Midpeninsula Regional Open Space District

R-20-08
Meeting 20-08
April 8, 2020

SPECIAL MEETING AGENDA ITEM 1

AGENDA ITEM

Study Session on the Proposed Wildland Fire Resiliency Program

GENERAL MANAGER'S RECOMMENDATIONS

Receive an overview and provide feedback on the scope of the proposed Wildland Fire Resiliency Program, which includes the following elements: Vegetation Management Plan, Prescribed Fire Plan, Wildland Fire Pre-Plan and Resource Advisor Maps, and Monitoring Plan.

SUMMARY

The Midpeninsula Regional Open Space District (District) is developing a Wildland Fire Resiliency Program (Program) that will further one of the Board of Directors' (Board) Strategic Objectives to "work with fire agencies and surrounding communities to strengthen the prevention of, preparation for, and response to wildland fires for enhanced ecosystem resiliency and public safety". The proposed Program aims at managing vegetation and infrastructure on District lands to reduce catastrophic wildland fire risks, facilitate fire suppression activities and emergency response, and establish healthy, resilient, fire-adapted ecosystems. The purpose of this meeting is to present the various elements of the proposed Program and receive Board feedback and guidance in preparation for finalizing the California Environmental Quality Act (CEQA) project description and holding a future scoping meeting to solicit public input on the scope of the environmental review.

BACKGROUND

California's fire season is now longer and more intense due in part to dense regrowth of historically logged forests, more than a century of fire suppression, an increase in home construction adjacent to wildland areas, and a changing climate with extreme weather patterns. These factors raise the need for additional measures across the state to reduce the risk of a catastrophic fire. For the District, catastrophic fires in its wildland areas can severely damage, if not destroy, sensitive habitat and the natural resources that the agency is entrusted to protect on behalf of the public.

In the summer of 2018, the District entered into contracts with two consultants, Spatial Informatics Group, Inc., (SIG) and Panorama Environmental, Inc., (Panorama) to assist with development of a Prescribed Fire Program and the associated environmental review. Prescribed fire, including integrating Native American cultural burning practices, can be used as a strategy to reduce wildland fire risk and support fire-dependent plant communities. With an ever-growing concern about fire risk across the state, the scope of work was subsequently expanded to develop a more comprehensive, robust, and strategic Wildland Fire Resiliency Program (Program) that aligns with the District's mission and Resource Management Policies. This broader Program serves to further a Board of Directors Strategic Objective: "Work with fire agencies and surrounding communities to strengthen the prevention of, preparation for, and response to wildland fires for enhanced ecosystem resiliency and public safety". The contracts with SIG and Panorama were amended in 2019 to incorporate the expanded program (R-19-52; R-19-69).

Wildland Fire Prevention and Preparation -- Work to Date
Each year, the District commits extensive staff time and resources on various land management activities to protect natural resources and facilitate public safety in the event of a wildland fire. These activities include maintaining hundreds of miles of fuel breaks and fire roads within preserves that facilitate fire agency response and suppression activities, fulfilling defensible space clearance requirements for District-owned structures, and implementing vegetation treatments to protect public open space lands and sensitive habitats.

District staff are experienced professionals that receive specific training in working within California's fire-adapted landscapes. As a fire-safety precaution for District-led activities occurring within preserves during fire season, staff and hired contractors must regularly monitor weather conditions and have on-hand a water source, fire extinguishers, and/or hand tools if the activities have the potential for creating sparks or ignitions. Construction and maintenance activities that could potentially spark a fire are halted when weather conditions warrant.

The District retains staff trained in wildland firefighting who are equipped during the fire season with wildland fire gear and pumper trucks for initial response. Additional staff are trained as Resource Advisors to help fire responders avoid impacts to sensitive resources where possible during fire response activities.

The District focuses its vegetation management fuel reduction work on District-owned fire roads, fuel breaks, escape routes, and infrastructure within the open space preserves and other District-managed lands. To assist neighbors in creating 100-foot defensible space clearance around neighboring private structures, the District maintains a free and easy-to-use permit system for homeowners to receive permission to perform required vegetation clearance on District land. In addition, the District continues to work with and partner on fuel reduction work proposed on District lands that is initiated and performed by fire departments and fire safe councils.

The District also grants utility company access for completing cyclical fuels management and maintenance of their electrical transmission and distribution lines and poles to reduce accidental ignitions.

Community Role and Partnerships
According to CAL FIRE, approximately 95% of all fires are human caused. Preventing accidental ignitions remains one of the best ways to minimize risk from wildfire. Surrounding communities play an important role in preventing wildland fire ignitions and protecting private property, including residential homes. Specific actions that local communities and residents can take include:

- Hardening homes and structures against fire, creating defensible space, and having an evacuation plan (local fire safe councils provide resources);
- Signing up for county emergency alerts;

- Being aware of red flag warning weather when fire danger is highest and planning accordingly;
- Enjoying open space wildlands safely by adhering to bans on smoking, campfires, and use of firearms, as well as other public safety rules; and
- Safely engaging in activities while outdoors to reduce the demand on emergency resources in the event a fire response is required, such as: staying cool, carrying and drinking plenty of water, or considering other fire-safe activities during fire weather events.

DISCUSSION OF THE PROPOSED WILDLAND FIRE RESILIENCY PROGRAM

Prevention of wildland fire to protect sensitive habitats is a part of the District's ongoing land stewardship. With the proposed Wildland Fire Resiliency Program (Attachments 1 and 2), the District wishes to take additional proactive steps to further protect and enhance the natural environment while facilitating public safety agency response to wildland fires. These additional proactive steps not only further protect public open space lands and sensitive natural resources, they also provide greater overall protection from the direct impacts of fire on neighboring lands and indirect impacts to the larger Bay Area region.

On September 24, 2019, District staff presented to the Planning and Natural Resources Committee on the Program background and development. A review of the Resource Management (RM) Policies by SIG and Panorama determined that the goals and components of the District's Program are generally supported by the RM Policies. Staff provided recommendations for revised and additional policies that support the overarching objectives and goals of the Program. The Committee recommended forwarding the RM Policy changes and areas for clarification to the full Board, which include the following (Attachment 3; R-19-127, PNR Committee Meeting Minutes). These policy amendments are part of the project and the Board will consider approval at the time they also consider approving the Wildland Fire Resiliency Program:

- Add ecosystem resiliency to the Wildfire Management policies and a recommendation to identify acceptable levels of change to the environment that allow for establishment and maintenance of resiliency at the landscape level.
- Expand the focus of non-fire vegetation management actions as a strategy to reduce fire risk.

The proposed Program would increase the annual acreage of strategic, environmentally sensitive vegetation management conducted on District land (Attachment 4). The objectives of the Program are as follows:

- Manage vegetation to establish healthy, resilient, fire-adapted ecosystems, furthering the District's mission to protect and restore the diversity and integrity of the ecological processes and facilitate post-fire recovery;
- Integrate Native American cultural practices of vegetation management, particularly as they relate to prescribed fire;
- Manage vegetation and infrastructure on District lands to reduce wildland fire risks and aid wildland fire fighting capabilities and coordination, thus also providing enhanced fire safety for people and property across the region; and
- Provide an adaptive framework for periodic review of and revisions to District decisions within the Program in response to changing conditions (e.g. climatic

changes), new information (e.g. new research findings and expanded data layers), and improved technology (e.g. new tools and equipment).

The proposed management actions and projects under the Program are organized into the following four major elements:

- Vegetation Management Plan
- Prescribed Fire Plan
- Wildland Fire Pre-Plan/Resource Advisor Maps
- Monitoring Plan

Vegetation Management Plan (VMP)
This plan covers the creation and maintenance of potential new fuel treatment areas and maintenance of existing fuel treatments areas using various treatment methods (excluding the use of prescribed fire) to enhance two main wildland fire objectives: ecosystem resiliency and fire management. Collectively, vegetation treatments that reduce fuel loads to achieve these two objectives can dramatically reduce the spread and intensity of wildland fire. The District's ecologically sensitive vegetation management includes prioritizing the treatment of invasive species, leaving tree canopies intact, and providing buffers for special status species.

On October 28, 2019, the Planning and Natural Resources (PNR) Committee reviewed and provided input on the criteria to locate and prioritize the vegetation management areas for District lands (Attachment 5; R-19-141, PNR Committee Meeting Minutes). These criteria include:

- Proximity to occupied District structures, target hazards, and along designated District evacuation routes;
- Fire risk (based on CAL FIRE's map wide map) and field recommendation by professional fire staff;
- Proximity to critical emergency response infrastructure (e.g. communications tower, fire station, helicopter landing zone);
- Known presence of sensitive resources or diseases such as Sudden Oak Death where treatment would favorably benefit the resources; and
- Sites that are adjacent to other fuelbreaks or vegetation management areas and increase the effectiveness of work done on District lands.

The amount of vegetation management work planned and completed each year will be dependent on annual staff capacity, funding, and other resource availability, and will need to be balanced with other District priorities that further the mission, annual Strategic Goals & Objectives, and Vision Plan. As the District continues to grow, the location and prioritization criteria will be applied to new lands. District staff, with input from surrounding fire agencies, will annually prioritize areas for treatment and bring the anticipated budgets to the Board for review and approval as part of the annual capital improvement and action plan development process.

District staff analyzed current and potential future fuels reduction work to identify the maximum acreage of work that could occur during any one year. Factors considered in the development of maximum yearly acreage include:

- Potential impacts to wildlife;
- Requests from surrounding fire agencies;

- Criteria for grant funding opportunities to accomplish the work; and
- Capacity of District Biological staff to oversee the work or oversee consultant support.

Ecosystem Resiliency VMP
Due to past land uses, fire suppression practices, and diseases such as Sudden Oak Death, reducing fuel loads in certain habitats can make the ecosystem more resilient to wildland fire and reduce the fire risk overall for a certain region. This reduction of fuels lowers fire intensity and severity in the event of a wildland fire, preventing a catastrophic loss or significant damage to the natural resources. Table 1 details the maximum yearly acreage the District would perform in any year for ecosystem resiliency.

Table 1: Maximum Yearly Acreage for VMP: Ecosystem Resiliency

	Shaded Fuel Break	Non-Shaded Fuel Break	Total
New	400	100	500
Maintenance[1]	400	100	500
Total	800	200	1,000

Fire Management VMP
The Fire Management VMP defines and prioritizes vegetation management activities on District land to reduce wildland fire risks (e.g. fuelbreaks, defensible space), while also preserving biodiversity and minimizing negative environmental effects. Vegetation management for fuels reduction slows the spread of fire to allow additional time for responding fire personnel to arrive on scene and engage the fire to reduce fire damage and spread, and/or allow residents in the WUI to evacuate. The District strives to balance the needs of human communities with natural resource goals through ecologically sensitive vegetation management. Table 2 details the maximum yearly acreage the District may perform in any year to enhance fire management and suppression activities, which in turn enhances overall public safety for neighboring communities and the larger region.

Table 2: Maximum Yearly Acreage for VMP: Fire Management

Activity	Unit	Create New or Maintain[1] Existing	Annual Treatments
Shaded Fuelbreaks	Acre	New	50
		Maintain	100
Non-Shaded Fuelbreaks	Acre	New	5
		Maintain	80
Evacuation Routes, Critical Infrastructure, Fire Management Logistics Fuelbreaks	Acre	New	400
		Maintain	400
Target Hazards Fuelbreaks	Acre	New	20
		Maintain	20
Fire Agency New Recommended Fuelbreaks	Acre	New	100
		Maintain	N/A
Ingress/Egress Route Fuelbreaks	Acre	New	25
		Maintain	25
Disclines	Acre	New	10
		Maintain	60

[1] Maintenance acreage is to maintain already existing vegetation management areas and any new areas created under this Program.

Activity	Unit	Create New or Maintain[1] Existing	Annual Treatments
District Structures and Facilities Defensible Space	Acre	New	As needed
		Maintain	175
Emergency Staging Areas, Emergency Landing Zones, and Other Fire Management Logistics Areas	Acre	New	100
		Maintain	30
Eucalyptus and Acacia Removal	Acre	New	20
		Maintain	10
Total		**New**	**730**
		Maintain	**900**

Prescribed Fire Plan
Prescribed fire is one of the most important tools used to manage fire today. Prescribed fire uses a scientific prescription, prepared in advance, that describes the objectives, fuels, size, the precise environmental conditions under which a fire would be initiated, and conditions under which it would be suppressed. If weather conditions or forecasts vary from the prescribed conditions, then prescribed fire operations cease and active fire is immediately suppressed. For example, if winds or temperatures exceed the prescription, then the prescribed fire is deferred until conditions return to prescription. Prescribed fire can be designed to create a mosaic of diverse habitats for plants and animals, allow for the germination of fire-obligated or culturally-significant species, control invasive species to help rare and endangered species recover, or to reduce fuels and thereby prevent a more destructive fire during adverse weather conditions (i.e. high winds, high temperatures).

Prescribed fire can restore natural ecosystem processes and ecosystem health, and enhance cultural resources by integrating Native American cultural practices while also reducing fuel loads. Prescribed fire is particularly useful in grassland and oak woodland habitats, as it can both reduce fire hazard conditions and meet biological objectives by reintroducing a natural ecological process to improve ecosystem health. While not always feasible where structures are present, prescribed fire remains an important, cost-effective, fuel reduction technique to reduce dead and dense vegetative material.

The proposed Program includes a Prescribed Fire Plan (PFP) that is being addressed at a programmatic level. Areas of District land where prescribed fire would likely ***not*** be considered include:

- Areas where burning is prohibited by law/regulation/ordinance;
- Any area where the fire jurisdiction does not support using prescribed fire as a management tool;
- Less than 0.25 miles from a smoke sensitive area (e.g., hospitals, schools, nursing homes); and/or
- Where topography (e.g., slope, aspect) makes it unsuitable for a prescribed burn.

Wildland Fire Pre-Plan/Resource Advisor Maps
To assist responding fire agencies during a wildland fire, the Wildland Fire Pre-Plan/Resource Advisor Maps identify infrastructure and related fire suppression resources as well as important natural and cultural resources that may be impacted by wildland fire or suppression activities on District lands. The maps are for individual Preserve or, when it makes tactical/logistical sense, for groups of Preserves.

Monitoring Plan
The Monitoring Plan establishes baseline conditions for post-project analysis, including pre-project vegetation, soil, erosion, and water quality, as well as changes to the environment as time progresses after a project has been completed. The monitoring plan outlines the procedures for assessing the effectiveness of vegetative fuel load reduction projects and identify when maintenance of an area is warranted.

Monitoring requirements will vary depending on the activity undertaken and the conditions in the area where the activity is to occur. Monitoring and reporting may also be required as part of the mitigation adopted with the Final EIR for the program or any permits obtained to perform specific work activities under the program. Individual monitoring protocols will be determined on a case-by-case basis for each project at the discretion of professional District staff and/or as required by mitigation.

Overview of the CEQA Process
The California Environmental Quality Act (CEQA) review is planned to be completed using a two-phased approach to expedite the District's ability to expand its fuels reduction work:

Phase I – Program Environmental Impact Report (EIR): Detailed environmental review of all Program elements except the Prescribed Fire Plan, which will be reviewed at the programmatic level
The District's consultant, Panorama, will prepare a Program EIR with detailed descriptions of the vegetation management activities, wildland fire pre-plan mapping, infrastructure improvements, and monitoring component. A general programmatic description of the prescribed fire component will be included and analyzed. The District would be able to expand its fuels reduction work upon certification of the Program EIR (anticipated winter 2021).

Phase II – Tiered EIR: Detailed environmental review of the Prescribed Fire Plan
The environmental impacts of the Prescribed Fire Plan will be addressed within a second EIR that is tiered off the Phase I Program EIR and the California Vegetation Treatment Program that was recently approved by the Board of Forestry and Fire Protection. Staff anticipates certification of the tiered EIR in spring of 2022.

FISCAL IMPACT

This item will result in no direct fiscal impact. The Fiscal Year 2019-20 (FY20) budget includes sufficient funds to cover project costs for development of the Program and draft EIR through the end of the fiscal year. Every year, staff will prepare a recommended work plan and budget for the various Program elements. The Board will consider the anticipated budgets and any capital projects for review and approval as part of the annual capital improvement and action plan development process. Work plans will be dependent on staff capacity, funding, partnerships, grants, and other resources, and will need to balance other District priorities that further the mission, the annual Strategic Goals and Objectives, and Vision Plan.

BOARD COMMITTEE REVIEW

On September 24, 2019, District staff presented the Program background and development to the PNR Committee (Attachment 3; R-19-127, PNR Committee Meeting Minutes). The PNR

Committee recommended several RM Policy changes and areas for clarification. The PNR Committee recommended forwarding the proposed changes to the full Board (this report).

On October 29, 2019, District staff presented the Vegetation Management Plan for ecosystem resiliency and fire management to the PNR Committee (Attachment 5; R-19-141, PNR Committee Meeting Minutes). During this meeting, the PNR Committee confirmed the recommended criteria to locate and prioritize sites for vegetation treatments. The PNR Committee recommended forwarding the proposed Vegetation Management Plan and criteria to the full Board.

PUBLIC NOTICE

Public notice was provided as required by the Brown Act. Notices were also sent to interested parties, including partner agencies, stakeholders, and individuals with interest in Wildland Fires and Resource Management, by postal or electronic mail.

CEQA COMPLIANCE

This meeting is for the Board to provide feedback regarding the scope of the proposed Program to prepare for an upcoming public scoping meeting to solicit input on the scope of the environmental review pursuant to CEQA.

NEXT STEPS

Staff and the consultant team will continue to refine the Program elements based on direction received from the Board. The table below provides a tentative project schedule for Phase I:

Task	Date
Board Study Session on the Proposed Program	April 8, 2020
Notice of Preparation released for Public Comment Period, 30-days	April 20, 2020
CEQA Scoping Meeting	May 19, 2020
District staff and Consultants refine the Wildland Fire Resiliency Program elements based on further focused studies, environmental review, and permitting feasibility.	Spring 2020
Release of revised Wildland Fire Resiliency Plan, draft EIR, and draft first year work plan for public review	Summer 2020
EIR Public Comment Period, 45-day	Summer 2020
Board of Directors considers EIR certification and adoption of the Program	Winter 2021

The Project schedule for the tiered EIR with a focus on the Prescribed Fire Plan (Phase II) will be refined and presented to the Board at a future the public meeting.

Attachments
1. Program Description
2. Appendices to the Program Description

3. Planning and Natural Resources Committee Report, R-19-127
4. Ecologically Sensitive Vegetation Management
5. Planning and Natural Resources Committee Report, R-19-141
6. Public Comments received on the Proposed Program through March 30, 2020

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Attachment 1

Midpeninsula Regional Open Space District

Wildland Fire Resiliency Program

March 2020

SIG

PANORAMA ENVIRONMENTAL, INC.

Attachment 1

Midpeninsula Regional Open Space District
Wildland Fire Resiliency Program

March 2020

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Acronyms and Abbreviations

A

ATV	all-terrain vehicle

B

BAAQMD	Bay Area Air Quality Management District
BMPs	best management practices

C

CARB	California Air Resources Board
CEQA	California Environmental Quality Act
CAL FIRE	California Department of Forestry and Fire Protection
CDFW	California Department of Fish and Wildlife
CNPS	California Native Plant Society
CSC	California Special Concern
CWPP	Community Wildfire Protection Plan

D

DBH	diameter at breast height

E

EDDR	Early Detection Rapid Response
EIR	Environmental Impact Report

F

FRA	Fuel Reduction Area

G

GIS	Geographic Information Systems

I

IPM	Integrated Pest Management
IPMP	Integrated Pest Management Program

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N

NGO	non-governmental organization
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System

O

OSP	Open Space Preserve

P

PFP	Prescribed Fire Plan
PG&E	Pacific Gas and Electric Company
Program	Wildland Fire Resiliency Program

R

RM	Resource Management

S

SIG	Spatial Informatics Group
SMP	smoke management plan
SOD	Sudden Oak Death
SR	State Route

U

USFWS	U.S. Fish and Wildlife Service

V

VMA	vegetation management area

W

WUI	wildland-urban interface

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1 Introduction

1.1 Overview of the Midpeninsula Regional Open Space District

1.1.1 Overview

The Midpeninsula Regional Open Space District (Midpen) is a public agency formed by voter initiative in 1972. Midpen's purpose is to acquire and permanently protect a regional greenbelt of open space lands, preserve and restore wildlife habitat, watersheds, viewsheds, and fragile ecosystems, and provide opportunities for low-intensity recreation and environmental education. In 2004 Midpen expanded to protect the San Mateo coastside. Reflecting the interests of coastside residents, Midpen's San Mateo Coastside mission includes preserving the rural character and agricultural heritage of the coastside,and encouraging viable agricultural use of land resources. Midpen's mission outlines the critical functions of the agency, balancing the preservation of open space with active land restoration, low-intensity public recreation, and viable agricultural use. Midpen has preserved a regional greenbelt system of nearly 65,000 acres of public land and manages 26 open space preserves (OSPs) and other land under management agreements (referred to as "Midpen lands" throughout this document).

The Wildland Fire Resiliency Program (Program) addresses wildland fire management across all Midpen owned and managed lands.

1.1.2 History

Post-World War II was a time of rapid growth in the San Francisco Bay Area. As tract housing and commercial development began to dominate the "Valley of Heart's Delight," concern for the preservation of the mid-peninsula's irreplaceable foothill and bayland natural resources mounted among open space advocates. Midpen was created by successfully placing a voter initiative, Measure R, on the ballot in 1972.

