Stanford University

Wildfire Management Plan 2021

September 2021

SIG

vibrant planet

PANORAMA ENVIRONMENTAL, INC.

Stanford University

Wildfire Management Plan 2021

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Prepared for:

Stanford University
ESF – 480 Oak Road
Stanford University Fire Marshal's Office
Stanford, CA 94305-8007

Prepared by:

Tania Treis
Panorama Environmental, Inc.
717 Market Street, Suite 650
San Francisco, CA 94103
650-373-1200

Scott Conway
Vibrant Planet
PO Box 5940
Incline Village, NV 89450

Phil Dye
Prometheus Fire Consulting
PO Box 41187
San Jose, CA 95160

Spatial Informatics Group
2529 Yolanda Ct.
Pleasanton, CA 94566

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Preamble

Stanford University (Stanford) lands encompass over 8,100 acres spread across six jurisdictions. The campus landscapes range from built urban settings to areas of expansive foothills and oak woodland. Stanford recognizes that the threat of wildfire across the campus and in the region varies from low in urban areas to very high in wildland areas, and a wildfire could quickly impact large areas of undeveloped land, structures, and facilities. The location of Stanford lands epitomizes the threats of the wildland–urban interface (WUI). The WUI is also the site of unique resources including critical infrastructure, Jasper Ridge Biological Preserve (JRBP), and irreplaceable research facilities such as the SLAC National Accelerator Laboratory.

In September 2019, the Stanford University (Stanford) Fire Marshal's Office (SUFMO) published the Stanford University Wildfire Management Plan (2019 Plan). The 2019 Plan addresses wildfire threats, prevention measures, and wildfire response. While the 2019 Plan provided a solid framework, Stanford recognized that the plan would benefit from a deeper analysis into wildfire hazards and risks, the identification of specific methods and locations of wildfire hazard mitigation through fuel (vegetation) treatment design, and the identification of a program of vegetation management projects that includes coordination and collaboration with the jurisdictions and agencies within which Stanford lands are located. The 2021 Wildfire Management Plan (2021 Plan) was created to provide a "deeper dive" than 2019 Plan with these important details for a more comprehensive and robust plan. The 2021 Plan more explicitly addresses the vegetation management needed for defensible space, ignition prevention and containment, and ecosystem health. The 2021 Plan uses the 2019 Plan framework and content and further supports that work with supplemental data and analysis to inform outcomes and conclusions in Chapter 2: Wildfire Threat Assessment and Chapter 3: Prevention Measures, a. Fuel Management of the 2019 Plan, effectively replacing those chapters of the 2019 Plan. Other components of the 2019 Plan related to other fire prevention methods beyond fuel management (e.g., home hardening, fire weather monitoring), wildfire response, and roles and responsibilities and communication with the community have been copied into this 2021 Plan as Chapters 6, 7, and 8, with no modification from how they appeared in the 2019 Plan.

It is important to note that the 2021 Plan describes a fluid and dynamic fuel management program, with the actions prescribed herein designed to be constantly adapted to the changing climatic conditions and modifications of the built environment over time.

1 Introduction

1.1 Stanford's Goal and Objectives for Fuel Management

The goal of the 2021 Plan is to define a program of strategic wildland fuels and fire management, based on sound science and state-of-the-art risk modeling, to substantially reduce fire hazards on Stanford's lands. The objectives of the 2021 Plan are to:

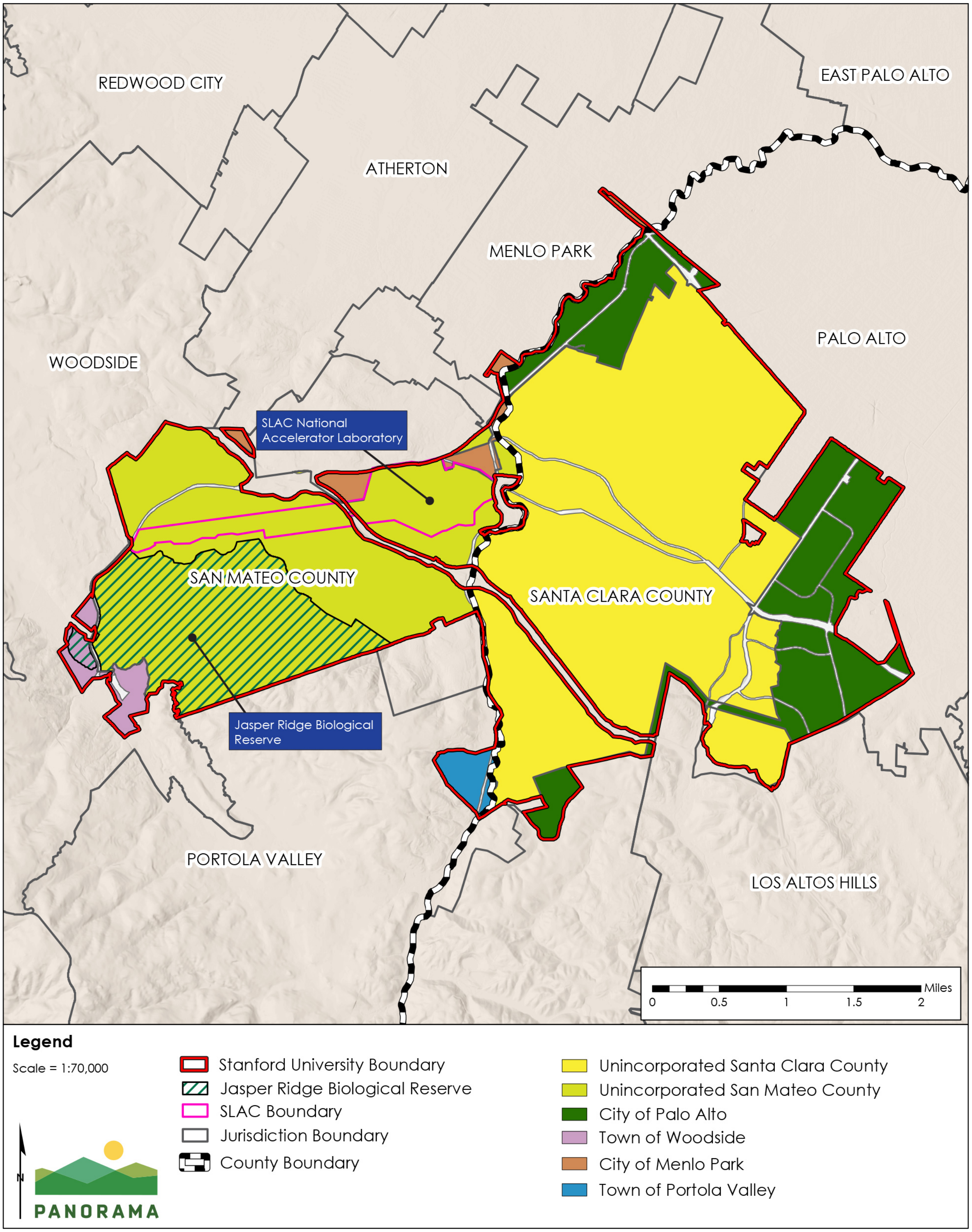
- Identify high fire-hazard areas using modeling techniques;
- Identify important resources and assets on Stanford's lands for protection;
- Define and prioritize vegetation management treatments to protect the most at-risk resources;
- Coordinate fuels management activities with Stanford functions;
- Coordinate with adjacent jurisdictions and communities on fuel management activities in neighboring areas; and
- Include ways to identify and incorporate new technologies and methods of fuel management over time to maximize program efficiency.

The 2021 Plan area, including the jurisdictions within which Stanford's land are located is shown in Figure 1-1.

1.2 Scope of the 2021 Wildfire Management Plan

The 2021 Plan addresses all of Stanford lands, with a focus on areas where wildfire hazards generate the greatest risks to life, property, and other high value resources as defined through a detailed wildfire risk assessment. The wildfire hazard for Stanford lands and the surroundings was determined through development and implementation of a tailored, spatially dependent framework that utilized industry-standard probabilistic fire models designed specifically for land management. In addition, time was invested to conduct ground-truthing work (extensive site visits to assess and document wildfire hazard areas) that was used to further confirm fire modeling work. The outcome of the modeling and ground-truthing was then used to identify the areas of moderate and high fire risk in relation to the type of land use and vegetation and the High Valued Resources and Assets (HVRAs) identified on the campus. Based on this assessment, fuel treatment methods and locations were identified and prioritized on a parcel-by-parcel basis. The 2021 Plan also includes implementation and annual and long-term planning, integrating regulatory considerations, and outreach and coordination with adjacent and underlying jurisdictions. The 2021 Plan is a living document and will be frequently updated as annual work is completed and results assessed and incorporated, and as regulations may change.

Figure 1-1 Jurisdictional and Municipal Boundaries within Stanford Lands



Source: *(Tele Atlas North America, Inc., 2019; Bay Area Open Space Council, 2011)*

1.3 Team Development Process

After the 2019 Plan was completed, Stanford established a cross-departmental working group that set out to enhance the wildfire planning work by building on the data collected using GIS mapping and other tools to accurately identify how best to manage fire mitigation and prevention practices on Stanford lands. In preparation for the 2021 Plan, the working group identified existing constraints and opportunities, hosted multiple internal meetings, and developed a Request for Proposals to hire a consultant team to spearhead the effort. The working group also identified liaisons from SLAC and JRBP to participate in the effort.

1.4 Key Terms

The following terms used in this 2021 Plan are defined as follows (Scott, Thompson, & Calkin, 2013):

- **High Valued Resources and Assets (HVRAs):** Valued elements of the manmade and natural environment.
- **Hazard:** A process, a phenomenon, or a human activity that may cause loss of life, injury, or other health impacts, property damage, social and economic disruption, or environmental degradation.
- **Exposure analysis:** An analysis that explores the potential spatial interactions of HVRAs with risk factors—fire likelihood and fire intensity—without considering how these factors affect HVRA value.
- **Effects analysis:** An analysis that explores the response of HVRAs to varying levels of these risk factors. Fire effects are often expressed as a percentage loss of value for a given intensity level.
- **Restorative Return on Investment:** The composite of (1) the probabilistic change in the effects of unplanned disturbance(s) on value (i.e., change in risk or "Change in Disturbance Effects") and (2) the probabilistic effect that treatments have on value, regardless of disturbances (i.e., "Treatment Effects").
- **Treatment or prescription:** A method for managing vegetation, such as manual or mechanical thinning, prescribed burning, or grazing, applied to a specific area.
- **Wildfire risk:** The likelihood of wildfire occurring, associated fire behavior, and impacts of the fire on HVRAs.
- **Area of Interest (AOI):** Area examined and considered through fire modeling.
- **Relative Potential Socio-Economic (ROSE)Value:** Normalized values assigned to HVRAs based on survey ratings of their replaceability, uniqueness, and contribution to safety.

2 Wildfire Risk Assessment and Plan Development Methods

2.1 Concepts

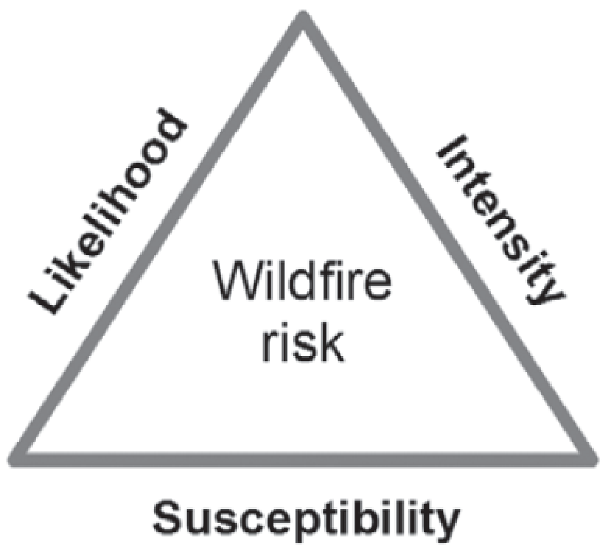
2.1.1 Wildfire Risk Assessment Concepts

A wildfire risk assessment was undertaken to inform and serve as the foundation of the 2021 Plan's recommended fuel management plans. A summary of the components of the assessment and key concepts needed to understand the 2021 Plan are presented in this chapter. A baseline report (Panorama Environmental, Inc., 2021a) was prepared that summarizes existing practices on campus; existing conditions including past wildfires, on-going wildfire management, wildfire hazards and risks, and ignition sources; fire suppression capabilities; and campus social, cultural, plant, wildlife, hydrology, and soils resources. The background research and information also informed the risk assessment.

Three main components comprise wildfire risk: likelihood, intensity, and susceptibility to effects. Wildfire hazard, HVRA response ("susceptibility"), and HVRA value are integrated to determine "risk" (Scott, Thompson, & Calkin, 2013), visualized in the Wildfire Risk Triangle in Figure 2-1. Wildfire "hazard" is the probable intensity of fire (i.e., conditional flame length multiplied by the burn probability). The term "risk" is used to represent the probable HVRA value change associated with a disturbance. Because "risk" is typically associated with "loss," areas where HVRA loss would occur with a given disturbance intensity and probability are represented with positive values; negative risk values in the results are areas that would benefit from the wildfire intensity that is likely to occur in that location.

Wildfire intensity (and consequently, HVRA risk) can be altered depending on vegetation treatments. A critical piece of the workflow developed for the 2021 Plan was to take the typical risk assessment framework a step further by assessing the change in wildfire intensity associated with recommended treatments and then evaluating how that change in wildfire intensity impacts HVRA risk. The Change in Disturbance Effects were thereby quantified as the difference in HVRA risk across the landscape pre and post treatment.

Figure 2-1 Components of Wildfire Risk

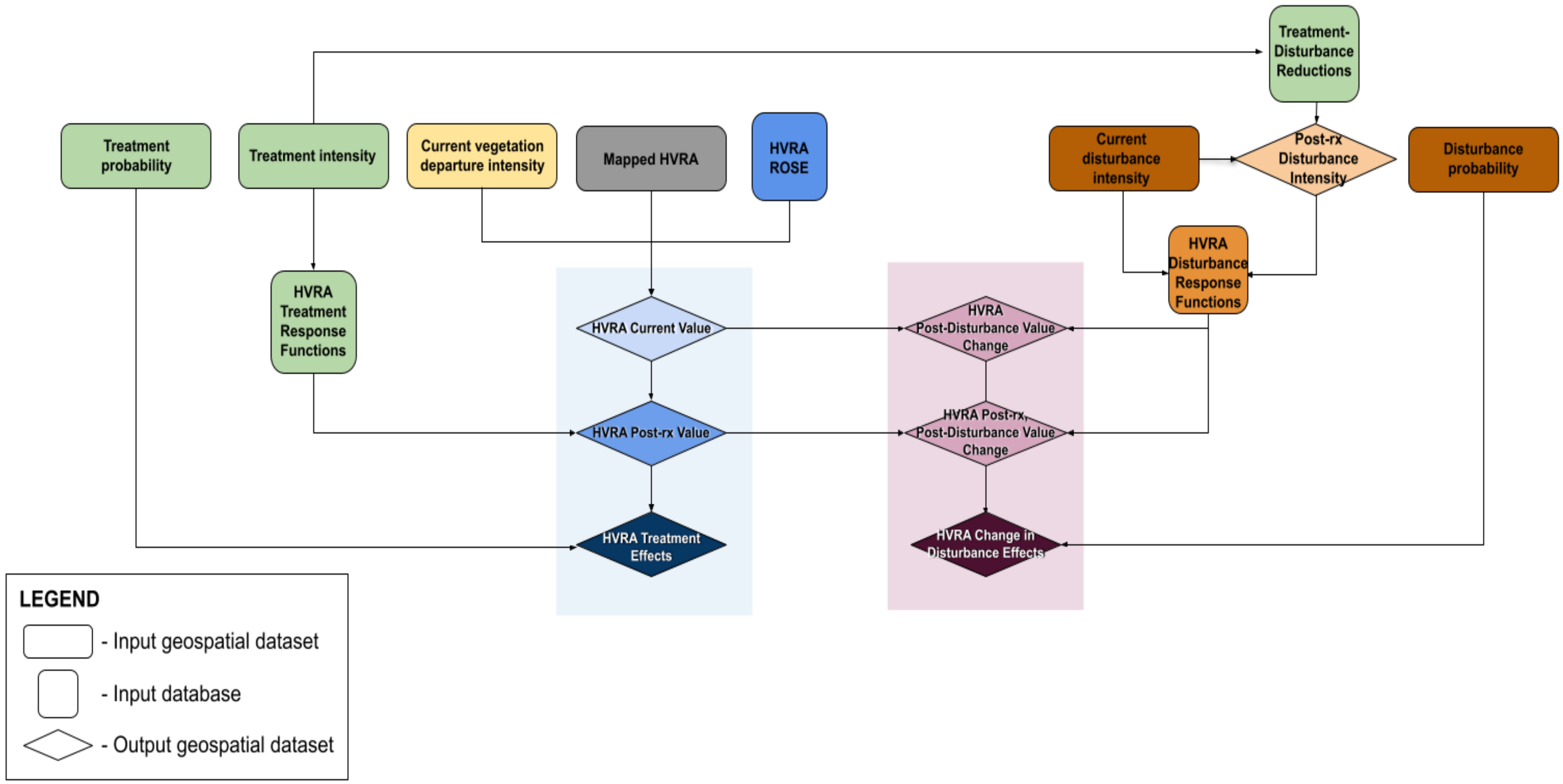


2.1.2 Restorative Return on Investment Concept

The fundamental factor driving fuel treatment efforts is often the need to reduce the risk associated with disturbances, such as wildfire and drought. Frameworks for prioritization of fuel treatment efforts are consequently entirely related to the co-location of the highest hazard areas with the highest value areas. These risk-based frameworks do not assess the impacts of proposed treatments, either on (1) the change in risk associated with disturbance(s) or (2) the functional value of the landscape itself, regardless of disturbance(s). Although risk should certainly be a piece of information that helps inform decision-makers about areas that need treatment, a treatment and disturbance effects-based framework helps provide decision-makers information about the where, when, why, and how of vegetation management plans so that they can better understand the return on investment from performing treatments.

In developing the 2021 Plan, a treatment/disturbance effects-based framework was applied to derive landscape-scale information about restorative return on investment from performing vegetation management treatments. The restorative return on investment is the composite of (1) the probabilistic change in the effects of unplanned disturbance(s) on value (i.e., change in wildfire risk, or "Change in Disturbance Effects") and (2) the probabilistic effect that treatments have on value, regardless of disturbances (i.e., change in ecological function, or "Treatment Effects"). The framework is rooted in the methodology laid out in GTR-315 by Scott, Thompson, and Calkin (2013) but greatly expands the evaluation of "effects" by accounting for impacts of not only unplanned disturbances but also planned disturbances (i.e., vegetation management/fuel treatments). The general workflow that was used to determine HVRA Change in Disturbance Effects and Treatment Effects is depicted in Figure 2-2.

