



CONNECTED COMMUNITIES: TRAILS MASTER PLAN

APPENDIX VII. FIRE HARDENED TRAILS PRESCRIPTION

Fire- Hardened Trails Prescription

The following proposal is a cross discipline collaborative concept proposal from Sierra Buttes Trail Stewardship in partnership with: US Forest Service Pacific Southwest Region 5. Plumas, Tahoe, Lassen and Humboldt-Toiyabe National Forest. Nevada, Sierra, Plumas, Lassen and Butte Counties as well as the cities of Loyalton and Portola.

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Proposal

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Background

During the Dixie Fire and North Complex Fire of 2020, trails were used as firelines for fire crew access, fire containment, anchor points, and strategic firing operations.

The USDA Forest Service's longstanding history of managing for multiple uses is embodied by the 1960 Multiple Use Sustained Yield Act, which recognizes public benefit in managing multiple and often overlapping or congruent resources, including forest health, recreation, water, and wildlife habitat. Concerning twenty-first century trends of interacting landscape scale

disturbances threaten these resource values through climate exacerbated drought, landscape level tree mortality, and increasing scale and proportion of high severity wildfire. Across the Plumas National Forest, over 16% of forests have been converted to non-forest types within the past 5 years. These alarming rates impact not only forest cover across watersheds and landscapes, but have cascading adverse impacts on recreation, water, and wildlife habitat. Considering these challenges have interconnected adverse effects across resource values, perhaps solutions should also be synergistic in nature across resource disciplines.



This Fire-Hardened Trails concept proposal represents a measured attempt to harness the interconnectivity of resources and benefits and has the potential to amplify these ideas across local, regional, and statewide trail-users and clientele. Traditional knowledge provides awareness and context of how important culture and social use of forest ecosystems are to forest stewardship, and this proposal tries to honor these concepts in a contemporary culture of recreation and trail-user groups.

The Sierra Buttes Trail Stewardship Connected Communities Project is a landscape-level project that connects rural communities throughout the Northern Sierra and provides local and regional recreation opportunities for forest use. This proposed trail system is much more than a route for recreation enthusiasts. These trails provide access and transportation through the forest that can be used to augment or enhance opportunities for forest stewardship, fuel and fire management, and improve or conserve wildlife habitat.

Primarily, these trails play a significant role in shaping the user's experience and impacting the culture and ecosystems of the forest. Yet, because of a century of fire suppression, many of these forests have deviated significantly from their natural fire patterns and the variability they once exhibited. In essence, by offering recreation opportunities without addressing restoration or management needs and without providing interpretation, we inadvertently present forest conditions to the public that are neither natural nor beneficial. Therefore, combining recreation and restoration serves as a medium to provide interpretation, education, and foster a contemporary culture of connectedness with public forests underscoring the imperative for forest restoration and responsible stewardship

Purpose and Need

Increasing scale and proportion of high-severity wildfire is a well-documented trend across the Sierra Nevada Mountain range (Miller and Safford 2012), and the Northern Sierra, in particular, has exhibited concerning trends wherein high-severity fire of past fires, drives future high severity fire (Coppoletta et al. 2016). Moving forward in the 21st century, recent research (Bernal et al. 2022) indicates that future climate will support far more open and less dense forests, and resilient forest conditions may be far more open with 80-90 percent fewer trees (North et al 2022). Forest and fire ecologists and managers recommend that taking a "pyro silviculture" approach to management actions requires consideration and incorporation of wildfire as an anticipated disturbance and suggests that management actions that build in mechanical treatments to augment anchor points, ecosystem assets, and revenue considerations in project planning (North et al. 2022). These concepts and strategies can help promote forest resilience to disturbances, thereby enhancing the resilience of linked resource values like recreation opportunities, watershed health, and wildlife habitat.

The Connected Communities Project provides approximately 551 miles of trail. This project not only represents recreation opportunities in the Northern Sierra, but contributes to accomplish stewardship by increasing vegetation management acres, increasing safe access/egress, and providing fuels management corridors. Incorporating fire, fuel and vegetation management planning into trail plans provides critical safe access for fire crews, fuel containment corridors and fire management opportunities, as well as provides public interpretation and education on the importance of managing forest ecosystems.

