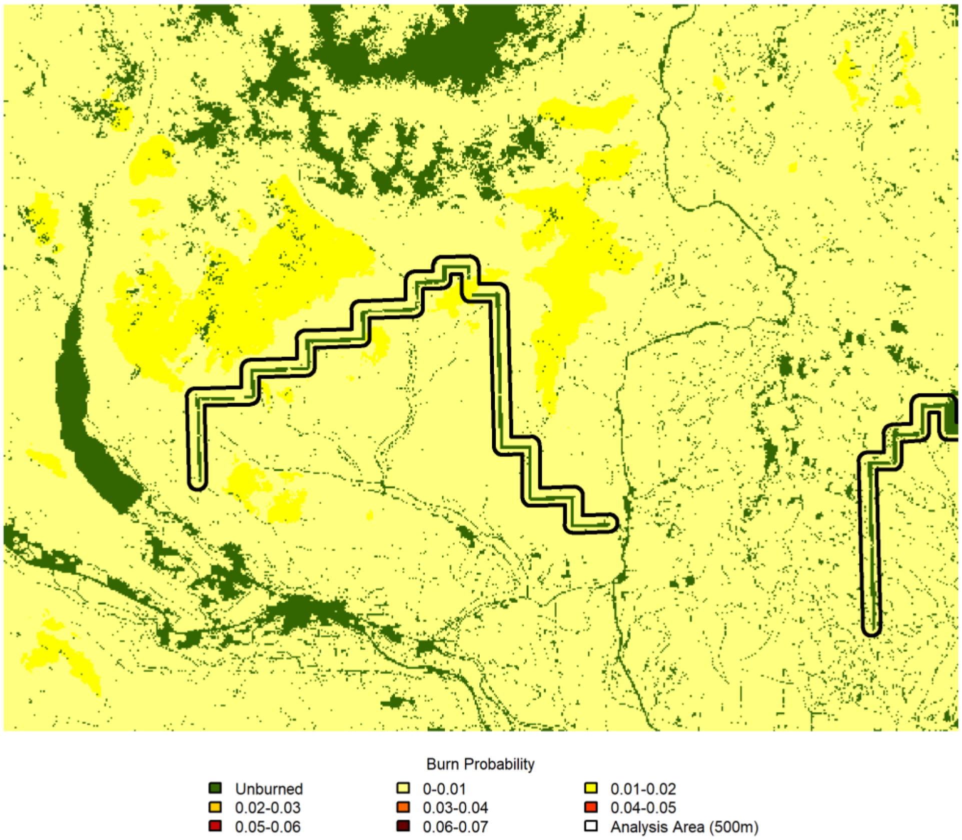
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



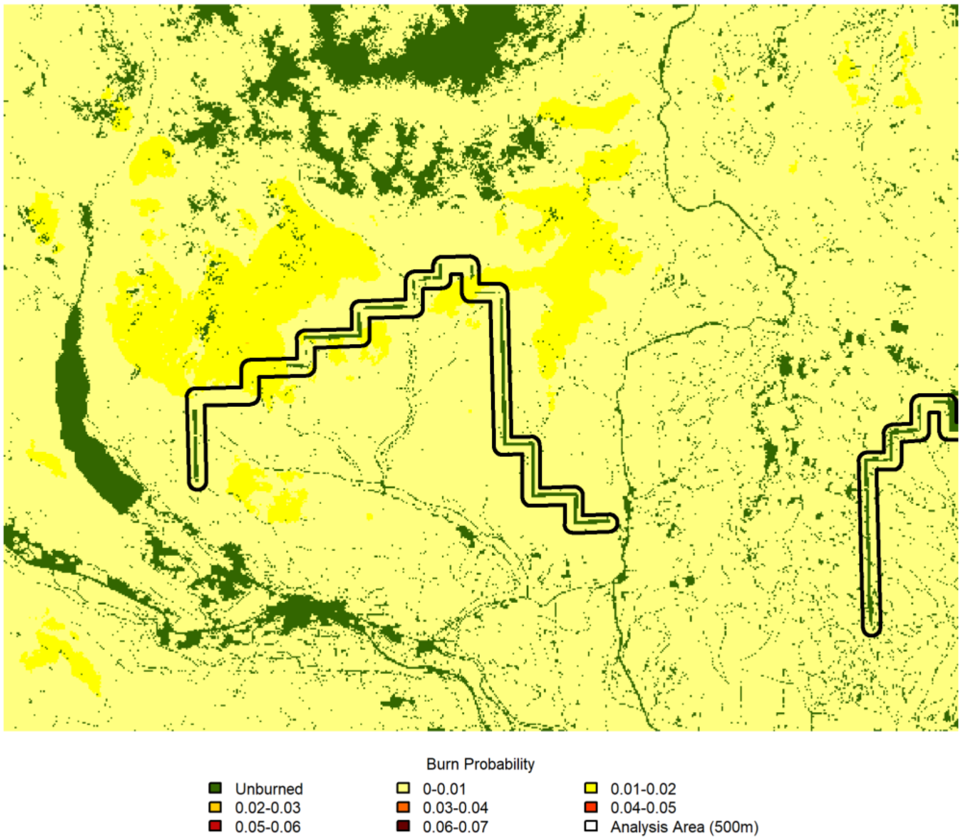
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 250 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