Figure 2-2 Workflow for Calculating HVRA Restorative Return on Investment



The HVRA Treatment Effects and Change in Disturbance Effects were then geospatially aggregated to treatment areas and grouped into "pillars" based on similar treatment objectives. Because of Stanford's overarching management objective of minimizing risk through vegetation management treatments while also minimizing negative ecological impacts of those treatments, a Restorative Return on Investment (RROI) metric was calculated for each pillar that summed the Change in Disturbance Effects with any zero or negative Treatment Effects. Effectively, this inclusion of only zero or negative Treatment Effects (rather than all Treatment Effects, including positive ones) ensures that treatments are not driven to areas solely due to their benefit on ecological function of those areas. Areas with positive RROI would indicate that the risk reduction was greater than negative ecological effects of treatment (if any). Conversely areas with negative RROI would indicate that the risk reduction (if any) did not outweigh negative ecological impacts of treatments. Ultimately, the geospatial datasets of pillar RROI are used to determine the where, when, why, and how for the vegetation management plan as part of the treatment prioritization process.

2.2 Summary of Assessment Process Undertaken to Develop the 2021 Plan and Results

2.2.1 Fire Behavior Modeling

Fire behavior modeling was performed using the Interagency Fuel Treatment Decision Support System (IFTDSS). IFTDSS is a web-based application designed to make fuels treatment planning and analysis more efficient and effective. IFTDSS provides access to data and models through one simple user interface (US Department of Interior, 2020). A 3-mile analysis buffer was applied around Stanford lands. The Fire Behavior Fuel Model (FBFM40) used included the following:

- LANDFIRE 2016 FBFM40 was manually updated within the Stanford area of interest (AOI) based on site visits and input from Stanford's staff.
- Areas outside Stanford AOI were updated with the San Mateo Countywide Fine Scale Vegetation Map and Landscape Database Project lidar-based Fuel Model (same classifications as FBFM40) released in 2021 (San Mateo County Resource Conservation District, 2021).

Stochastic fire simulations (27,690 random ignitions with 97th percentile fire weather) were then performed using the Minimum Travel Time (MTT) probabilistic model to generate burn probability and average fire intensity (i.e., conditional flame length) maps.

The outcome of the fire behavior modeling including flame lengths, burn probabilities, and integrated hazards are shown in Figure 2-3 through Figure 2-5. Fire behavior on Stanford's campus was found to range from low to high, with the highest hazard areas corresponding to the western areas of campus, such as at Jasper Ridge Biological Preserve, in areas near Portola Valley and the Town of Woodside, along the SLAC facilities, and in the grasslands and oak

Figure 2-3 Conditional Flame Lengths Indicating Potential Fire Intensity

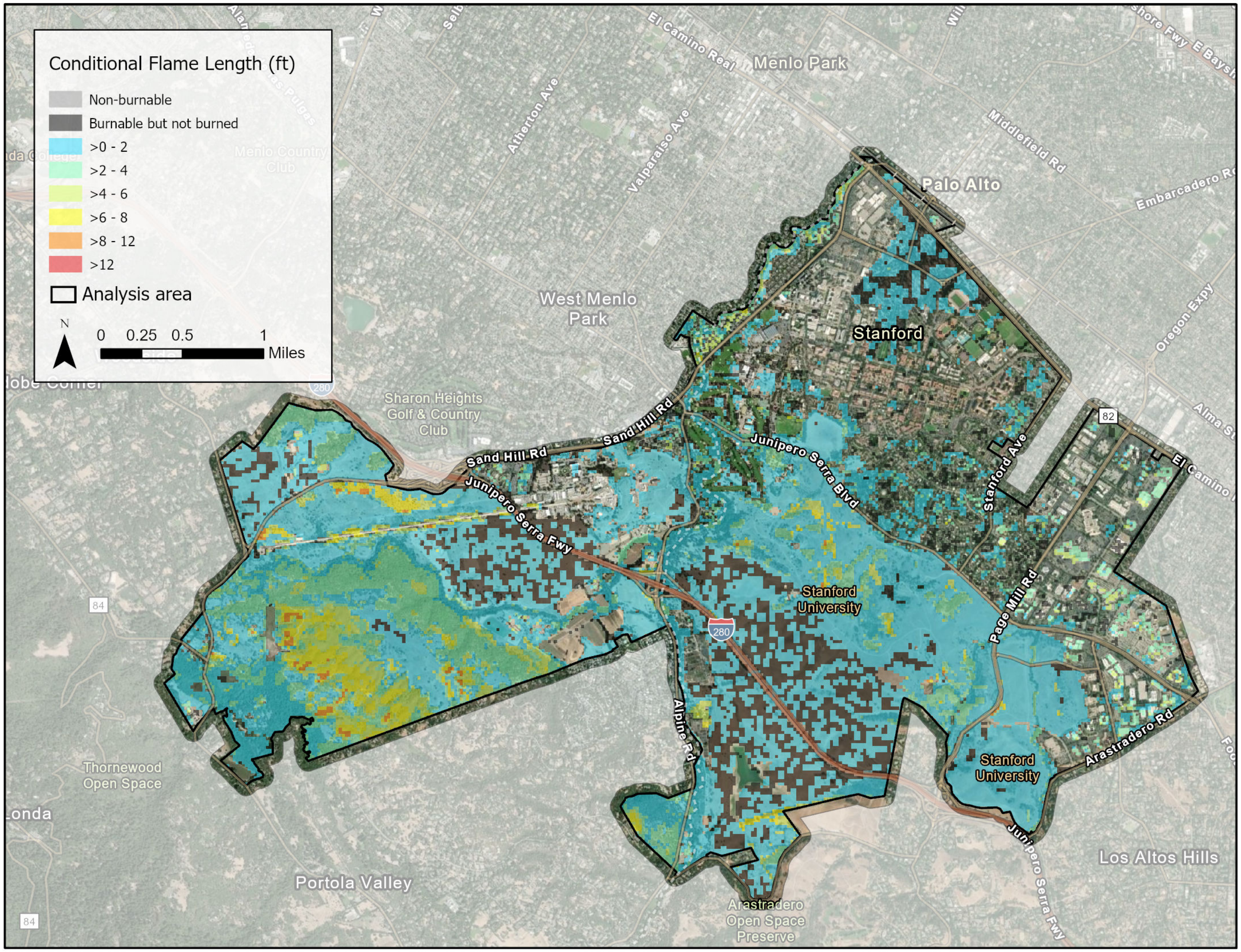


Figure 2-4 Burn Probability Indicating Areas Most Likely to Burn in Wildfire

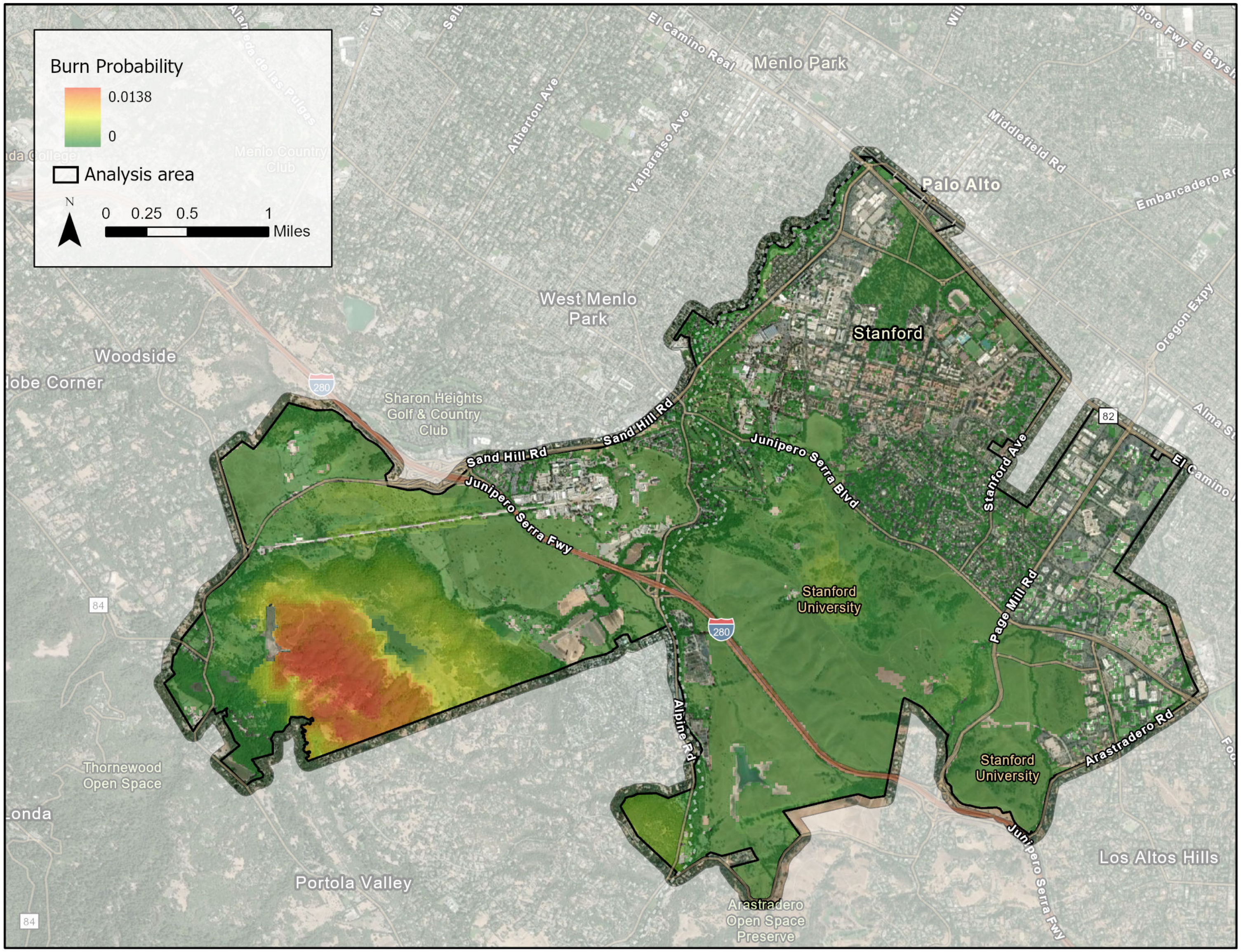
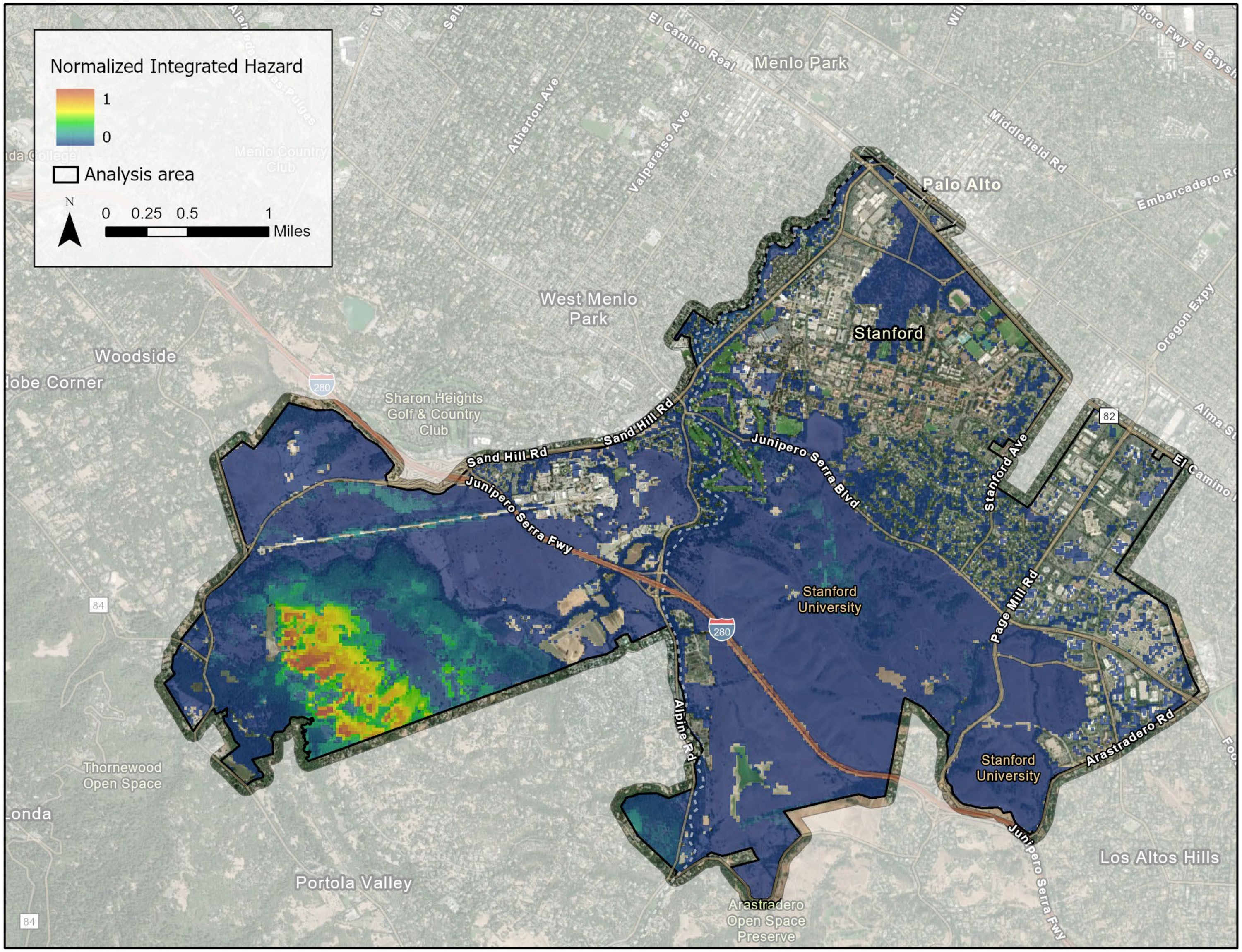


Figure 2-5 Normalized Wildfire Hazard on Stanford Lands



*Notes: Hazard = Burn Probability * Conditional Flame Length. Values were rescaled to a 0-1 range (0 lowest to 1, highest relative integrated hazard) - this figure points to the areas of highest wildfire hazard relative to other areas of the map.*

savannah south of Junipero Serra Boulevard and north of Highway 280 near the Stanford Dish. Fire behavior in terms of flame lengths was greater than desired on approximately 1,400 acres of campus.

2.2.2 HVRA Analysis

Identification of HVRAs

The HVRAs were identified and mapped in coordination with Stanford University Fire Marshal's Office, Stanford Real Estate, Jasper Ridge Biological Preserve, and Land Use and Environmental Planning GIS staff. Knowing where wildfires are probable and the intensity at which they might burn gives the critical information needed to understand and address possible impacts to HVRAs. As mentioned earlier, HVRAs are valued elements of the man-made and natural environment. The identification and characterization of HVRAs on Stanford lands was a critical step in the risk assessment process. Three primary characteristics must be determined for each HVRA identified: spatial extent (mapping), response to wildfire (benefit or loss), and relative importance (Scott, Thompson, & Calkin, 2013). HVRAs must:

1. Have the ability to be mapped with some precision;
2. Be affected by fire or affect fire behavior; and
3. Have social value or value in excess of $10,000 for Stanford.

The categories and specific types of HVRAs present on Stanford lands were identified and mapped and are summarized in Table 2-1.

Table 2-1 High Value Resources and Assets Found on Stanford Lands

HVRA Category	Definition	Detailed HVRA Types
Structures	All structures within Stanford-owned lands including private non-Stanford lands within the overall Stanford land boundaries	• Primary residential • Commercial • Academic • Emergency
Utility Infrastructure	All aboveground utility infrastructure or groups of infrastructure that can be negatively impacted by fire	• Communication infrastructure (cell towers) • SLAC transmission lines • Primary distribution lines • Secondary distribution lines • Other electrical infrastructure (i.e., SLAC substations and generators)
Cultural	All cultural sites on Stanford lands that can be affected by fire	• Prehistoric • Historic

HVRA Category	Definition	Detailed HVRA Types
Recreation	All established and maintained recreation sites managed by Stanford	• Motorized and non-motorized trails • Recreation infrastructure and areas (e.g., bridges, golf course holes)
Biological/Research Areas	Areas of known sensitive species occurrence or habitat as well as important research areas	• Bay checkerspot butterfly habitat • Central California Coast steelhead habitat • California red-legged frog habitat • California tiger salamander habitat • Intergrade gartersnake habitat • Western burrowing owl habitat • Western pond turtle habitat • Golden eagle occurrence • Dirca occidentalis occurrence • Sagittaria sanfordii occurrence • Lessingia hololeuca occurrence • Bryophyte occurrence • Mature chaparral occurrence • The Dish • California tiger salamander research pitfall traps • JRBP research sites • Matadero/Deer Creek stream gages

Characterization of HVRAs

Once HVRAs were identified, they were then characterized using the following process:

- Calculated HVRA Relative Potential Socio-Ecologic (ROSE) value:
  - Base values derived from a Relative Importance survey, where HVRAs were rated in terms of their replaceability, uniqueness, and contribution to safety.
  - Normalized base values using geospatial HVRA metrics to calculate ROSE values
- Generated HVRA response functions to characterize the percent value change of each HVRA when exposed to wildfire and/or different vegetation management treatments. Most Anthropogenic HVRAs have a high change in value when exposed to fire due to fire's negative effects on these features. Ecological effect values are lower because fire can be beneficial at lower intensities.