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Combining trail development with trailside forest stewardship promotes shared stewardship for the resilience of forest ecosystems, recreation and natural resource-based economies. Outdoor recreation and resource related jobs are essential economic drivers of rural forested communities. Implementation of the design criteria contained in this report will create more resilient communities, sustainable recreation, and contribute to long-term, improved overall forest health.

Disturbances like high-severity wildfire and drought-driven tree mortality events create widespread impacts to forest ecosystems AND recreation opportunities dependent on these ecosystems. Over the past decade, hundreds of miles of recreation trails have been impacted by high-severity wildfire and tree mortality. These events compromise ecosystem values, visual quality objectives, access, and visitor safety. Standing dead trees within the trail prism serve as hazards to trail user groups. For example, the Cold Stream Trail in the Plumas National Forest was impacted by the 2001 Stream Fire, 2007 Antelope Complex and Moonlight Fires; the areas that burned with higher-severity fire created conditions where standing snags and impenetrable shrub recolonization years after the fire compromised safety and access to trail users. As a result, portions of this trail have seen decreased use and in some sections become impassable for users.

Restoration of the forests surrounding trails during their development provides an opportunity to strategically plan and implement forest and trail stewardship tactics that can both mitigate the potential for adverse effects in a pre-disturbance context and provide for nimble and flexible post-disturbance restoration assessment and response. Moreover, these trail systems with managed vegetation corridors can enhance fuels management and restoration activities by providing access and operational infrastructure for prescribed fire operations and wildfire incident management containment operations. (Moghaddas and Craggs 2007); For example, the 2021 Fly Fire (managed as part of the 2021 Dixie Fire Incident) was largely contained from spreading into the community of Quincy, due to backfiring operations that were facilitated by pre-fire fuel treatment infrastructure, which had been implemented a decade prior to the fire. These types of treatments, which facilitate access, mechanical and prescribed fire treatments, are critical infrastructure used for wildfire containment tactics in large wildfire incident management. Trail-side vegetation management corridors can be interchangeably defined as Fire-Hardened trails.

Fire-Hardened Trail Concept Proposal

A Fire-Hardened Trail is a designated and managed corridor that combines both vegetation management and recreational trails. It is a planned corridor where the preservation and enhancement of the forest plays a significant role in forest restoration and fuels reduction work, and is integrated with the creation of trails for recreational use.

Fire-Hardened Trails serve as multi-functional spaces that cater to both environmental conservation and community well-being. They are designed to provide a harmonious blend of nature and recreation, promoting a healthier lifestyle while preserving and enhancing the natural environment.

Much like a Shaded Fuel Break, The Fire-Hardened Trail prescription utilizes forest management techniques to create a resilient forest that supports healthy ecosystems, recreational benefits and wildfire resiliency. The community and forest benefits of a Fire-Hardened Trail can be accomplished by creating fuel conditions that pose low wildfire risk to communities while fostering a pattern of forest fuels that slow wildfire spread and intensity when wildfire encounters the trail corridors. The Prescription is a concept consistent with the goals and aims to implement actions identified in California's Joint Strategy for Sustainable Outdoor Recreation and Wildfire Resilience. Specifically, these desired conditions would implement Goal #1 of the Strategy: Integrate Forest Health and Sustainable Outdoor Recreation. Additionally, Fire Hardened Corridors embrace the essence of Shared Stewardship by considering 'using all available tools for active management.' (California Wildlife and Forest Resilience Task Force , 2022).

During the Dixie Fire and North Complex Fire, trails were used as firelines for containment, anchor points, and strategic firing operations. Removing fuels along trail corridors allows for the protection of the investment in the trail systems, accounts for wildfire prevention from trail users, and provides strategically placed and tactically feasible trails for wildland fire operations.

The Fire-Hardened Trail prescription for vegetation management corridors can be accomplished through generally accepted fuels reduction practices and non-commercial thinning (i.e., mechanical thinning, mechanical piling, mastication, towed and tracked chipping, hand cutting, hand piling, pruning, pile burning and underburning). The site specific Prescription for a Fire Hardened Trail will be created in partnership with the local land managers, applicable fire control agencies and the Natural Resources Conservation Service, Conservation Practice Specification Fuel Break – Forestland (Code 383).