> *Measure R will preserve open space by creating the Midpeninsula Regional Park District (currently named the Midpeninsula Regional Open Space District). Open space is our green backdrop of hills. It is rolling grasslands – cool forests in the Coast Range – orchards and vineyards in the sun. It is the patch of grass between communities where children can run. It is uncluttered baylands where water birds wheel and soar, where blowing cordgrass yields its blessings of oxygen, where the din of urban life gives way to the soft sounds of nature. It is the serene, unbuilt, unspoiled earth that awakens all our senses and makes us whole again … it is room to breathe.*

Midpen was first created in northwestern Santa Clara County. Fulfilling the conservationists' original dream to include portions of San Mateo County within the Midpen jurisdiction, voters expanded the boundaries in 1976 to include southern San Mateo County. Midpen further expanded in 1992, by annexing a small portion of Santa Cruz County. With the final approval of the Coastside Protection Program on September 7, 2004, Midpen's boundary was extended to the Pacific Ocean in San Mateo County, from the southern borders of Pacifica to the Santa Cruz county line.

1.1.3 Mission Statement and Organization

Midpen's mission is:

"To acquire and preserve a regional greenbelt of open space land in perpetuity, protect and restore the natural environment, and provide opportunities for ecologically sensitive public enjoyment and education."

Midpen's Coastside mission is:

"To acquire and preserve in perpetuity open space land and agricultural land of regional significance, protect and restore the natural environment, preserve rural character, encourage viable agricultural use of land resources, and provide opportunities for ecologically sensitive public enjoyment and education."

Midpen is divided into seven geographic wards, each represented by a publicly elected Board member for a four-year term.

1.2 Wildland Fire Resiliency Program Overview

1.2.1 Purpose, Need, and Objectives

Wildland fire prevention, preparation, and response are a part of Midpen's land stewardship. California's fire season is now longer and more intense due in part to dense regrowth of historically logged forests, more than a century of fire suppression, and a changing climate. To meet these growing challenges, Midpen is establishing this Program to allow for increased and environmentally sensitive vegetation management.

The objectives of the Program are as follows:

1. Manage vegetation to establish healthy, resilient, fire-dependent or fire-adapted ecosystems, furthering Midpen's mission to protect and restore the diversity and integrity of the ecological processes on Midpen lands and facilitate healthy post-fire recovery.
2. Integrate Native American cultural practices of vegetation management, particularly as they relate to prescribed fire, that promote ecological resiliency and enhance biodiversity.
3. Manage vegetation and infrastructure on Midpen lands to reduce wildland fire risks, improve wildland fire fighting capabilities and coordination, and improve overall safety to reduce the harmful effects of wildland fire on people, property, and natural resources.

4. Provide an adaptive framework for periodic review of and revisions to Midpen decisions in response to a changing climate, improved knowledge, improved technology. This framework also considers competing Midpen priorities, capacity, funding, and partnerships to determine the location, scale, timing, and scope future vegetation management activities.

1.2.2 Framework of the Program

This Program documents and permits the various planning efforts needed to meet Midpen's objectives for establishing wildland fire resiliency on its lands. It is meant to guide a comprehensive approach to vegetation management, including pre- and post-response activities to wildland fire on Midpen lands.

This document is organized as follows:

- **Introduction:** Provides an overview of Midpen lands, management, and purpose of the Program;
- **Background and Environmental Setting:** Describes the open space preserves and managed land system, resources, landscape, and other current site conditions;
- **Wildland Fire Resiliency Program Policies:** Identifies Midpen's Resource Management Policies that require updating to support the Program;
- **Vegetation Management Plan (VMP):** Addresses creation and maintenance of fuelbreaks, fuel management zones, and defensible space zones using vegetation management techniques addressed in Midpen's Integrated Pest Management Program (IPMP);
- **Prescribed Fire Plan (PFP):** Addresses the methods and implementation of prescribed fire to manage fuel and improve ecosystem health;
- **Wildland Fire Pre-Plan/Resource Advisor Maps:** Describes the creation of Resource Advisor maps for each OSP and other managed land (or groups of managed lands) that will include information on existing conditions, infrastructure, and resources constraints that can aid fire suppression activities and locate sensitive resource areas that merit protection from potential damage due to fire or fire suppression activities;
- **Monitoring Plan:** Provides a framework for recording pre-project conditions, vegetation treatment response, and fuels inventories to inform future adaptive management techniques; and
- **Maximum Acreage of Annual Treatment:** Describes the maximum treatment areas by activity per year.

1.2.3 Planning and Development Process

Collaboration and Approval of the Program

The Program requires approval by the Midpen Board of Directors (Board). The Program development process has included numerous public meetings, in-person meetings, phone calls and email feedback from partners and stakeholders, including cooperating and collaborative agencies, local fire agencies, tribes, and the public (including non-governmental organizations), including:

- California Department of Forestry and Fire Protection (CAL FIRE) (Santa Clara and San Mateo-Santa Cruz Units)
- The Amah Mutsun Tribal Band
- San Mateo County Fire Department
- Santa Clara County Fire Department
- Woodside Fire Protection District
- Los Altos Hills County Fire District
- San Mateo County Fire Safe Council
- Santa Clara County Fire Safe Council
- The Sierra Club, Loma Prieta Chapter
- The University of California, Berkeley Forests
- Communities of Grandview/Espinosa, Heather Heights, Redwood Estates, Blackberry Hill, and Skyline/Kings Mountain

The Program has also been reviewed by the Board's Planning and Natural Resources Committee. Moreover, during the week of August 19th, public meetings were held in the communities of Half Moon Bay, Los Gatos, and Woodside. The objective of these meetings was to communicate Midpen's Program components and invite early public comments on its development.

Communication with local fire departments is also a critical component of the plan. The following fire departments have been contacted or will be contacted during more detailed development of the PFP:

- Coastside Fire Protection District
- La Honda Fire Brigade
- Santa Clara County Fire Department
- Palo Alto Fire Department
- Mountain View Fire Department
- San Jose Fire Department
- National Park Service
- San Carlos/Redwood City Fire Department
- Kings Mountain Fire Brigade

California Environmental Quality Act Process (CEQA)

The approval and implementation of this Program requires review under CEQA, with Midpen serving as the lead agency. A Program Environmental Impact Report (EIR) has been determined to be the appropriate document under CEQA. The Program EIR addresses the potential impacts from the Vegetation Management Plan in detail. Projects or activities under that plan would be able commence as soon as the Program EIR is completed and certified. The Program EIR also addresses the potential environmental impacts of the PFP and any new infrastructure that may be built under the Wildland Fire Pre-Plan, at a programmatic level. Additional CEQA review, likely tiered from the Program EIR may be required to implement these plans and activities if these are not sufficiently addressed in the 2020 Program EIR.

Permitting

Activities or projects carried out under the Program may require permits from resource agencies or local jurisdictions before the work can commence. Table 1-1 summarizes some of the permits that may be required.

Table 1-1 Potential Permits or Approvals Needed for the Program

Agency	Approval	Component of Program
U.S. Army Corps of Engineers	Clean Water Act, Section 404, Nationwide Permit 14	Potential impacts to jurisdictional waters of the U.S., such as for stream crossings for equipment or infrastructure.
U.S. Fish and Wildlife Service	Endangered Species Act Biological Opinion and Take Authorization	If any activities could result in take of a threatened, endangered, or candidate species.
California Department of Fish and Wildlife	Responsible and Trustee agency for CEQA review	During CEQA compliance process.
	1602 Streambed Alteration Agreement	For potential impacts to riparian areas or any stream crossings.
	2081 Incidental Take Permit or Consistency Determination	If any activities could result in the death of a state listed species.
California Department of Transportation (Caltrans)	Encroachment permits	For encroachment on Caltrans right-of-way
Bay Area Air Quality Management District	Prescribed Burn Permit	For any prescribed burn activities
San Francisco Regional Water Quality Control Board or Monterrey Regional Water Quality Control Board	Section 401 Water Quality Certification	If a Section 404 permit is needed
	National Pollutant Discharge Elimination System (NPDES) General Permit	For ground disturbing impacts over 1 acre in size
	Waste Discharge Requirement	For potential impacts to waters of the state that are not waters of the U.S.
Local Public Works Departments, Building Departments (San Mateo County, Santa Clara County, Santa Cruz County)	Various types of encroachment, building, or grading permits	For encroachment into roadways to perform work, for any new fire protection infrastructure that may be needed.
	Local tree protection and brush removal ordinances for various counties and cities	For potential impacts on trees and brush

2 Background and Environmental Setting

2.1 Program Area

2.1.1 Midpen Lands

Managed Land
The lands within Midpen's boundary are located along the San Francisco Peninsula between the Pacific Ocean and the San Francisco Bay (Figure 2-1). Midpen's boundary extends from San Carlos in San Mateo County in the north to the unincorporated Santa Clara County area located south of Los Gatos in the south.

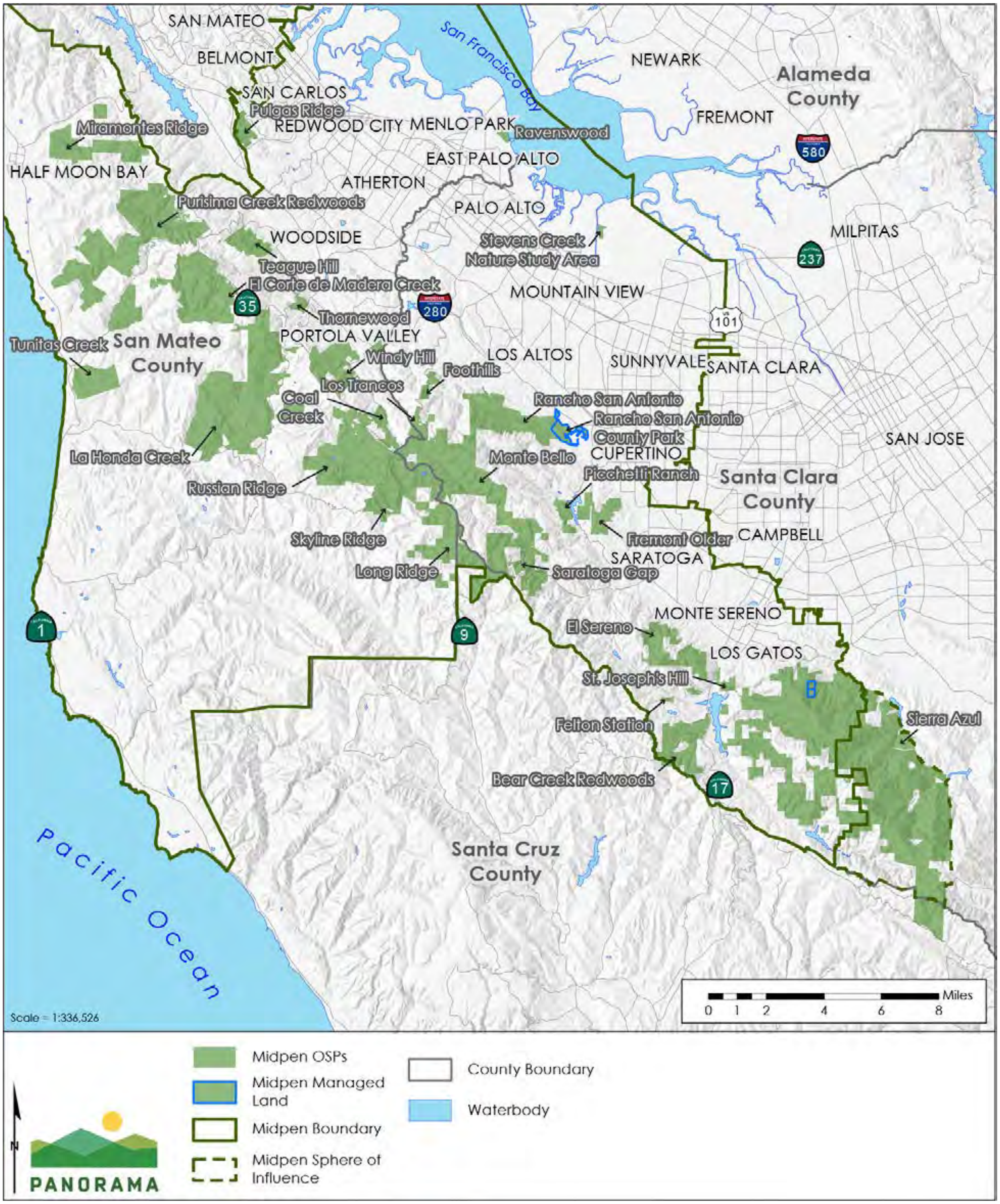
The unique location is dominated by the Santa Cruz Mountains, which is influenced by a Mediterranean climate composed of mild, wet winters and long, hot, and dry summers cooled by coastal fog. The San Andreas Fault, one of the world's longest and most active faults, cuts through the eastern side of the Santa Cruz Mountains. Continual seismic movement along the fault and the differing composition of the underlying rocks have created many soil types and terrain features, including steep, narrow canyons, rolling hills, and flat bay lands. Habitat communities on Midpen lands represent a wide spectrum, including bayside tidal wetlands, grasslands, oak woodlands, riparian corridors, coyote brush scrubland, and evergreen forests. Of the 26 OSPs, 25 are open to the public free of charge, 365 days a year from sunrise to one-half hour after sunset. Table 2-1 summarizes key information for each of the 26 OSPs and other Midpen-managed lands.

Facilities within OSPs and Managed Land

Recreational, Administrative, and Operational Facilities
Midpen owns and operates recreational, administrative, and operational facilities. Recreational facilities available to the public include trails, restrooms, a visitor center, and parking areas. One campground, Black Mountain Backpack Camp, is available for visitors within Monte Bello OSP. Administrative and operational facilities include two main field offices, two satellite field offices, the main administrative office, and various residences occupied by employees and members of the public. The main field offices are located at Rancho San Antonio OSP and Skyline Ridge OSP.

Historic Sites
Several historic sites are located within OSPs. Examples of historic sites include the Alma College Cultural Landscape, a historic residence and garden in Fremont Older OSP, historic barns in La Honda Creek OSP, Picchetti Brothers Winery and surrounding homestead, Deer Hollow Farm's historic ranch buildings, and the Hawthorns Historic Complex.

Figure 2-1 Midpen Lands



Source: (USGS, 2013; USGS, 2016; Tele Atlas North America, Inc., 2018; Midpen, 2019c)

Table 2-1 Summary of Midpen Lands

Managed Land	Acres	Description
Bear Creek Redwoods OSP	1,437	• Major amenities: trails open to hiking and horseback riding, stables, historical/cultural artifacts, Upper Lake, restrooms, parking lot • Major uses: recreation, horse boarding • Primary vegetation: redwood and fir forests, oak woodland
Coal Creek OSP	508	• Major amenities: trails open to hiking, horseback riding, biking, and dogs on-leash • Major uses: recreation • Primary vegetation: oak woodland, grassland
El Corte de Madera Creek OSP	2,906	• Major amenities: trails open to hiking, horseback riding, and biking, coastal views, sandstone formation, picnic tables, creeks, restrooms, parking lots • Major uses: recreation • Primary vegetation: mixed evergreen and redwood forest
El Sereno OSP	1,430	• Major amenities: trails open to hiking, horseback riding, biking, and dogs on-leash, creeks, permit parking • Major uses: recreation • Primary vegetation: chaparral
Foothills OSP	212	• Major amenities: trail open to hiking, horseback riding, and dogs on-leash, scenic view point, roadside parking • Major uses: recreation • Primary vegetation: chaparral, oak woodland
Fremont Older OSP	739	• Major amenities: trails open to hiking, biking, and dogs on-leash, benches, restrooms, historic residence, parking lot and roadside parking • Major uses: recreation • Primary vegetation: chaparral, grassland, oak woodlands
La Honda Creek OSP	6,144	• Major amenities: trails open to hiking, horseback riding, and dogs on-leash, vista point, active grazing, creeks, restrooms, historic barns, residences, parking lots • Major uses: agriculture, recreation, coastal field office • Primary vegetation: redwood and oak forests, grassland
Long Ridge OSP	2,226	• Major amenities: trails open to hiking, horseback riding, biking, and dogs on-leash, benches, scenic vistas, ponds, creeks, roadside parking • Major uses: recreation • Primary vegetation: grassland, hardwood forest, oak savanna
Los Trancos OSP	274	• Major amenities: trails open to hiking and horseback riding, San Andreas fault trail, benches, creeks, restrooms, parking lot and roadside parking • Major uses: recreation • Primary vegetation: forest, grassland, oak woodland

Managed Land	Acres	Description
Miramontes Ridge OSP	1,716	• Not currently open to the public • Major uses: agriculture, horse stable • Primary vegetation: coastal scrub
Monte Bello OSP	3,537	• Major amenities: trails open to hiking, horseback riding, and biking, scenic vistas, campsite, creeks, benches, restrooms, parking lot • Major uses: recreation • Primary vegetation: chaparral, forest, grassland
Picchetti Ranch OSP	308	• Major amenities: trails open to hiking and horseback riding, vineyard, ponds, restrooms, historic homestead and ranch, Picchetti Winery, picnic tables, parking lots and roadside parking • Major uses: agriculture/winery, recreation • Primary vegetation: chaparral, oak woodland
Pulgas Ridge OSP	366	• Major amenities: trails open to hiking and dogs on-leash, benches, restrooms, off-leash dog area, parking lot • Major uses: recreation • Primary vegetation: chaparral, hardwood forest
Purisima Creek Redwoods OSP	4,798	• Major amenities: trails open to hiking, horseback riding, and biking, creeks, scenic vistas, picnic tables, benches, restrooms, parking lots, active grazing • Major uses: agriculture, recreation • Primary vegetation: coastal scrub, redwood forest
Rancho San Antonio OSP	3,988	• Major amenities: trails open to hiking, horseback riding, (limited) biking, benches, water troughs, vista points, Deer Hollow Farm and ranch buildings, Foothills field office, historic Grant Cabin, restrooms, parking lots • Major uses: education, agriculture/farming, recreation, field office • Primary vegetation: chaparral, hardwood forest
Rancho San Antonio County Park	287	• Major amenities: trails open to hiking, horseback riding, (limited) biking, picnic tables, benches, model aircraft field, water troughs, vista points, restrooms, parking lots • Major uses: recreation • Primary vegetation: grassland, oak woodland
Ravenswood OSP	374	• Major amenities: trails open to hiking and biking, benches, observation decks, parking lot • Major uses: recreation • Primary vegetation: marshland
Russian Ridge OSP	3,491	• Major amenities: trails open to hiking, horseback riding, and biking, viewing platforms, creeks, commemorative site, restrooms, parking lots, active grazing • Major uses: agriculture, recreation • Primary vegetation: conifer forest, grassland

Managed Land	Acres	Description
Saratoga Gap OSP	1,613	• Major amenities: trails open to hiking, horseback riding, and biking, sandstone rock outcrops, parking lots and roadside parking • Major uses: recreation • Primary vegetation: oak and Douglas fir forests
Sierra Azul OSP and Easements	19,023	• Major amenities: trails open to hiking, horseback riding, biking, and dogs on-leash, scenic vistas, picnic tables, water troughs, Mount Umunhum Summit, Ceremonial Space, natural/cultural interpretation restrooms, parking lots and roadside parking • Major uses: recreation • Primary vegetation: chaparral, oak woodland forest, serpentine grassland
Skyline Ridge OSP	2,143	• Major amenities: trails open to hiking, horseback riding, and biking, picnic tables, Alpine Pond, Horseshoe Lake, creeks, multimedia nature tours, David C. Daniels Nature Center, Skyline field office, restrooms, parking lot • Major uses: agriculture, recreation, field office • Primary vegetation: grassland, mixed evergreen forest
St. Joseph's Hill OSP	270	• Major amenities: trails open to hiking, horseback riding, biking, and dogs on-leash, benches, scenic vistas, restrooms, roadside parking • Major uses: recreation • Primary vegetation: chaparral, grassland, oak woodland
Stevens Creek Shoreline Nature Study Area	55	• Major amenities: trails open to hiking and biking, birdwatching, parking lots • Major uses: recreation • Primary vegetation: wetland
Teague Hill OSP	626	• Major amenities: trails open to hiking and horseback riding • Major uses: recreation • Primary vegetation: Douglas fir, oak, madrone forest
Thornewood OSP	167	• Major amenities: trails open to hiking, horseback riding, and dogs on-leash, Schilling Lake, parking lot • Major uses: recreation • Primary vegetation: oak and redwood forest
Tunitas Creek OSP	1,660	• Not currently open to the public • Major uses: agriculture • Primary vegetation: coastal scrub
Windy Hill OSP	1,414	• Major amenities: trails open to hiking, horseback riding, biking, and dogs on-leash, benches, picnic tables, Sausal pond, restrooms, parking lots and roadside parking • Major uses: recreation • Primary vegetation: grassland, oak and redwood forest
Note: Midpen has actively preserved nearly 65,000 acres, of which approximately 59,000 acres are managed by Midpen; the remaining acreage is managed by other park and open space entities.		

Roads and Trails
Midpen maintains 21 miles of paved roads and 235 miles of unpaved roads within the OSPs. Over 240 miles of trails are available to the public (Midpen, 2020a). Segments of four regional trails are located within OSPs, including the Bay Area Ridge Trail, Skyline-to-the-Sea Trail, Bay to Ridge Trail, and the Bay Trail.

State Route (SR) 35, also known as Skyline Boulevard, runs adjacent to 15 of the 26 OSPs, serving as a key gateway to Skyline Ridge OSP and other managed areas. Several major roadways provide access to Midpen lands, including SR 9, 17, 35, 84, and 92, as well as Interstate 280. Private vehicles are not permitted within OSPs except in parking lots and access roads/driveways leading to them.

Utilities
Water for use in administrative buildings and public facilities on Midpen OSPs generally comes from springs, creeks, and groundwater or from commercial water supplies. Irrigation water for agricultural production on Midpen OSPs comes from on-site surface waters and wells. Wastewater from public restrooms on Midpen OSPs is stored in on-site vaults before removal and disposal by local service providers. Solid waste disposal services on Midpen OSPs are provided for employee and tenant residences by local providers.