The results of the HVRA analysis are summarized in Figure 2-6 and Figure 2-7. Understanding these values helps to determine the fire susceptibility of the HVRAs and Restorative Return on Investment (RROI), which is used to define and focus treatments. The HVRAs with the greatest Relative Potential Socio-Ecological Value per square meter were central energy structures, SLAC, academic structures, research areas, and communication infrastructure. Areas with concentrated and/or overlapping HVRA Relative Potential Socio-Ecological Value exhibited the greatest landscape value per square meter. These mapped HVRA values were assessed with

Figure 2-6 Cumulative HVRA Relative Potential Socio-Ecological Value per Square Meter (higher number is higher relative value)

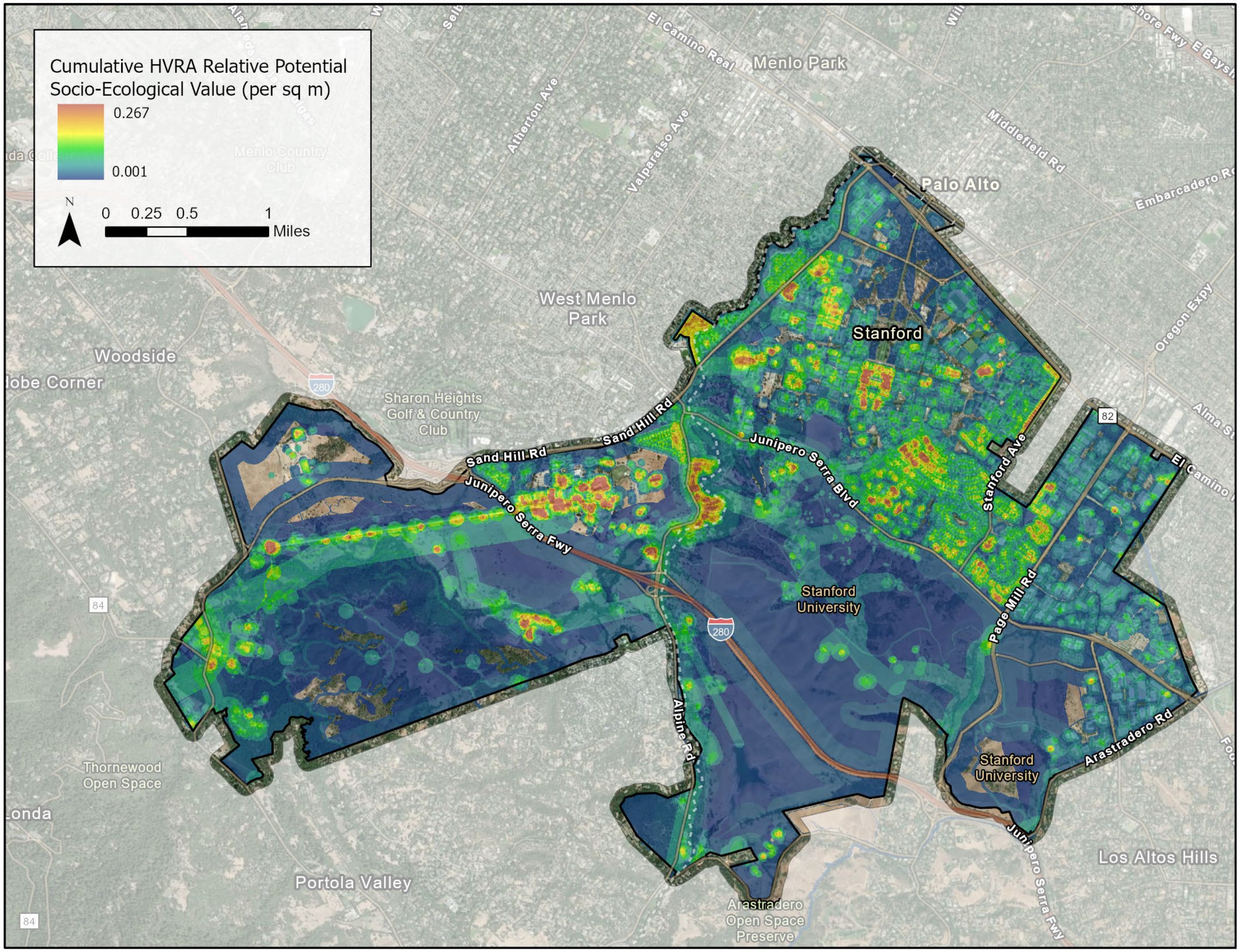
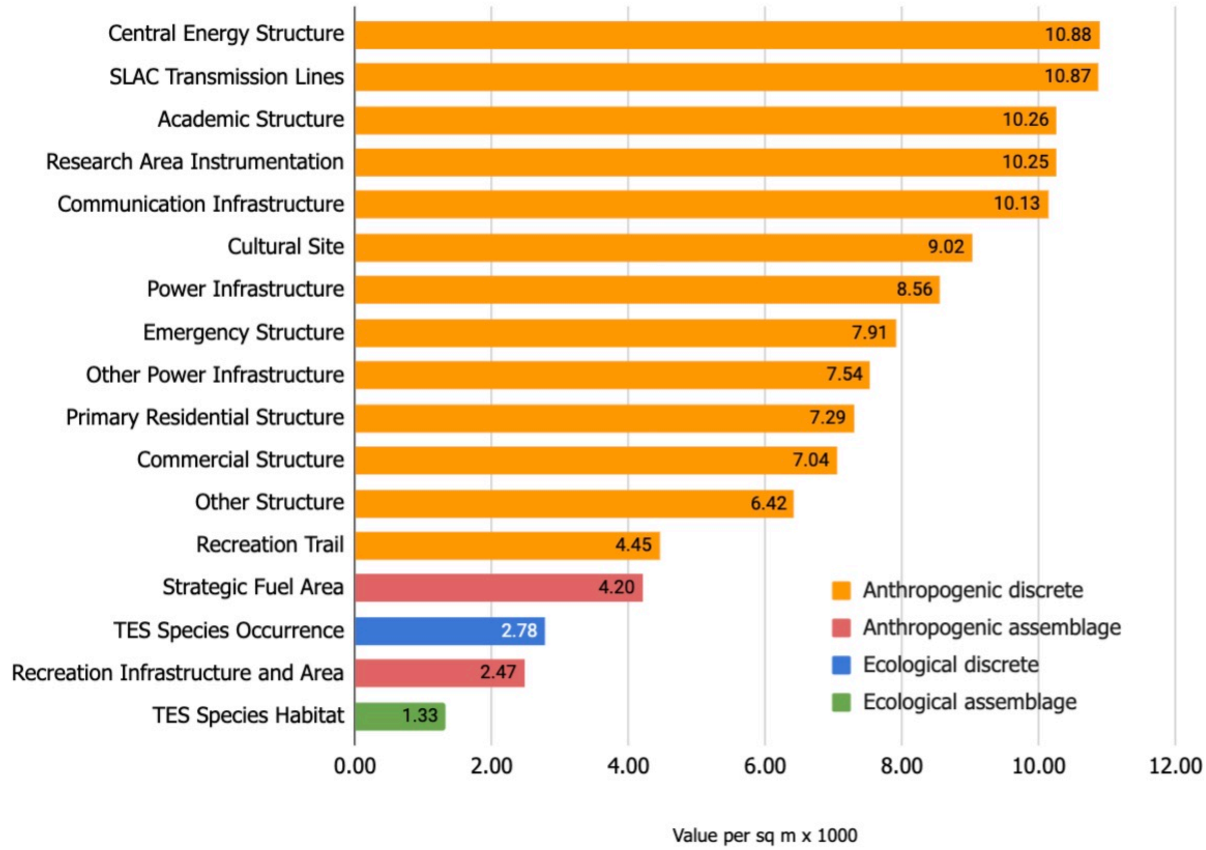


Figure 2-7 HVRA Relative Potential Socio-Ecological Value per Square Meter



mapped wildfire hazard to determine HVRA susceptibility and determine potential avoided loss from vegetation management treatments.

2.2.3 Stanford Management Area Groups and Treatment/Maintenance Objectives

Management areas and groups were identified, and prioritized treatment objectives were determined for each management group as follows:

- **Community Assets**: Protect nearby community infrastructure and assets.
- **Academic Assets:** Protect academic infrastructure and research facilities.
- **Asset Protection:** Minimize fire intensity/behavior.
- **Ecosystem Services:** Protect, enhance, and maintain ecological function.

Weights were assigned to each treatment objective, which was then used to calculate the total weighted RROI for each treatment area based on its management group and treatment objectives. See Section 3.2 for the map of the management area groups used in the plan.

2.2.4 Fire Susceptibility Analysis

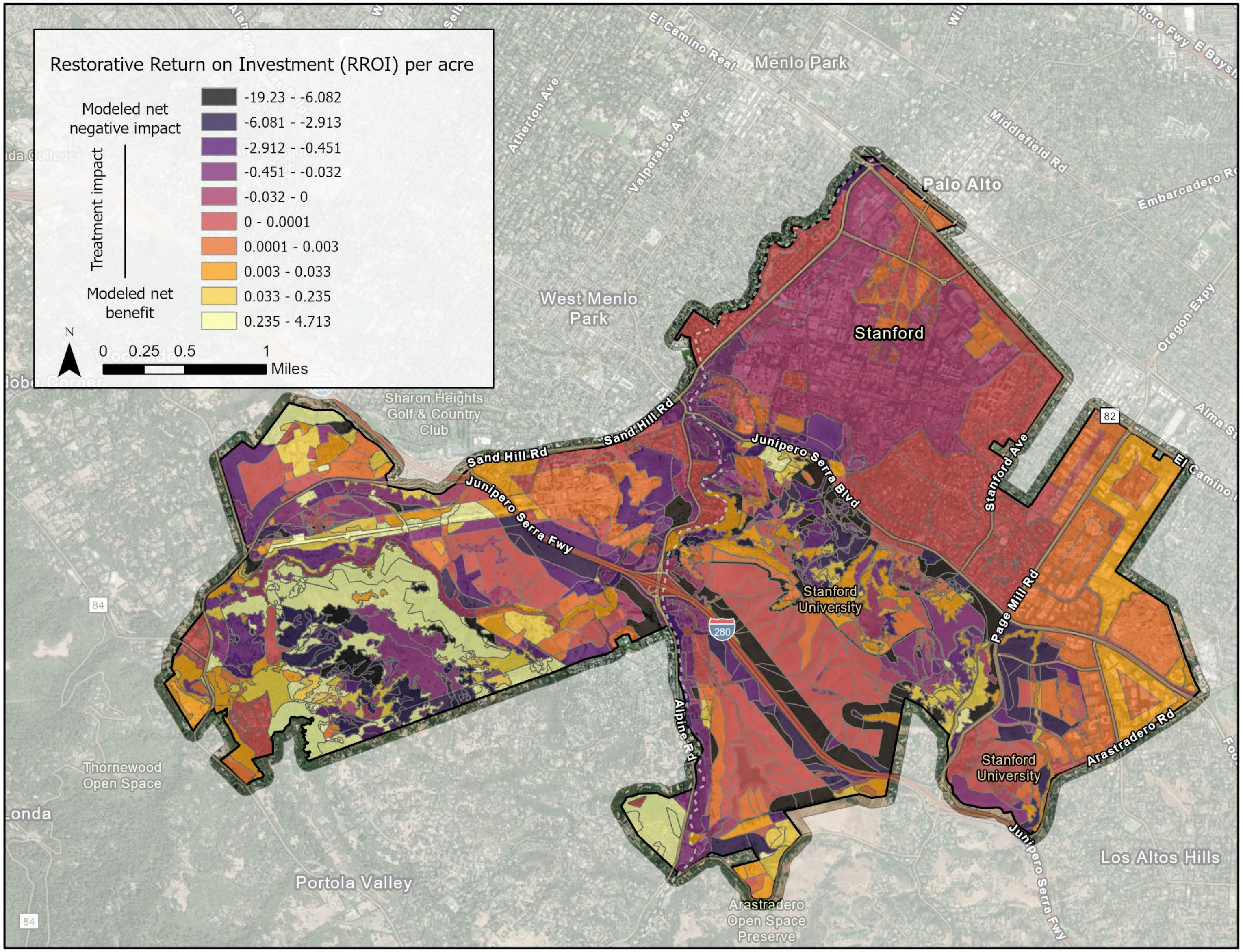
The fire susceptibility analysis included calculating the impact of vegetation management on wildfire avoided loss and ecological function (i.e., RROI) for each HVRA. HVRAs were aligned to the four treatment objectives to calculate RROI for each treatment objective, or pillar. Each pillar was weighted differently for each treatment unit area, depending on its Management Group Area designation. Lastly, a composite-weighted RROI was calculated based on management area treatment objectives for each treatment unit. The results are shown in Figure 2-8. Areas with higher, positive RROI value represent where there was a cumulative net benefit from treatment for reducing risk of value loss due to wildfire. Conversely, areas with negative

RROI indicate that the negative impacts from treatment on ecological function outweigh the wildfire risk reduction (if any).

2.2.5 Prioritization of Treatment Areas

The initial sequenced treatment areas were then generated using Forsys (Ager et al., 2020), a spatial-optimization model, with inputs of composite-weighted RROI and budget constraints. The final sequenced treatment areas were generated from small manual adjustments based on Stanford's feedback. See Section 3.2 for the maps of the prioritized treatment areas.

Figure 2-8 Composite-Weighted Relative Return on Investment per Acre



3 Vegetation Management Plan

3.1 Vegetation Treatment Prescriptions

3.1.1 Treatment Methods

Overview
This section describes the fuel treatment methods that will be utilized by Stanford to manage vegetation on their properties and around their infrastructure. Vegetation and fuels treatments will be conducted primarily using hand thinning and mechanical means (e.g., mowers, masticators) as well as limited grazing (prescribed herbivory). Cut or pulled vegetation may be trucked away from the treatment area. If the vegetative material is left in the treatment area, the material will be disposed of using pile burning or chipping. Prescribed burning may be implemented at a future date

Hand Thinning and Rearrangement Using Manual and Mechanical Methods

Description of Methods
Hand thinning is a method to thin out woody vegetation. Herbaceous vegetation grasses and forbs are generally unaffected when using this method. The methods used for hand thinning include cutting, pulling, dragging, and piling of vegetation.

Rearrangement utilizes methods to remove air from the combustible triangle equation by rearranging and distributing fuels relatively evenly across the treated ground. Treatment intensity is determined by the need to reduce the effects of unplanned disturbance, existing vegetation management plans, and understood operational or social limitations. Rearrangement methods can target either woody or herbaceous vegetation but can rarely significantly alter the structure of both at the same time. The methods used for different intensities of rearrangement include mowing, discing, and mastication by wheeled or tracked vehicles.

Cutting, a tool used in **rearrangement,** refers to the removal of the above ground portions of target vegetation. This activity encompasses pruning and limbing, designed to leave trees and shrubs alive but reduced in size; brushing and mowing activities, which remove all aboveground parts of a plant but leave the roots intact below ground; and tree felling, particularly of trees of smaller diameter and fire-prone non-natives such as eucalyptus. Depending on the species and the specific technique used, cutting may result in mortality, or it may simply reduce the height or seeding capacity of vegetation for one or more seasons. Girdling refers to removing a strip of bark from the entire circumference of a tree, which results in death in many species. Girdling is generally conducted with hand tools, specifically a hatchet or chainsaw. Pulling is used to completely remove target vegetation via uprooting.

Heavy diesel-powered equipment that could be used for cutting and pulling includes excavators, backhoes, and skid steers. Motorized heavy machinery is mounted with various mowing, mulching, chipping, and masticating heads for larger scale vegetation removal projects. Towable chippers or tub grinders may be used to chip cut material. Equipment operates both on road and off road; any equipment used off road is track-mounted to minimize soil disturbance and compaction. A backhoe or excavator may push or pull-down individual non-native trees, either with the arm or with a cable or chain attached to the arm. A backhoe or excavator may be used to dig out large weeds. Articulating arms are used to reach both outward and upward so that equipment can stay on existing roads. Heavy equipment is typically transported to an access point along an existing access road. The masticator size may vary depending on average tree removal size and equipment availability. Smaller masticator/mulching equipment is available and can be used on steeper slopes or smaller work areas.

Power hand tools used for cutting are most commonly brush cutters (metal blade), string trimmers (monofilament plastic line), and chainsaws but may also include power pole saws and hedge trimmers. These tools are powered by two-stroke engines that use a mix of gas and engine oil. Brush cutters and chainsaws work where heavy equipment cannot safely reach, generally more than 30 feet from a road edge and on slopes exceeding 30 percent. Chainsaws are used to limb trees or remove individual shrubs or trees. Brush cutters are used where stem diameters at cut level are small, or the vegetation is predominantly herbaceous. Cutting of herbaceous vegetation, including grasses and very young seedlings, is done with string trimmers.

Hand tools are used to perform fine-scale tasks and finishing work behind heavy equipment. Non-powered hand tools used for cutting are most commonly loppers, hand pruners, hand saws, and hatchets but may also include pulaskis, machetes, brush hooks or brush axes. Tasks include lopping, pruning, and girdling trees or large single-stem shrubs that do not resprout at the base.

Non-power tools used for pulling plants are primarily Weed Wrenches (trade name, similar to the Extractigator, Rootjack, or Pullerbear) for taprooted woody plants, hand-picks for tenacious herbaceous species, or occasionally dandelion poppers (curved short-forked metal rod attached to a handle) for levering rosettes out of the ground. Digging with shovels or pulaskis is usually limited to short depths around individual root crowns of weedy shrubs.

Removal of Biomass and Slash Material

With rearrangement, the biomass and material cut is left on site. Hand thinning results in the need to remove some vegetation once it is dragged and piled to a location. This section summarizes the ways in which material may be left on site or removed.

Pile burning is a method of biomass disposal that uses fire to eliminate piles of dried plant material. Piles vary in size from 5 to 10 feet in diameter and 4 to 6 feet in height. Piles are constructed in concert with brush or weed removal and are placed in openings away from power lines and tree canopies to allow for safe ignition. The composition of piles varies with vegetation type. Pile burning typically occurs between November and May on days when weather conditions meet the specifications and permitting of the Bay Area Air Quality Management District. Multiple piles may be burned on a single day. Drip torches or other ignition devices are used to start ignitions.

Chipping is another method of biomass disposal that uses a chipper or tub grinder to reduce branches and other woody material to chips. Most chippers are tow-behind models, but a tracked chipper may be used as a standalone piece of equipment as needed. Chippers vary in size and weight, largely depending on the maximum diameter of material it can chip, but all are diesel equipment.

Where cut material may not be chipped, burned, or removed, material may be lopped and scattered in place. Where feasible, cuts will be bucked in place; limbs will be removed; and the main trunk will be cut into lengths sufficient to ensure contact with the ground to accelerate decomposition. Lop and scatter is performed to meet or exceed requirements specified under the 2020 California Forest Practice Rules (CABOF 2020).

Use of Herbicides

Herbicides may be used sparingly to control invasive species following treatments and as a maintenance prescription and in accordance with all requirements that may apply, such Stanford's Santa Clara County General Use Permit Condition N.10. The cut-stump method of herbicide use is implemented to maintain treatment areas that contain decadent woody vegetation. Trees or large shrubs that require removal within the inner 30 feet of defensible space can effectively be treated with an application of herbicide to the cut stump. Although brush encroaching into disclines and fuelbreaks will primarily be removed with chainsaws, more stubborn woody plants may require treatment with herbicide by cut-stump method.

To meet legal requirements for defensible space, flammable vegetation within 30 feet of a structure may be spot-sprayed with herbicide. Spot-spraying with herbicide is sometimes conducted within this inner zone, especially next to buildings and fences where it is difficult to operate a brushcutter or mower safely without damaging the structure or equipment.

All pesticide use, handling, and application rules would be applied. Applications would likely be by hand spraying methods. The following table summarizes the types of herbicides typically used by treatment type.

Table 3-1 Herbicide Use

Herbicide	Typical Application	Treatment Type
Glyphosate Round-up Promax	Cut-stump	Invasive species or SOD removal Removal of vegetation for treatment
	Spot spray	Treatment of defensible space

Herbicide	Typical Application	Treatment Type
Clethodim, Aminopyralid, and Clopyralid	Spot spray	Invasive plant control
Imazapyr	Spot spray	Invasive plant control
	Cut-stump	Invasive plant control/SOD
Triclopyr BEE/TEA	Cut-stump	Invasive species or SOD removal Removal of vegetation for treatment
	Spot Spray	Invasive species removal or treatment of defensible space

Intensities of Treatment

The following tables describe the potential intensities of hand thinning and rearrangement.