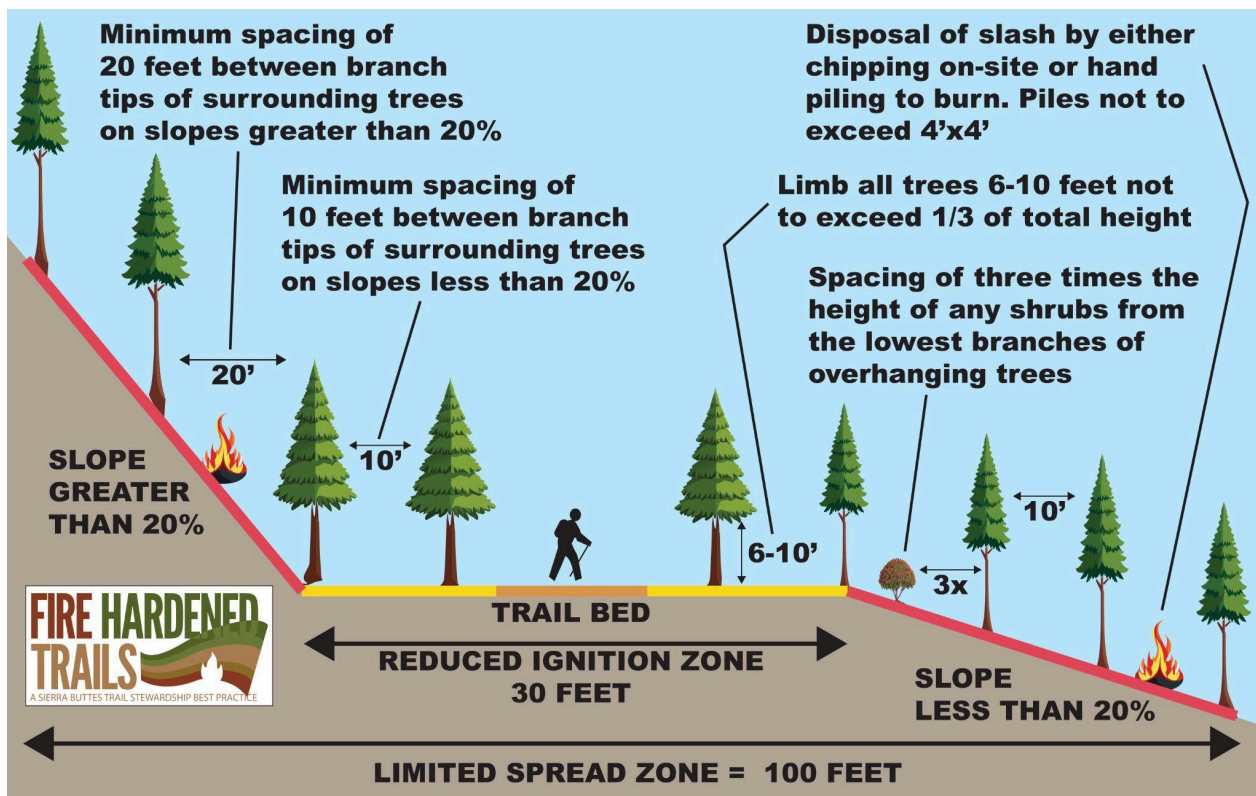
Below is a sample Fire-Hardened Trail prescription that would maximize the 100-foot trail corridor as a fuel break that is conducive for trails as fireline. The prescriptions described for the Reduced Ignition Zone will be included within the Limited Spread Zone.

Reduced Ignition Zone - Within 15 feet of both sides of centerline of the trail:

- Remove all dead standing or downed trees and all brush.
- Remove all trees less than 6 inch DBH.
- Limb all trees to a height of 8 feet, not to exceed $\frac{1}{3}$ the total height of the tree.