Pacific Gas and Electric Company (PG&E) maintains power lines and underground gas lines through many of the OSPs. PG&E maintains these facilities through easements. Standards for vegetation management and clearance requirements under PG&E utility lines are governed by General Order 95, Section III of the California Public Utilities Commission. PG&E retains the responsibility for vegetation clearance associated with PG&E infrastructure.

2.1.2 Surrounding Lands

Nearby Communities and Development
Midpen lands lie entirely within the Santa Cruz Mountain Region. The eastern edge is heavily influenced by the urban areas of San Francisco, San Jose, and other San Francisco Peninsula cities. Low density suburban development also extends from the flat bay lands westward into the foothills of the Santa Cruz Mountains where narrow, meandering roadways provide access to single family homes situated among the chaparral-covered hillsides. Development on the lower western slopes of the Santa Cruz Mountains consists of scattered small communities and rural residences. Much of the land in the upper portions of the Santa Cruz Mountains includes natural areas that are held in OSPs and parks.

Midpen's jurisdiction encompasses 17 cities (Atherton, Cupertino, East Palo Alto, Half Moon Bay, Los Altos, Los Altos Hills, Los Gatos, Menlo Park, Monte Sereno, Mountain View, Palo Alto, Portola Valley, Redwood City, San Carlos, Saratoga, Sunnyvale, and Woodside) and unincorporated areas in San Mateo, Santa Clara, and northern Santa Cruz counties with a combined population of over 700,000 residents. Although uses within OSPs are predominantly natural open space and agriculture (primarily grazing), many of the OSPs abut small areas of low-density residential development. Residential land uses are adjacent to Midpen OSPs. According to CAL FIRE, approximately 95 percent of all fires are human caused. Fires started in residential areas in the WUI can ignite natural areas and spread.

The majority of the wildland-urban interface (WUI) along the OSPs has a CAL FIRE Fire Hazard Severity Zone rating of "High" or "Very High" (Figure 2-2). Fire can spread rapidly throughout WUI areas through adjacent structures and/or vegetation, or by ember dispersion. The majority of land owned by Midpen is within the WUI. Community Wildfire Protection Plans (CWPPs) have identified priority areas for fuel reduction within several OSPs, including Pulgas Ridge, Bear Creek Redwoods, and Sierra Azul OSPs and along Highway 35 within several OSPs.

WILDLAND-URBAN INTERFACE

The Wildland-Urban Interface, or WUI, refers to the area where houses and other structures are built close to, or intermingled with, undeveloped wildlands.

The WUI poses significant concern in the event of fire, as it combines the characteristics of wildlands (where larger fires generally occur) and developed areas (where lives, homes, and property are vulnerable).

Within Midpen lands, many neighborhoods fall within this interface. As a result, vegetation management on Midpen lands not only enhances ecological resiliency of the natural lands, it also minimizes fire hazard for adjacent communities.

Open Space

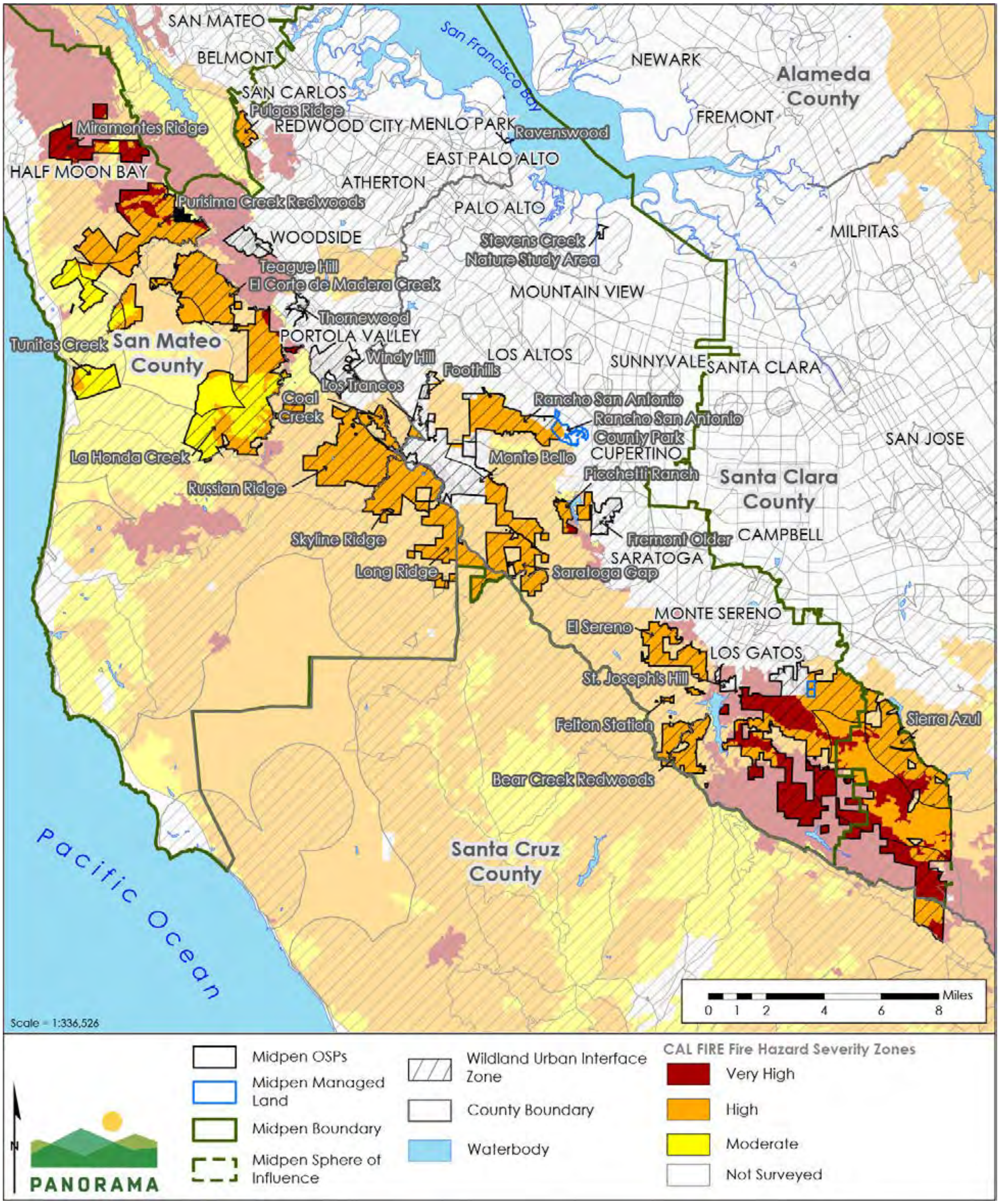
Midpen OSPs abut open space owned and maintained by various agencies, as shown in Figure 2-3. Agencies with the largest quantity of open space land in the surrounding area include California State Parks, San Mateo County Parks, and Santa Clara County Parks.

Valley Water (formerly known as the Santa Clara Valley Water District) operates 10 reservoirs within Midpen's jurisdiction (but outside of the OSPs), that provide water for surrounding communities. These reservoirs are within open space lands owned and/or managed by Valley Water or Santa Clara County Parks. Several reservoirs are adjacent to Midpen OSPs. Stevens Creek Reservoir is located between Picchetti Ranch OSP and Fremont Older OSP. Lexington Reservoir, Guadalupe Reservoir, and Almaden Reservoir are located within the vicinity of Sierra Azul, St. Joseph's Hill, and Bear Creek Redwoods OSPs.

Agriculture

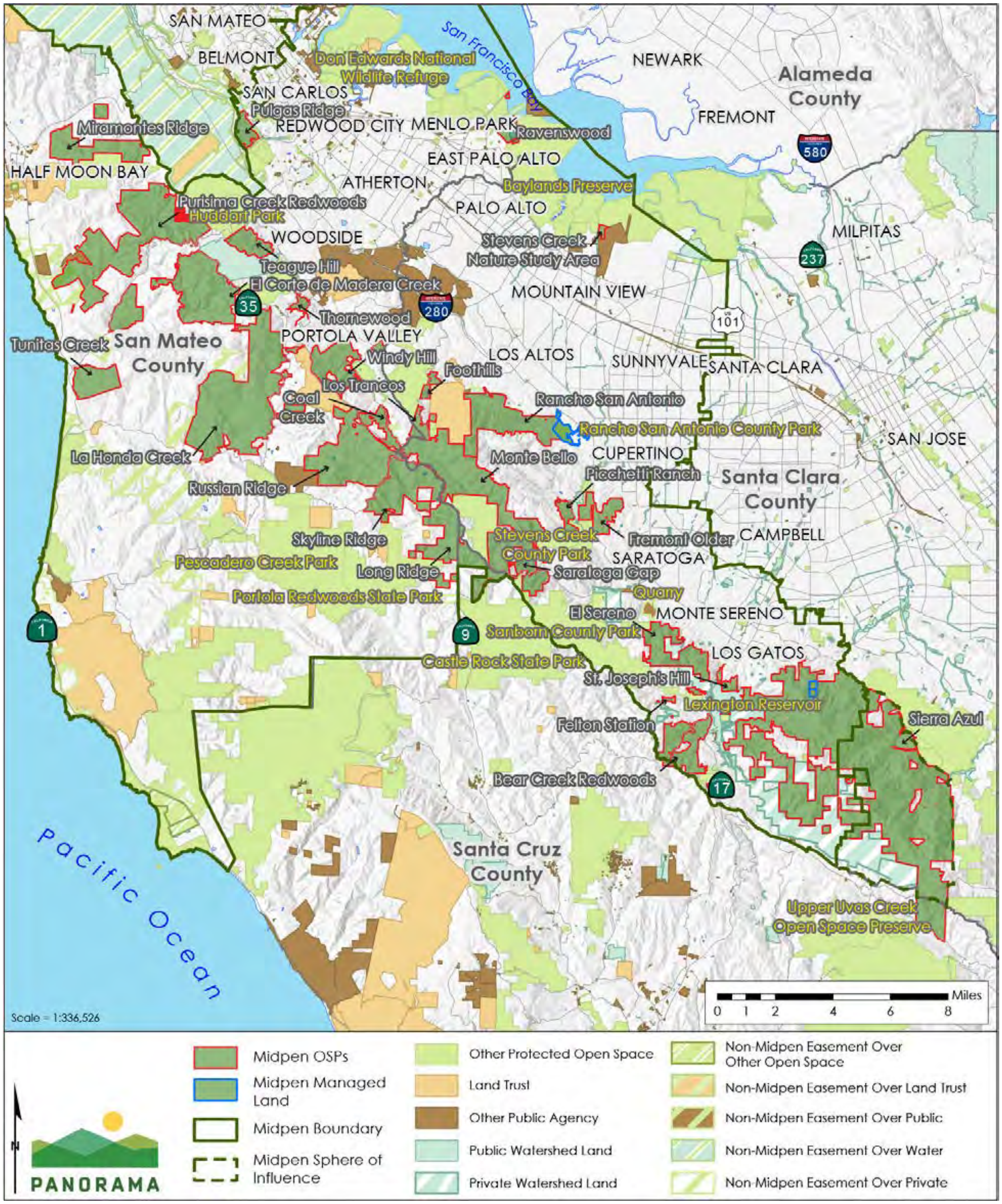
Agricultural production on the San Francisco Peninsula dates back to the late 18th century. Today, small family-owned farming and ranching businesses play an important role in the coastal economy, production of locally sourced food, and continuing the agricultural heritage of the area. The key types of agriculture in the area are livestock grazing, cultivated agriculture, nursery crops, and vineyards. Midpen actively manages approximately 8,500 acres of land under its Conservation Grazing Program. Approximately 5,800 acres of land within 0.25 mile of Midpen-owned lands are zoned for agriculture.

Figure 2-2 CAL FIRE Fire Hazard Severity Zones Within and Surrounding Midpen Lands



Source: (USGS, 2013; USGS, 2016; Tele Atlas North America, Inc., 2018; CAL FIRE, 2007; Midpen, 2018c; Midpen, 2019c)

Figure 2-3 Open Space Within and Surrounding Midpen Lands



Source: (USGS, 2013; USGS, 2016; Tele Atlas North America, Inc., 2018; Midpen, 2018a; Midpen, 2019c)

2.2 Resources on Midpen Lands

2.2.1 Agricultural Lands

Midpen manages approximately 8,500 acres under its current Conservation Grazing Program. Midpen uses conservation grazing to manage vegetation to enhance the diversity of native plants and animals; for fire protection; to help sustain the local agricultural economy; and to foster the region's rural heritage. More about Midpen's Conservation Grazing Program can be found here https://www.openspace.org/our-work/resource-management/grazing.

Five Midpen OSPs (La Honda Creek, Russian Ridge, Purisima Creek, Skyline Ridge, and Tunitas Creek) use conservation grazing as a method of vegetation management, including wildland fuel reduction. These OSPs are along the San Mateo coast. Midpen leases suitable agricultural lands to tenants with expertise in managing livestock for this purpose. All leases are subject to grazing management plans to ensure that priority resource management goals are met. Approximately 7,700 acres of OSP land is in Williamson Act contracts. These contracts are within 21 OSPs (Midpen, 2019c). A map of the conservation grazing areas is shown in Figure 2-4. Small agricultural areas are located within some Midpen OSPs as shown in Table 2-2.

Table 2-2 Agricultural Uses on Midpen Lands

Managed Land (Property)	Size (Acres)	Agricultural Use/Activity
Purisima Creek Redwoods OSP (Lobitos Ridge)	6.7	Two crop fields; flowers and vegetables
Miramontes OSP (Madonna Creek Ranch)	27	Dry hay farming
Miramontes OSP (Madonna Creek Ranch)	47.9	Irrigated area for pumpkins, other crops, and Christmas tree farm
Skyline Ridge and Monte Bello OSPs	72.4	Christmas tree farm and chestnut orchard
Saratoga Gap OSP	4.7	Historic fruit orchard
Picchetti and Monte Bello OSPs	4.3	Winery complex
Rancho San Antonio OSP (Deer Hollow Farm)	10	Classes and camps for thousands of schoolchildren covering various themes: farming, edible/native gardening, native peoples, and local history

2.2.2 Forested Lands

Midpen lands encompass approximately 30,000 acres of forest and woodland habitat, including roughly 11,500 acres of redwood and Douglas fir associated coniferous forest and 18,500 acres of other hardwood forest and woodlands. In the past, the redwood and Douglas fir forests of the Santa Cruz Mountains were the center of intense commercial logging activities; however, there are no ongoing commercial timber harvesting activities on Midpen lands today, except for the active Christmas tree farm (approximately 50 acres) at Skyline Ridge OSP. An important goal for Midpen is the preservation and protection of forests and woodlands by promoting late seral conditions on its OSPs.

2.2.3 Natural Resources

Habitats and Biological Resources

The rich biodiversity on Midpen lands provides vital ecological services (e.g. clean air, clean water, groundwater replenishment), biological resources (e.g. protection of ecological biodiversity), and human health benefits (e.g. physical, social, emotional, psychological health benefits). Midpen lands protect a variety of habitats that support diverse plant and animal species. Midpen lands straddle the eastern and western flanks of the Santa Cruz Mountains and include a diverse mix of oak woodland, grassland, chaparral, coastal scrub, and both evergreen and coniferous forests (Figure 2-5). The eastern portion of Midpen's boundary contains tidal salt marshes adjacent to urban areas on the San Francisco Peninsula. The westernmost portion of Midpen lands is dominated by coastal vegetation communities near areas of low densities. On Midpen lands to the north and south, hardwood and chaparral vegetation communities are found at generally lower elevations with conifer forests and grasslands typically at higher elevations.

Biological resources of special significance or importance are described briefly in Table 2-3. The table identifies species and habitats currently known to occur or listed as sensitive by resource agencies. The numbers and statuses of species may change over the life of this Program, and sensitive species may be present outside of mapped areas.

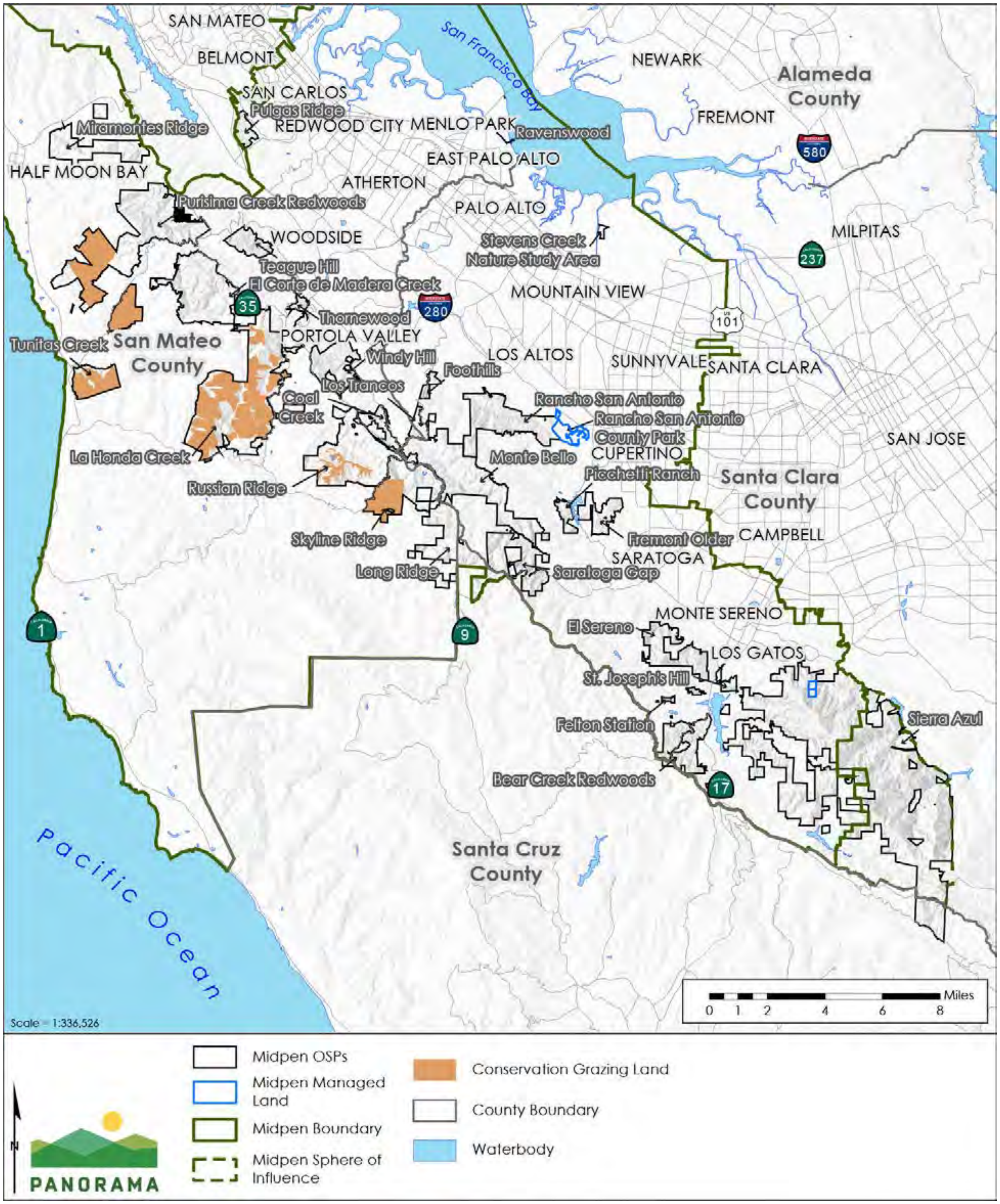
Geology and Soils

In general, Midpen lands consist of a diverse set of dynamic geological resources characterized by wide variations in elevation (from at sea level to more than 3,400 feet in elevation), variety of aspects and slopes (west-facing, east-facing), earthquake faults, pressure ridges, sag ponds, landslides, high variation of soil types and soil formations, and attractive but fragile rock formations. Midpen lands are located in seismically active areas that could experience significant ground shaking or result in fault rupture, seismic-related ground movement, and/or land sliding.

Hydrology

Midpen lands contain a variety of water resources that include freshwater, estuarine/brackish, and marine habitats. Surface water bodies include reservoirs, ponds, seasonal wetlands, and ephemeral and perennial streams. Groundwater resources within Midpen lands include springs, seeps, and underground aquifers. Salt marshes occur along the edge of San Francisco Bay. Drainages range from ephemeral and intermittent to perennial streams. Runoff from the peninsula flows to the Pacific Ocean to the west and the San Francisco Bay and estuaries to the east.

Figure 2-4 Conservation Grazing Within Midpen Lands



Source: (USGS, 2013; USGS, 2016; Tele Atlas North America, Inc., 2018; Midpen, 2020b; Midpen, 2019c)

Midpen OSPs are located within 22 major watersheds extending from the Pacific Ocean in San Mateo County to the bay lands in San Mateo and Santa Clara counties. Many of the OSPs are located within the headwaters or uppermost sections of these watersheds.

Rainfall occurs mostly between November and April with varying seasonal rainfall totals. The greatest rainfall quantities occur along the west facing slopes near the summit of the mountain range where totals can typically reach 40 to 50 inches per year, however, averages around 20 to 30 inches per year are more typical. In the Santa Cruz Mountains, fog accounts for approximately 10 to 20 inches of this precipitation, much of which is delivered in the dry summer months. Many smaller creeks and streams are intermittent, reflecting this seasonal distribution of rainfall. Winter flows are higher, especially during and immediately following storms.