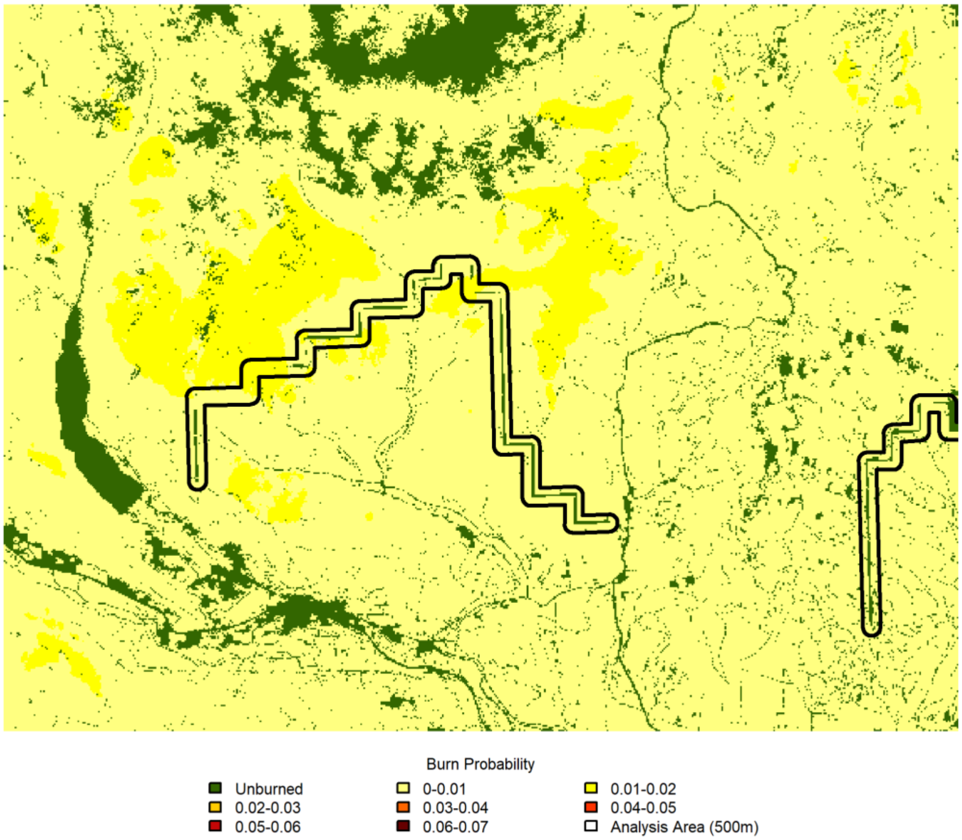
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



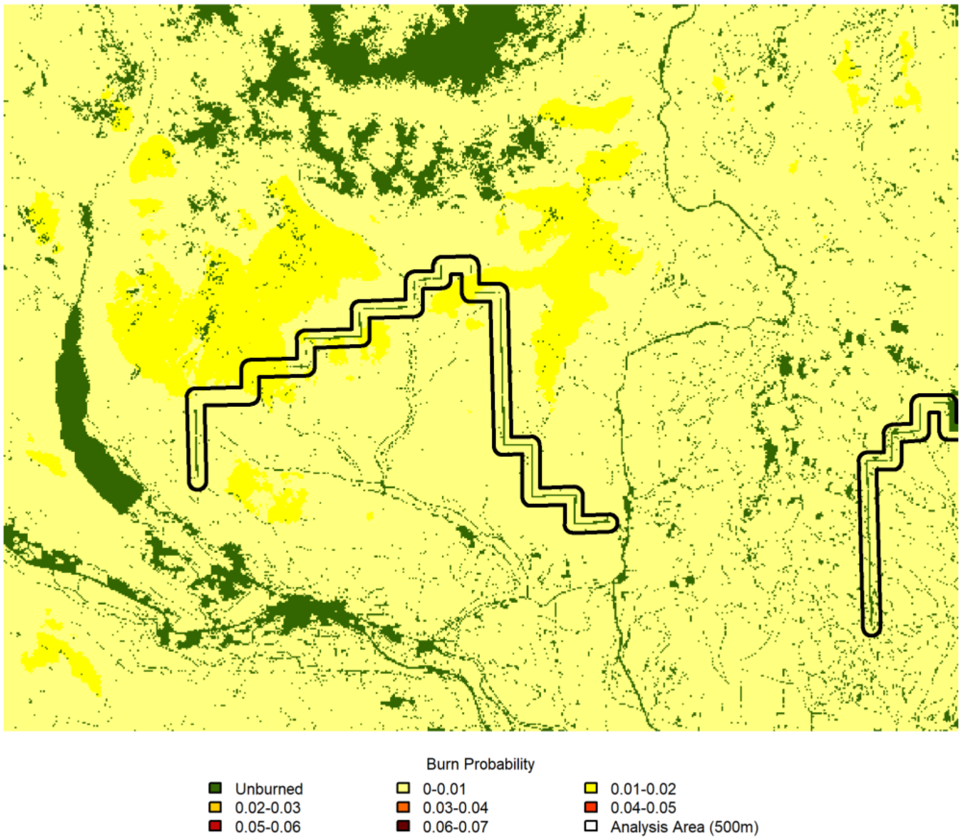
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 200 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