Limited Spread Zone - From 15 to 50 feet of both sides of the centerline of the trail:

- Thin 40 percent of trees less than 6 inch DBH and reduce brush components by 50 percent.
- Remove all dead standing trees less than 12" DBH.
- Leave trees will have a minimum spacing of 10 feet between branch tips of surrounding trees on slopes less than 20% and will have 20 feet of spacing on slopes greater than 20%.
- Limb all trees to a height of 8 feet, not to exceed $\frac{1}{3}$ the total height of the tree.
- Maintain a spacing of three times the height of any shrubs between the shrubs and the lowest branches of overhanging trees.
- Disposal of slash will be accomplished either through chipping on site or hand piling not to exceed 4'x4' piles to be burned by the US Forest Service.



Design Criteria Specific to Post-Fire Environments

In High Severity Environments - The post fire recovery environment represents an excellent opportunity to manage the Fire Hardened Trail areas immediately following a wildfire. Care should be taken to recognize and manage special habitats appropriately.

- Retain all live conifer trees greater than or equal to 16" diameter at breast height (dbh).
- Retain all live hardwood trees greater than or equal to 6" diameter dbh.
 - Live trees greater than these limits would only be removed/mitigated if they qualify as a hazard under the Region 5 FHP Hazard tree guidelines.
- Any dead, dying, or fire injured tree of sufficient probability of mortality and located in distance and arrangement making it capable of striking the trail system should be removed according to the following:
 - All dead trees less than 14" diameter shall be felled and piled for burning.
 - Dead trees greater than 14" dbh should be felled if they pose a striking hazard to the trail and slash piled for burning.
- Fire-injured trees that have crown scorch that equates to a probability of mortality of 50% or greater (respective to species and diameter per USFS Hood and Cluck Guidelines) could be removed to manage the development of future hazard trees or fuel profiles.
- Maintain shrub fuels according to the Reduced Ignition and Limited Spread zone prescriptions as the shrubs regrow through use of mechanical, machine or herbicide treatment methods.
- Pile and burn or chip slash or biomass debris.
- Treat up to 80% of the 10 and 100 hour naturally occurring ground fuels within 50 feet from both sides of the centerline of the trail.
- Consider trailside planting of conifers in a clustered or micro-sited arrangement to mimic a wild forest aesthetic.
 - Tree stocking could be lower density ranging from 50-75 trees per acre.
- Consider thinning or pruning and re-sprouting hardwoods to expedite the development of larger stems and individuals.