2.2.4 Cultural Resources

The San Francisco Peninsula has a rich and diverse history, including settlement by Native American groups; the Spanish (1776-1821) and Mexican Republican (1821-1848) colonization of the region; the annexation of California by the United States in 1848; and subsequent industrial, agricultural, and residential development. Evidence of these periods remain on Midpen lands, including Native American village sites and bedrock mortars, barns and other ranching features, orchards, wineries, historic homes, sawmill sites, mines, historic roads and trails, and outdoor recreational sites.

This region was home to one of the largest Native American population centers on the continent, with 70 diverse, healthy, economically flourishing tribal units. The Ohlone were the primary Native American people that occupied what is now Midpen lands.

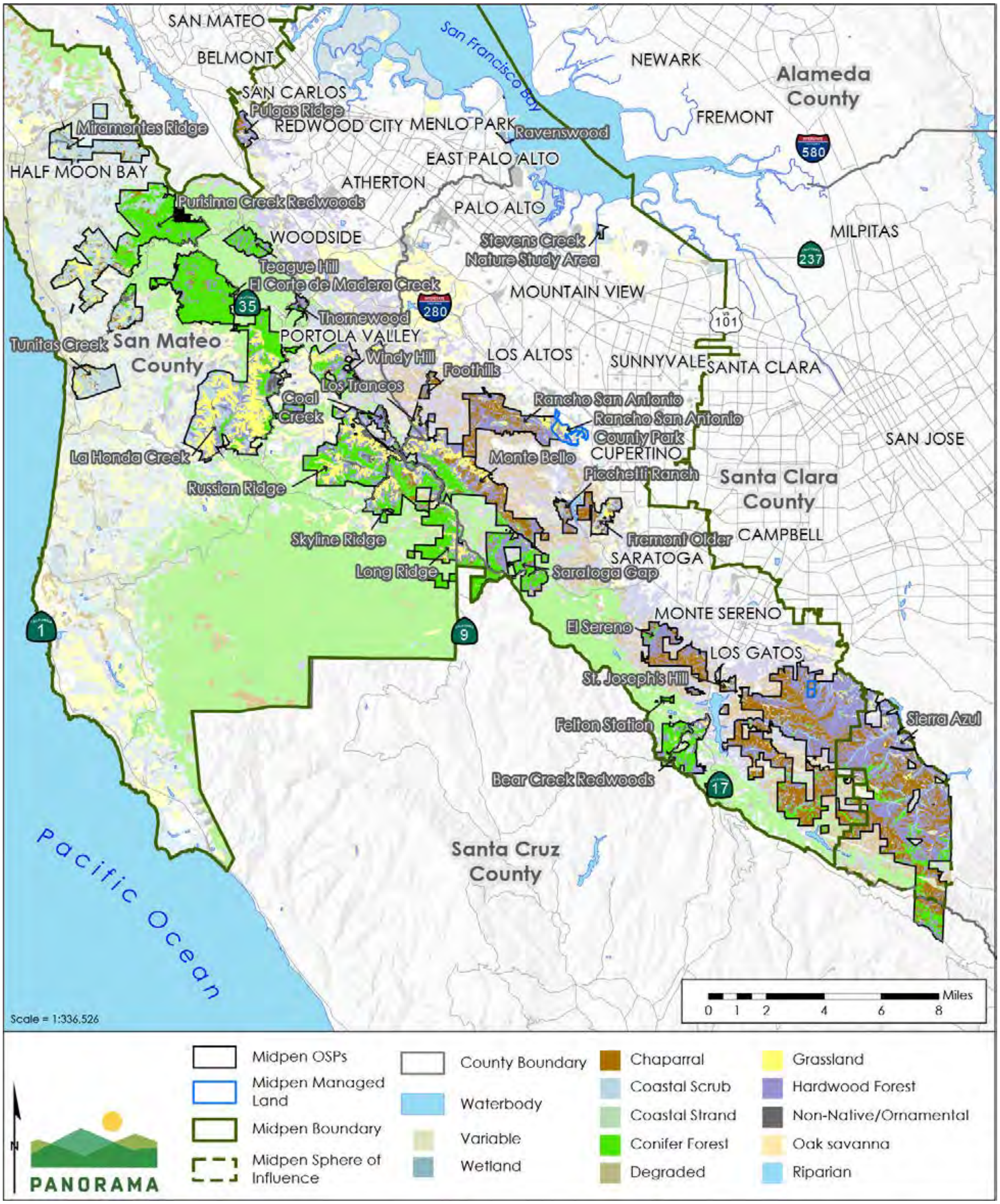
2.3 Past and Present Fire and Fuel Management

2.3.1 History of Wildland Fire

Prior to European contact, Native American tribes actively managed vegetation within their communities and surrounding areas using fire. These fires were lit intentionally at various times of the year to enhance vegetation growth, facilitate food collection, and improve forage for animals they hunted.

In addition, Native American tribes did not actively suppress natural lightning ignitions at a landscape scale, which resulted in fires burning for days, weeks, and even months, shaping the patterns of vegetation cover and composition over the centuries (Anderson, 2013). A detailed fire history study was conducted in the Santa Cruz Mountains, San Mateo County, Huddart Park, and McGarvey Gulch. These studies found that fires burned redwood forests every 12 years, on average.

Figure 2-5 Vegetation Types Within Midpen Lands



Source: (USGS, 2013; USGS, 2016; Tele Atlas North America, Inc., 2018; Midpen, 2018b; Midpen, 2019c)

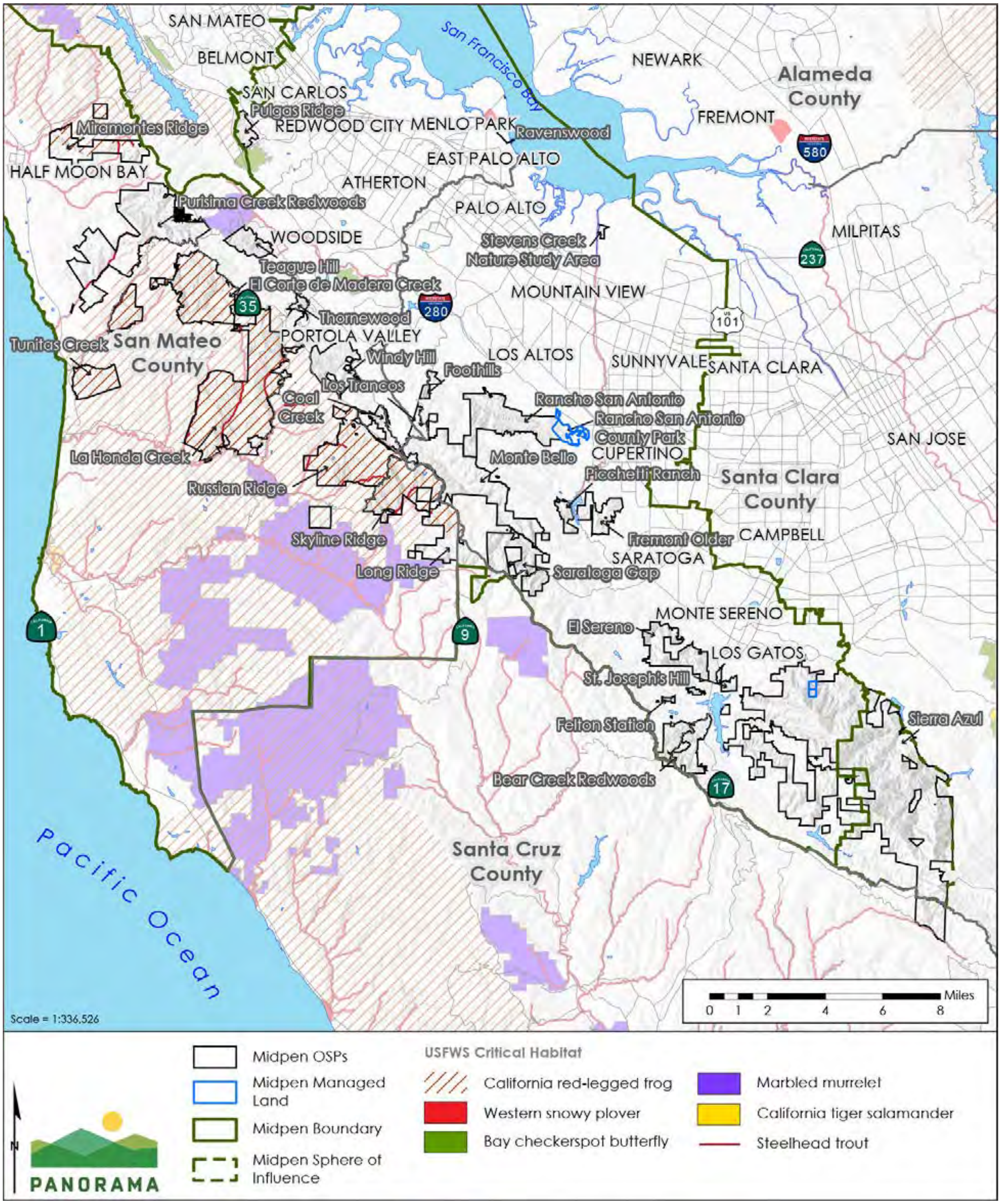
Table 2-3 Types of Biological Resources that Occur or May Occur on Midpen Lands

Resource	Description
Sensitive Natural Communities	Most natural communities within Midpen lands are considered sensitive, with a few exceptions such as non-native annual grasslands. Sensitive natural communities within Midpen lands include, but are not limited to redwood forests, California buckeye groves, oak woodlands, bigleaf maple forests, black oak forests, northern maritime chaparral, northern interior cypress forest, California bay forests, riparian woodlands, and wetlands. Serpentine grassland is a highly sensitive natural community that is not mapped in the study area because of the scale of the mapping unit but is present in small patches.
Critical Habitat	Critical habitat is a U.S. Fish and Wildlife Service (USFWS)-designated geographic area that is considered essential for the conservation of a federally threatened or endangered species that may require special management and protection. Critical habitat may include an area that is not currently occupied by the species, but that will be needed for its recovery. A critical habitat designation only applies to activities performed by Federal agencies or that involve a Federal permit, license, or funding, and that are likely to destroy or adversely modify the area of critical habitat. Critical habitat has only been designated for 704 of the more than 1,500 listed species. Critical habitat within Midpen lands has been designated for numerous species, including Franciscan manzanita (USFWS, 2013a), steelhead (USFWS, 2005a), tidewater goby (USFWS, 2013b), California red-legged frog (USFWS, 2010), bay checkerspot butterfly (USFWS, 2008), western snowy plover (*Charadrius alexandrines nivosus*) (USFWS, 2012), and marbled murrelet (*Brachyramphus marmoratus*) (USFWS, 2011). Figure 2-6 shows the critical habitat areas.
Special-Status Species	Special-status species include: • Designated (rare, threatened, or endangered) and candidate species for listing by the California Department of Fish and Wildlife (CDFW). • Designated (threatened or endangered) and candidate species for listing by USFWS. • Species considered to be rare or endangered under the conditions of Section 15380 of the California Environmental Quality Act Guidelines, such as those identified on lists 1A, 1B, and 2 in the 2001 Inventory of Rare and Endangered Plants of California by the California Native Plant Society (CNPS). • And possibly other species which are considered sensitive or of special concern due to limited distribution or lack of adequate information to permit listing or rejection for state or federal status, such as those included on list 3 in the CNPS Inventory or identified as a "California Special Concern" (CSC) species by the CDFW. Species designated as CSC have no legal protective status under the California Endangered Species Act but are of concern to the CDFW. Included in this are 11 plant and 16 animal species that are state and/or federally listed as threatened or endangered.
Special-Status Plants	45 special-status plant species have the potential to be found within Midpen land. Species include but are not limited to: • Santa Clara Valley dudleya • Franciscan onion • Bent-flowered fiddleneck • Robust spineflower • Western leatherwood • Santa Cruz cypress

Resource	Description
Special-Status Invertebrates	Two special-status invertebrates: • Bay checkerspot butterfly • Monarch butterfly
Special-Status Fish	Two special-status fish: • Central California coast steelhead • Central California coast coho salmon
Special-Status Amphibians and Reptiles	Nine special-status amphibians: • California giant salamander • Santa Cruz black salamander • California red-legged frog • Foothill yellow-legged frog • California tiger salamander • Western pond turtle • San Francisco garter snake • Red bellied newt • Coast horned lizard
Special-Status Birds	32 special-status birds have the potential to be found within Midpen land. Species include but are not limited to: • golden eagle • long-eared owl • Vaux's swift • Purple martin • California yellow warbler • Marbled murrelet
Special-Status Mammals	Ten special-status mammals, including six bat species: • Townsend's big-eared bat • Western red bat • Fringed myotis • Hoary bat, long-eared myotis • Long-eared myotis • Pallid bat • Salt marsh harvest mouse • San Francisco dusky-footed woodrat • Santa Cruz kangaroo rat • American Badger

Source: (Midpen, 2014)

Figure 2-6 Critical Habitat Within and Surrounding Midpen Lands



Source: (USGS, 2013; USGS, 2016; Tele Atlas North America, Inc., 2018; Midpen, 2019c; USFWS, 2019; NMFS, 2005)

Since 1962, there have been approximately 10 fires on lands that are now owned by Midpen. The vast majority (10,800 acres) of acreage burned by these fires occurred when lands in the area of Sierra Azul OSP were held in private ownership, including the 1961 Austrian Gulch Fire (5,200 acres), 1985 Lexington Fire (4,961 acres), and 2009 and 2016 Loma Fires (530 acres between 2009 and 2016). Aside from these fires, and limited prescribed burning up until 2009, the vast majority of Midpen lands have not burned within the last 30 years.

2.3.2 Fire Suppression

Fire suppression has been implemented by federal and state agencies throughout California for more than a century, significantly altering the fire regime. This policy of fire suppression has reduced biodiversity on lands that Midpen now owns or manages, and has facilitated the spread of invasive plant species into grasslands and other plant communities.

Many plant communities in the area are adapted to cyclical fires. As of 2014, an estimated 8,419 acres of fire-dependent communities have been cataloged within the OSPs. Fire suppression allows other plants to outcompete and eventually eliminate fire-adapted and early successional species, including rare species such as Kings mountain manzanita (*Arctostaphylos regismontana*), and can ultimately result in conversion of vegetation communities such as chaparral or grasslands to forest. Additional information on fire suppression history is in Chapter 4: Vegetation Management Plan of this Program.

2.3.3 Current Fire Threats and Risks

Invasive Species

Invasive species are plant species that invade and dominate sufficiently large areas causing a reduction in biodiversity. They proliferate in the absence of natural control and interfere with the natural processes that would otherwise occur on wildlands. Once established, invasive species can become difficult to manage and can eliminate or outcompete rare, sensitive, or otherwise important native species that are important to maintain a species-rich assemblage, habitat, host plants, food, and cover for wildlife. Although the vast majority of invasive species are non-native, a disruption in disturbance regimes (e.g., natural fire) or influx of outside influences (e.g., nitrogen deposition from anthropogenic activities such as fossil fuel combustion) can cause native species to act invasive.

Invasive plants are implicated in many natural resource and conservation problems and are considered by most land managers to be a threat to natural resource management goals. Some invasive plants can alter ecosystem processes, such as reducing or changing seasonal food sources for wildlife, hydrological patterns, fire regimes, soil chemistry, or the genetic integrity or other species. The San Mateo County Weed Management Area and the Santa Clara County Weed Management Area set regional priorities for eradication of invasive plants in the San Francisco Bay Area, particularly those for which early action could substantially reduce future risk of ecological impacts.

In 2014, invasive species were mapped as dominating approximately 860 acres (<2 percent) within Midpen OSPs. Not all land within OSPs has been mapped. Prominent invasive species found on the OSPs include yellow star-thistle, French broom, and blue gum eucalyptus. French broom has the potential to disrupt fire cycles because broom plants grow in dense stands, with inner stems that die back and create flammable fuels that can carry fire to the tree canopy, potentially increasing the intensity and severity of wildland fires.

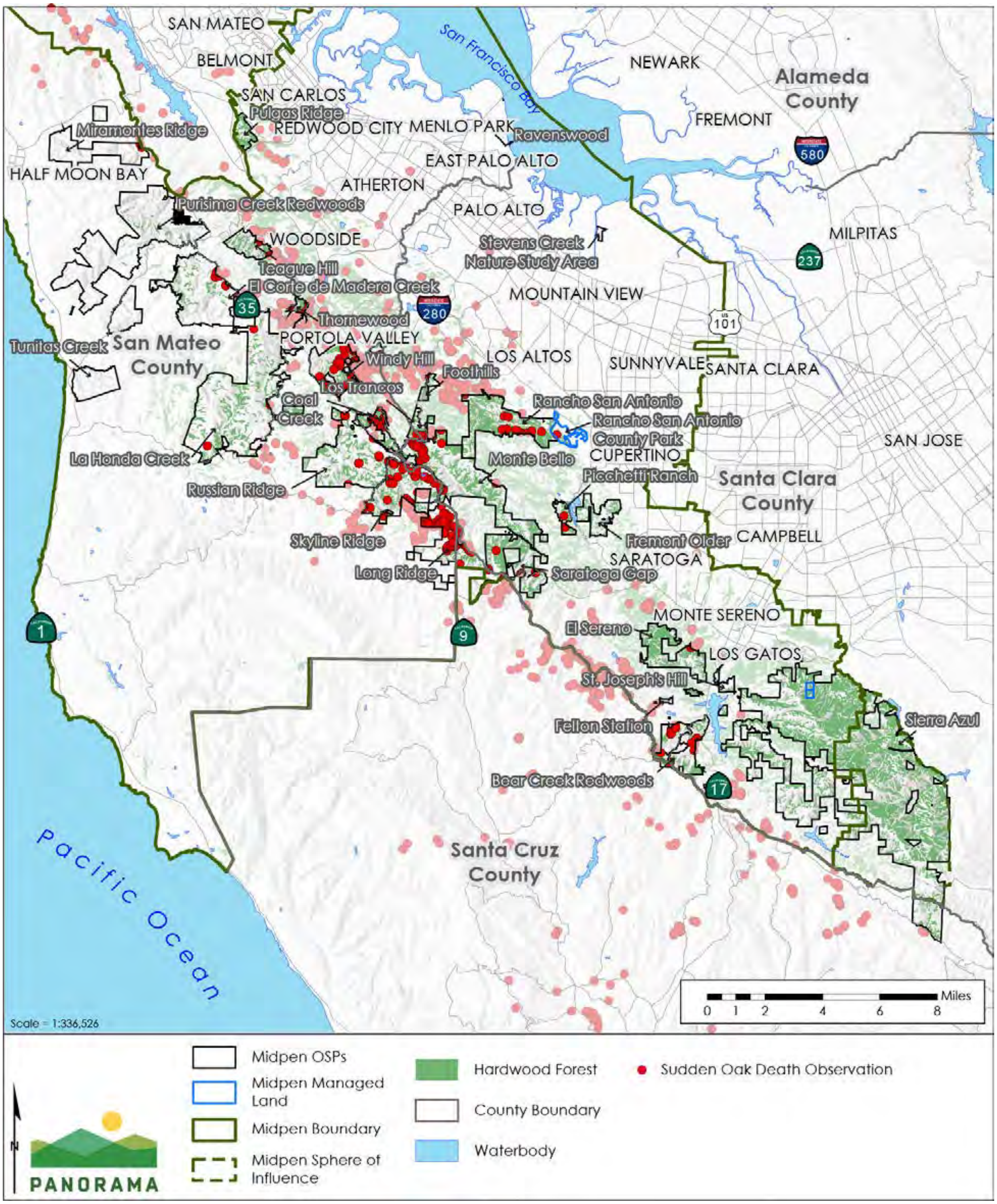
Although many species of non-native annual grasses are ubiquitous throughout California, and not typically considered noxious, management of these grasses are an important part of land stewardship to reduce fuels and maintain or enhance grassland habitat. Without conservation grazing or other forms of vegetation management, non-native annual grass biomass can build up over time as thatch. Thatch increases the flammable fuels in grassland habitats and helps carry fire. If left unmanaged, thatch buildup can negatively impact and suppress native seed germination, prevent water infiltration into the soil, and alter soil dynamics.

Forest Disease

Sudden Oak Death (SOD) is a prevalent disease within forested lands. SOD has killed over one million native oak and tanoak trees and infests many other forest species in one Oregon and 15 coastal California counties. Hundreds of dead tanoak trees and other symptoms of the SOD pathogen, *Phytophthora ramorum*, are commonly seen on Midpen OSPs, contributing to greater fuel loads. No cure is currently available for SOD, and as with other extensive forest diseases, a strategy may take decades to develop. In 2006, Midpen began its efforts to address SOD impacts by adopting a ten-year Sudden Oak Death plan to map oak trees on Midpen OSPs that are potentially resistant to the SOD pathogen, treat a selected number of specimen oak trees, and establish collaborative funding for SOD research to help guide land management decisions (Midpen, 2014a). The plan also included a collaborative study of impacts on wildland ecology and recreation, and development of a restoration strategy for heavily infested forests. The disease threatens to degrade the more than 47,000 acres of hardwood forest in the region, of which 18,000 acres occur in Midpen OSPs (Figure 2-7). Since 2000, SOD has spread from what is believed to be its initial core in the Long Ridge, Saratoga Gap and Skyline Ridge OSPs in a northerly and easterly direction primarily as a result of weather conditions.

To date, Midpen staff continue to conduct research, monitor, and manage SOD in accordance with the IPMP. This work occurs on Rancho San Antonio, Monte Bello, El Corte de Madera Creek, Los Trancos, Russian Ridge, Skyline Ridge, Long Ridge and Saratoga Gap OSPs. Because the long-term effects of the disease on California's forests are unknown, Midpen is also currently working with the California Oak Mortality Task Force to further study and monitor the impacts of the disease. Research into SOD treatment options was conducted at Rancho San Antonio, El Corte de Madera, and Los Trancos OSPs. The research evaluated the success of three scenarios: removal of California bay; application of fungicide; and not conducting any treatment. Ongoing treatment is continuing at El Corte de Madera OSP, with one more fungicide application projected to occur in 2020. Midpen educates the public and staff on SOD prevention techniques in addition to supporting outreach and monitoring efforts conducted by University of California Berkeley and Oregon State University.