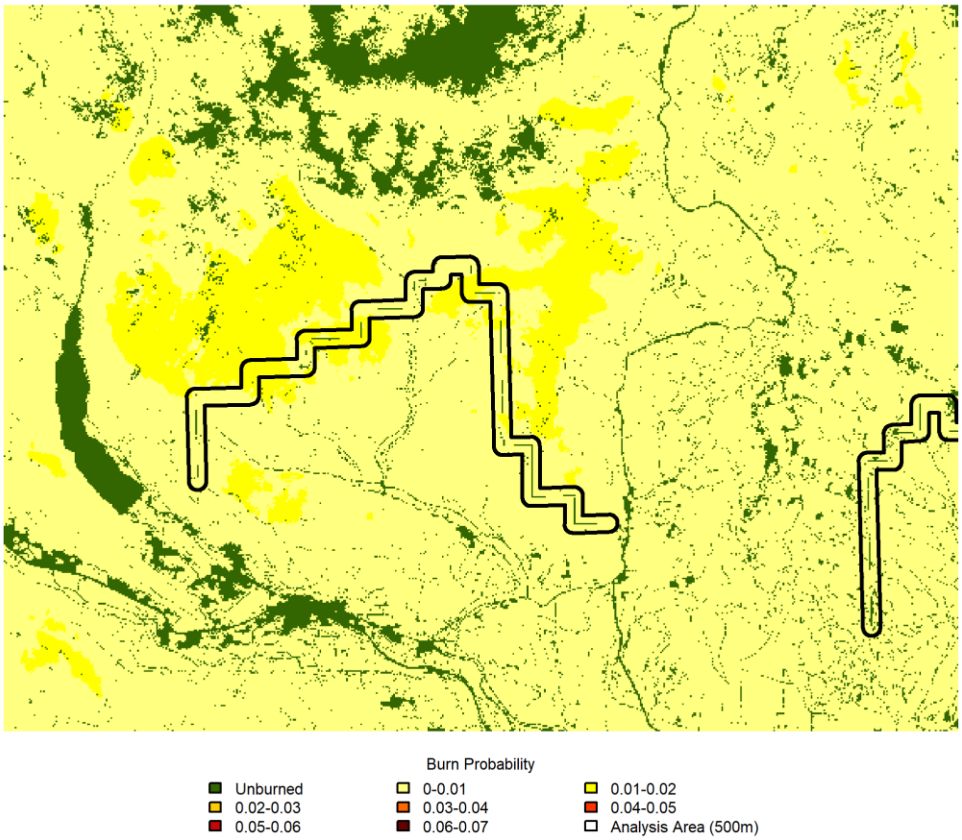
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