Table 3-2 Hand Thinning Treatment Intensity Classes

Categories	Category Definition
Hand Thinning Intensity Class 1	Dominant and co-dominant woody vegetation is generally unaffected, while as much as 50% of subdominant woody vegetation is cut and removed. Herbaceous vegetation is minimally disturbed by foot traffic and the dragging or piling of cut woody vegetation. Soil disturbance is insignificant.
Hand Thinning Intensity Class 2	Treatment is generally consistently and equally applied across an area and is focused on significantly reducing the effects of high intensity fire. Dominant woody vegetation is generally unaffected. Co-dominant woody vegetation is affected by as much as 25%; however, overall canopy cover remains intact. As much as 90% of subdominant woody vegetation is cut and removed. Herbaceous vegetation is disturbed by as much as 25% through foot traffic and the dragging or piling of cut woody debris. Soil disturbance is insignificant.
Hand Thinning Intensity Class 3	Treatment is generally variable and is applied to mimic vegetation structure patterns that would exist in the area's intact disturbance regime. Dominant woody vegetation is affected by as much as 25% over the treatment area but can be as high as 90% in some areas and as low as 10% in others. Co-dominant woody vegetation is affected by as much as 50%, but effects are also variably distributed. Overall canopy cover may be reduced by as much as 40%. As much as 75% of subdominant woody vegetation is cut and removed but may also be left in concentrations. Herbaceous vegetation is disturbed by as much as 40% through foot traffic and the dragging or piling of cut woody debris. Soil disturbance is insignificant.
Hand Thinning Intensity Class 4	Treatment is generally consistently and equally applied across an area and is focused on eliminating effects of high intensity fire. Effects are substantial and often equate to a site change or ecological succession reset done for ease of maintenance over time. Dominant woody vegetation is affected by no less than 90%. Co-dominant woody vegetation is affected by no less than 95%. Canopy cover is all but eliminated. Herbaceous vegetation is disturbed by as much as 75% through foot traffic and the dragging or piling of cut woody debris. Soil disturbance is insignificant.

Table 3-3 Rearrangement Intensity Classes

Categories	Category Definition
Rearrangement Intensity Class 1	Predominantly achieved by mowers. Treatment is generally consistently and equally applied across an area and is focused on significantly reducing fine fuels and a fire's rate of spread. Woody vegetation is generally unaffected. Herbaceous vegetation is significantly affected at no less than 90 percent. Rearranged material is left on site. Soil is disturbed by as much 10 percent.
Rearrangement Intensity Class 2	Predominantly achieved by discing. Treatment is generally consistently and equally applied across an area and is focused on significantly reducing fine fuels and a fire's rate of spread for longer periods than mowing alone. Woody vegetation is generally unaffected, mostly because there should not be much woody vegetation on optimal discing ground. Herbaceous vegetation is significantly affected at no less than 90 percent. Rearranged material is left on site. Soil is disturbed by as much 90 percent. It is important to note that this treatment creates ideal conditions for invasive plant establishment where treated.
Rearrangement Intensity Class 3	Predominantly achieved by mastication using wheeled or tracked machines. Treatment is generally consistently and equally applied across an area and is focused on significantly reducing fine fuels and ladder fuels, which decreases a fire's rate of spread and the potential for crown initiation. Dominant and co-dominant woody vegetation is generally unaffected. As much as 90 percent of subdominant woody vegetation is affected. Herbaceous vegetation is disturbed by as much as 50 percent. Rearranged material is left on site. Soil is disturbed by as much 15 percent.
Rearrangement Intensity Class 4	Predominantly achieved by mastication using tracked machines. Treatment is generally consistently and equally applied across an area and is focused on significantly reducing fine fuels and ladder fuels and by reducing a canopy's bulk density, which decreases a fire's rate of spread, the potential for crown initiation, and the ability for sustained crown fire. Dominant woody vegetation is generally unaffected. Co-dominant woody vegetation is affected by as much as 25 percent. Overall canopy cover may be reduced by as much as 25 percent. As much as 90 percent of subdominant woody vegetation is affected. Herbaceous vegetation is disturbed by as much as 35 percent. Rearranged material is left on site. Soil is disturbed by as much 20 percent.
Rearrangement Intensity Class 5	Predominantly achieved by mastication using tracked machines. Treatment is generally consistently and equally applied across an area and is focused on eliminating effects of high intensity fire. Effects are substantial and often equate to a site change or ecological succession reset done for ease of maintenance over time. Dominant vegetation is affected by no less than 90 percent. Co-dominant vegetation is affected by no less than 95 percent. Canopy Cover is all but eliminated. Herbaceous vegetation is disturbed by as much as 35 percent. Rearranged material is left on site. Soil is disturbed by as much 20 percent.

Prescribed Herbivory

Description of Method

Grazing, also known as prescribed herbivory, includes the use of livestock (sheep, goats, or cattle) to reduce fuel loads and suppress weeds. Grazing can be used to "spot treat" areas of brush or herbaceous plants that pose a fire hazard within and outside burned areas, particularly on steeper slopes or where other forms of equipment or crews cannot be efficiently utilized.

Grazing can be used in the WUI, with several examples available in the East Bay Hills that have been grazed multiple times. Temporary electrified fencing and water facilities are installed to allow grazing.

Intensities of Treatment

The following tables describe the potential intensities of herbivory.

Table 3-4 Prescribed Herbivory Intensity Classes

Categories	Category Definition
Herbivory Intensity Class 1	Predominantly achieved by cattle and horses that are grazing over a large range. Feed is supplemented. Benefit of grazing is the reduction of fine fuels and therefore a fire's rate of spread. Woody vegetation is generally unaffected. Some herbaceous vegetation is significantly affected at no less than 90 percent while other types are not preferred and are affected at rates closer to 20 percent. Soil is disturbed by as much as 15 percent.
Herbivory Intensity Class 2	Predominantly achieved by goats that are used for fuel reduction but either move through a focused area quickly or cover a large range. Feed is supplemented. Goat grazing helps reduce fine fuels and therefore a fire's rate of spread as well as some ladder fuel reduction, which reduces flame lengths. Woody vegetation is generally unaffected. Some herbaceous vegetation is significantly affected at no less than 90 percent while other types are not preferred but are still affected at rates closer to 50 percent. Soil is disturbed by as much as 15 percent.
Herbivory Intensity Class 3	Predominantly achieved by goats that are used for fuel reduction and are confined to a specific area for a considerable amount of time. Feed is supplemented, but less so than other intensity classes so that unpreferred vegetation is targeted. Goat grazing helps reduce fine fuels and a fire's rate of spread as well as some ladder fuel reduction and subsequent flame lengths. Shorter woody vegetation can be affected by as much as 50 percent. Some herbaceous vegetation is significantly affected at no less than 90 percent while other types are not preferred but are still affected at rates closer to 75 percent. Soil is disturbed by as much as 50 percent.

Prescribed Burning

Prescribed burning is a specific activity in which fire is ignited under specific environmental conditions to burn a well-defined area (burn unit) with discrete boundaries for the purpose of fuel load reduction. Burns are typically conducted between June and October to achieve the benefits of mimicking the historic fire regime and when vegetation is dry enough to carry a fire with minimal smoke production and minimal damage to the seed bank. Burn units are generally selected to take advantage of natural breaks such as reservoirs and access roads. Prescribed burning occurs in four distinct phases: planning and pre-treatment, the burn event, mop up, and rehabilitation. Pre-treatment and planning generally involves identification of the burn unit and control lines. Existing control lines are used as feasible and may be improved by clearing vegetation and dead trees as well as widening. New control lines may be installed where needed. Once the burn unit is prepared and fire prescription parameters are met, fire is carefully applied at one or more ignition points and allowed to run between control lines across the designated unit. The fire is typically ignited in the morning when temperatures and wind are low. During the burn, fire suppression equipment and personnel will be on –site, typically including fire engines and water tenders to provide control and on-scene safety. Mop-up begins immediately following the main burn event and continues until all burning material is extinguished or removed near the control lines. Rehabilitation consists of the decommissioning of control lines as well as follow-up weed control. Control line decommissioning is generally limited to the manual re-distribution of duff and brush back into the previously cleared lines. Prescribed burning is a cost-effective way to reduce fuel loads over larger acreages (up to hundreds of acres at a time).

Schedule and Timing of Treatments

Work generally occurs during daylight hours and following any requirements of the local jurisdiction for allowable work hours. Vegetation management activities will occur year-round, with certain tools and techniques confined to specific months due to limitations such as the wet season, species protection requirements, permitting restrictions, and official fire season as determined by the local fire agencies, as detailed in Table 3-5. Scheduling and timing will be dependent on annual staff capacity, funding, partnerships, and other resource availability.

Table 3-5 Summary of Typical Timing for Each Treatment Method

Treatment Type	Treatment Method	Typical Timing of Work[1]
Manual and mechanical	Mowing	April through December
	Discing and cutting	April through July
	Masticating	April through December
	Pulling	April through December
	Chipping	April through December
	Pile burning	October 31 to mid-May (wet season)
Chemical application	Various herbicides	Spring and summer
Prescribed herbivory	Livestock	Year-round

[1] All work timing is subject to weather restrictions to minimize potential for activities, such as mowing, to cause fires.

3.1.2 Prescriptions by Vegetation Types – Initial Treatments and Maintenance

Prescriptions for Grasslands

Initial treatments and on-going maintenance in grasslands will be similar. Work is mostly accomplished by **rearrangement**, using mechanical methods and **prescribed herbivory**. Mowing will be used to reduce potential fire spread and increase suppression efficiency in grasslands. Grasses in fuel reduction areas will be reduced in height to less than 4 to 6 inches, rather than cleared to mineral soil, to minimize soil erosion. Non-native and/or non-local shrubs and trees, decadent native trees and

> **Grassland Treatment Objectives**
> 1. Reduce fuel volumes and maintain fuel volumes consistent with low severity fire
> 2. Reduce volume of flammable fuels and cultivate plants on the landscape that are generally native and fire-resistant
> 3. Remove encroaching woody materials and non-native shrubs into grasslands

shrubs (i.e., old plants with a substantial number of dead limbs and twigs), and conifers under 8 inches in diameter at breast height (DBH) may be removed entirely. In some instances, limited dead and or downed material may be left in place as a habitat feature if it poses little overall fire risk. Cyclical mowing of grasses in defensible space areas and other ignition zones (around parking lots and picnic areas) will typically be performed annually. Discing may also be used by mowing a swath of 10 or more feet in width and tilling the soil, essentially to create a firebreak line in the grassland. Discing is often performed around potential ignition sources, such as under power lines.

Removal of encroaching woody material will typically occur once every 3 to 5 years in fuel breaks, depending on the rate of regrowth, typically using **hand thinning.** The maintenance of fuel reduction areas will be based on site-level assessments and implemented to maintain vegetation within the range of desired conditions using previously described tools and techniques. The work will be accomplished by top-cutting with power tools, such as string trimmers and brush cutters, with infrequent use of chainsaws and heavy equipment with mower heads mounted on articulating arms. Disposal of woody cut material (slash) less than 1 inch DBH will be performed by lopping and scattering. Larger stemmed material will be chipped on site and removed from the work area or piled and burned on site after curing for a minimum of 60 days. In some instances, limited dead or downed material may be left in place as habitat features if it poses little overall fire risk.

Prescriptions for North Coastal Scrub and Chaparral

Initial Treatments

Initial treatments will be accomplished primarily through **rearrangement** and **hand thinning**. Shrubs will be removed or thinned until spacing between individual shrubs or shrub islands is more than double the height of the canopy (e.g., for shrub canopies 6 feet in height, 12-foot gaps will be created). To create or maintain the required gap size, all target invasive species, dead shrubs, conifers, and chamise will be removed only as necessary. In some instances, limited dead and/or downed material may be left in place as habitat features if it poses little overall fire risk (e.g., dusky footed woodrat middens, single snags, logs). Rare native species may be pruned but not removed in their entirety. Removal of shrubs will be accomplished by top-cutting with hand tools such as chainsaws and brush cutters and with cutting or masticating heads mounted on heavy equipment. All stumps will be flush cut as low as possible parallel to the slope of the ground surface. Only resprouting target weed species will be completely uprooted if herbicides are not applied. Uprooting will be minimized on steep slopes. Disposal of the cut material will be performed by chipping, pile burning, or lopping and scattering.

Scrub and Chaparral Treatment Objectives

1. Reduce fuel volumes and maintain fuel volumes consistent with low severity fire
2. Reduce volume of flammable fuels and cultivate plants on the landscape that are generally native and fire-resistant
3. Establish and maintain fuel discontinuity
4. Maintain healthy, dominant, natural, fire-resistant vegetation cover that is consistent with historical densities in an intact fire regime

On-Going Maintenance

Cyclical maintenance in shrublands will typically be performed once every 3 to 4 years, though high densities of weeds may necessitate annual maintenance. The maintenance of fuel reduction areas will be based on site-level assessments and implemented to maintain vegetation within the range of desired conditions using previously described tools and techniques. Techniques could include **hand thinning, rearrangement**, and **prescribed herbivory**.

Prescriptions for Oak Woodlands and Hardwood Forests

Initial Treatments

Initial treatments are performed using **Hand Thinning** and **Rearrangement.** Understory shrubs, target weeds, and target conifers less than 12 inches DBH will be removed by the means described above. Depending on the site, more trees may need to be removed to reduce unnatural high densities of trees and to promote late seral conditions. For retained trees, dead limbs up to 12 feet above ground may be removed. Live limbs up to 12 feet above the ground or up to one third of the tree's total live foliage may also be removed. Select snags (standing dead trees) or limited downed woody debris may be retained for wildlife habitat, but snags or other material that pose a high risk of firebrand production in a fire event may be removed. Fuel reduction will be accomplished with hand tools and with cutting or masticating heads mounted on heavy equipment. Disposal of the cut material will be performed by chipping, pile burning, or scattering. Downed trees over 6 inches in diameter will be bucked in place, limbs will be removed, and the main trunk will be cut into lengths sufficient to ensure contact with the ground, chipped, or removed from the work area, if feasible.

Oak Wooland and Hardwood Forest Treatment Objectives

1. Reduce fuel volumes and maintain fuel volumes consistent with low severity fire
2. Reduce volume of flammable fuels and cultivate plants on the landscape that are generally native and fire-resistant
3. Establish and maintain fuel discontinuity
4. Reduce the possibility of fire traveling through tree crown; maintain that separation
5. Maintain healthy, dominant, natural, fire-resistant vegetation cover that is consistent with historical densities in an intact fire regime

These treatments are aimed at removing the flammable understory vegetation to reduce the overall fuel load as well as to decrease the chance of a crown fire and to preserve the woodland by removing ladder fuels. This treatment type creates a more open shaded site as shrubs are removed and smaller herbaceous plants and ferns are retained.

On-Going Maintenance

Cyclical maintenance in woodlands or forests will typically be performed once every 5 to 10 years, though high densities of weeds may necessitate annual maintenance. Techniques could include **hand thinning, rearrangement**, and **prescribed herbivory**.

Prescriptions for Riparian Forest

Initial Treatments

Typically, work in riparian corridors would be conducted by hand methods (**Hand Thinning**). Limited equipment may be used in cases where it would cause less disruption and/or is needed to achieve habitat and fire management objectives. Considerations for where and what type of fuel reduction may occur could include, but are not limited to, the following:

Riparian Forest Treatment Objectives

1. Reduce fuel volumes and maintain fuel volumes consistent with low severity fire
2. Reduce volume of flammable fuels and cultivate plants on the landscape that are generally native and fire-resistant by removing uncharacteristic vegetation (e.g., invasives)
4. Reduce the possibility of fire traveling through tree crown but miimize effects to the function and habitat provided by riparian vegetation
5. Maintain healthy, dominant, natural, fire-resistant vegetation cover that is consistent with historical densities in an intact fire regime

- Retain at least 75 percent of the overstory and 50 percent of the understory canopy of native riparian vegetation within the limits of riparian habitat. Retain native riparian vegetation in a well-distributed multi-storied stand composed of a diversity of species similar to that found before the start of treatment activities.
- Limit treatments to removal of uncharacteristic fuel loads (e.g., removing dead or dying vegetation), trimming/limbing of woody species as necessary to reduce ladder fuels, and select thinning of vegetation to restore densities that are characteristic of healthy stands of the riparian vegetation types.
- Avoid removal of large (greater than 12 inches DBH) native riparian hardwood trees.
- Trees to be removed will be directed away from adjacent streams or waterbodies when cut and piled outside of the riparian vegetation zone (unless there is an ecological reason to do otherwise that is approved by applicable regulatory agencies, such as adding large woody material to a stream to enhance fish habitat).
- Avoid vegetation removal that could reduce stream shading and increase stream temperatures.

On-Going Maintenance

On-going maintenance would be similar to initial treatment, but at a lower expected intensity. Hand Thinning will be the predominant method of maintenance. Maintenance intervals will be determined based on assessment of regrowth.

Eucalyptus and Acacia Tree Removal

Eucalyptus Treatment Objectives

1. Reduce fuel volumes of flamable non-native trees to a level appropriate to reduce fire hazards

Initial Treatments

Fallen eucalyptus leaves create dense carpets of flammable material, and the tree bark peels off in long streamers that drop to the ground and act as tinder. The debris from eucalyptus provides large amounts of fuel that draws ground fires up into the leaves, creating massive, fast-spreading "crown fires" in the upper stories of eucalyptus forests. The leaves from some species of Acacia contain resin and flammable oils, which can increase the spread of fires. Eucalyptus and Acacia trees should be removed from locations where the trees could pose a fire hazard.

These trees are removed using **hand thinning** with manual and mechanical methods as well as limited herbicide use to control re-sprouting from cut stumps. Replanting of native trees and vegetation will be conducted as appropriate, with consideration for the type of vegetation community that should be in the area. Advisement from fire agencies regarding fuel loads will also be considered prior to replanting.

On-Going Maintenance
On-going maintenance may include the assessment of regrowth and additional removal or application of herbicide, as needed.