Figure 2-7 Sudden Oak Death Observations in 2016 Within and Surrounding Midpen Lands



Source: *(USGS, 2013; USGS, 2016; Tele Atlas North America, Inc., 2018; Midpen, 2018b; Midpen, 2019c; UC Berkeley, 2016)*

Fuel Load

The historic fire regime in the area greatly reduced much of the fuel load on the ground and significantly reduced the severity of fires within these fire-managed landscapes. From 1860 through the early 1920's, unprecedented alterations took place within the forests of the Santa Cruz Mountains. The ancient "old growth" forests were primarily harvested for local home construction, removing the largest, most fire-resistant trees from the forested landscape. The forest that has grown back typically consists of a much higher density of trees, particularly Douglas-fir, that are more susceptible to fire. In addition, due to fire exclusion, fuels have accumulated within oak woodland, chamise, and grassland dominated vegetation types. Coupled with extensive development in the WUI, local fire risk is a critical regional issue.

Climate Change

California is experiencing climate changes with more frequent heat waves, higher temperatures, and successive periods of drought. Temperatures in California are projected to increase 5.6 to 8.8 degrees by 2100. Conversely, the snowpack is anticipated to decline to less than half the historical average. Changes in precipitation patterns and increased temperatures are expected to alter the distribution and character of natural vegetation and associated moisture content of plants and soils. These changes are expected to lead to increased frequency and intensity of large wildland fires and greater fire risk if fuel management activities are not expanded across the state (CNRA, 2018).

3 Wildland Fire Resiliency Program Policies

3.1 Overview

Midpen's Board-adopted Resource Management Policies (RM Policies) guide the ongoing management of the natural resources on Midpen lands. Resources covered under the policies include plants, animals, water, soil, terrain, geologic formations, and historic, scenic, and cultural features. The purpose of the RM Policies is to:

- Set the framework for Midpen's resource management program;
- Provide general guidance for issue-specific and site-specific planning;
- Provide staff and the Board a tool for informed, consistent, and effective resource management decision making;
- Inform the public of the purpose and intent of Midpen's resource management program; and
- Provide a basis for evaluating Midpen's progress in reaching its resource management objectives.

The Program is intended to be consistent and supported by the RM Policies, including Chapter XV on wildlife fire management. This policy was recently reviewed and analyzed by Midpen's consultants, Spatial Informatics Group (SIG) and Panorama Environmental, Inc. (Panorama). The consultants reviewed Midpen and other agency policies related to fire ecology, fire management, prescribed fire, suppression activities, vegetation management and ecosystem resiliency, and post-fire response. The resulting report (Appendix A) presents recommendations to update Midpen policies and actions that support the overarching objectives and goals of Midpen's Wildland Fire Resiliency Program.

The recommendations for the revised RM Policies were presented to Midpen's Planning and Natural Resource Committee, which recommended forwarding the revised RM Policies to the full Board for approval. The full text of the revised policies and implementation measures can be found in Section 4 of the Policy Analysis and Recommendations report, provided in Appendix A.

3.2 Summary of Policy Review and Recommendations

3.2.1 Methods

The methodology for the policy review started with a compilation of existing Midpen policies, with a focus on policies related to wildland fire management, vegetation management, forest management, ecological succession, climate change, and scenic and aesthetic resources. The primary focus was on the Board-approved RM Policies, but other sources were also consulted for guidance or language related to vegetation management and fuels treatment. The policies of the following agencies were similarly compiled and included in this analysis:

- Bear Creek Redwoods Preserve Plan (adopted January 2017)
- Defensible Space (Fuel Reduction) Permit Program (adopted in April 2009)
- Good Neighbor Policy (adopted October 1988, last amended September 2007)
- Integrated Pest Management Program (adopted September 2014, last amended January 2019)
- La Honda Creek Open Space Preserve Master Plan (adopted August 2012)
- Regulations for Use of Midpeninsula Open Space District Lands (adopted July 1993, last amended February 2014)
- Service Plan for the San Mateo Coastal Annexation Area (adopted June 2003)

Surrounding jurisdictions and CAL FIRE have their own policies and practices related to wildland fire management. The policies of these agencies were similarly compiled. The following agency policies were included in this analysis:

- CAL FIRE
- San Mateo County Parks and Recreation Commission
- San Mateo County Planning
- Santa Clara County Planning
- State of California Government
- Woodside Fire Protection District
- California Board of Forestry and Fire Protection

Fire safe councils are grassroots community-based organizations that share the objective of making California's communities less vulnerable to catastrophic wildland fire. Fire safe councils accomplish this objective through education programs and projects such as shaded fuelbreaks or firebreaks to protect area residents against an oncoming wildland fire and to provide firefighters with a place to fight the oncoming fire. The first fire safe councils started in the early 1990s, and there are now over 100 across the state. Local fire safe councils usually include representatives from:

- Fire agencies, including CAL FIRE, the U.S. Forest Service, the Bureau of Land Management, and/or local fire protection districts as appropriate
- Local governments, such as cities, counties, and special districts
- Other agencies, such as Resource Conservation Districts
- Public members
- Tribes
- Businesses, especially insurance

All local fire safe councils are independent entities. Some are organized as non-profit 501(c)(3) corporations; others operate under a memorandum of understanding with a county, city, and/or local fire protection district; some have no formal structure at all. Fire Safe San Mateo County, Santa Clara County Fire Safe Council, and the South Skyline Fire Safe Council are the fire safe councils that operate in the Program area. All fire safe councils pursue public and private partnerships to enhance public education and expand fuel reduction. The fire safe councils do not operate under specific policies and regulations but, as entities, provide numerous resources for defensible space, homeowners' fire risk reduction, fire codes, fire crews, information on invasive species, shaded fuelbreaks, fire history, chipper programs, and more. CWPPs are also developed under local fire safe councils. The CWPP for San Mateo and Santa Cruz Counties was published in April 2018 and the Santa Clara County CWPP was published in August 2016. Midpen coordinates with the fire safe councils within Midpen boundaries. Midpen also participated in the development of both CWPPs and was a signatory to the Santa Clara County CWPP.

Neither the San Mateo County nor the Santa Clara County CWPPs includes specific policies, but each summarizes goals and strategies of the entities and agencies within its coverage areas and provides overarching guidance on many aspects of fuel management and wildland fire preparedness that would be relevant to Midpen's Program. The considerations of the CWPPs were, therefore, included in this policy analysis.

3.2.2 Process for Making Recommendations

Recommendations for updates to the RM Policies were made by evaluating the objectives and general components of the Program against existing policies for consistency and compatibility. The policies of other jurisdictions were then evaluated to determine if they were already included in Midpen policies or if they provide important guidance that should be incorporated into the RM Policies for Board consideration. The CWPPs were also evaluated to ensure that existing policies encompass the important tenets of the Program.

3.3 Policy Revisions to Support the Program

The policy analysis revealed that the goals and components of Midpen's Wildland Fire Resiliency Program are generally supported by the RM Policies, however, the following updates to the RM Policies may be considered to better address wildland fire management and ecosystem resiliency. The specific text revisions are available in the Wildland Fire Resiliency Program Resource Management Policies Analysis and Recommendations report (Appendix A).

- Adding ecosystem resiliency to the Wildland Fire Management policies, including an objective to identify acceptable levels of environmental change that allows for establishment and maintenance of resiliency at the landscape level;
- Adding language to address post-fire restoration and response;
- Adding language regarding the indigenous use of fire and objectives to coordinate with tribes on prescribed burning practices and incorporate cultural practices of prescribed fire for desired outcomes;
- Adding language that defines and supports programmatic planning efforts to implement wildland fire resiliency activities and address regulatory barriers;

- Adding language acknowledging the adopted CWPPs for San Mateo and Santa Clara Counties and consideration of supporting the CWPPs implementation actions that are consistent with Midpen practices;
- Adding language that defines and describes the importance of adaptive management and decision-making flexibility to respond to ecological feedback;
- Adding an objective to identify the focus of non-fire fuel management actions versus prescribed fire actions;
- Adding an objective to adopt new emerging technology into management methods;
- Allowance for landscape visual changes for fuels management under Scenic and Aesthetic Resource policies; and
- Updates to the Climate Change policies that acknowledges the actions and related tradeoffs that should be considered to avoid large, catastrophic carbon emissions (and major ecological impacts) from large destructive fires, such as selective fuel clearance and controlled prescribed burns.

4 Vegetation Management Plan

4.1 Introduction, Purpose and Need

4.1.1 Background

Vegetation management is the practice of removing or modifying live and dead vegetation to reduce the potential spread of wildland fire ignitions, overall rates of wildland fire spread, flame lengths, and catastrophic fire severity. Vegetation management can be used to reduce dead fuels in areas affected by diseases such as SOD, remove stands of invasive weeds, and remove overly dense vegetation to improve ecological health and reduce competition with native plants that suppresses healthy plant growth. Vegetation management may also aid in the following:

- Reduction of ecological resource impacts from forest disease, invasive species, and wildland fire;
- Maintenance of emergency response and evacuation access roads;
- Minimization of rehabilitation needs associated with fire suppression activities; and/or
- Suppression of fires.

For Midpen, vegetation management for fuels reduction is a complex process that helps further mission-driven ecological resource goals. The best approach for managing fire risk and reducing fuel loads using non-fire vegetation management methods (i.e., without using prescribed burning) on Midpen lands is to focus active management in areas that are affected by disease infestations and/or heavy, dense vegetation, as well as near potential ignition sources, including along roads and adjacent to critical infrastructure.

4.1.2 Purpose and Need

Wildland fire behavior is influenced by three main factors: weather, fuels, and topography. Wind, temperature, and humidity are important weather variables used to predict fire behavior. The arrangement and type of the vegetation, amount and distribution of smaller-diameter fuels, and the ratio of live-to-dead material factor into how fuels affect wildland fire behavior. Slope and angle of sun exposure affects how a fire will burn. A north-facing slope supports lower fire activity than a south-facing slope. However, under very dry and windy conditions north-facing slopes can burn with high intensities due to higher fuel loading found on these hillsides. Fires burn more rapidly uphill than downhill, if sufficient vegetation is available. The steeper the slope, the faster the fire travels in the uphill direction.

Changing climatic conditions, past land uses, and years of fire suppression have increased fuel loads and fire-prone conditions that could contribute to larger, more intense wildland fires. Midpen has the goal of protecting the natural resources on its land and facilitating improved fire suppression capabilities on Midpen land, which in turn supports local and state fire agency efforts to protect public safety.

The primary need for vegetation management is to reduce the presence of unnaturally high fuel loads and secondarily to manage vegetation near ignition sources (e.g. WUI, roads, structures), thus reducing the intensity and harmful impacts of fires.

Vegetation management may help to restore ecosystem fuel loads closer to pre-fire suppression conditions through the removal of dead and accumulated vegetation and treatment of forest disease and invasive species. Prior to the mid to late 20th century, landscapes in the San Francisco Bay Area were either naturally disturbed through lightning-ignited fires or managed through Native American practices of burning that kept fuel loads down. Prior to European contact, the spread of invasive species that alter ecosystems and increases fire risks was also much less of a concern.

The purpose of the VMP is to define the suite of vegetation management activities that Midpen may implement to reduce the potential for ecologically-catastrophic wildland fires while also preserving biodiversity and minimizing the environmental effects. This VMP identifies the following:

- Historic regional vegetation and fire regimes;
- History of vegetation management on OSPs and current practices;
- Types of vegetation management areas (VMAs) that can be created;
- Process to prioritize VMAs and projects;
- Planning process for undertaking vegetation management projects;
- Methods for creating and maintaining VMAs; and
- Standard best management and environmental protection measures for vegetation management projects.

The VMP focuses on what is referred to as "non-fire" vegetation management. Only manual, mechanical, prescribed herbivory, and limited chemical methods of vegetation management are considered in this VMP. Prescribed fire to reduce fuel loads and restore natural ecological processes in interior areas of OSPs, away from the WUI and other infrastructure, will be described in detail in a future PFP (underway, to be presented at a public meeting later in 2020) and is described at a programmatic level in Chapter 5 of this Program.

4.1.3 Overall Plan Structure

This VMP describes (1) treatments to enhance ecosystem resiliency, and (2) vegetation management work that facilitates fire management, reduces fire ignitions, and minimizes the intensity of wildland fires to reduce the damage to ecological functions, which also serves to enhance public safety. Treatments created solely for ecosystem resiliency will be focused on general fuel reduction and may be maintained less frequently and/or be relocated or modified in response to changing environmental conditions and expanded land holdings. Treatments that help enhance fire management are generally considered semi-permanent and maintained with more regularity as needed.

Overall Plan Structure

1) Treatments for Ecosystem Resiliency
    a. Fuel Reduction Area
    b. Temporary
    c. Objective to make fire resilient forests by reducing fuel loads (disease)
2) Fuel Treatments for Fire Management
    a. Permanent Fuelbreaks (Shaded, defensible space, landing zone, etc.)
    b. Maintenance every 3 to 5 years

The VMP will help guide Midpen as it considers how and where to expand its current vegetation management work (e.g., fuelbreaks, defensible space) and Fuel Reduction Areas (FRAs) each year. Midpen staff, with input from surrounding fire agencies, would prepare an Annual Wildland Fire Resiliency Plan that describes the extent, scope, and location of the VMAs to be created. The annual plan would be dependent upon numerous factors, including annual staffing capacity, funding availability, partnerships, and other resource availability, and be balanced with other Midpen priorities that also further Midpen's mission, as well as annual *Strategic Goals & Objectives*, and the *Vision Plan*.

As Midpen continues to expand its land holdings, the amount of vegetation management work within its lands is expected to also increase. Midpen continues to actively acquire new lands to preserve as open space in perpetuity. For example, between 2015 and 2020, Midpen added approximately 1,600 acres to its land holdings.

4.2 Vegetation Management History

4.2.1 Historic and Current Vegetation Management and Fire History

Prior to European contact, Native American tribes actively managed vegetation within their communities and surrounding areas using fire. These fires were lit intentionally at various times of the year to enhance vegetation growth, facilitate food collection, and improve forage for animals they hunted. In addition, Native American tribes did not actively suppress lightning ignitions at a landscape scale, which resulted in those fires often burning for days, weeks, and even months, shaping the patterns of vegetation cover and composition over the centuries (Anderson, 2013). A detailed fire history study was conducted in the Santa Cruz Mountains, San Mateo County, Huddart Park, and McGarvey Gulch. These studies found that fires burned redwood forests every 12 years, on average. There were intervals both shorter and longer (2 to 43 years) without fire (Stephens & Fry, 2005). These findings are consistent with studies that have documented extensive human and lightning-caused wildland fire burning in the state of

California. Correspondingly, the vegetation composition in the region had been originally shaped by a variety of disturbance pressures, including fire and grazing by large herds of native ungulate animals.

The arrival of Europeans, including Spanish and Anglo settlers, dramatically changed the management of vegetation communities, particularly grasslands. Major changes included tilling the grasslands for crop production, logging, introduction of cattle herds from Europe, and reduced populations of native grazing animals. The introduction of nonnative plants resulted in changes to grassland species composition from primarily perennial, native plant species to annual, nonnative plant species. Some nonnative species (invasive species) now compete with native plants in the same ecosystems, reducing the abundance and diversity of native species.

Within the last 100 plus years, more recent land use and management practices have resulted in higher fuel loads on and adjacent to natural lands. The policy of fire suppression has further exacerbated the issue, reducing biodiversity on open space lands. Invasive plant species continue to spread within grasslands and other plant communities. Since the 1990s, SOD has infected oak woodlands, resulting in succession of habitats and increased fuel loads. Grasslands and oak woodlands are decreasing due to the spread of brush and forest species in the absence of periodic fires and grazing. Coastal scrub and chaparral habitats are aging with minimal new growth. The understory of redwood and Douglas fir forests, and mature oak woodlands have been converted from low-density plants to denser, taller brush and young trees. Second-growth forests feature higher densities of smaller diameter trees compared to old growth forests.

Today, in the absence of decades of fire, in some areas both live and dead fuels have accumulated creating higher surface fuel loads, vegetation density, and varied species composition from what was seen prior to European contact.

4.2.2 Current Fuels Management Practices

Midpen undertakes several actions and activities on its lands to prepare for fire season. The actions related to fuel maintenance and reduction and fire management include:

- Maintaining existing fuelbreaks in OSPs, including but not limited to Pulgas Ridge, Windy Hill, Sierra Azul, Saratoga Gap, and Monte Bello OSPs;
- Defensible space clearing around 117 Midpen-owned structures;
- Maintaining hundreds of miles of fire roads; and
- Managing over 8,500 acres of grasslands using conservation grazing, in part to manage fuels.

Midpen's IPMP, adopted in 2014 with an addendum certified and adopted in January 2019, prescribes pest management activities on Midpen lands over a 10-year period covering five major categories of work, including vegetation management. Vegetation management prescriptions within the WUI and around structures aim to reduce the potential rates of spread, and intensity and flame lengths of wildland fires within treated areas. This includes the spread of wildland fires that originate in and around buildings. This work is accomplished primarily through mechanical means, using handheld power tools or heavy equipment. Current treatments, methods, locations, and acreages under the IPMP are identified in Table 4-1. Figure 4-1 shows the percent of each treatment method used in 2018 under the IPMP (Midpen, 2019a). It should be noted that this figure includes all treatment applications and not just the applications for the fuels management category, as shown in Table 4-2.

Table 4-1 2014 IPMP Treatments and Annual Application for Fuels Management

Treatments	Treatment Type	Treatment Method	Locations	Annual Application [a]
Grasslands: Annual mowing **Shrublands:** Thin brush and mow tall grasses, increase spacing between shrub clusters **Forests:** Limb up trees to a height of 8 to 10 feet, thin brush, and mow tall grasses **Agricultural land:** Mowing and brush thinning along roads, discing along borders of agricultural and rangeland properties, conservation grazing	Manual and Mechanical	Mowing and Cutting	Defensible space, fuelbreaks, emergency landing zones	136 acres [b]
		Discing and Cutting	Disclines	75 acres over approximately 30 miles
	Chemical	Glyphosate Round-Up ProMax used for spot treatment or cut-stump	Defensible space, disclines, fuelbreak	2 gallons concentrate per year
			Defensible space	5.2 gallons concentrate over 14 acres per year

Notes:

[a] 1 percent increase annually in treatment is allowed with the value presented as the 2014 allowance.

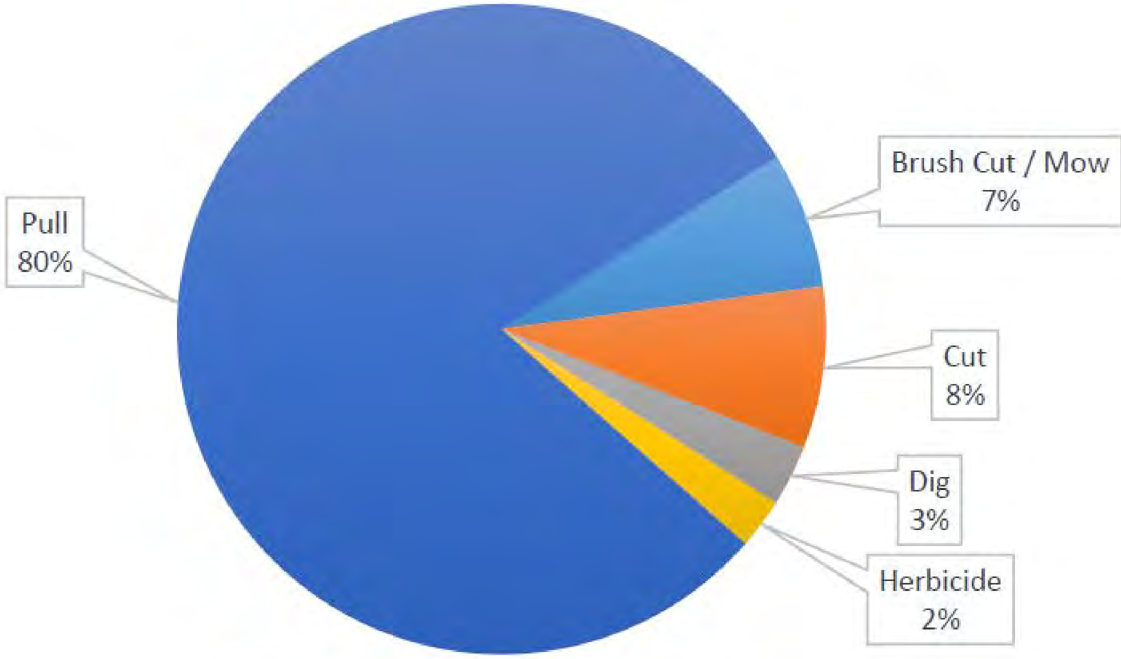
[b] For 2019, an additional 225 acres of treatments was approved from other programs to increase the vegetation management capacity while the VMP was being prepared.

Source: (Midpen, 2014)

Treatments are implemented in grasslands, shrublands, forests, and agricultural land. While the IPMP allows for some degree of vegetation management for fuel reduction, it currently only covers maintenance of existing fuelbreaks and does not allow for construction of new major fuelbreaks or VMAs. Figure 4-1 summarizes the vegetation management projects conducted Midpen-wide in 2018. Note that conservation grazing on Midpen lands is not included in the IPMP as it is a stand-alone program.

Locations of existing fuelbreaks, defensible space, landing zones, and disclines that have been maintained within the last 5 years are shown in Appendix B. Table 4-3 provides a summary of the existing mowing, disclines, and fuels treatments on Midpen lands by managed land.