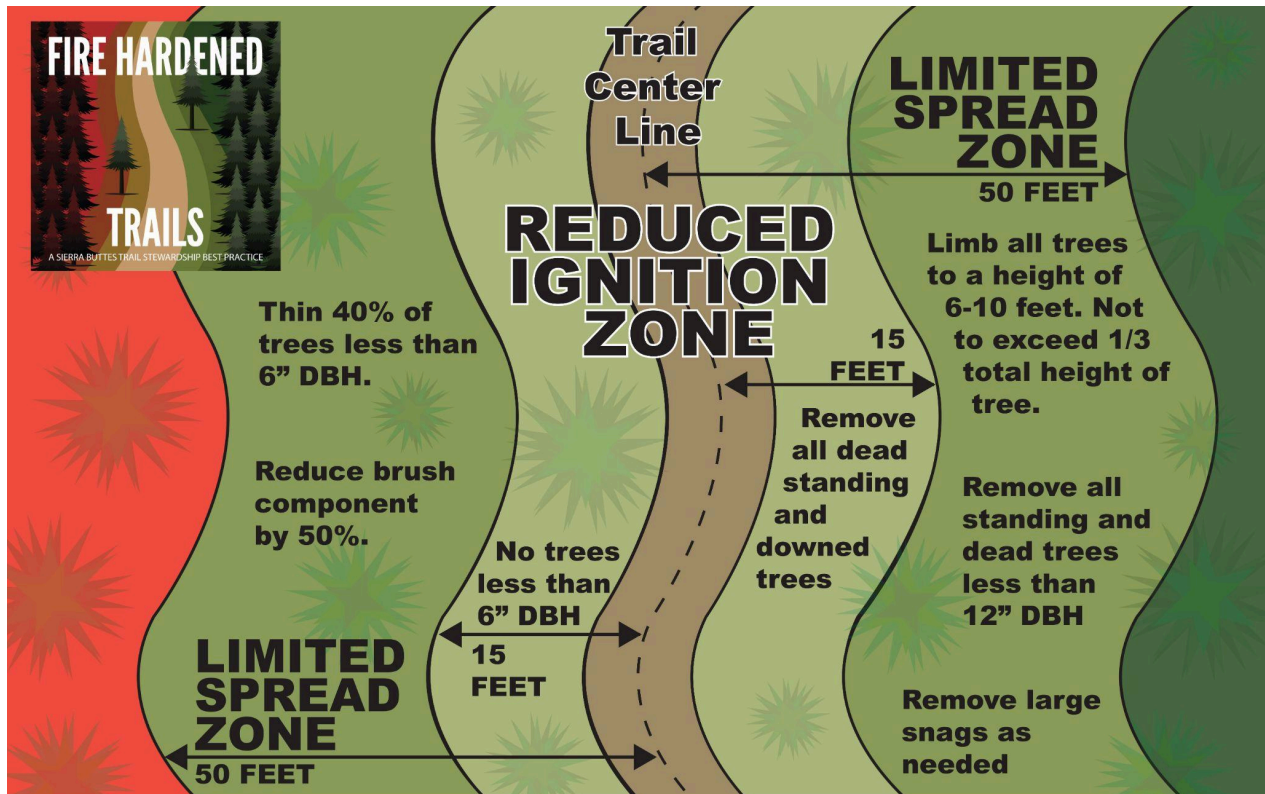
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Implementation of the Fire-Hardened Trail prescription on all 551 miles of Connected Communities Identified Routes would result in 6,679 acres of healthy forest with only 267 acres of permanent infrastructure. The proposed trail prescription would be slightly modified from the trailhead in order to discourage ATV traffic.

Proposed Desired Conditions for Trailside Forest & Vegetation Restoration

The overall desired condition for the project area is to have a resilient forest that supports healthy ecosystems, recreational benefits, and wildfire resiliency. This can be accomplished by restoring forest structure to improve forest health, and creating fuel conditions that pose low wildfire risk to communities while fostering a pattern of forest fuels that slow wildfire spread and intensity when wildfire encounters the trail corridors.



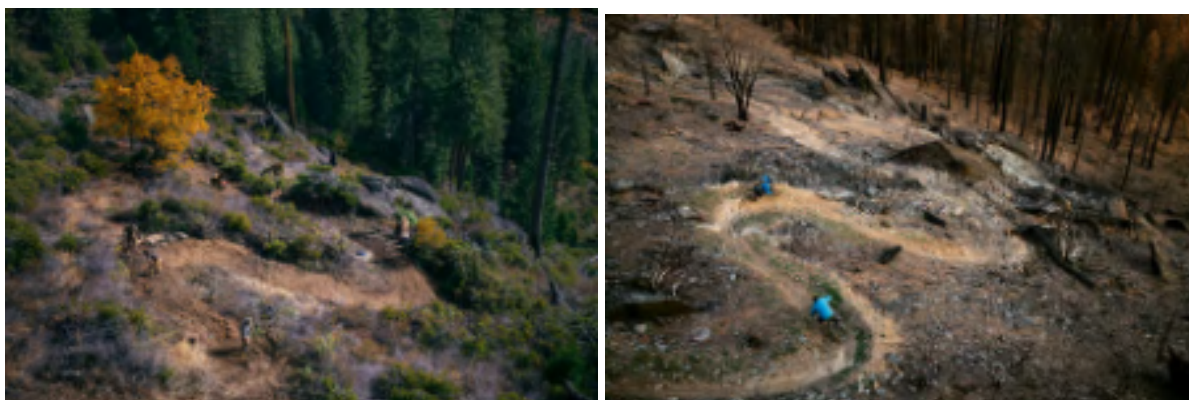
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Removing fuels along trail corridors improves resistance to disturbances and contributes to resiliency of the overall trail system, reduces the opportunity and likelihood of accidental wildfire ignition by trail users, and increases options for ingress and egress during fires. Treated trail corridors allow wildlife access to fragmented habitat while providing for increased sightlines and escape routes from threats. Strategically placed and tactically feasible trail corridors with fuels reduction can be a critical component during wildland fires, prescribed fire operations, and overall forest health.