3.2 Recommended Treatment Prescriptions by Areas – Stewardship Atlas and Restoration Abacus

3.2.1 Overview of Stewardship Atlas and Restoration Abacus

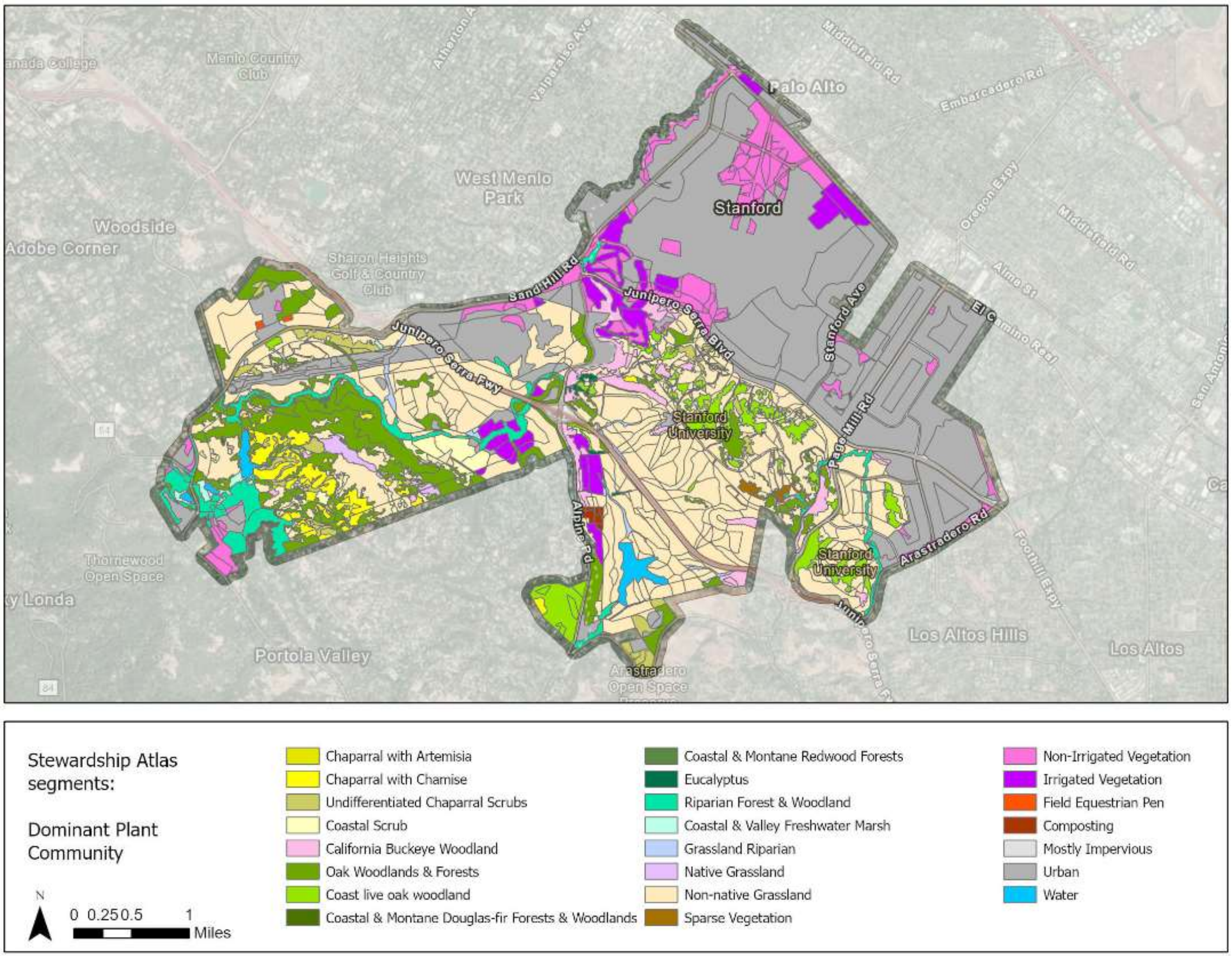
While effects analysis at the grid-cell level is important for risk and treatment effects calculations on a spatially resolved scale, the results are difficult to use for delineating treatment areas, assigning vegetation prescriptions, and ultimately fuels-management planning and treatment prioritization. Rather, a more operable integration of effects analysis into planning is to package metrics by socio-ecologic landscape segments, where treatments can be prescribed uniformly across the segment. The compilation of landscape segments is referred to as the Stewardship Atlas and provides socio-ecologically based packaging of information regarding vegetation metrics, management area types, recommended likely treatments and costs, treatment and wildfire effects metrics, treatment prioritization, necessary mitigations, etc.

A risk and opportunity-based framework using econometrics to quantify planned and unplanned disturbance effects was also applied to derive landscape-scale information about RROI from performing vegetation management treatments. This framework is referred to as the "**Restoration Abacus**" in the 2021 Plan, which is a stepwise, combination of fuzzy and probabilistic-logic workflows that guides a host of geospatial and database inputs through a series of calculations to estimate pre- and post-treatment and/or disturbance states of landscape components.

3.2.2 Stewardship Atlas

The campus is segmented into socio-ecologically based units (i.e., polygons) housed within the Stewardship Atlas. The Stewardship Atlas was then attributed with a host of other pertinent information, including dominant vegetation community, percent canopy cover, percentage area covered by particular types of HVRAs (e.g., biological habitat, structures), and vegetation departure conditions. The atlas is shown in Table 3-1, with segments classified by dominant vegetation community.

Figure 3-1 Stewardship Atlas Segments



3.2.3 Management Groups and Treatment Objectives

Stewardship Atlas segments were additionally populated with information about managing authority areas (provided by Stanford), which provide information about current management and/or type of landscape characteristics within each segment (i.e., athletic fields, natural, campus). These managing authority areas were identified for the purposes of determining treatment objectives and are not reflective of zoning designations. Managing authority areas were then further grouped into broader categories called management area groups, based on similar treatment objectives of those areas (see Table 3-6).

Table 3-6 Objectives for Vegetation Management by Management Area Group

Management Area Group	Managing Authority Areas	Treatment Objectives
Urban – Academic, Academic Support	Athletic fields Campus	Protect academic infrastructure and research facilities. Minimize fire intensity/behavior. Protect nearby community infrastructure and assets.
Urban – Non-academic, Housing	Housing Roads School	Protect community infrastructure and assets. Minimize fire intensity/behavior. Protect nearby academic infrastructure and research facilities.
Rural – Medium natural lands	Natural Natural open space Semi-natural open space (except areas around SLAC infrastructure, which were grouped with Stanford campus/facilities areas)	Protect, enhance, and maintain ecological function. Protect academic infrastructure and research facilities. Minimize fire intensity/behavior.
Rural – Low natural lands	Semi-natural	Minimize fire intensity/behavior. Protect nearby community infrastructure and assets. Protect, enhance, and maintain ecological function.
Rural – Agricultural, Grazing	Agricultural Equestrian Grazing Manure composting	Minimize fire intensity/behavior. Protect nearby community infrastructure and assets. Protect, enhance, and maintain ecological function.

3.2.4 Sequencing of Treatments

Treatment priority areas were determined using the management group and RROI and are shown in the figure below. Treatments are prescribed in this plan for a total of 2,825 acres. It should be noted that treatments do not need to be implemented in the priority area, and adjustments annually may occur based on funding, access, or other considerations. The priority list is meant to provide a guideline for highest RROI targets at the highest priority level, but any work performed within the list is beneficial. Acreages by year are as shown in the following table.

Table 3-7 Years 2021 through 2025 Priorities and Total Acres Treated

Implementation fiscal year	Sequenced Initial Treatment Area	Initial Treatment Acres	Annual Maintenance Acres
FY 2021	0	107	
FY 2022	1	466	505
FY 2023	2	412	505
FY 2024	3	300	505
FY 2025	4	221	505
Total		**1,506**	**2,020**

3.2.5 Recommending Treatments and Intensities by Area

The treatment prescriptions, as identified in Section 3.1, will be applied to specific areas. Data compiled in the Stewardship Atlas segments regarding operability (slope), vegetation type and densities, and managing authority were used to assign recommended treatments for each landscape segment (e.g., grazing areas, open space areas). Recommended initial, follow-up, and maintenance treatment types and intensities (along with associated costs) were assigned according to a set of heuristics. Figure 3-4 shows and Table 3-8 summarizes the initial recommended 5-year treatments by type and intensity. It should be noted that these recommendations and follow up work will be actively tracked through GIS data managed by the University (refer to Section 4 Annual Planning and Implementation). Figure 3-5 shows the annual maintenance acreages. Two options for maintenance vegetation management treatments for Stanford are recommended:

- **Adaptive Management:** Stanford could choose to update the wildfire modeling based on completed treatments and then re-run the Restoration Abacus (i.e., effects analysis) on an annual or semi-annual basis to determine areas that are a priority for continued maintenance treatments.
- **Repeat Treatments:** Stanford could alternatively choose to revisit and re-treat areas that were already identified as priority in this analysis.

The Stewardship Atlas, Restoration Abacus, and Product Guide (all GIS based tools that identify the program areas and methods) developed for the project will be utilized to define the treatments in the annual implementation planning, described in **Section 4** of this plan.

Figure 3-2 Management Area Groups on Stanford Lands

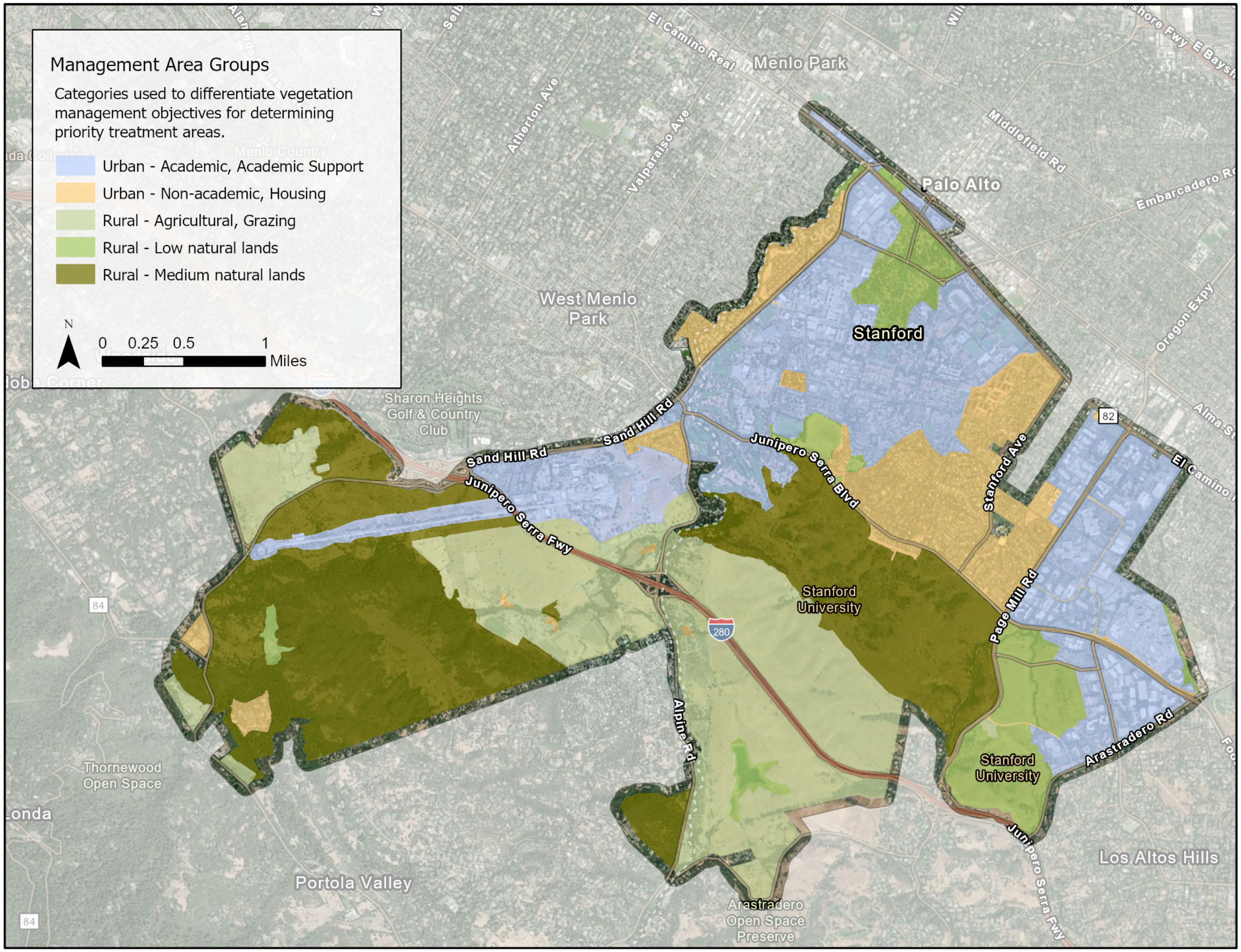
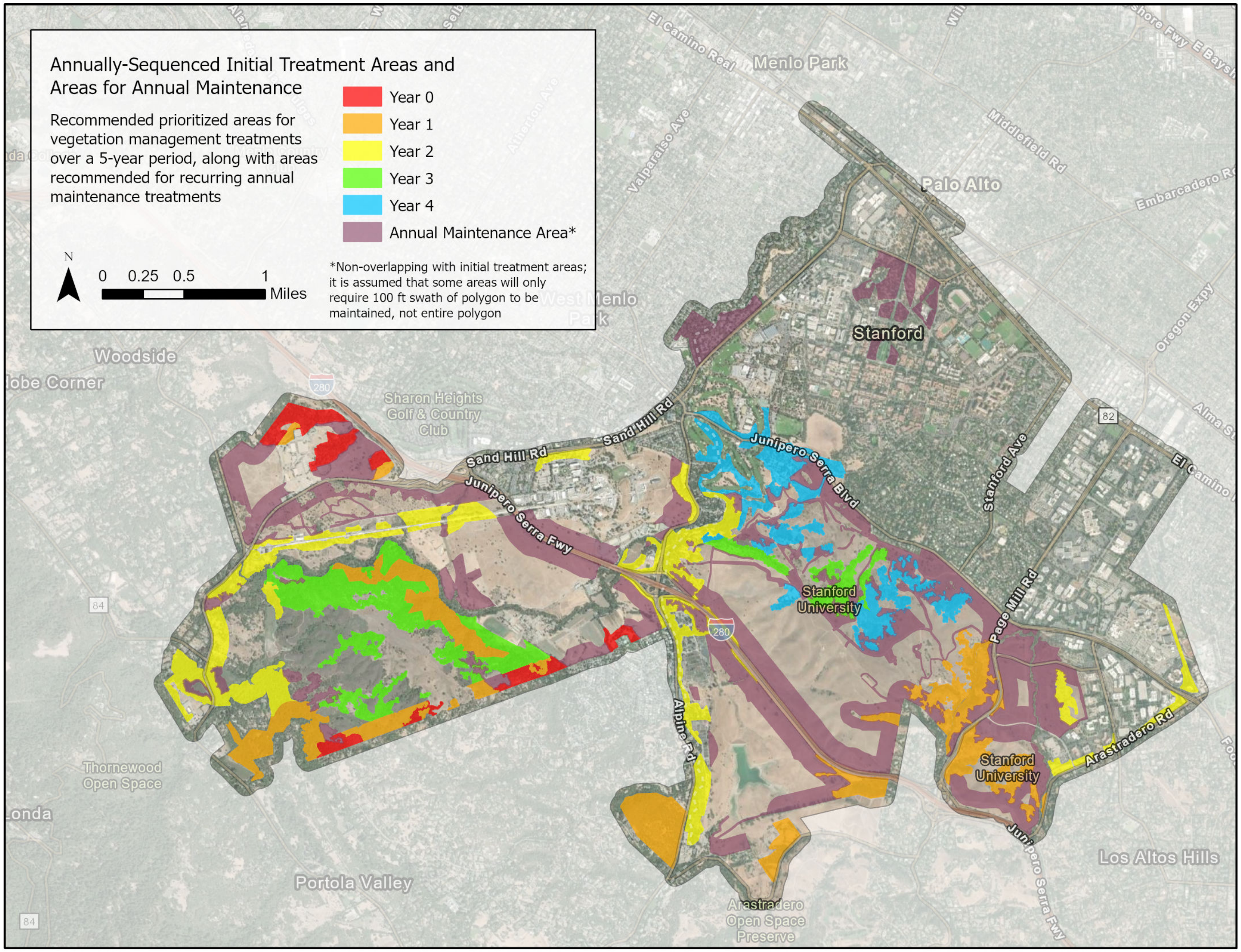
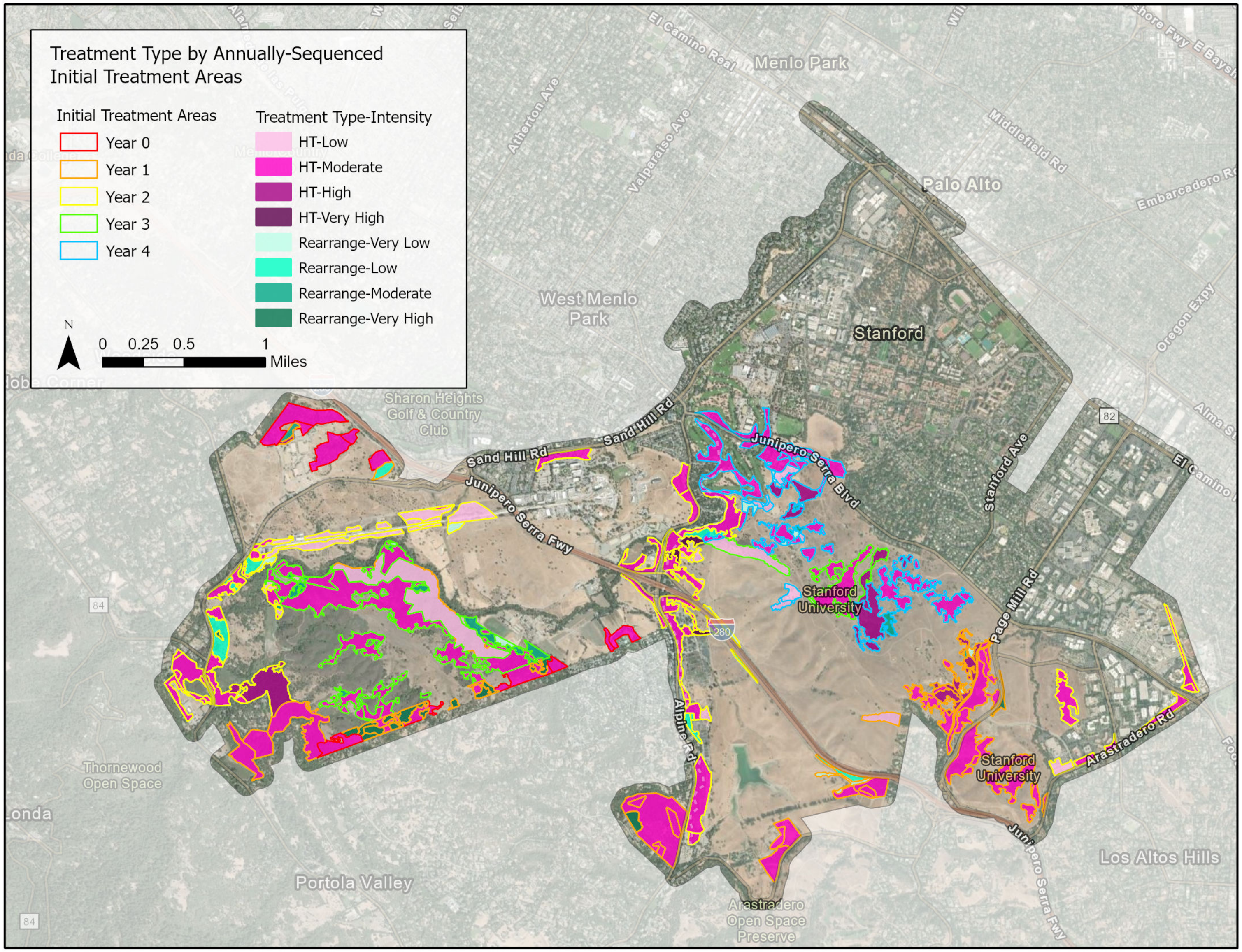


Figure 3-3 Treatment Priorities by Area



Note: The areas and sequencing are accurate as of publication date of this document (September 30, 2021) but is subject to change each year based on the implementation process defined in Chapter 4.