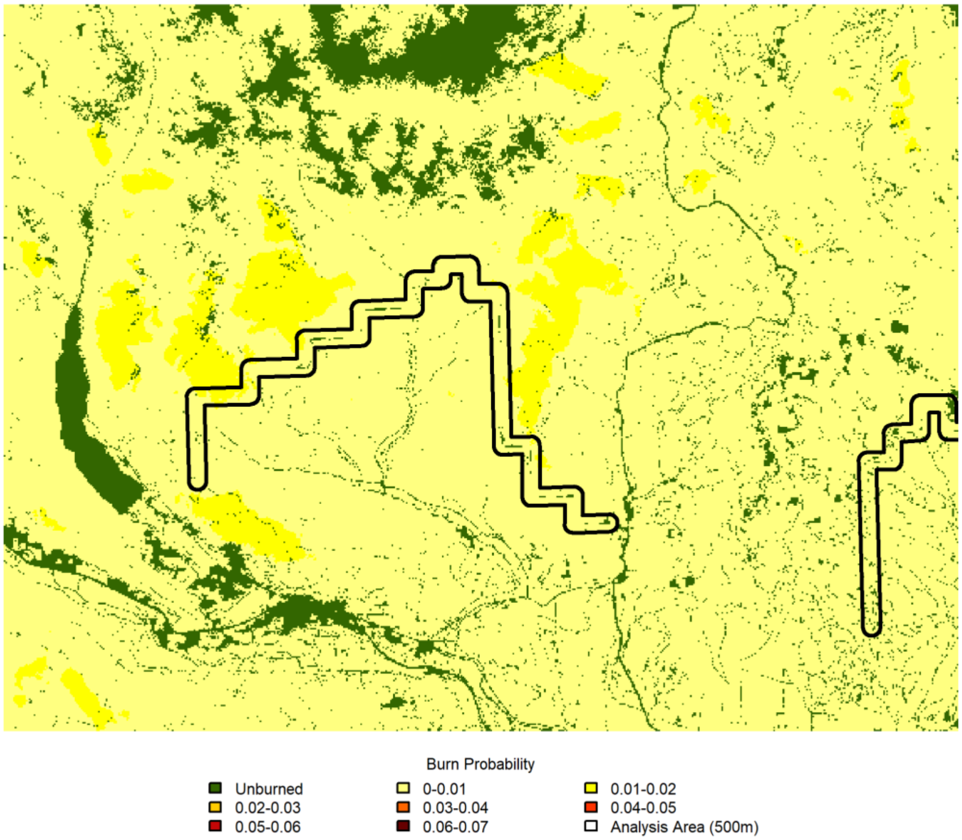
Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 100 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



Clearcut with Prescribed Burn Simulations
Treatment Width per Entity: 50 m
Wind Direction: SSW Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



Shadetree with Prescribed Burn Simulations
Treatment Width per Entity: 150 m
Wind Direction: NNE Wind Simulation
Weather: Jolly Mountain Weather
Treatment Placement: Collaborative Treatment



APPENDIX F

Example .kcp file for use in FVS to crosswalk FARSITE outputs to metrics more suitable for use by forest managers.

For a thinning to a specific canopy closure amount based on starting density within the stand, the combination of keywords TCONDMLT and THINCC can be used. The use of TCONDMLT prior to THINCC allows the user to utilize the removal priority formula, which allows for the thinning of the densest portion of the stand first. The keyword sequence below would thin from below, starting at the inventory point with the most trees per acre as calculated by FVS, to a residual canopy closure of 60%, thinning only Western redcedar (RC) up to 25 inches DBH. If the condition is not met within the first inventory point, then the second densest point in tress per acres is thinned until the overall stand canopy closure measures 60%. Users can specify tree species to be thinned, dbh range and height range.

```
* TCondMLT: Change the impact of tree value class on the determination of removal priority.
TCondMLT     2022     0     0     0     0    1000
* Thin to a residual percent canopy cover
ThinCC       2022    60     1    RC     0    25     1
```

Information regarding each keyword can be found within Essential FVS (Dixon 2022) and the Keyword Reference Guide for the Forest Vegetation Simulator (Van Dyck and Smith-Mateja 2022).

In order to view outputs from the above thin-from-below, a second .kcp file can be utilized with the following keywords: ATPA, ATOPHT, AADBH, ABA, ASDI, CrBaseHt, FuelLoad(1,1), FuelLoad (2,2), FuelLoad(3,3), FuelLoad(4,9). These keywords would tell the user the after-thinning trees per acre (ATPA), after-thinning average top height (ATOPHT), after-thinning quadratic mean DBH (AADBH), after-thinning basal area per acre (ABA), after-thinning stand density index (ASDI), crown base height (CrBaseHt), and fuel loadings for 1-hrs (FuelLoad(1,1)), 10-hrs (FuelLoad(2,2)), 100-hrs (FuelLoad(3,3)), and 1000-hrs (FuelLoad(4,9)). This information can be outputted to an access database with the following .kcp file.

```
StrClass
Compute         0
SBAa = ABA
TPAa = ATPA
SDI = ASDI
TopHt = ATOPHT
BQMD = AADBH
cbh = CrBaseHt
cbd = CrBulkDn
* FUELS
fuel1hr=FuelLoad(1,1)
fuel10=FuelLoad(2,2)
fuel100=FuelLoad(3,3)
fuelcwd=FuelLoad(4,9)
End
Database
DSNOut
FVSOut.mdb
Compute         0      1
End
```