Wildfire and drought resilience can be improved through commonly used fuels reduction activities and forest density reduction. Both of these concepts are important to long term resiliency of trail systems. While surface and ladder fuels are the primary drivers of wildfire behavior, canopy fuels contribute to annual surface fuel accumulation and dense forest conditions can drive competition and low tree vigor, contributing to tree mortality in extended drought conditions. Treatments such as mechanical thinning, mechanical piling, mastication, towed and tracked chipping, hand cutting, hand piling, lop and scatter, pruning, pile burning, and underburning can be used to modify forest structure and reduce surface, ladder and canopy fuels to improve forest resistance to disturbances like wildfire, and promote forest resilience to compounding disturbances like extended drought, insect-driven tree mortality, and subsequent high-severity wildfire (Stephens et al 2022).

Fire-Hardened Trail prescriptions would be created in partnership with stakeholders and USDA Forest Service National Forest units (i.e. the Tahoe, Plumas and Lassen National Forests) to meet forest restoration and stewardship goals, while also meeting fuel treatment standards such as those detailed in the SNFPA 2004 ROD and/or the [Natural Resources Conservation Service \(NRCS\) Conservation Practice Specifications for fuel breaks \(Code 383\)](#).

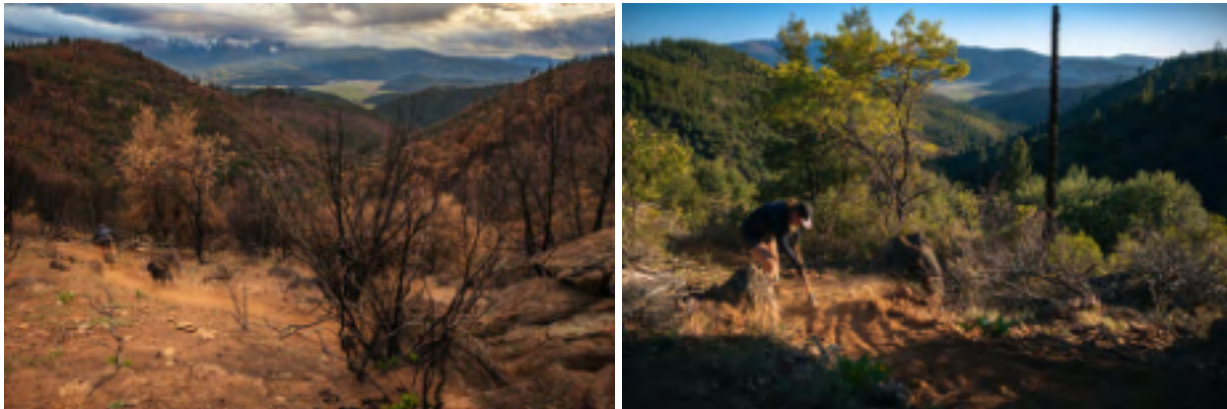


Proposed Design Criteria

Design criteria would be developed for pre-wildfire environments and post-fire environments, respectively, to address the unique variables in each environment. Post-fire environments present unique challenges for trail safety and maintenance due to the dynamic nature of post fire

environments. Within the first decade, standing snags deteriorate and fall either in part or in entirety. Dead tops or limbs pose an equally fatal hazard considering potential fall distances. The accumulation of this dead material contributes to surface fuel accumulations. Concurrently, shrub germination and growth can rapidly colonize sites, creating access barriers as well as impacts to trail view sheds, depth of penetration, and plant species diversity. In combination, the accumulation of dead woody fuels and live shrub fuels contribute to the development of fuel profiles, which can facilitate future high-severity fire (Coppoletta et al 2016).