Figure 3-4 Recommended Initial Treatment Types



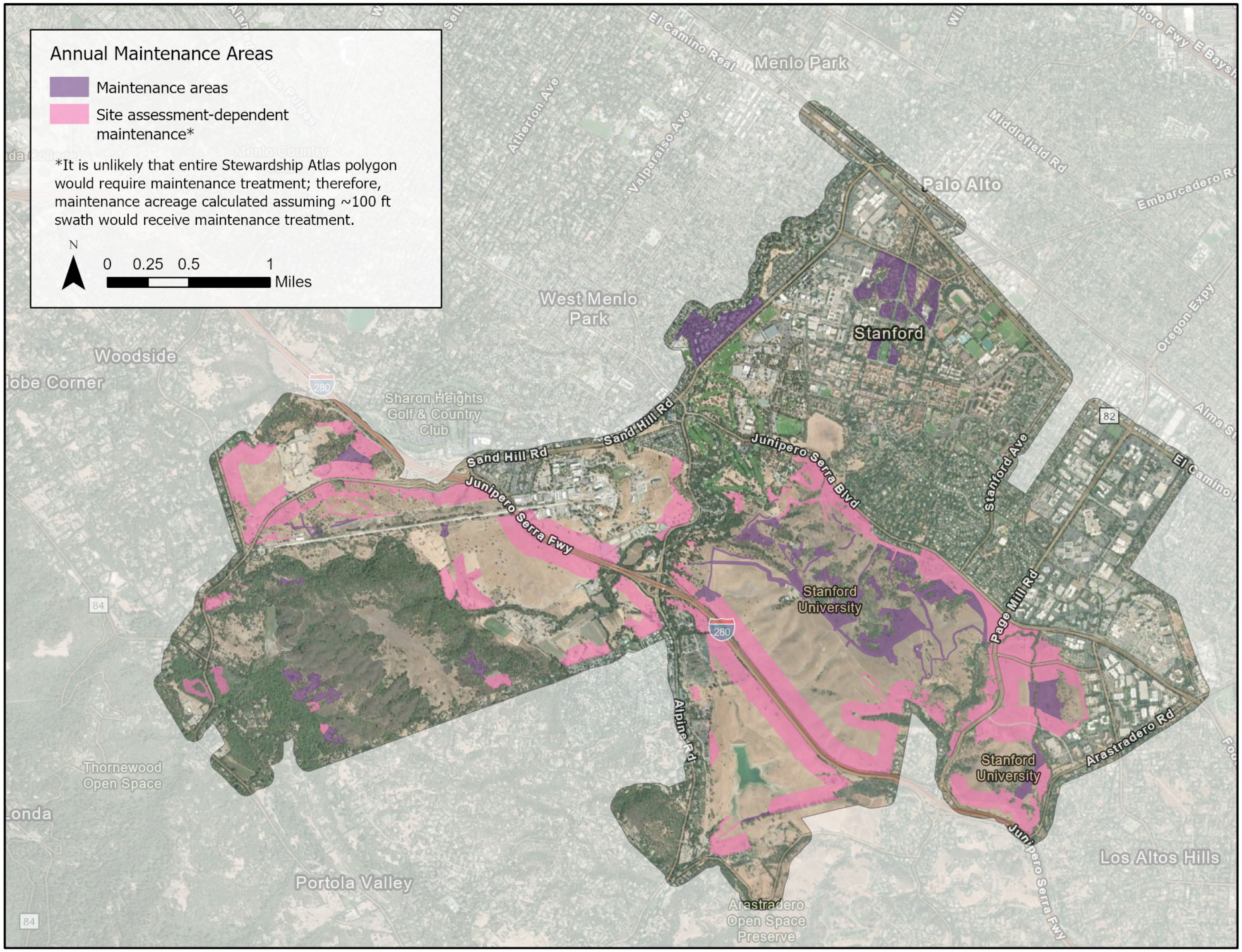
Note: The areas and sequencing are accurate as of publication date of this document (September 30, 2021) but is subject to change each year based on the implementation process defined in Chapter 4.

Table 3-8 Initial Recommended Treatment Types Legend Items

Treatment Category	Initial Recommended Treatment Type	Description
Hand Thinning	HT-Low	Dominant and co-dominant woody vegetation is generally unaffected, while as much as 50 percent of subdominant woody vegetation is cut and removed. Herbaceous vegetation is minimally disturbed by foot traffic and the dragging or piling of cut woody vegetation. Soil disturbance is insignificant.
	HT- Moderate	Treatment is generally consistently and equally applied across an area and is focused on significantly reducing the effects of high intensity fire. Dominant woody vegetation is generally unaffected. Co-dominant woody vegetation is affected by as much as 25 percent, however overall canopy cover remains intact. As much as 90 percent of subdominant woody vegetation is cut and removed. Herbaceous vegetation is disturbed by as much as 25 percent through foot traffic and the dragging or piling of cut woody debris. Soil disturbance is insignificant.
	HT- High	Treatment is generally variable and is applied to mimic vegetation structure patterns that would exist in the area's intact disturbance regime. Dominant woody vegetation is affected by as much as 25 percent over the treatment area but can be as high as 90 percent in some areas and as low as 10 percent in others. Co-dominant woody vegetation is affected by as much as 50 percent, but effects are also variably distributed. Overall canopy cover may be reduced by as much as 40 percent. As much as 75 percent of subdominant woody vegetation is cut and removed but may also be left in concentrations. Herbaceous vegetation is disturbed by as much as 40 percent through foot traffic and the dragging or piling of cut woody debris. Soil disturbance is insignificant.
	HT- Very High	Treatment is generally consistently and equally applied across an area and is focused on eliminating effects of high intensity fire. Effects are substantial and often equate to a site change or ecological succession reset done for ease of maintenance over time. Dominant woody vegetation is affected by no less than 90 percent. Co-dominant woody vegetation is affected by no less than 95 percent. Canopy Cover is all but eliminated. herbaceous vegetation is disturbed by as much as 75 percent through foot traffic and the dragging or piling of cut woody debris. Soil disturbance is insignificant.
Rearrangement	Rearrange-Very Low	Predominantly achieved by mowers. Treatment is generally consistently and equally applied across an area and is focused on significantly reducing fine fuels and a fire's rate of spread. Woody vegetation is generally unaffected. Herbaceous vegetation is significantly affected at no less than 90 percent. Rearranged material is left on site. Soil is disturbed by as much 10 percent.
	Rearrange-Low	Predominantly achieved by disking. Treatment is generally consistently and equally applied across an area and is focused on

Treatment Category	Initial Recommended Treatment Type	Description
		significantly reducing fine fuels and a fire's rate of spread for longer periods than mowing alone. Woody vegetation is generally unaffected, mostly because there should not be much woody vegetation on optimal disking ground. Herbaceous vegetation is significantly affected at no less than 90 percent. Rearranged material is left on site. Soil is disturbed by as much 90 percent. It is important to note that this treatment creates ideal conditions for invasive plant establishment where treated.
	Rearrange-Moderate	Predominantly achieved by mastication wheeled or tracked machines. Treatment is generally consistently and equally applied across an area and is focused on significantly reducing fine fuels and ladder fuels which decrease a fire's rate of spread and the potential for crown initiation. Dominant and co-dominant woody vegetation is generally unaffected. As much as 90 percent of subdominant woody vegetation is affected through rearrangement. Herbaceous vegetation is disturbed by as much as 50 percent. Rearranged material is left on site. Soil is disturbed by as much 15 percent.
	Rearrange-Very High	Treatment is generally consistently and equally applied across an area and is focused on eliminating effects of high intensity fire. Effects are substantial and often equate to a site change or ecological succession reset done for ease of maintenance over time. Dominant vegetation is affected by no less than 90 percent. Co-dominant vegetation is affected by no less than 95 percent. Canopy Cover is all but eliminated. Herbaceous vegetation is disturbed by as much as 35 percent. Rearranged material is left on site. Soil is disturbed by as much 20 percent.

Figure 3-5 Annual Maintenance Acres



3.3 Best Management Practices

Best management practices (BMPs) are measures incorporated by design into work activities and processes to minimize effects to natural and man-made resources. Many BMPs are standardized across the industry for vegetation management work and have proven successful. Measures to address access, minimize erosion, and minimize slope stability concerns may be implemented where needed. Resources such as the Forest Practice Rules also identify BMPs to ensure work can be performed with minimal effects. A separate list of BMPs will be maintained by Stanford for fuel management work based on several sources such as Midpeninsula Regional Open Space District BMPs, the Forest Practice Rules recommendations, Stanford's HCP, and other sources. BMPs may not apply to every project and may need to be adapted in the field. The list of BMPs will be reviewed each year to determine which should be incorporated into the specifications for the work each year (see Section 4.2).

3.4 Regulatory Process

Fuel-management activities may require compliance with various environmental requirements, particularly pertaining to natural resources and water-quality protection, depending on the activities undertaken. Stanford lands are private lands that fall within six different jurisdictions: unincorporated Santa Clara County, unincorporated San Mateo County, City of Palo Alto, Town of Woodside, City of Menlo Park, and Town of Portola Valley. At the local level, activities may need to comply with local tree protection policies and building and grading requirements (where activities could include installation of new roads or infrastructure to support firefighting or fuel management). As part of the annual planning process, the regulatory requirements will be investigated early to plan activities to minimize the need for regulatory permits, or to plan ahead early so that enough time is available to obtain any approvals needed. Portions of the campus fall under the Stanford Habitat Conservation Plan (HCP) and vegetation management will need to be reviewed and conform to the policies and requirements of the HCP. Other upcoming projects may also require considerations, such as the Searsville Dam Removal projects. The potential regulatory requirements for the project are outlined in the *Policy and Regulatory Review and Summary of Jurisdictional Outreach* (Panorama Environmental, Inc., 2021b) report.

4 Annual Planning and Implementation

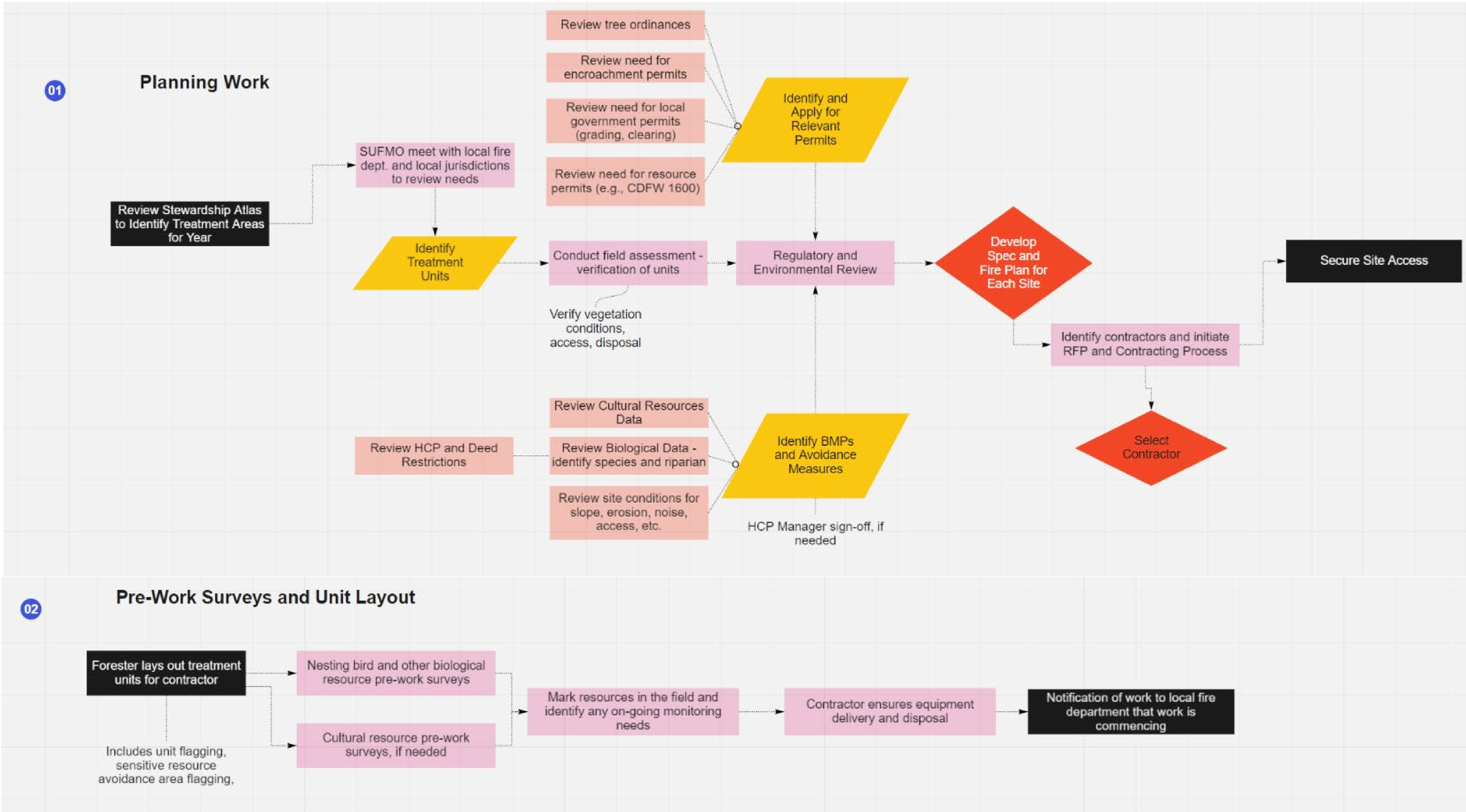
4.1 Process Flow Chart for Annual Planning and Implementation

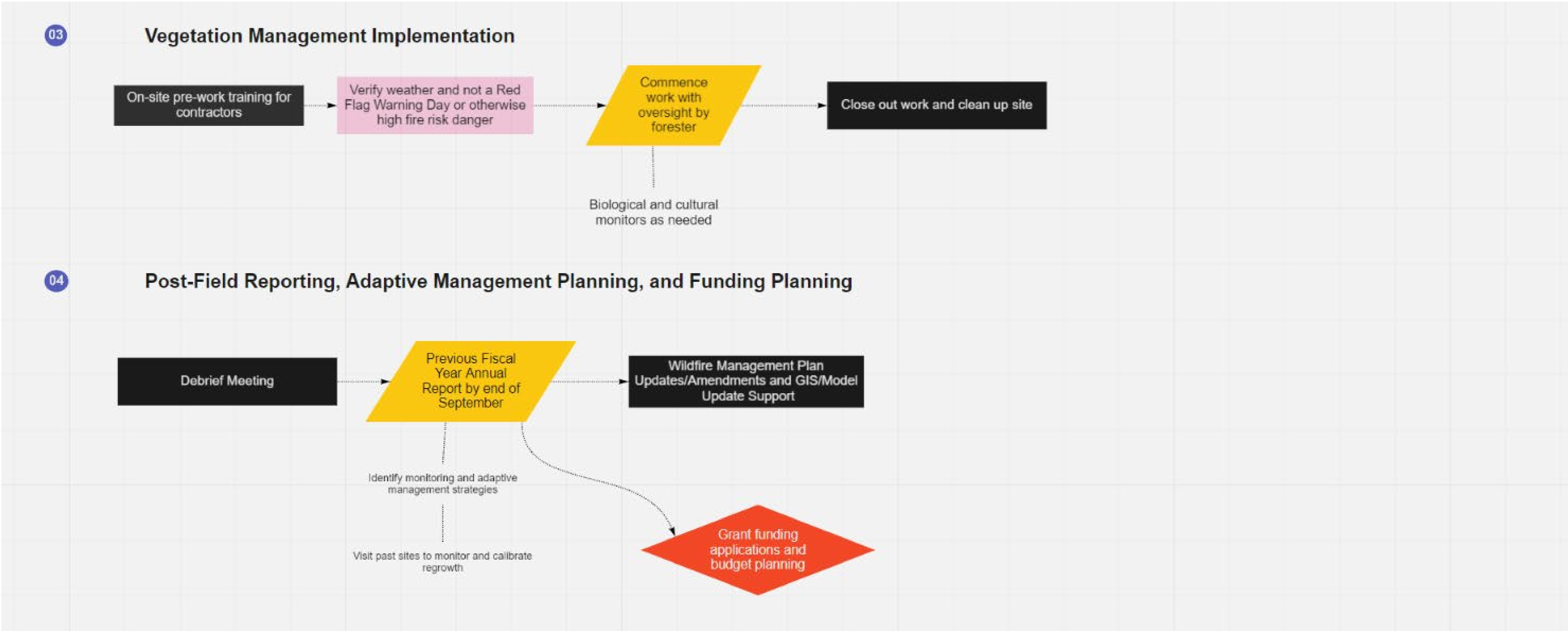
Vegetation management work, including implementation and planning of work will occur year-round. Table 3-5 shows the best times of year for the various types of treatments, which run from April through December. The treatment season in each year does not neatly correlate to Stanford's fiscal years (that run from September 1st through August 31st); however, budget planning will need to occur by fiscal year. The following graphic demonstrates how vegetation management planning and implementation will align by fiscal year.

Figure 4-1 Annual Work Planning and Implementation Timing

The flow charts in Figure 4-2 encapsulate the entire plan process. Each phase is described in greater detail in this section.

Figure 4-2 Implementation Process for the Wildfire Management Plan




03
Vegetation Management Implementation
On-site pre-work training for contractors
Verify weather and not a Red Flag Warning Day or otherwise high fire risk danger
Commence work with oversight by forester
Close out work and clean up site
Biological and cultural monitors as needed
04
Post-Field Reporting, Adaptive Management Planning, and Funding Planning
Debrief Meeting
Previous Fiscal Year Annual Report by end of September
Wildfire Management Plan Updates/Amendments and GIS/Model Update Support
Identify monitoring and adaptive management strategies
Visit past sites to monitor and calibrate regrowth
Grant funding applications and budget planning

4.2 Planning Work – Selecting Areas for Treatments Annually and Defining Prescriptions and Treatments

4.2.1 Determining Annual Treatment Units from Stewardship Atlas and Prescription Matrix

Before each fire season, generally in March and April, planning for the upcoming work will commence. The planning phase includes a desktop review of the Stewardship Atlas to determine the priority areas to treat for the upcoming treatment season.