Figure 4-1 Hours per Treatment Method from the 2018 IPMP Annual Report



Source: (Midpen, 2019a)

Table 4-2 Summary of IPMP Vegetation Management Projects Across Midpen Land in 2018

Purpose	Acres		Total Area (Acres)
	Foothills OSP	Skyline OSP	
Defensible Space	21.9	33.2	**55.1**
Landing Zones	6.5	5.3	**11.8**
Shaded Fuelbreak	36.8	22.7	**59.5**
Other Fuelbreak	--	14.4	**14.4**
Total	**65.2**	**75.6**	**140.8**

Note:
Conservation grazing is not a part of the IPMP and is covered by the Conservation Grazing Program.

Source: (Midpen, 2019a)

Table 4-3 Existing Treatments on Midpen Lands Under the IPMP (Acres)

Managed Land	Shaded Fuelbreaks	Non-Shaded Fuelbreaks	200-foot Fuelbreaks	Ingress/Egress Route Fuelbreaks	Disclines	Defensible Space 100-foot	Defensible Space 30-foot	Grand Total
Bear Creek Redwoods OSP	1.2	1.0	0.8	--	7.0	10.1	3.3	23.3
Coal Creek OSP	--	0.1	--	--	--	1.8	0.4	2.3
El Corte de Madera Creek OSP	1.2	0.1	0.6	--	--	1.6	0.4	4.0
El Sereno OSP	1.5	0.2	2.2	--	--	0.4	0.1	4.4
Foothills OSP	2.4	--	--	--	0.1	0.0	--	2.5
Fremont Older OSP	--	0.1	1.0	--	14.1	2.3	0.6	18.0
La Honda Creek OSP	7.0	2.5	1.7	--	--	15.8	4.4	31.5
Long Ridge OSP	19.0	1.7	3.4	--	--	1.9	0.4	26.4
Los Trancos OSP	0.8	--	--	--	4.9	--	--	5.6
Miramontes Ridge OSP	--	1.1	--	--	--	2.2	0.4	3.7
Monte Bello OSP	28.5	0.5	2.8	--	4.3	3.8	0.7	40.6
Picchetti Ranch OSP	0.1	--	1.9	--	5.4	2.7	0.9	11.0
Pulgas Ridge OSP	--	0.1	0.7	--	--	--	0.1	0.9
Purisima Creek Redwoods OSP	19.3	0.5	0.3	--	--	7.9	2.1	30.1
Rancho San Antonio OSP	2.9	0.1	2.8	--	9.6	12.6	3.1	31.0
Ravenswood OSP	--	0.1	--	--	--	--	--	0.1

Managed Land	Shaded Fuelbreaks	Non-Shaded Fuelbreaks	200-foot Fuelbreaks	Ingress/Egress Route Fuelbreaks	Disclines	Defensible Space 100-foot	Defensible Space 30-foot	Grand Total
Russian Ridge OSP	22.5	0.9	2.8	--	5.8	10.6	2.4	44.9
Saratoga Gap OSP	17.8	4.8	--	--		2.3	0.6	25.5
Sierra Azul OSP	38.3	14.3	8.6	9.1	4.6	23.0	5.3	103.2
Skyline Ridge OSP	5.6	1.6	0.9	--	0.1	13.4	3.3	24.9
Saint Joseph's Hill OSP	--	--	1.4	--	--	--	--	1.4
Teague Hill OSP	6.6	--	--	--	--	0.0	--	6.6
Thornewood OSP	13.8	0.2	--	--	--	3.0	0.7	17.7
Tunitas Creek OSP	--	5.2	--	--	--	5.4	1.3	11.9
Windy Hill OSP	1.3	30.7	2.1	--	3.4	9.0	2.1	48.6
Other Areas Managed by Midpen	--	11.5	--	--	1.5	--	--	**13.0**
Grand Total	**189.7**	**77.0**	**33.9**	**9.1**	**60.9**	**130.1**	**32.5**	**533.1**

Note:

Depending on habitat type, maintenance of existing treatment areas is typically completed on a 3- to 5-year rotation.

Numbers may not add up to the total due to rounding.

Appendix I provides a key for the terms used in this table and the terms used in Appendix B.

4.3 Vegetation Management Areas

4.3.1 Overview

Midpen would like to expand its ability to create and treat new ecologically-sensitive VMAs as resources allow. Midpen recognizes the need to expand its vegetation management work in the short- and long-term due to higher fire risk, the potential for catastrophic fires, and to manage future new open space acquisitions. This section identifies the types of high priority VMAs and their locations.

Vegetation management is intended to decrease the risk of extreme wildland fire behavior, slow the spread of a wildland fire, aid in the suppression and control of a wildland fire, and/or reduce the impacts of wildland fire should it occur. Unnaturally excessive fuel loads are the primary factor that Midpen can change to alter the behavior of a wildland fire. Dead vegetative material on the ground surface, referred to as surface fuels, can be removed.

Key types of VMAs include FRAs, fuelbreaks, and defensible space, which are detailed below. FRAs would be implemented, then maintained as needed based on field inspections by qualified staff and/or consultants, whereas fuelbreaks and defensible space would be more regularly maintained.

4.3.2 Types of VMAs

Overview

This section describes the types of VMAs proposed for fire management and improved ecosystem resiliency. VMAs for ecosystem resiliency improve habitat health and includes FRAs. FRAs are less permanent than fuelbreaks and are typically implemented in more natural areas where fuel load reduction achieves a combination of habitat enhancement goals and wildland fire risk reduction. FRAs can also enhance public safety when created near the WUI and/or adjacent to existing fuelbreaks.

VMAs that aid fire management typically involve periodic maintenance to operate as intended. If not regularly maintained, the level of effort and cost required to re-establish the desired conditions of the VMA begins to approach the same level as new construction. Developing design standards and dimensions for VMAs are part of Midpen's strategy to reduce the intensity of wildland fire, should a fire occur. Each of the types of VMAs are described in this section.

Ecosystem Resiliency VMAs

FRAs

Ecosystem-resiliency FRAs are locations where fuels are manually or mechanically removed but not to the same extent as fuelbreaks. These areas are typically implemented to achieve a combination of habitat enhancement and wildland fire risk reduction. FRAs can be areas of managed vegetation adjacent to fuelbreaks (as described below and shown in Figure 4-2) and can also occur in areas where fuel loading is particularly problematic, such as areas affected by forest disease. FRAs could be used in oak woodlands adjacent to a non-shaded fuelbreak where understory fuels are removed and over-topping conifers, such as Douglas fir, are removed or in grasslands where shrubs are removed. Fuel ladders and surface fuels are greatly reduced, and overstory and understory vegetation is spatially separated so that a ground fire will not, under normal fire conditions, burn too hot and/or climb into the canopy and turn into a crown fire. FRAs are maintained as needed.

Refugia

Prior to the creation of an FRA, a Midpen-designated Biologist may designate sites as "refugia" areas. These may be single or multiple sites as needed.

Activities prohibited within refugia during FRA implementation include:

- Use of artificial light;
- Creation of new capital improvements or uses, including:
  - Roads,
  - Trails,
  - Structures, or
  - New recreational uses
- Motorized/mechanical equipment; and
- Use of any herbicides (e.g., glyphosate).

Prohibited activities can only be waived or revoked by a Midpen biologist. Prohibited activities in refugia may resume once FRA implementation is complete but is generally discouraged except to resume baseline conditions that were suspended during FRA implementation.

Enhanced Fire Management VMAs

Fuelbreaks

Definitions and Functions of Fuelbreaks

Fuelbreaks are linear strips of land where trees, vegetation, and dead material have been reduced or removed. These areas can slow, and even stop the spread of a wildland fire because fewer fuels are present to combust. Fuelbreaks also provide firefighters with zones to take a stand against or control the spread of a wildland fire, or retreat from fire if the need arises. For the purposes of this VMP, fuelbreaks encompass a range of fuel reduction intensities, depending on the resources being protected and the ecological setting.

Terminology: Target Hazards

According to the Federal Emergency Management Agency, target hazards are "facilities in either the public or private sector that provide essential products and services to the general public, are otherwise necessary to preserve the welfare and quality of life in the community, or fulfill important public safety, emergency response, and/or disaster recovery functions."

Examples include:

- Hospitals
- Assisted living centers
- Community shelters
- Schools
- Airports
- Important government offices
- Emergency operations centers
- Water /sewage treatment facilities

Typically, fuelbreaks are strategically located considering terrain, existing roads, communities, critical infrastructure, presence of potential ignition sources, fire management logistics areas, evacuation routes, target hazards, and sensitive resources. Other locations may be identified by fire agencies or Midpen staff. Future fuelbreaks on Midpen lands will generally be located along primary and secondary roads and around critical infrastructure. Fuelbreaks can vary in width from approximately 15 feet around minor ingress and egress routes to up to 200 feet around major routes of travel (e.g. highways) or associated with regional vegetation management treatments. Additional areas can be included near fuelbreaks such as FRAs, as described in the above section (under Ecosystem Resiliency). The maximum fuelbreak widths by habitat type are shown below in Table 4-4.

Table 4-4 Maximum Fuelbreak Widths by Habitat Type

Habitat Type	Fuelbreak Width (feet)
Grass	100
Shrub	100
Oak woodland	200
Redwood or Douglas fir forest	200

Fuelbreaks function as potential anchor points to control lower intensity fires, flank higher intensity fires, and provide firefighter safety. Vegetation is managed to reduce the continuity of live and dead fuels both horizontally and vertically in fuelbreaks. Fuelbreaks can reduce fire intensity and severity. It should be noted that fuelbreaks typically do not stop fires without fire department response and fire may still jump a fuelbreak regardless of fuelbreak size during extreme fire weather, intense fire behavior, or other confounding scenarios (e.g., multiple ignition events). Alternative means to protect homes in the WUI, such as home hardening and defensible space, are important for individual landowners to implement.

Shaded Fuelbreaks

A shaded fuelbreak is an area where the tree canopy is thinned to reduce the potential for a fire to move quickly through and/or to reduce fire spread into or through the canopy. Enough tall tree canopy is retained to maintain shade, reduce the potential for rapid re-growth of shrubs and sprouting hardwoods, and minimize erosion. Ladder fuels and woody understory vegetation are thinned out. A shaded fuelbreak can be created manually or by using mechanical techniques (heavy equipment). Shaded fuelbreaks require follow-up maintenance along roads that includes annual mowing in grasslands adjacent to the road, clearance of brush and dead vegetation, and removal of ladder fuels to the canopy in forested areas. In addition to manual and mechanical methods, herbicides may be applied to control invasive species.

Shaded fuelbreaks included in this VMP may be up to 200 feet wide. Width varies depending on the presence of sensitive resources, the location of habitat transitions, slope, expected fire behavior, the features or infrastructure that need protection, and the capacity to create and maintain the fuelbreak.

Non-shaded Fuelbreaks

A non-shaded fuelbreak is a swath of land where fuels are reduced in areas without a tree canopy, typically at a change in vegetation type, such as from forest or shrubland into grassland, or within grasslands. Heavy equipment is typically used for construction, except on steep slopes, where manual treatments are employed. Non-shaded fuelbreaks are most often maintained in grasslands or shrublands versus wooded areas, although they can be implemented at a transition, particularly near structures if professional fire agency personnel deem critical for fire safety or necessary to meet defensible space requirements (see Figure 4-2). Herbicides may be applied to control invasive plants.

Figure 4-2 Example of a Non-Shaded Fuelbreak

A non-shaded fuelbreak (orange outline) implemented between homes and dense trees on El Granada Boulevard in San Mateo County to reduce the risk of wildland fire spread.

Source: (County of San Mateo, 2016)

Ingress/Egress Route Fuelbreaks

Due to limited resources, challenging terrain, and/or variable vegetation patterns, it is not always possible to maintain fuelbreaks at an optimal width related to flame length along all routes on Midpen lands. An ingress/egress fuelbreak is a zone located on both sides of roads identified as critical for emergency vehicle passage, typically designed to accommodate a smaller Wildland Type 3 fire engine. Fuelbreaks would also be located at driveways within Midpen land to facility emergency egress, as well as around certain recreational facilities such as parking lots and picnic areas. Vegetation management on easements over Midpen lands is the responsibility of the easement holder unless there is a cost-share agreement in place. Vegetation management in this zone improves access and reduces radiant heat during a wildland fire, allowing improved firefighter access during a wildland fire. These fuelbreaks are typically cleared of all understory vegetation for 10 to 30 feet from road edges (on either side), using primarily manual and mechanical techniques, and then mowed annually.

Disclines

Disclines are a type of vegetation treatment that is conducted using a tractor attachment with a series of metal discs to disturb soil 6 to 12 inches deep. By turning over the soil and leaving mostly a dirt surface, a discline is intended to slow or stop fire progression. Midpen staff have previously documented disclines stopping ignitions on Midpen lands as shown in Figure 4-3. A discline is typically placed along the perimeter of undeveloped land, ranches, and roadways. Herbicides may be applied to control invasive species. To avoid or reduce potential impacts to ground-dwelling species and surface erosion, disclines are only installed in limited locations after a thorough evaluation of benefits and consequences.

Figure 4-3 Example of a Discline

Photo of a fire originating from a powerline that was stopped due to an existing discline.

Defensible Space

Defensible space is the area immediately surrounding a structure where vegetation management measures to reduce fuels are implemented, providing the key point of defense from an approaching wildland fire, or defense against escaping structure fires. This zone is an area where fuel loads are reduced within 100 feet of the structure, comprised of three zones. Zone 0 involves removal of all vegetation using a variety of methods within 5 feet of structures and allows only non-flammable hardscaping or similar techniques. Zone 1 involves removal of all dead matter and dense fuels within 30 feet of buildings, decks, and other structures typically using manual and mechanical techniques. Zone 2 involves mowing, removal of ladder fuels, and thinning of vegetation extending from 30 to 100 feet out from buildings and structures (California Government Code 51182, and Public Resources Code Sections 4290 and 4291).

Midpen has developed a Defensible Space Permit Program and Clearing Guidelines for adjacent property owners, tenants, homeowners' associations, educational institutions, civic groups and other organizations to create defensible space on Midpen lands adjacent to their homes and other qualifying structures. Defensible space surrounding Midpen-owned structures is maintained annually by Midpen and/or its tenants.

Maintenance of defensible space will occur on an annual basis around an estimated 117 Midpen-owned structures by Midpen staff and/or by residential, commercial or agricultural/rangeland tenants. Along the perimeter of Midpen lands, additional vegetation treatment may be required by other agency regulations or ordinances. Defensible space of private property, including private homes located adjacent to Midpen lands, is the responsibility of the person that owns, leases, controls, operates, or maintains the building or structure. Midpen works with communities, fire safe councils, and local fire agencies who wish perform fuel reduction on Midpen lands to permit ecologically sensitive work by other parties.

Emergency Staging Areas, Emergency Landing Zones, and Other Fire Management Logistics Areas

Emergency fire management logistics areas are key during a wildland fire where fire suppression resources may safely park, gather crews, or land a helicopter. Fire management locations may also serve as a temporary refuge area during a wildland fire. Emergency landing zones allow helicopters to land in the event of an emergency. These areas are maintained annually or bi-annually via mowing with a tractor or brushcutter at 47 locations on Midpen lands, as shown in the figures in Appendix B. An additional 200-foot wide fuelbreak may be constructed according to the fuelbreaks discussed above.

Non-Native Eucalyptus and Acacia Removal

Fallen eucalyptus leaves create dense carpets of flammable material, and the tree bark peels off in long streamers that drop to the ground, providing additional fuel that draws ground fires up into the leaves, creating massive, fast-spreading "crown fires" in the upper story of eucalyptus forests. The leaves from some species of Acacia contain resin and flammable oils, which can encourage fires. Eucalyptus and Acacia trees may be removed from locations where the trees could pose a fire hazard using manual and mechanical methods, as well as limited herbicide use to control re-sprouting from cut stumps.

4.4 Creation of New VMAs

4.4.1 Overview

Generally, vegetation management techniques implemented to create new VMAs involve reducing the density of vegetation and strategically opening areas to reduce spread and improve fire management and response. At key locations, shrubs, small trees, and grass that can act as fuel ladders, allowing a surface wildland fire to travel up into the tree canopy, can be removed or reduced in density. Grasses can be mowed or grazed to manage fuel loads. Small trees and shrubs can be thinned, leaving larger diameter trees with often thick fire-resistant bark and promoting late-seral forests.

4.4.2 Mapping and Description of Potential New VMA Areas

The potential areas within which new VMAs could be established in the future are identified in maps (refer to Appendix B), and tabulated in Table 4-5. The acreages and areas shown are meant to represent the "envelope" within which the VMAs can be built. The actual acreages and areas of VMAs built are likely to be less than the full envelope shown, particularly in the first few years of Program implementation.

FRAs are not tabulated in Table 4-5; however, Appendix B includes maps showing stands greater than 100 acres of oak woodland, Douglas fir, and redwood forest that represent potential areas where FRAs for ecosystem resiliency may be constructed.

VMA areas (including FRAs) are prioritized in accordance with the methods described in Section 4.4.3. Although Midpen intends to gradually increase the amount of VMAs created annually, this will depend on staffing capacity, funding resources, partnerships, and other resource factors with consideration and weight given to other Midpen priorities that further its mission. Only areas within the very highest VMA priorities that can be accommodated in Annual Work Plans and can be adequately maintained over the long-term, are expected to be implemented each year.

4.4.3 Method of Prioritizing the Establishment of New VMAs

Methodology for Locating Potential Fuel Reduction Areas for Ecosystem Resiliency

The location of new FRAs on Midpen lands are confined to native forests or woodland areas of at least 100 acres in size. Areas classified as "water" or "wetland" are excluded from treatment. Ecosystem health and condition factor into the locating of new FRAs. FRAs will be identified by Midpen or other professional fire management or vegetation management staff as important areas for ecosystem health and resiliency.

Methodology for Prioritizing Fuel Reduction Areas

Prioritization is established by assigning points for each of the following factors. The areas with the most points receive the highest priority ranking.

- Within 300 feet of sensitive natural resources that would benefit from and/or respond favorably to treatment;
- Within high fire risk areas (Priority zones: CAL FIRE Very High, Santa Cruz High C-Fire M-Fire);
- Within 500 feet of points designated as having mortality due to forest disease, such as SOD;
- Identified by professional Midpen or vegetation management staff as important fuel treatment areas for ecosystem resiliency;
- Where past land use history has increased the number of trees per acre to unnatural conditions;

Table 4-5 Potential Areas within which New VMAs Could be Established (Acres)

Type of Treatment	Shaded Fuelbreaks	Non-Shaded Fuelbreaks	Evacuation Routes, Critical Infrastructure, and Fire Management Logistics Fuelbreaks [a]	Target Hazards Fuelbreaks [b]	Fire Agency Recommended Fuelbreaks	Ingress/Egress Route Fuelbreaks	Disclines [d]	Midpen Structures and Facilities Defensible Space [f]	Emergency Staging Areas, Emergency Landing Zones, and Other Fire Management Logistics Areas [e]	Eucalyptus and Acacia Removal
Treatment Size	**≤100-foot Fuelbreak**	**≤60-foot Fuelbreak**	**200-foot Fuelbreak**	**300-foot Fuelbreak**	**Variable [c]**	**≤30-foot Fuelbreaks**	**Variable [c]**	**30-foot and 100-foot Defensible Space**	**Variable [c]**	**Variable [c]**
Bear Creek Redwoods OSP	17.5	--	194.7	--	--	--	--	--	5.3	--
Coal Creek OSP	--	--	54.8	--	15.9	--	--	--	--	--
El Corte de Madera Creek OSP	--	--	141.4	--	--	--	--	--	1.8	--
El Sereno OSP	--	--	69.4	--	--	25.0	--	--	9.3	0.4
Felton Station OSP	--	--	0.4	--	--	--	--	--	--	--
Foothills OSP	--	--	52.6	<0.1	--	--	--	--	--	--
Fremont Older OSP	<0.1	--	18.2	--	--	--	--	--	4.8	0.9
La Honda Creek OSP	2.5	11.7	183.7	16.5	--	85.9	0.5	--	10.3	4.0
Long Ridge OSP	--	--	326.1	0.7	--	--	--	--	9.4	--
Los Trancos OSP	0.1	15.6	26.2	0.6	--	--	--	--	0.5	0.2
Miramontes Ridge OSP	--	--	26.3	--	--	2.5	--	--	--	72.3
Monte Bello OSP	0.9	0.8	215.7	4.1	--	4.3	--	--	9.5	0.1
Picchetti Ranch OSP	--	--	42.1	--	--	--	--	--	5.6	0.5
Pulgas Ridge OSP	9.4	--	5.1	0.5	9.9	--	--	--	1.6	30.7
Purisima Creek Redwoods OSP	6.5	6.0	181.6	--	--	0.5	--	--	0.6	3.2
Rancho San Antonio OSP	--	--	67.5	--	--	0.8	--	--	7.2	0.1
Ravenswood OSP	--	--	2.0	--	--	--	--	--	--	--
Russian Ridge OSP	90.7	3.3	216.1	--	--	9.3	--	--	9.1	--
Saratoga Gap OSP	--	--	164.4	--	--	0.2	--	--	0.5	--
Sierra Azul OSP	0.2	--	445.1	--	29.1	31.2	--	--	34.6	6.3
Skyline Ridge OSP	<0.1	--	242.6	2.9	--	--	--	--	4.7	--
St. Joseph's Hill OSP	--	--	49.6	--	--	--	--	--	4.6	--

Type of Treatment	Shaded Fuelbreaks	Non-Shaded Fuelbreaks	Evacuation Routes, Critical Infrastructure, and Fire Management Logistics Fuelbreaks [a]	Target Hazards Fuelbreaks [b]	Fire Agency Recommended Fuelbreaks	Ingress/Egress Route Fuelbreaks	Disclines [d]	Midpen Structures and Facilities Defensible Space [f]	Emergency Staging Areas, Emergency Landing Zones, and Other Fire Management Logistics Areas [e]	Eucalyptus and Acacia Removal
Treatment Size	**≤100-foot Fuelbreak**	**≤60-foot Fuelbreak**	**200-foot Fuelbreak**	**300-foot Fuelbreak**	**Variable [c]**	**≤30-foot Fuelbreaks**	**Variable [c]**	**30-foot and 100-foot Defensible Space**	**Variable [c]**	**Variable [c]**
Stevens Creek Shoreline Nature Study Area	--	--	--	--	--	--	--	--	--	--
Teague Hill OSP	--	--	1.8	--	22.2	--	--	--	--	--
Thornewood OSP	36.1	--	25.5	--	--	--	--	--	--	--
Tunitas Creek OSP	--	--	142.7	--	--	--	--	--	1.1	42.6
Windy Hill OSP	1.2	280.3	178.3	30.5	--	--	--	--	--	--
Other Areas Managed by Midpen	--	--	46.7	5.8	--	--	0.7	--	9.6	--

Notes:

Numbers may not add up to the total due to rounding.