Across environments, design criteria for trail specifications, drainage, erosion control, vehicle and equipment travel, maintenance, and repair would conform to trail specifications. Best management practices would be employed to reduce and mitigate potential for negative effects to hydrology, wildlife, botanical, or heritage resources. With regards to forest vegetation management, hazard tree guidelines would conform to the [Region 5 Forest Health Protection Hazard Tree Guidelines for Forest Service Facilities and Roads](#) (USDA Forest Service Forest Health Protection Report# R)O-12-01).



Point Protect Specific Trail Alignments for Projects In or Near the Wildland Urban Interface, and Areas of Ecological and Cultural Importance

Partnered education programming and information transparency amongst participating agencies to create a map for a unified understanding of individual agency/organization objectives, known hazards, areas of cultural or biological concerns, and potential for escape routes, safety zones, and landing zones in the event of an emergency.

When applicable:

- Trails to be built parallel and in close proximity of existing man made (i.e. roads) and natural (i.e. ridges) features that can also be used as fire control lines.
- Design trails in conjunction with predicted localized weather conditions that exist during critical fire season (i.e. more emphasis on fuels reductions with wider trail corridors in areas of Wildland Urban Interface that have predicted seasonal wind events).
- Trails built in conjunction with timber stand objectives to slow the rate of spread and provide firefighters time for suppression.
- Trails aligned to allow for easy implementation of backfiring and holding operations during fire emergencies.
- Create connector trails and cutoffs to allow easy egress for firefighters while working in the wildland urban interface.
- Trails to be used as control lines for prescribed burning. Consider a top down approach to trail design in conjunction with prescribed burn plans.

Design Criteria specific to Unburned Forests

1. Retain all live conifer trees greater than or equal to 20" diameter at breast height (dbh). Retain all live hardwood trees greater than or equal to 8" diameter dbh. Live trees greater than these limits would only be removed/mitigated if they qualify as a hazard under the Region 5 FHP Hazard tree guidelines.
2. In general, focus tree removal to reduce suppressed understory trees and ladder fuels less than 12 inches DBH 15 feet from both sides of the centerline of the trail
3. Limb all trees to a height of 6-10 feet, not to exceed $\frac{1}{3}$ of the total height of the tree.
4. Thin trees less than 10 inches DBH to 20-35 foot spacing from equal or larger size residual live trees. Clumping of trees and increasing spacing can be used to promote heterogeneity and diversity in forest structure.
5. Reduce shrub component to no more than 20-percent cover 50 feet from both sides of the centerline of the trail. Remove all brush and shrubs within 15 feet of trail centerline. Pile burn or chip cut material.
6. Pile and burn or chip slash or biomass debris. Treat up to 80% of the 10 and 100 hour naturally occurring ground fuels within 50 feet from both sides of the centerline of the trail.
7. Fall and remove or stably place hazard trees that have the potential to fall on or across the trail.
8. Where safe and feasible, integrate the treated trail network for use as fire lines on future prescribed fires.
9. Use a combination of future thinning, pruning, cutting, chipping, pile burning, and underburning to maintain corridor resiliency over time.
10. Allow for managing jurisdiction to modify prescription on case by case basis to respond to user issues related to trail use.

Design Criteria Specific to Post-Fire Environments

In High severity environments

1. Retain all live conifer trees greater than or equal to 16" diameter at breast height (dbh). Retain all live hardwood trees greater than or equal to 6" diameter dbh. Live trees greater than these limits would only be removed/mitigated if they qualify as a hazard under the Region 5 FHP Hazard tree guidelines.
2. In general, focus on the removal of dead trees that pose a hazard to the trail or could contribute to undesirable fuel loads/ fuel profile over time. Any dead, dying, or fire injured tree of sufficient probability of mortality and located in distance and arrangement making it capable of striking the trail system should be removed.
3. Dead trees less than 14" diameter could be felled and piled for burning. Dead trees greater than 14" dbh could be felled and limbed, with activity slash piled for burning.
4. Fire-injured trees that have crown scorch that equates to a probability of mortality of 50% or greater (respective to species and diameter per USFS Hood and Cluck Guidelines) could be removed to manage the development of future hazard trees or fuel profiles.
5. Consider shrub removal and management through manual, mechanical, or chemical (herbicide) means. Reduce shrub component to no more than 20 percent cover 50 feet from both sides of the centerline of the trail. Remove all brush and shrubs within 15 feet of the trail centerline. Pile burn or chip cut material.
6. Pile and burn or chip slash or biomass debris. Treat up to 80% of the 10 and 100 hour naturally occurring ground fuels within 50 feet from both sides of the centerline of the trail.
7. Consider trailside planting of conifers in a clustered or micro-sited arrangement to mimic a wild forest aesthetic. Tree stocking could be lower density ranging from 50-75 trees per

acre.