Year 1 through 5 priority treatment areas and treatment types and intensities have been identified (see Table 3-7 and Table 3-8 and Figure 3-3 and Figure 3-4), understanding that level of effort and areas may change or increase each year, depending on many parameters. During the initial planning phase each year, the priority areas should be identified for that year and then cross-walked with the matrix to define the specific prescriptions per unit (e.g., hand thinning, mowing) and intensity of prescription. The treatment units should then be mapped and summarized to support outreach to the fire providers and jurisdictions and a field assessment, described in the following sections. An example of the one-page summary for 2021 is provided in Figure 4-4. Coordination with Fire Providers and Jurisdictions

Stanford will need to coordinate with the fire protection/emergency services provider for the area of treatment to receive feedback and input on the treatment units and to develop the Fire Plan for the work that meets the jurisdictions and fire departments requirements. The information obtained will ultimately be incorporated into the contractor specification for each area. Coordination should also occur with the local jurisdiction to keep them informed, to receive feedback on any conflicts, and so that they are aware of the work should they receive any public comments or concerns.

4.2.2 Regulatory Review

A regulatory review will also occur, which should be overseen by Land Use and Environmental Planning staff. The process includes review of the work areas against the Stanford HCP requirements and conservation easement requirements, as well as existing biological and cultural data. A site habitat assessment or other surveys, such as for rare plants or riparian habitat, may be needed. Based on the assessment of resources, BMPs will be identified and included into the contractor specification to ensure that resource impacts are minimized. Staff or consultants with the appropriate expertise should be consulted to evaluate conditions and determine appropriate BMPs and protection measures. If the project is within an area covered by the Stanford HCP, it will need additional review and approval by the HCP Manager. The potential regulatory requirements for the project are outlined in the *Policy and Regulatory Review and Summary of Jurisdictional Outreach* (Panorama Environmental, Inc., 2021b) report.

Figure 4-3 Management Area Groups on Stanford Lands

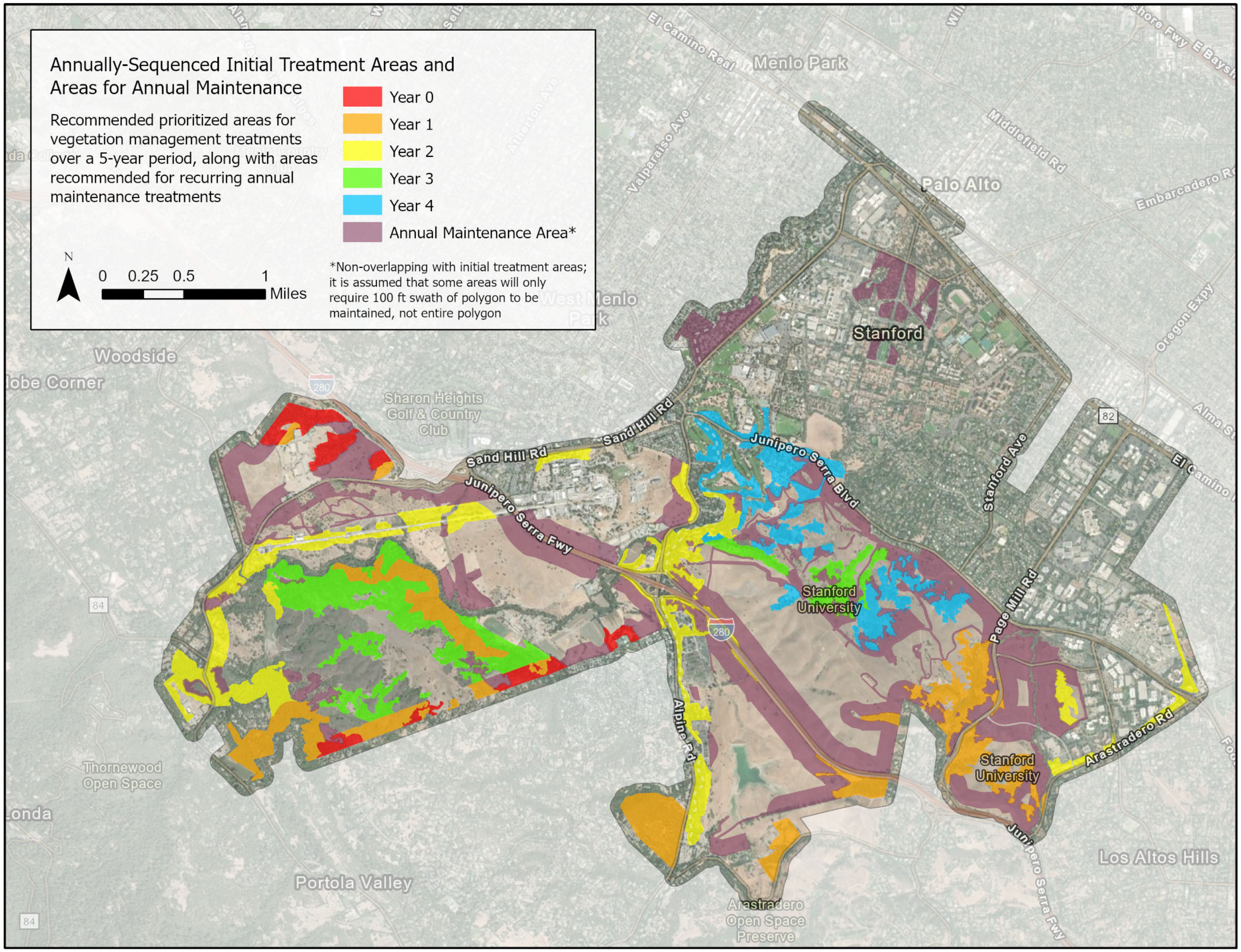


Figure 4-4 One Page Prescription Summary Example from 2021

2021 Stanford Wildfire Management Plan Treatment Areas

Vibrant Planet has completed a wildfire and treatment effects analysis to determine and prioritize treatment areas on Stanford lands. The recommended treatment areas are locations on the landscape where treatments would result in the greatest avoided loss (both anthropogenic and natural resources) from wildfire. These areas are grouped into five priority areas for treatment, which could be phased over a roughly five-year period (Figure 1).

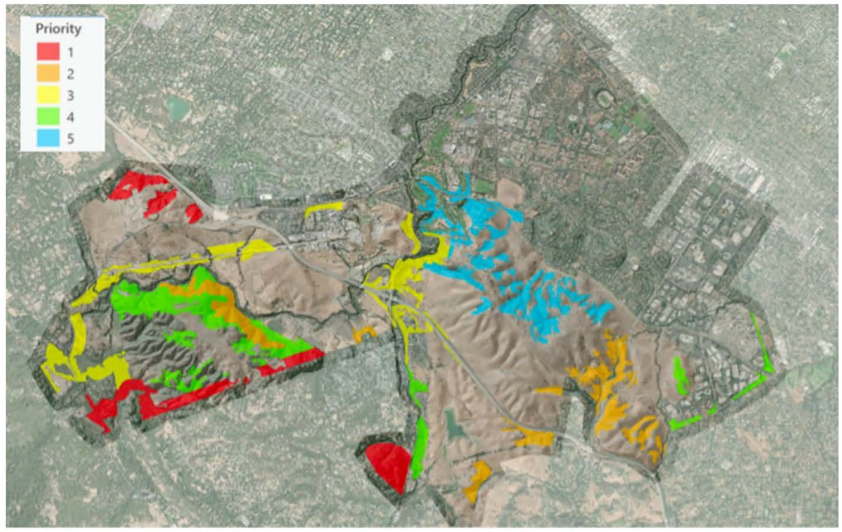


Figure 1. Recommended and prioritized treatment areas

The Priority 1 treatment area was further subset to recommend areas for immediate treatment within FY 2021. These areas are shown in the map below, totaling 107 acres. The recommended treatment within these areas is hand-thinning only applied as a “thin from below” prescription, which is less complicated and intensive to implement than other treatment types. The total cost of treatment is estimated to approximately $3,000/acre, for a total of $321,000.

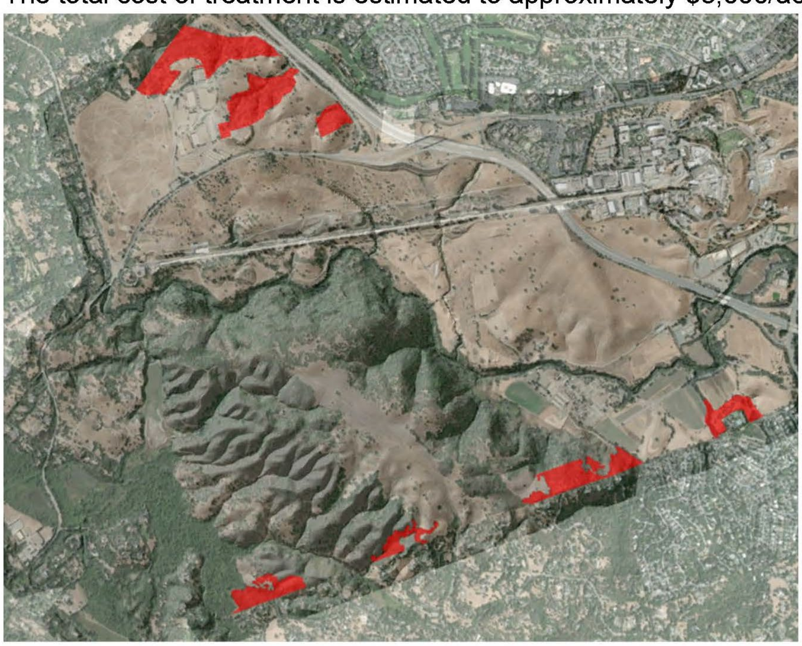


Figure 2. Recommended immediate treatment areas within Priority 1; treatment recommendation is for hand-thinning only

Other permits and approvals to consider based on the treatment area and type include the following:

- **Tree ordinances for the local jurisdiction:** The specifications should be modified to exclude any trees that may be protected by a local ordinance. If protected trees must be removed, tree removal permits will be obtained.
- **Encroachment permits for roads:** Staging of equipment, chippers, and vegetation management along roadways may require the need for an encroachment permit from the local jurisdiction. Any permits should be identified and obtained early.
- **Work in riparian corridors:** Work that could occur within a riparian corridor could trigger the need for a permit from the California Department of Fish and Wildlife under Section 1600 for a Lake and Streambed Alteration Agreement.
- **Grading or larger land clearing:** Should work necessitate the need to grade or create new access, local grading permits could apply and should be identified.

4.2.3 Field Assessment to Write Specification and Preparing the Specification

Field assessments will be performed to ground-truth and refine the 1-page prescription summary into a contractor's specification. Ground-truthing is needed to ensure the specification is appropriate and to verify access and staging. After the field visit, detailed mapping of the units to be treated will also be provided with the specification. A Fire Plan will also be prepared.

The specification will include the following components:

- Scope of the contract
- Project location and description
- Maps
- Estimated start date and contract time
- Restrictions on work
- Licenses and insurance requirements
- Technical requirements
  - Definitions
  - Specifications
  - Contractor furnished equipment
  - Landowner furnished property
  - Public safety
  - Special contract provisions (e.g., environmental)

Specification will be reviewed by the appropriate Stanford staff and faculty before finalization.

4.2.4 Contracting Procedures

Stanford will implement their contracting procedures to initiate a task order for a contractor to complete the work.

4.2.5 Securing Access

Access to the site may need to be secured if access is through private homeowner properties. Access will be secured through written letter requests, follow up, and written agreement, where appropriate. Fire department staff may be asked to assist with securing access to private properties.

4.3 Pre-Work Surveys and Unit Layout

4.3.1 Layout of Units

A forester or field oversight manager with understanding of the forestry practices in the plan will conduct in-field layout and marking of units with flagging for treatment, marking/flagging of avoided resources, marking/flagging of access routes, marking/flagging of trees and shrubs or sensitive plant species to leave in place or avoid, and areas of refugia. A flagging method will be clearly articulated to the crews in the environmental awareness training, as described under Section 4.4.1.

4.3.2 Biological and Cultural Resources Surveys and Reports

Surveys for nesting birds or other biological and cultural resources may need to be implemented just prior to work in accordance with the BMPs and HCP requirements. A short report of the findings of surveys will be prepared. Results of the surveys will be articulated to the project manager and field oversight manager to ensure that any additional protection measures (such as nest avoidance buffers) are implemented.

4.4 Vegetation Management Implementation

4.4.1 Environmental Awareness Training

An environmental awareness tailgate training will be performed and can be led by the field oversight manager, a biologist, or other qualified staff knowledgeable of resource protection particular to the site. The environmental training will consist of a review of the specification, access, allowable actions, trees and other resources to protect or avoid, spill prevention and control, smoking, and other provisions to ensure successful work with minimal effects to the community and environment.

4.4.2 Forester Oversight of Work

Each project will be overseen by a forester or someone with expertise in vegetation management who will serve as the field oversight manager for the project. This person will direct work, make decisions as they come up regarding treatments and disposal, address any emergency situations or complaints, and report to Stanford staff on the progress of the work.

4.4.3 Biological/Cultural or Other Environmental Monitors

In some situations, biological or cultural resource monitors will need to be on site during the implementation of the work to ensure no damage to sensitive resources. The monitors will be on site when work is occurring in proximity of the resource and will have the authority to direct or stop work as needed to ensure the protection of the resource. Monitors will report on their monitoring at the end of the project; however, issues that arise will be addressed immediately in the field.

4.5 Post-Field Reporting, Adaptive Management Planning, and Funding Planning

4.5.1 Annual Reporting and Adaptive Management

Throughout each year, Stanford will document and monitor the details of treatment efforts including acres, methods, and cost. The results of the monitoring efforts, fuel treatment activities undertaken the previous year, fire monitoring or prevention technology deployed, fire event monitoring (if occurred), and recommended modifications for future years will be presented in an Annual Report to be prepared by Stanford staff managing the program or their delegate. The Annual Report will be short and will utilize graphs and figures/images to portray information. It will evaluate the effectiveness of the treatments, including any new tools or technology, to identify whether the activities undertaken are meeting the overall objectives of the work and will make recommendations to modify methods in the planning of future activities. Stanford will identify any recommended changes to fuel treatment activities including integration of new methods or technology. The Annual Report will assist Stanford in decision-making on future treatment areas, methods, and scale. The Annual Report for the previous year will be prepared in January through March of the following year, with a report due by March 31st. The Annual Report from the previous year is designed to flow into the planning for the upcoming year in terms of timing.

An Annual Report template should be developed to create consistency across years. One option is to update the 1-page prescriptive summaries are the work is completed for each parcel/project area and provided in or summarized in the Annual Report. As part of the post-work efforts, areas of previous treatment should also be monitored to better understand effectiveness of the treatment over time to adapt treatments in the future and to further characterize and refine maintenance intervals (i.e., adaptive management). Lessons learned in the Annual Reporting should also be carried forward into the subsequent year's planning efforts as part of an adaptive management approach.

4.5.2 Updates to Plan and GIS/Modeling and Database Management

The plan will be updated annually, including adding GIS layer files from surveys and treatments to Stanford's database. As part of the assessment process for the 2021 Plan, a very detailed database of existing assets and resources was collected and organized. This database will continue to be maintained and expanded under the 2021 Plan.

Plan updates can include revisions to methods, revisions to priorities, and updates to the modeling effort as new tools and technology becomes available. The wildfire modeling may also be updated based on completed treatments, and the Restoration Abacus (i.e., effects analysis) can be re-run on an annual or semi-annual basis to determine areas that are a priority for continued maintenance treatments.

4.5.3 Grant Funding and Budget Planning

Budget planning should occur during the post-work period from the previous year and the planning period for upcoming work (January through April). Throughout the year, grant opportunities may also arise that should be considered. Budgeting and grant funding are discussed further in Sections 4.6.1 and 4.6.2.

4.6 Implementation Costs and Funding

4.6.1 Estimated Annual Costs and Budgeting

Plan costs were estimated for likely scenarios of treatment based on prioritization. Stanford will continue to budget for treatments as needed to maximize benefits and efficiency of treatments. Budgets will be determined each fiscal year based on the planning efforts described in this chapter. The cost will be dependent on market prices, and Stanford will implement the necessary treatments for each area. The costs are anticipated to be in the range $1M to $2M per year but could be adjusted for annual need.

4.6.2 Grant Funding Opportunities

Table 4-1 provides a summary of the applicable funding sources that Stanford could be independently eligible for as well as funding sources that Stanford could potentially be eligible for through teaming with local partners (e.g., RCD, Fire Safe Council, counties). For many of the independently eligible funding sources, Stanford may have greater success of grant approval by collaborating as part of a larger regional and multi-stakeholder opportunity. The Hewlett foundation has a robust network of conservation-focused grantee partners in this region through its Western Conservation strategy.

Grant funding tends to run in one to two cycles per year and seems to vary depending on source and available funds each year. Cycles seem to correlate to a spring round and a fall round.