Appendix I provides a key for the terms used in this table and the terms used in Appendix B.

[a] Includes some smaller ≤40-foot fuelbreaks around driveways for emergency egress.

[b] Target hazards include schools, hospitals, and care facilities.

[c] Treatment area determined by staff or fire management recommendation.

[d] Includes bladed firelines, which are up to 20 feet wide.

[e] The 200-foot fuelbreak around emergency staging areas, emergency landing zones, and other fire management logistics areas are accounted for under "Evacuation Routes, Critical Infrastructure, and Fire Management Logistics"

[f] Defensible space around Midpen structures and facilities are currently maintained. No new defensible spaces are part of the potential treatment areas but could be created in the future.

- Identified as an area for prescribed fire for natural resource benefits;
- Promotes late-seral habitat conditions; and
- Site is experiencing vegetation encroachment that is changing the fuel regime or converting the vegetation type.

Methodology for Locating Potential VMAs for Enhanced Fire Management

Potential new VMAs on Midpen lands will be located using the following criteria:

a) Areas that enhance and facilitate fire suppression activities (e.g., fire management locations, disclines) and ingress/egress safety for fire responding agencies, their personnel, and fire suppression equipment;
b) Adjacent to or near existing or planned fuel treatment areas as identified by fire agencies;
c) Identified by state or local fire management agency professional staff as important areas for fuels treatment;
d) Up to 300 feet from target hazards (school, hospital, nursing home);
e) Up to 100 feet from existing Midpen structures;
f) Up to 200 feet from emergency response infrastructure (communications tower, fire station, police station, medivac location, evacuation center, critical water infrastructure, such as storage tanks and pumps for fire suppression);
g) Up to 200 feet from a state or local fire management agency-designated expanded fire response/fire monitoring clearing zone (safety zone, parking area, staging area, helicopter landing zone);
h) Within 200 feet of Midpen staff-identified sensitive resources or other Midpen High Value Asset that would benefit from and/or respond favorably to treatment or may be at risk of loss in the event of a wildland fire;
i) Within 200 feet of a state or local fire agency-designated Midpen evacuation route; and
j) Within 10 to 25 feet (depending on flame length) of primary Midpen-designated emergency access roads accessible by a Wildland Type 3 fire engine.

Methodology for Prioritizing VMAs

Prioritization of VMAs is established by assigning points for each of the following factors. The areas with the most points receive the highest priority ranking. VMAs that are currently in the Conservation Grazing Program will be reduced by 1 point recognizing the beneficial reduction of fuel loads that already occurs through conservation grazing activities.

- Within 300 feet of target hazards (schools, hospitals, nursing homes);
- Within 300 feet of designated Midpen evacuation routes;
- Within 100 feet of Midpen structures;
- Within 300 feet of critical emergency response infrastructure (communications tower, fire station, police station, medivac location, pre-planned Incident Command Post, evacuation center);
- Within 300 feet of Midpen-designated fire response/fire monitoring clearing zones (safety zone, parking area, staging area, landing zones);

- Within 300 feet of sensitive natural resources that would benefit from and/or respond favorably to treatment;
- Within 500 feet or adjacent to current and planned fuel management treatments;
- Within high fire risk areas – i.e. CAL FIRE Very High (shown in Figure 2-2);
- Within 1,000 feet of current and planned fuel management treatments;
- Within 300 feet of other high value Midpen assets or potential treatment areas identified by Midpen staff (including strategic regional fuelbreaks and cooperative efforts with neighboring property owners);
- Within 200 feet of sites designated as having SOD outbreaks; and
- Vegetation treatments identified in the field by professional fire staff.

The fuelbreak prioritization criteria will be integrated into a Geographic Information Systems (GIS) for primary and secondary public paved roads, around critical emergency response infrastructure, and adjacent to communities in the WUI, focusing on the CAL FIRE-designated Very High Fire Hazard Zones. Fuelbreaks are mapped per the "Methodology for Locating Potential VMAs for Enhanced Fire Management". Fuelbreaks are assigned as shaded, non-shaded, or ingress/egress fuelbreaks with a maximum width indicated in the GIS. FRAs are also identified in/adjacent to each fuelbreak, where applicable for each OSP, as are existing and any new areas of defensible space.

4.4.4 Prioritized VMAs

Priority VMAs, based on the methods described in Section 4.4.3, are summarized in Table 4-6 and shown in Appendix B. With new land acquisitions and/or changing environmental factors, actual annual priorities may change year to year. Midpen anticipates targeting as many of the higher priority VMAs as possible based on available resources. Initially, Tier 1 and Tier 2 VMAs will be prioritized for creation first. Dependent upon logistics, proximity, and economy of scale, contiguous lower prioritized VMAs may be created simultaneously with Tier 1 and Tier 2 VMAs for efficiency.

Table 4-6 Priority VMAs on Midpen Lands (Acres) – Excludes Ecosystem Resiliency FRAs[1]

Managed Land	Tier 1	Tier 2
Bear Creek Redwoods OSP	14.3	32.8
Coal Creek OSP	40.3	16.0
El Corte de Madera Creek OSP	2.2	8.7
El Sereno OSP	--	2.7
Felton Station OSP	--	--

[1] The prioritization of FRAs will be determined according to the methods described in Section 4.4.3.

Managed Land	Tier 1	Tier 2
Foothills OSP	--	0.3
Fremont Older OSP	--	2.2
La Honda Creek OSP	10.4	18.0
Long Ridge OSP	100.0	80.2
Los Trancos OSP	0.3	3.2
Miramontes Ridge OSP	1.2	1.1
Monte Bello OSP	44.7	16.1
Picchetti Ranch OSP	--	0.6
Pulgas Ridge OSP	0.2	5.9
Purisima Creek Redwoods OSP	2.0	66.6
Rancho San Antonio OSP	0.5	4.4
Ravenswood OSP	--	--
Russian Ridge OSP	70.4	24.6
Saratoga Gap OSP	1.4	5.9
Sierra Azul OSP	0.8	11.3
Skyline Ridge OSP	56.3	32.1
St. Joseph's Hill OSP	--	0.2
Stevens Creek Shoreline Nature Study Area	--	--
Teague Hill OSP	16.5	7.5
Thornewood OSP	33.0	4.0
Tunitas Creek OSP	--	0.8
Windy Hill OSP	100.6	44.1
Other Areas Managed by Midpen	--	3.4

Note:
Numbers may not add up to the total due to rounding.

4.5 Cyclical Maintenance of VMAs

4.5.1 Overview

Vegetation management is performed periodically to keep fuelbreaks and other VMAs functional over time. The time between treatments depends on how fast the vegetation in the fuelbreak grows, if invasive species colonize the disturbed area (Midpen, 2014; Midpen, 2019b), the likelihood of an ignition and fire spread, and/or the proximity to buildings and other high value assets. For example, areas such as defensible spaces around structures with grassy fuels, or ingress/egress road corridors with rapidly growing woody weeds, typically need to be treated annually. Similarly, areas adjacent to picnic facilities also require regular maintenance. Cyclical maintenance is performed using combinations of different treatment techniques to ensure that the maintenance work is efficient and performed in a timely manner while minimizing ecological impacts. Techniques include a combination of cutting with heavy equipment, mowing, and/or hand tools as well as on-site mastication, mulching, and pile burning. Some chemical methods may also be used in very limited circumstances and in most circumstances is not intended for cyclical maintenance activities. These techniques are described in detail in Section 0.

4.5.2 Maintenance Strategies for VMAs

VMAs Maintained by Midpen

The maintenance requirements of Midpen's VMAs (e.g., FRAs, fuelbreaks, and defensible space) is related to the structure and composition of the vegetation retained within and surrounding it. VMAs with large numbers of perennial, fast-growing weeds in or adjacent to them require more frequent maintenance than those without. Should invasive species take hold in the VMAs, they can compromise surrounding natural areas by serving as a seed source for invasive, non-native species that may spread.

VMAs that border or traverse largely intact ecosystems still dominated by native species can be maintained with low-intensity brushing, performed as needed based on field inspections. Frequency of maintenance can vary from annual for VMAs in grass-dominated vegetation types, to approximately once every 3 to 10 years depending on vegetation type, the fuel conditions, and regrowth. Larger cut vegetative material (e.g., trees and limbs) is chipped or cut up and scattered on-site. Other vegetative material may be left in place or trucked out to the work area to another location on Midpen lands. VMAs bordering intact ecosystems will likely be absent of invasive species or show signs of persistent but small populations of perennial weeds. In intact ecosystems, the likelihood for the spread of invasive species into surrounding areas is not a significant concern; however, all VMAs will be treated as determined appropriate by Midpen staff (typically after the first year of creation and then every 3 to 5 years thereafter) with Early Detection Rapid Response (EDRR). The goal of EDRR practices is to detect invasive species problems earlier and to take control actions when populations are still relatively small and eradication is feasible.

VMAs that are bordered or traversed by degraded ecosystems dominated by weeds need a different and more intensive maintenance prescription to reduce the spread of weeds in the VMA and into surrounding areas. VMAs with non-native species are maintained with annual brushing of the fuels and dominant weeds; disposal of brush is accomplished via chipping, pile burning, or hauling. Invasive species treatment is addressed in Midpen's IPMP. The types and methods of invasive species treatment are stipulated in the IPMP and IPMP EIR. The IPMP, however, does not address the acreages of mowing and the quantities of pesticides needed for VMA creation and maintenance; these are therefore included in this VMP and discussed under Section 4.6. Disclines will typically be maintained annually through tractor discing.

Midpen currently mows over 100 miles of roadside to eliminate weeds and encroaching vegetation and, where applicable, to allow access for Wildland Type 3 fire engines. These activities will continue on an annual basis, as defined in the IPMP and covered under that Program. The VMP would potentially expand on this existing treatment by creating and maintaining fuelbreaks along Wildland Type 3 ingress and egress routes and major routes, and widen the area of treatment, as appropriate.

Fuelbreaks Maintained by Others

Fuelbreaks completed by other individuals or entities may or may not be on lands owned by Midpen. An outside party, such as private landowners, owners of leases or easements, non-governmental organizations (NGOs), or public landowners, retain the responsibility to maintain these fuelbreaks.

Midpen enters into lease and easement agreements with communication and utility companies, such as PG&E[2], that have infrastructure (e.g., powerlines, water tanks) on Midpen land. Easements are typically managed by the easement holder, with Midpen having limited input on the location, timing, and intensity of vegetation management pursued under that easement by the easement holder. For leases, the responsibility of vegetation management to help protect private assets lie with the leaseholder, and the requirement for vegetation management and defensible space are written into the lease or lease renewal. In all cases, the leaseholder's vegetation management activities that occur on Midpen lands must be reviewed and approved by Midpen to ensure that they meet standards for natural resource protection, fuel reduction, and other policies.

Many fuelbreaks along the perimeter of OSPs span ownership boundaries and are jointly managed by adjacent public and/or private landowners, or private entities. For example, Midpen would manage one side of the road while the adjoining landowner(s) manages the other side, even though the property line may not exactly follow the road. Midpen and its adjoining landowners would continue to rely on existing relationships, communication, and partnerships to maintain effective management of these areas.

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[2] Standards for vegetation management and clearance requirements under PG&E utility lines are governed by General Order 95, Section III of the California Public Utilities Commission.

4.6 Annual Planning

4.6.1 Implementation

The maximum annual acreages of VMAs to be created are identified in Chapter 8: Maximum Annual Treatment Areas and Annual Planning. Midpen's objective is to gradually expand its acreage of VMAs, depending on numerous factors, including funding sources and availability of work crews, while minimizing negative impacts to the natural resources. At least initially, Midpen will focus on creating VMAs for enhanced fire management within the priority VMAs shown in Table 4-6. Annual VMP priorities may change over time based on new land acquisitions and changing environmental conditions; priorities are expected to be periodically reevaluated using the methods presented in Section 4.4.3.

4.6.2 Annual Reporting

The Annual Vegetation Management Report will describe the vegetation management activities undertaken the previous year and to make recommended modifications to the Program, as needed, using adaptive management strategies. The draft Annual Vegetation Management Report will be prepared by the appropriate Vegetation Management or staff Coordinator, forwarded to the General Manager for review and finalization, and then presented to the Board of Directors for acceptance.

At a minimum, the Annual Vegetation Management Report will include the following basic information:

- A summary of the areas treated for the year by vegetation treatment category, including habitat type, acreages, and methods used by type of control (e.g., mowing, brushcutting, pulling, flaming, herbicide). A cost per acre will be provided for major treatment types.
- A qualitative assessment of effectiveness of Midpen's Vegetation Management Program, and suggestions for increasing future effectiveness. This assessment will be based in part on follow up discussions with staff, contractors, and stakeholders involved in the overall vegetation treatment process.
- A summary of pesticide use (e.g., herbicide application within a fuelbreak, insecticide use within a VMA), active ingredient (e.g., glyphosate, imazapyr) or pesticide formulation (e.g., Roundup ProMax™) used. This information would also be presented in the annual IPM report.
- A brief summary of public notifications, inquiries, and responses about vegetation management on Midpen lands.
- Assessment of compliance with the VMP including:
  - An evaluation of the effectiveness of any changes in practices implemented in the past 12 months.
  - A description of any experimental vegetation management projects (test studies) and the results, including a cost/benefit analysis.

- Suggested changes to the Program or the vegetation management practices proposed for adoption within the next 12 months, including:
  - Any changes in acreages, focus treatment areas to adapt to changing conditions; and
  - Any changes in methods or funding.

4.7 Vegetation Management Methods

4.7.1 Vegetation Management Toolbox

Vegetation will be managed primarily manually, mechanically, with prescribed herbivory (using goats, sheep, horses or other livestock to reduce fuels in a specific area), and to a significantly limited extent, pesticides. Invasive species are prioritized over removal of native species. Table 4-7 identifies the treatment actions and estimated maximum annual application of each vegetation management treatment, including creation and maintenance of VMAs. Midpen will also employ a series of best management practices (BMPs) for each management activity. Pesticides allowed are only those identified in the IPMP EIR and Addendum (Midpen, 2014; Midpen, 2019b), or subsequently approved by Midpen through further addendum processes. Specific vegetation management treatments are determined by Midpen staff who take into consideration location of treatment, the biology of the species being treated, availability of resources, and/or presence of non-target species.

It should be noted that under the IPMP, the current treatments result in 80 percent of vegetation management performed through pulling and 7 percent through brush cutting and mowing. This plan will result in a larger increase in the percent of work performed by brush cutting and mowing.

Midpen will evaluate the possibility of setting up permanent composting sites and stock piling of chipped material at or near field offices for vegetation removed during treatment. Compost may be used at other project sites to amend soils and chips used as mulch.

Table 4-7 VMA Treatment Methods and Estimated Maximum Annual Application

Treatment Type	Treatment Method	Typical Method of Application	Purpose	Maximum Annual Application
Manual and Mechanical	Mowing and Cutting	Tractor, brushcutter, chainsaw, chipper, skid steer with mounted head, jawz implement, pole pruner, pile burn	Removal of vegetation for VMA creation	See Table 8-1
	Discing and Cutting	Tractor, pole pruner	Discline creation	
Mechanical	Flaming	Propane torch	Invasive non-native species treatment in VMAs	

Treatment Type	Treatment Method	Typical Method of Application	Purpose	Maximum Annual Application
	Mowing	Tractor, skid steer with mounted head, brushcutter	Invasive species treatment in VMAs	
Chemical	Glyphosate Round-up Promax	Cut-stump	Invasive species or SOD removal in VMAs; Removal of vegetation for VMA creation	2 gallons concentrate
		Spot spray	Creation of defensible space	5 gallons concentrate
	Clethodim, Aminopyralid, and Clopyralid	Spot spray	Invasive plant control in VMAs	2 gallons concentrate per chemical type
	Imazapyr	Spot spray	Invasive plant control in VMAs	0.5 gallons concentrate
		Cut-stump	Invasive plant control/SOD in VMAs	0.25 gallons of concentrate
	Triclopyr BEE/TEA	Cut-stump	Invasive species or SOD removal in VMAs; Removal of vegetation for VMA creation	5 gallons of concentrate
		Spot Spray	Invasive species in VMAs or creation of defensible space	10 gallons of concentrate
Prescribed herbivory	Livestock	Livestock foraging	Pre-treatment of VMAs	100 acres

4.7.2 Treatment Types and Methods

Manual

Manual methods using power and non-powered hand tools to implement the VMP will be consistent with those described in Midpen's IPMP and focused on VMA creation and maintenance. Non-powered hand tools used for cutting are most commonly loppers, hand pruners, hand saws, and hatchets, and may also include pulaskis, machetes, brush hooks, and brush axes. Powered hand tools are also used, including brushcutters (metal blade), string trimmers (monofilament plastic line), and chainsaws, and 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. Ground crews of 3 to 15 persons with brushcutters and chainsaws work where heavy equipment cannot reach, generally more than 30 feet from a road edge and on slopes exceeding 30 percent. Chainsaws are used to limb or remove individual trees or shrubs. Brush-cutters are used where stem diameters are less than 5 inches at cut level, or the vegetation is predominately herbaceous. Cutting of herbaceous vegetation, including grasses and very young seedlings, is done with string trimmers. Vegetation management tasks include lopping, pruning, and girdling trees or large single-stem shrubs. Push mowers, leaf blowers, and weed-whips are also used.

Tasks where manual treatments are implemented include lopping and pruning. Hand tools are used in virtually all management areas to perform fine-scale tasks and finish work following use of heavy equipment. Invasive species may be encountered during creation of the VMAs. Handling of invasive species is covered under this VMP, and methods will be consistent with the IPMP (see Table 10-7 [Annual and Biennial Invasive Plants] and 10-8 [Perennial Invasive Plants] of the September 2014 IPM Guidance Manual). For herbaceous weeds, without viable seed heads, or woody weeds with small diameter twigs, slash is scattered on-site. Larger diameter woody material or very large volume of seedless herbaceous material may be piled for burning. State-regulated noxious weeds with viable seeds, including goatgrass and starthistles, are bagged and either composted and/or solarized on-site or landfilled off-site. Vining weeds, such as periwinkle and cape ivy, may be bagged and landfilled off-site or piled between tarps and solarized to prevent re-rooting while the vegetation decomposes.

Mechanical

Mowing and brushcutting are the primary categories covered under mechanical removal. Motorized heavy machinery is mounted with various mowing, mulching, chipping, and masticating heads for larger scale vegetation removal projects and cyclical maintenance tasks. Grass is typically mowed with tractors. Heavy, renewable diesel-powered equipment includes excavators, backhoes, skid-steers, and tracked chippers, and tractors.

Equipment operates both on-road and off-road. Any equipment used off-road is typically track-mounted to minimize soil disturbance and compaction. The mowing or grinding heads and chippers reduce material to a size that does not require pile burning. Articulating arms are used to extend reach both outward and up so equipment can primarily stay on existing roads. A backhoe or excavator may push or pull down individual small trees (less than 8 inches diameter at breast height [DBH]) either with the arm or with a cable or chain attached to the arm.

Heavy equipment is typically transported to an access point along an existing service road. Use of heavy equipment is generally restricted to sites with 30 percent slopes or less and unsaturated soils. To maintain public safety, road guards, signage, and temporary closures are used when equipment operates in close proximity to recreational roads and trails.

A masticator is a high-rotation drum with fixed teeth mounted on the hydraulic arm of an excavator that pulverizes vegetation. A masticator is used primarily for fuelbreaks, but also sometimes for brushing around structures, roads, parking lots and brush removal in grasslands.

The masticator cuts vegetation ranging from grass to 6-inch diameter trees and can reach up to 22 feet horizontally. Masticators leave behind mulch and pieces of shattered wood up to approximately 12 inches long and can require, depending on vegetation, follow-up use of chainsaws by field staff. Use of a masticator is limited by terrain and soil moisture (i.e. soft ground).

Chipping is another method of biomass disposal that uses a chipper to reduce branches and other woody material to chips (usually 1 to 2 inches long and less than an inch thick). 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 renewable diesel equipment. Chipping differs from mulching in two ways: chips are generally larger in size than mulch and are dispersed widely and shallowly with no intent to smother or suppress vegetation. Chips generally should not be piled more than 3 inches deep in most instances, and should not be placed in drainages, grasslands, or against tree trunks. Chips may also be hauled off-site and utilized as ground cover or erosion control in other areas.