8. Consider managing competing shrub vegetation around planted trees with manual or herbicide methods retaining no more than 20 percent shrub cover to promote tree growth and understory plant diversity.

Consider thinning or pruning and re-sprouting hardwoods to expedite the development of larger stems and individuals.

Public Benefits

Fire-Hardened Trails can play a crucial role in addressing wildfire recovery and forest resilience in California, aligning with the goals of the California Wildfire and Forest Resilience Action Plan and the Sierra Nevada Conservancy (SNC) Watershed Improvement Program. Fire Hardened Trails with the inclusion of recreational trails can offer several public benefits, including both natural resource benefits, recreational advantages and economic stability. Here are some of the key benefits:

1. Fuel Breaks and Firebreaks: Vegetation management corridors can serve as strategically placed fuel breaks and firebreaks. By reducing the density of vegetation in these areas, they can reduce the continuity of flammable vegetation, slow the spread of wildfires, prevent catastrophic wildfires, and provide firefighters with safer access to control and contain fires. This will also support defensible space to protect homes and strengthen community resilience.

2. Wildlife Habitat Preservation: Well-designed vegetation management corridors can provide essential habitat for wildlife by maintaining or restoring native plant species. The presence of such corridors can help support biodiversity by creating connected habitats and migration routes for animals. This will also help habitats remain or recover more quickly from wildfire, improve long term resilience of ecosystems and species.

3. Ecosystem Health and Biodiversity: Properly managed corridors can promote forest health by removing diseased, dead, or overgrown vegetation. This reduces competition for resources among trees and supports the growth of healthier, more resilient forests. Maintained corridors with also support diverse native vegetation that will enhance biodiversity and ecosystem resilience from disturbances, including wildfires.

4. Improved Air and Water Quality: Vegetation within these corridors can act as natural filters, improving air quality by absorbing pollutants and filtering dust particles. They can also help to maintain water quality by reducing runoff and filtering contaminants before they reach bodies of water.

5. Erosion Control: The roots of vegetation help stabilize soil, preventing erosion and reducing the risk of landslides, particularly in hilly or sloped areas. This contributes to the preservation of natural landscapes and infrastructure.

6. Climate Change Mitigation: Vegetation in these corridors can absorb carbon dioxide (CO₂) through photosynthesis, thereby helping to mitigate climate change by sequestering carbon. Additionally, shading from trees can reduce urban heat island effects, helping to mitigate local temperature increases.

7. Recreational Opportunities: Including recreational trails within these corridors provides the

public with opportunities for outdoor activities such as hiking, biking, jogging, bird-watching and more. These activities promote physical fitness, mental well-being, and a connection to nature.

8. Economic Benefits: Access to recreational trails can boost local economies through increased tourism and visitor spending on accommodations, food, and outdoor equipment. Well maintained trails can also enhance property values in nearby areas.

9. Educational and Cultural Value: These corridors can serve as educational resources by providing opportunities for nature-based learning and environmental education programs. Additionally, they may have cultural significance for indigenous communities and can help promote cultural awareness and preservation.

10. Community Engagement: Involving local communities in the creation and maintenance of vegetation management corridors fosters a sense of ownership and responsibility. Communities can be educated about the importance of wildfire resilience and engaged in activities like controlled burns or invasive species removal. They can also bring communities together by serving as gathering spots for community engagements and events.

11. Health and Security: Access to green spaces and recreational trails has been linked to reduced stress, improved mental health, and overall well-being. These areas can provide places for relaxation and stress relief. These open spaces also contribute to a sense of safety and security.

12. Visual Resources: Well-maintained vegetation corridors and recreational trails can enhance the visual appeal of an area, making it more attractive to residents and visitors alike.