Table 4-1 Potential Funding Sources

Grant	Agency	Funding Summary	Relevant Qualifying Projects	Main Contact	Recommendations
Stanford Is Independently Eligible					
State Fire Assistance Program (SFAP)	California Fire Safe Council	Competitive grant: Maximum request is $200,000; mandatory cost share is 100% (federal funding can account for up to 50% of the project's cost, and remaining 50% must come from non-federal sources).	Projects may focus on fuel-hazard mitigation vegetation treatments, including chipping, thinning, burning, grazing, and mastication. Projects must be in the wildland–urban interface, protecting an officially designated Community-at-Risk (CAR) (such as the town of Woodside and Portola Valley), and identified in the Community Wildfire Protection Plan (CWPP) or similar plan (such as the 2021 Plan).	Dan Lang, Senior Grant Specialist (916) 256-3621 dlang@cafiresafecouncil.org	Teaming with local partners (e.g., RCD, local Fire Council) could increase strength of grant application.
California Climate Investments (CCI) Forest Health Grant Program	CAL FIRE	Competitive grant: available funds vary by year (minimum grant request is typically $750,000). Funding not available for 2020/2021.	Projects may include forest-fuels reduction, prescribed fire, pest management, reforestation, biomass utilization, conservation easements and/or land acquisition through the forest legacy program, or research as a component or stand-alone through the forest research program. All Forest Health projects must have calculated climate benefits related to reduced greenhouse gas emissions.	Julie Howard, Local Forest Health Representative (831) 345-4942 Julie.Howard@fire.ca.gov	Typically, the approved projects are larger-scale efforts. Recommend teaming with local partners (e.g., RCDs, local fire councils).
California Forest Improvement Grant Program (CFIP)	CAL FIRE	Competitive grant: caps defined for each project type.	Planning, reforestation, and resource-management investments that improve the quality and value of forestland. Landowners must own at least 20 acres of forest land. "Forest land" means land at least 10 percent occupied by trees of any size that are native to California, including native oaks, or formerly having had that tree cover and not currently zoned for	Guy Anderson (559) 243-4109 (559) 281-8479 guy.anderson@fire.ca.gov	Recommend determining what areas of Stanford lands meet definition of forestland and if Stanford could consider rezoning forest-resource management zones (through the Counties). If determined to be

Grant	Agency	Funding Summary	Relevant Qualifying Projects	Main Contact	Recommendations
			uses incompatible with forest-resource management. To determine that at least 10 percent of the property is occupied by trees, average canopy cover of native species across the property shall be used to determine whether the property meets the definition.		acceptable, proceed to apply for preparation of a Forest Management Plan approved by CAL FIRE, and then apply for implementation of discrete projects.
Environmental Quality Incentives Program (EQIP)	Natural Resources Conservation Service (NRCS)	Competitive grant: caps defined for each project type.	Projects to address natural-resource concerns and deliver environmental benefits such as improved water and air quality, conserved ground and surface water, and more through implementation of specific conservation practices; forest-stand improvement practices include manipulation of species composition, stand structure, or stand density by cutting or killing selected trees or understory vegetation to achieve desired forest conditions.	Whitney Haraguchi District Conservationist (831) 227-2901 whitney.haraguchi@usda.gov	Determine if Stanford meets eligibility requirement of less than $900,000/year adjusted gross income (we understand this may be unlikely). Contact the Farm Service Agency for a land-use determination to verify which portions of Stanford lands are eligible (e.g., rangeland, pastureland, non-industrial private forest land, or other farm or ranch lands). If so, apply during application period (expected to include two or three “batches” per year in 2021 or following years).
Stanford Eligible Through Joint Teaming					

Grant	Agency	Funding Summary	Relevant Qualifying Projects	Main Contact	Recommendations
CCI Fire Prevention Grant Program	CAL FIRE	Competitive grant; no cap Funding not available for 2020/2021.	Projects and activities related to hazardous-fuel reduction and removal of dead, dying, or diseased trees, fire prevention planning, and fire prevention education. Projects must provide benefits to habitable structures in the State Responsibility Area (SRA). Non-SRA lands may be included within project boundaries, but project activities must provide a benefit to SRA.	Andy Hubbs (831) 335-6794 Andrew.Hubbs@fire.ca.gov	Not available to privately held for-profit company/ corporation or individual landowners requesting a grant specifically for a project to be completed on only their own land. Consider teaming up with local partners (e.g., RCD, Fire Council).

4.7 On-Going Outreach and Coordination with Other Jurisdictions

Stanford's lands are privately owned and fall within several governmental jurisdictions. Development of the 2021 Plan includes outreach to coordinate and collaborate with other efforts being undertaken in the region, including by local fire departments, fire protection districts, and CAL FIRE.

Fire does not respect jurisdictional boundaries, and an effective strategy for fuels management must be regional in scope. Stanford is developing methods for increased coordination of data and experience-sharing that can have positive impacts beyond Stanford's boundaries.

Continued outreach and coordination with local and regional agencies after release of the 2021 Plan and during plan implementation should be a part of the process. Recommended timing and topics of discussion between neighboring jurisdictions are outlined in Table 4-2. It is also recommended that Stanford identify the divisions and personnel to participate in regional collaborative efforts, such as the Santa Cruz Mountains Stewardship Network, the San Mateo and Santa Cruz County RCD efforts, the Santa Clara County RCD efforts, and the regional Fire Safe Councils.

Table 4-2 Coordination and Communication Recommendations

Topics	Timing
Regional and Local Agencies	
Discuss: • Overview of the 2021 Plan • Adjacent agency-designated evacuation routes or other resources (e.g., Zone Haven)	After release of draft 2021 Plan
Discuss: • Proposed projects for the upcoming six months • Potential for teaming or collaboration on upcoming projects (e.g., projects that abut adjacent jurisdictional lands) • Potential regional or collaborative grant opportunities	Biannual
Discuss: • Status of ongoing projects • Completed projects • Any new technology deployed (e.g., wildfire detection cameras) • Successes and lessons learned from projects completed/started • Any new data available (e.g., vegetation, wildfire hazard) • Potential regional or collaborative grant opportunities	Annual
Organizations	
Subscribe to regional organization email lists	Continuous
Attend regional organization meetings to stay current on regional actions and identify teaming opportunities	Periodic

5 New Treatments and Tools or Technology for Vegetation Management

5.1 Review and Identification

New and cutting-edge fuel and vegetation management methods and technologies are under development and will continue to be developed at a rapid pace in the coming years. Techniques and technologies may be recommended or identified during continued outreach efforts with local jurisdictions, through research with Stanford faculty, and from other regional and state-wide efforts and initiatives (such as the collaborative efforts on vegetation mapping for landscape stewardship led by the Santa Cruz Mountains Stewardship Network). Stanford's staff and professors are also conducting research on new methods and tools ranging from fire detection tools through augmented learning systems to better understand potential wildfire and its dynamic behavior across large areas to community and policy research to facilitate wildfire management.

The 2021 Plan includes a review and identification annually or as information is relayed on new tools, methods, and technologies to aid in and improve Stanford's wildfire management on their own lands.

5.2 Fire Modeling

The field of fire modeling is also rapidly evolving. As previously described, efforts are underway at the regional and State levels as well as through Stanford research to improve the modeling methods and data that informs how fuels and response management can be implemented. The 2021 Plan will remain a living document with annual review and updates to adapt to and integrate new and improved modeling or data that supports the prioritization of fuel treatments.

5.3 Preventative Fire Retardants

Fire retardants are typically ammonium polyphosphate mixed into a formulation called PC. These types of retardants are used during an active emergency to slow the spread of a fire and do not stick well to vegetation over long periods of time. Recently a material was developed to serve as a carrier for fire retardant formulations to allow the retardant to maintain a coat on vegetation and infrastructure throughout the fire season. This fire-retardant formulation, referred to as Phos-Chek Fortify, can be used as pre-treatment and prevention in areas of high ignition risk. Testing has found this formulation stops the spread of fire even after a half inch of simulated rain and two months of weathering. Stanford may be able to apply this retardant to vegetation in high-risk areas such as along roadways or near utilities.

Another preventive treatment developed by Stanford researchers led by Eric Appel (Appel Fire Treatment) involving an environmentally safe gel-like retardant provides season-long protection against wildfire ignitions. By preventing fires from starting, such treatments can be more effective and less expensive than current firefighting methods.

6 Other Prevention Measures

6.1 Home Safety Surveys

To better prepare Faculty/Staff homes located on campus property and within the wildland urban interface (homes within ½ mile of undeveloped wildland area), home safety surveys will be conducted by SUFMO from May through July. The initial surveys will be conducted from the public right of way. The surveys will primarily be noting: (1) visible address sign posted; (2) combustible debris on the roof and/or in rain gutters; (3) dead or dried vegetation on property; (4) dried branches adjacent to or overhanging structures; (5) branches or vegetation closer than 10 feet to any chimney; and (6) chimneys not equipped with spark arrestor. Survey findings will be provided to the residents so they can take necessary actions to protect their homes. SUFMO is also able to conduct complete home surveys at the request of residents.

SUFMO conducts home safety surveys for designated Faculty/Staff Housing areas that are located in the wildland urban interface area from May through July. Follow up surveys will be conducted as necessary.

6.2 Fire Weather Monitoring

Weather forecasts monitored by the National Weather Service (NWS) are monitored on a continual basis by SUFMO, and the Stanford University Department of Public Safety (SUDPS) is notified by Santa Clara County via CAL FIRE when Red Flag warnings are issued for the Stanford area. NWS monitors and forecasts weather conditions that increase the probability of a wildland fire. During periods of low humidity, high winds, and/or high temperatures, NWS may declare a Fire Weather Watch or a Red Flag Warning which are sent to all affected Counties by CAL FIRE. When a fire weather warning is issued, measures are taken to limit possible ignition sources such as prohibiting outdoor fires. If the fire weather warning is elevated to a Red Flag Warning, then SUDPS will close the Stanford Foothills to the public and all Foothill gates will be staffed to prevent entry. Any maintenance work that could potentially cause a fire or threat to public safety will be suspended. SUDPS alerts the campus community by AlertSU.

7 Wildfire Response

7.1 Wildfire Response

7.1.1 Overview

Wildfire response is a coordinated effort between CAL FIRE, local fire departments (Palo Alto, Woodside, Melo Park, Santa Clara County) and Stanford University. Location and intensity will determine the number and quantity of units responding to the emergency. CAL FIRE will take lead on sizeable events which generally required multiple local units and CAL FIRE units responding.

7.1.2 Local Fire Department Response

Santa Clara County

The standard fire response for the foothills area varies upon the size of the fire, fire conditions, and the threat to structures. Initially, the Palo Alto Fire Department response will include two Type III (Wildland Type) engines, one Type I (Structure Type) engine, two Type IV patrol units, one Paramedic ambulance, and one Battalion Chief (Appendix IV). With the exception of the ambulance, three personnel are assigned to each response unit vehicle. The ambulance requires two personnel. A Santa Clara County Fire Department brush unit from the Santa Clara County El Monte Fire Station (located at Foothill Community College in Los Altos Hills) with three to four personnel will also be dispatched.

For large fires, the Santa Clara County can respond an additional four Type I engines and three Type IV brush units, each unit with three personnel. The emergency response system has the depth to provide additional resources from other mutual aid entities in the same area (e.g., CAL FIRE Ranger Unit resources located in Cupertino and San Martin). These include additional Type III units, air assets, hand crew resources, bulldozers, and command staff to complete an overhead requirement in the event of a major fire. Other fire apparatus resources are available through the Santa Clara County Mutual Aid System.

San Mateo County

Based on the San Mateo County Fire Service's Wildland Alarm Plan, the level of fire department response to wildland fires is contingent on the wildfire threat due to weather conditions. The response levels are based on Low/Medium, High, and Extreme/Very High-Level Response fire danger:

Low/Medium Level Response	Three Engines and a Battalion Chief (Notification to the CAL FIRE Battalion Chief)
High Level Response	In addition to the resources for a Low/Medium Level Response, three more engines, a CAL FIRE Type 3 engine, a water tender, an additional Battalion Chief and a CAL FIRE Battalion Chief
Extreme/Very High Level	In addition to the resources for a Low/Medium Level and High-Level Responses, three more engines and twomore Battalion Chiefs

In addition to the resources listed for response, other wildfire equipment and resources are available from CAL FIRE including additional Type 3 engines, air attack resources (air command, helicopters, and air tankers, bulldozers, and fire crews.

7.1.3 Stanford University Response

Should a wildfire occur within Stanford property or on properties adjacent to Stanford with the possibility of spreading to Stanford lands, Stanford will respond in accordance with the strategies outlined in the Stanford University Emergency Plan.

Concurrent with fire department response, initial assessment of the fire and the potential to impact the educational or research missions of the institution or damage Stanford property will be conducted by the Stanford Situation Triage & Assessment Team (STAT). They will determine whether additional resources are necessary to address the situation and will activate teams as needed. STAT may direct the activation of one or more

Department Operations Centers (DOCs) and will determine the need for establishing an Emergency Operations Center (EOC) and its location. STAT will coordinate with outside agencies on specific fire response strategies based on the prevailing conditions at the time of the event.

The type and content of communication necessary to send out to the campus community based on the risk posed by the wildfire will be determined by STAT in consultation with University Communications. Communications may include all-campus emails, notices posted on the Stanford emergency website (https://emergency.stanford.edu), or activation of the University mass notification system, AlertSU (which can include mass text message and email notifications to the Stanford community). STAT will remain active until the Incident Commander of the event determines that the threat has been reduced sufficiently so that the fire no longer poses a threat to the Stanford campus.

7.1.4 Santa Clara and San Mateo County Emergency Alert Systems

Overview

Santa Clara County and San Mateo County both maintain their own emergency alert systems through their Offices of Emergency Services (OES). The messages sent out are not necessarily coordinated with AlertSU.

Santa Clara County Emergency Alert System (AlertSCC)

AlertSCC is a free and easy way to get emergency alerts sent directly to your cell phone or mobile device, landline, or email. Alerts can include:

- Fire
- Earthquake
- Severe weather
- Crime incident that affects your neighborhood
- Instructions during a disaster

To sign up for emergency alerts within Santa Clara County visit the AlertSCC website at https://www.sccgov.org/sites/oes/alertscc/Pages/home.aspx.

San Mateo County Alert System (SMC Alert)

SMC ALERT is a free alert notification system used to immediately contact you during urgent or emergency situations in San Mateo County. You can set alerts to send emergency and non-emergency text and voice messages to your:

- Email Accounts
- Cell Phones, Smartphones, Tablets
- Voice Messages to Landline Phones (home & work)

To sign up for emergency alerts within San Mateo County visit the AlertSCC website at https://hsd.smcsheriff.com/smcalert.

8 Roles and Responsibilities and Communication with the Community

8.1 Roles and Responsibilities

The effectiveness of the strategies identified in this plan can only be accomplished through the cooperation of the team of Stanford University partners. The campus partners that have a role in the 2021 Plan are shown in Table 8-1. Stanford's contacts are shown in Table 8-2.

Outside agencies also have roles related to mitigating wildfire hazards as well as providing emergency response related to wildfires on Stanford campus, as shown in Table 8-3.

Table 8-1 Stanford Roles and Responsibilities

Department or Group	Responsibilities
Environmental Health andSafety (EH&S) *Stanford University Fire Marshal's Office (SUFMO)*	Provides comprehensive services to the Stanford community encompassing all aspects of fire safety. As it pertains to wildfires, these responsibilities include meeting with the various stakeholders to review and confirm fuel reduction plans, meeting with local agencies toreview any of their concerns and completing Faculty/Staff Housing surveys.
Lands, Buildings and RealEstate (LBRE)	Responsible for all construction and maintenance of theStanford campus, including fuels management work.
Buildings and Ground Maintenance (BGM)	Responsible for managing and performing fuel management, including mowing and tilling fire breaks onStanford land that is not under lease agreement throughReal Estate (see *Real Estate* below).
Zone Management (Zone A)	Manages major maintenance and repair projects for the university, including facilities located in the foothills (Zone A), an area susceptible to wildfires. A Zone Map can be found here.
Real Estate	Responsible for fuel reduction on open lands with no leaseholders. Works with leasees to ensure required fuelmanagement work is conducted in accordance with this plan and the direction of local fire departments.
Land Use and Environmental Planning(LUEP)	Directly oversees Stanford's stewardship activities for biological and cultural resources located on Stanford lands, including the Stanford HCP.

Table 8-2 Stanford Contacts

Group	Contact	Email
LBRE: Real Estate	Ramsey Shuayto, Director,Asset Management Mimi Dunkle, Real Estate Asset Specialist Selina Whitlock, Real Estate Administrator	rshuayto@stanford.edu mimi.dunkle@stanford.edu selina.whitlock@stanford.edu
LBRE: Buildings & Grounds Maintenance	Ted Tucholski, Director,Grounds Services	lucky1@stanford.edu
LBRE: Land Use & Environmental Planning	Alan Launer, Associate Director, Conservation Planning Esther Cole Adelsheim, PhD, Conservation Program Manager	aelauner@stanford.edu ecolea@stanford.edu
LBRE: Zone Management (Zone A)	Edmund Chiu, LBRE Associate Director, Zone A M. Jovan Solis, LBRE Zone Management	edchiu8@stanford.edu jsolis@stanford.edu
Office of Public Affairs: Government and Community Relations	Lucy W. Wicks, DirectorCommunity Relations	lucy.wicks@stanford.edu
Department of PublicSafety	Bill Larson, Public Information Officer Chris Cohendet, Captain	william.larson@stanford.edu chris.cohendet@stanford.edu
SLAC National Accelerator Laboratory	Ralph Kerwin, Fire Marshal	rkerwin@stanford.edu

Table 8-3 Outside Agency/Entity Roles

Agency or Entity	Role
United States Department ofEnergy (U.S. DOE)	Owns and operates a set of 230-kV power lines that extend from SLAC for five miles to Skyline Boulevard. U.S. DOEfunds the ongoing power-transmission easement vegetation fuel-reduction program along with Stanford. SLAC is responsible for the maintenance of these lines.
Pacific Gas and Electric (PG&E)	Required to review and mitigate overhead power line exposures to adjacent tree limbs, etc., in accordance withtheir Wildfire Safety Plan approved by the State of California. Responsible for maintenance of all PG&E lines and some SLAC lines.

Agency or Entity	Role
Santa Clara County (SCC) Roadsand Airports Department *Roads and Signal Operations Division*	Provides fuel reduction services along Junipero Serra Boulevard within 10-foot easements present on both sides ofthe road.
Palo Alto Fire Department (PAFD)	Provides direct response services to Stanford lands. This includes the Faculty/Staff Housing areas and open lands within the main campus area and Palo Alto.
California Department of Forestry and Fire Protection (CAL FIRE)	Provides varied emergency services in Santa Clara and San Mateo County. CAL FIRE notifies affected Counties when Red Flag Warnings are declared by NWS.
Santa Clara County Fire Department (SCCFD)	Provides fire services for Santa Clara County. SCCFD has jurisdiction with regard to the enforcement of fire and life safety regulations for the main campus.
Woodside Fire Protection District (WFPD)	Provides emergency services to the communities of Woodside, Portola Valley, Emerald Hills, Ladera, Los Trancos, Skyline, and Vista Verde.
Menlo Park Fire District (MPFD)	Provides emergency services to the communities of Atherton, Menlo Park, East Palo Alto, and some of the unincorporated areas of San Mateo County.

8.2 Communication with the Community

Each spring, SUFMO provides information for the residents of the Faculty/Staff Housing areas on how they can protect their homes from a wildfire. This correspondence also contains information on the home safety surveys to be conducted from May through July. This information is sent to residents via email.

9 Preparers

This section lists the individuals who either prepared or participated in the preparation of plan.

Table 9-1 Plan Authors

Contributor	Role
Consultant	
Tania Treis, Panorama Environmental	Document Preparation, Quality Control, and Templates
Caitlin Gilleran, Panorama Environmental	Document Preparation
Scott Conway, Vibrant Planet	Modeling, Treatment Development
Danielle Perrot, Vibrant Planet	Modeling, Treatment Development
Jarrett Barbuto, SIG	GIS Data Management
Phil Dye, Prometheus Fire Consulting LLC	Site Visits, Ground Truthing
Stanford	**Title**
Jessica von Borck, LEED AP	Director Land Use Planning
Aaron McCarthy	Stanford Fire Marshal
Alan Launer, PhD	Associate Director, Conservation Planning
John Donahoe	Director, Planning and Entitlement
Jean McCowen	Associate Vice President, Government Affairs
Lucy Wicks	Assistant Vice President, Government Affairs
Ramsey Shuayto	Director, Asset Management
Mimi Dunkle	Assistant Director, Property Services
Kevin Bebb	Senior Associate Vice President and Chief Risk Manager
George Sandoval	Executive Director of Resilience and Response LBRE Academic Projects and Operations
Maria Cacho, Ph.D	Sr. Environmental Planner/Information Systems Manager
Ted Tucholski	Director of Grounds
Linda Liu	Senior University Counsel

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