Green flaming (propane flaming) is also used during vegetation management area creation to address broom and other invasive non-native species seedlings. Consistent with the IPM methods, specially designed small, hand-held propane torches are used in small areas to kill dense and newly emerged green seedlings. Flaming is usually conducted during light rains or on wet days when forest litter or grassland thatch is not likely to catch fire and additional precautions are implemented at the time of use, including bringing truck-mounted or backpack water tanks, and operating with more than one person on site. It is only appropriate for vegetation with low ignition potential per the IPMP.

Other methods to eliminate cleared biomass using mechanical methods is through pile burning. 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 8 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 at a later date. The composition of piles varies with vegetation type. Piles could consist of chaparral species, broom, as well as hardwoods, conifer limbs, and tanoak resprouts. The total volume of material burned in a year will not exceed 50 tons. Pile burning occurs between November and May under the direction of Midpen staff on days when weather conditions meet the specifications of the Bay Area Air Quality Management District (BAAQMD) permit. Multiple piles may be burned on a single day. Prior to burning, piles are rebuilt to ensure that wildlife have not begun using the piles. Drip torches or other approved ignition devices are used to start pile ignitions.

Chemical

Limited chemical control (herbicide) is used in vegetation treatment for stump and spot spray treatment during creation and maintenance of the VMAs. Broadcast spraying is not allowed under the IPMP nor the VMP. Chemical treatment methods used within VMAs include any method approved under the IPMP (including, but not limited to stump spray and/or spot spray). As shown in Figure 4-1, chemical use in 2018 was 2 percent of the total labor hours for vegetation management. The IPMP notes that typical annual use accounts for 10 percent of labor hours. This percentage may increase slightly given the greater acreages that can be treated under the VMP. Chemical control methods and requirements will follow the IPMP EIR and Addendum (Midpen, 2014; Midpen, 2019b) and Guidance Manual requirements; however, the acreage and amounts of herbicides needed specifically for vegetation system maintenance are covered under the VMP. Invasive species are prioritized for removal over native species on District lands.

Environmental and public protection measures, certification, the requirements to have a Pest Advisor, and other best management practices identified in the IPMP Guidance Manual and EIR are incorporated by reference into the VMP. The IPMP Guidance Manual is included as Appendix C. As BMPs are updated in the IPMP, they will also apply to the VMP.

Use of herbicide in a cut-stump method is used to maintain treatment areas that contain decadent woody vegetation. Trees or large shrubs that require removal within the inner 30 feet of defensible space are likely to be treated by cut-stump method with herbicide to permanently remove them from this high hazard zone. Although brush encroaching into disclines and fuelbreaks will be primarily removed with chainsaws, more stubborn woody plants may require treatment with herbicide by cut-stump method. Spot treatments of vegetation within VMAs with other herbicides, as identified in Table 4-7, may also be used to the limits specified.

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

Prescribed Herbivory

Midpen has employed both sheep and goats on a small-scale experimental basis for weed control purposes with limited success (prescribed herbivory). Prescribed herbivory under the VMP, with sheep, goats, or cattle, or potentially even horses can be used as pre-treatment prior to using other techniques described further above. Prescribed herbivory for pre-treatment may require the installation of temporary fencing and temporary or permanent water facilities and other infrastructure (tanks, corrals, fences etc.) as well as the deployment of guard animals and/or a shepherd.

4.7.3 Vegetation Management Strategies for Creation and Maintenance

Grasslands

Fire fuels treatment (grass mowing) will be used to reduce potential fire spread and increase suppression efficiency in grasslands. Grasses in VMAs will be reduced in height to less than 4 to 6 inches and not cleared to mineral soil to minimize soil erosion. Non-native and/or non-local shrubs and trees, decadent native trees and shrubs (i.e., old plants with a substantial number of dead limbs and twigs), and conifers under 8 inches 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; elsewhere grasses will not be mowed.

Removal of encroaching woody material will typically occur once every 3 to 5 years in fuelbreaks depending on the rate of regrowth. The maintenance of VMAs 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 brushcutters, with the 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. Removed vegetation would remain within Midpen land, but may be trucked out of the area in which the work was conducted in. In some instances, limited dead and or downed material may be left in place as habitat features if it poses little overall fire risk. Herbaceous vegetation is not mowed during the creation of FRAs.

Shrublands (Coastal Scrub, Chaparral)

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). Along property boundaries, shrubs may be completely removed to a width that reduces direct flame contact from adjacent developed properties, to a maximum of 100 feet. 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; this uprooting will be minimized on steep slopes. Disposal of the cut material will be done by chipping, pile burning, or lopping and scattering. 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 VMAs will be based on site-level assessments and implemented to maintain vegetation within the range of desired conditions using previously described tools and techniques.

Oak Woodlands and Mixed Hardwood Forests

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 density of trees and 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 are judged to 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. Cyclical maintenance in woodlands or forests will typically be performed once every 5 years (5 to 10 years or more in FRAs, if needed), though high densities of weeds may necessitate annual maintenance.

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.

Coniferous Forests

In some coniferous areas, mainly in dense Douglas fir and mixed hardwood forests, reducing the fuel load may require thinning of smaller, mid-canopy trees where densities are high. In these cases, the trees will be felled and their branches removed for chipping, hauling, or pile burning. The trunks, if small enough, will be chipped, hauled, or pile burned as well. If trunks cannot be chipped or hauled, they may be left standing and pruned for wildlife habitat or left on the ground. The number of trees to be removed will depend upon the particular location and site characteristics.

Agricultural Landscapes

Mowing and brush thinning will occur along agricultural service roads that could provide ignition sources for adjacent natural areas. Conservation grazing (under the existing Conservation Grazing Program) will continue to be used to reduce fuel loads in grassland areas.

Tree Removal

Individual tree removal may be considered in specific locations to reduce the production of firebrands and spotting during wildland fires and reduce risks to public safety The IPMP allows for 50 to 100 hazard trees to be removed per year. The VMP would allow up to 50 additional trees to be limbed or removed entirely per year for fire hazard reduction. For example, scattered live trees (<10 inches DBH) or SOD-killed trees may be removed at ridgetop locations that are vegetated mainly by grass or chaparral. The removal and disposal of these trees would be conducted as previously described. In some instances, trees may be left in place as a habitat feature until its use by a native species is complete (e.g., wait to fell a tree with a known raptor nest until fledglings have left the nest).

4.7.4 Equipment

Table 4-8 below lists the types of equipment used to implement vegetation management actions. While much of the equipment listed is conservatively showed to be run on gas or renewable diesel, Midpen is incrementally increasing its use of electric equipment to replace as much gas-powered equipment as possible. All of the equipment in Table 4-8 could eventually be electric powered, when suitable equipment and technology is made available.

4.7.5 Access

Access will be entirely from existing roads and trails. No new access roads are included as part of this VMP. In some cases, access to work sites will not be accessible directly from maintained trails and roads and will be achieved by creating skid trails, which include foot trails or using former trails that have grown over and can be cleared for access. Sensitive habitats, creeks, and wetlands will be avoided. Clearing of skid trails will not occur when soils are wet. The skid trails will not be graded or scraped. Skid trails will be rehabilitated following use, which involves de-compacting soils, removing skid lines, distributing surrounding litter/duff back on-site, and obscuring entrance points with brush.

Table 4-8 Typical Equipment Used for Vegetation Management Activities

Vehicle/Equipment Type	Fuel Type [a]
Light duty automobile (car/light truck)	gasoline
Heavy truck	gasoline or renewable diesel
Water truck	renewable diesel
Van/medium truck	gasoline
Wildland Type 3 fire engine	renewable diesel
Wildland Type 4 fire engine	renewable diesel
ATV	gasoline
Chainsaw/brushcutter	gasoline (25:1 or 50:1 with 2-stroke oil) or electric
Leaf blower	gasoline or electric
Chipper	renewable diesel
Skid steer loader [b]	renewable diesel
Backhoe [b]	renewable diesel
Excavator [b]	renewable diesel
Tractor [c]	renewable diesel
Generator	renewable diesel
Driptorch	gasoline and diesel (1:4)
Propane torch	propane

Vehicle/Equipment Type	Fuel Type [a]

Notes:
[a] Any of this equipment could also be electric powered, where available.
[b] May be used with masticator or mower head.
[c] May be used with disc harrow attached.

4.7.6 Personnel

Personnel needed to conduct various vegetation management actions depends upon the project and the year of implementation. The number of workers on any given project will depend upon the activity. Crews of up to 20 people may be required for some project types. Up to 60 workers may be conducting vegetation management activities in a single day, but generally, only a few crews will be operating simultaneously. The amount of vegetation management work that can be completed each year will depend on annual staff capacity, funding, partnerships, and other resource availability and will need to be balanced with other Midpen priorities that further the mission, annual Board-approved Strategic Goals and Objectives, and Vision Plan.

4.7.7 Schedule and Timing for Implementation

Work generally occurs during daylight hours, typically from 7:00 am to 7:00 pm. 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 Midpen's Chief Ranger of Area Superintendent, as detailed in Table 4-9. Scheduling and timing will be dependent on annual staff capacity, funding, partnerships, and other resource availability and will need to be balanced with other Midpen priorities that further the mission, annual Board-approved Strategic Goals and Objectives, and Vision Plan.

Table 4-9 Summary of Timing for Each Treatment Method

Treatment Type	Treatment Method	Timing of Work
Manual and Mechanical	Mowing and Cutting	April through December
	Discing and Cutting	April through July
	Pile Burning	October 31 to Mid-May (wet season)
	Flaming	December through March
	Mowing	April through November
Chemical	Glyphosate Round-up Promax; Clethodim; Aminopyralid; Clopyralid; Imazapyr; Triclopyr BEE/TEA	Spring and Summer
Prescribed Herbivory	Livestock	Year-round

4.8 Best Management Practices Incorporated into the VMP

Midpen has developed BMPs for the IPMP, which apply to the VMP as well. All BMPs apply to this Program and are incorporated here by reference. The most recently updated BMPs will apply to this Program in any given year.

5 Prescribed Fire Plan

5.1 Introduction

Prescribed fire is a land management tool that can be used to:

- Restore fire to the landscape, simulating prior natural processes;
- Reduce unnaturally high accumulations of vegetation;
- Decrease the risk and severity of unwanted wildland fires in the future;
- Lessen the potential loss of life and property;
- Control many undesirable plant species, plant diseases, and pest insects;
- Create and enhance wildlife habitat and increase availability of forage;
- Promote the growth of native trees, wildflowers and other plants; and
- Expose mineral-rich soil and recycle plant nutrients back to the soil.

While Midpen staff would take the lead on defining the location, objectives, goals, and monitoring of the prescribed fire, CAL FIRE or another local fire agency will take the lead role in approving, conducting, and supervising all activities. Typically, designated Midpen staff are trained to provide a discrete supporting role during prescribed burns, such as suppression staff or Resource Advisors.

Prescribed fire activities are implemented in accordance to a pre-written plan (Burn Plan) that identifies land management goals and specific fire use strategies to safely achieve those goals, with prior approval by the applicable regulatory agencies. Burn Plans address characteristics of the land being treated (like topography and vegetation type) and include carefully defined and required parameters to initiate a prescribed fire for temperature, humidity, wind, moisture of the vegetation, and conditions for the dispersal of smoke. The Burn Plans also specify how the fire will be applied, by whom, and what fire control people and equipment must be on-scene before the burn can commence. After the Burn Plan is complete and conditions are right, a prescribed burn can proceed under the supervision of a qualified Burn Boss. Low intensity fire is skillfully applied to selectively burn fuels like dead wood, brush, forest understories, and grassland.

SELECT PRESCRIBED FIRE STAFF

Agency Administrator - Authorizes the prescribed fire and assigns Burn Boss to execute prescribed fire under predefined conditions.

Burn Boss - Ensures that all prescribed fire plan specifications are met before, during, and after a prescribed fire. Supervises all prescribed fire resources and is responsible for the safe and effective implementation of the prescribed fire.

Firing Boss - Leads ground ignition operations and is responsible for the safety and coordination of assigned resources on prescribed fire and wildfire incidents. Reports to the Burn Boss and coordinates with the Holding Specialist.

SELECT PRESCRIBED FIRE STAFF CON'T

Holding Specialist - Supervises all resources that are responsible for ensuring the prescribed fire stays within the burn unit boundaries. Reports to the Burn Boss and coordinates with Firing Boss.

Resource Advisor - Provides professional knowledge and expertise for the protection of natural, cultural, and other resources within an incident environment.

Fire Effects Monitor - Responsible for collecting incident status information and providing this information to the Burn Boss. The information may include fire perimeter location, onsite weather, fire behavior, fuel conditions, smoke, and fire effects information needed to assess firefighter safety and whether the fire is achieving established incident objectives and requirements.

The smoke from a prescribed fire can be a nuisance, but when prescribed fire is planned and executed by fire professionals, smoke impacts can be greatly reduced. Prescribed fire is usually the ideal wildland fuel treatment method. It is very compatible with environmental goals and a cost-effective alternative to more labor intensive and time-consuming methods like mechanical or hand-clearing of vegetation (City of Austin and Travis County, 2014).

Prescribed fire is a powerful tool for Midpen. The Program includes using prescribed fire for habitat enhancement and reduction of fuel loads, particularly in interior areas of OSPs, away from developed roads and infrastructure. This PFP outlines the key elements of how Midpen will utilize prescribed fire as part of the Program. The description presented in the PFP is programmatic in nature and will be updated with additional details into the burn units, methods, locations, and planning prescriptions as they are developed.

5.2 Fire History

5.2.1 Historic and Current Vegetation Management and Fire History

Historic and current vegetation management and fire history are described in Section 4.2.1. Today, in the absence of fire for decades, both live and dead fuels have accumulated creating higher surface fuel loads, vegetation density, and varied species composition from what was seen prior to European contact.

5.2.2 Recent Use of Prescribed Fire

Midpen has utilized prescribed fire as a vegetation management tool in the past, primarily in grasslands. Prescribed burns were conducted for training and ecological purposes at Sierra Azul and Russian Ridge OSPs. These prescribed fires were focused in primarily annual grasslands with relatively well-developed road access and road boundaries. Midpen has not conducted a prescribed burn within the last 10 years.

5.3 Purpose and Need

Periodic fires historically were a part of natural ecological processes on Midpen lands; as a result, many species evolved with fire adaptations and need periodic fire for renewal. Fire opens forests to new generations of younger trees, preserves open grasslands by reducing the spread of encroaching shrubs and/or trees, and stimulates seed germination and shoot growth in chaparral. Without fire, fire-adapted communities are eventually replaced by forest, resulting in a reduction of biodiversity. Fuel in unburned areas can build up to such a high level that when a wildland fire occurs, it can have devastating effects.

Native Americans used fire to shape the natural environment and to clear underbrush and create meadow areas attractive to deer and other animals. Open meadows improved visibility for hunting and encouraged the growth of acorn oaks and other edible plants. Subsequent implementation of fire suppression policies eliminated these benefits, reversing their positive environmental effects.

Impacts of fire suppression continue to reduce biodiversity in Midpen lands. Grasslands and oak woodlands are decreasing in extent due to invading brush and forest species. Stands of coastal scrub and chaparral have aged and are not being renewed. Dense tangles of brush and young trees have largely replaced the park-like understory beneath redwood and Douglas fir forests and mature oak woodlands described by early European explorers.

Changing climatic conditions, past land uses, and years of fire suppression have increased fuel loads and fire-prone conditions that could contribute to larger more intense wildland fires. The primary need for the PFP is to reduce live and dead fuels, particularly in areas where mechanical treatments are not feasible or effective due to access and vegetation type. Secondarily, reintroduction of fire as an ecological process can reduce potential fire risk, thus enhancing public safety, and restore ecological function and resiliency, particularly for fire adapted species.

Prescribed fire helps to restore ecosystems closer to pre-fire suppression conditions through the removal of dead and accumulated vegetation and treatment of forest disease and invasive species. Prior to the mid to late 20th century, landscapes in the San Francisco Bay Area were either managed through natural fire or through Native American practices of prescribed burning that kept fuel loads down. Prior to European contact, the spread of invasive species that alter ecosystems and increases fire risks was also much less of a concern.

The purpose of this PFP is to define the activities that Midpen will implement to reinstate prescribed fire practices on their lands that reduce wildland fire risks, while also preserving and restoring biodiversity and minimizing effects on the environment. This PFP identifies the following:

- Historic regional vegetation and fire regimes;
- History of vegetation management on OSPs and current practices;
- Locations and prioritization of prescribed fire projects;
- Planning process for undertaking prescribed fire projects;
- Methods for creating, implementing, and maintaining prescribed fire projects; and
- Best management and environmental protection measures to use during prescribed fire projects.

This PFP focuses on prescribed fire to reduce fuel loads and restore natural ecological processes in OSPs, away from the WUI and other infrastructure. Another component of the PFP will be the use of cultural burns in coordination with Native American Tribes.

5.4 Prescribed Burn Units

5.4.1 Units

Prescribed fire burn units will generally be of continuous vegetation types. Units are sized to allow a prescribed fire to be implemented in one operational period (typically an 8- to 12-hour shift). Unit boundaries will follow existing infrastructure (roads, trails, and disclines) where feasible and will generally be dominated by one vegetation type (e.g., grasslands, shrublands, oak woodlands). In some cases, multiple vegetation types may be burned within the same unit where fireline construction, topography, vegetation boundaries, and access constrain burning a single vegetation type. Once developed, the burn unit maps will be available in Appendix D.

5.4.2 Prioritization

Prescribed burns will generally be prioritized by vegetation type, fuels reduction value, and potential for implementation. Initial burns may focus first on re-establishing prescribed fire training areas that may be used for interagency training both on live fire and simulated fires, in an effort to improve resource coordination between Midpen and its neighboring local, state, and federal fire agencies who may participate in future burns. Considerations for prioritization will be defined in the future, but may include condition of area in terms of forest health, invasive species, and fuel loads; location and ability to manage the burn; and type of vegetation with consideration for improvement of ecosystem function through prescribed burning.

5.5 Planning Process

Individual prescribed fires will be conducted under an appropriate Burn Plan. The Burn Plan would be prepared under the guidance of the appropriate approving entity, which include CAL FIRE and/or the local county fire department, and will include the BAAQMD. Burn Plans typically specify the burn unit level approach and are prepared by a qualified person. These Burn Plans specify weather parameters for burning, personnel and equipment needed for implementation/mop up/patrol, contingency plans, smoke management, and post burn monitoring. Before burning is allowed, Midpen must complete the following planning steps:

- Register their burn with BAAQMD;
- Obtain a burn permit from BAAQMD and/or the local fire agency;
- Submit a smoke management plan (SMP) to BAAQMD; and
- Obtain BAAQMDs approval of the SMP.

Smoke management is an important component of the planning process. The California Air Resources Board (CARB) has adopted Smoke Management Guidelines, that will be used to create the SMP. The SMP specifies the "smoke prescription," which is an assessment of the air quality, meteorological, and fuel conditions of the proposed burn. Depending on the size and complexity of the burn, the SMP will contain some or all of the following information:

- Burner name and contact information
- Burn method and fuel type
- Nearby population centers
- Planned burn time
- Acceptable burn ignition conditions
- Contingency planning
- Burn monitoring procedures
- Location and size of the burn
- Expected pollutant emissions
- Smoke travel projections – including maps
- Duration of the burn
- Smoke minimization techniques
- Description of alternatives to burning
- Public notification procedures

Midpen may begin making final preparations for CAL FIRE or a local fire agency to carry out a prescribed burn once BAAQMD (and if also required the local fire department) approves the Burn Plan, including the permit and SMP. For a prescribed burn conducted to enhance habitat for California red-legged frog or San Francisco garter snake, Midpen will notify USFWS in accordance with Midpen's Recovery Permit.

Midpen will organize the resources needed to conduct the burn, notifying the public about the planned timing and specifics of the burn, and obtaining final BAAQMD authorization to actually conduct the burn in accordance with the prior approved Burn Plan. Midpen would contact BAAQMD up to 96 hours prior to the desired burn time to obtain a forecast of the meteorology and air quality needed to safely conduct the burn. Midpen would continue to work with BAAQMD and CARB until the day of the burn to update the forecast information.

BAAQMD authorization to conduct a prescribed burn is provided for no more than 24 hours prior to the burn. The individual who is granted the authority to burn (Burn Boss) is responsible for assuring that all conditions in the approved SMP and burn permit are met throughout the burn. Once the fire has been ignited, Midpen and participating firefighting agencies must make all reasonable efforts to assure the burn stays within the approved SMP prescription. If a burn goes out of its prescription, or adverse smoke impacts are observed, the Burn Boss will implement smoke mitigation measures as described in the SMP (CARB, 2019).

5.6 Prescribed Burning

5.6.1 Overview

This section describes how prescribed burns are carried out, including pretreatment; definition of burn units; mop up; and different treatment types, equipment, personnel, and schedules.

5.6.2 Implementation

Planning and Preparation

Creation and Maintenance of Control Lines

Where feasible and effective, existing control lines (also known as firelines) including paved roads, dirt roads, trails, and disclines will be utilized for control lines. These existing lines may be improved by clearing accumulated vegetation on or near the lines; removing dead trees that may fall on, near, or across lines; blacklining; and widening. Blacklining involves pre-burning of fuels adjacent to a control line before igniting a prescribed burn. Blacklining is usually done in heavy fuels adjacent to a control line during periods of low fire danger to reduce heat on holding crews and lessen chances for spotting across control line. In fire suppression, a blackline denotes a condition where there is no unburned material between the fireline and the fire edge. New firelines will be constructed to standards described in the Burn Plan, but typically will be 1-foot to 6-foot wide, depending on location, vegetation type, and type of equipment used to construct the line. Hose lays may be used along firelines at the discretion of the Burn Boss, or as described in the unit-level Burn Plan. Temporary lines may be rehabilitated as needed once the prescribed fire is declared out by the Burn Boss.

Safety Precautions

The unit-level Burn Plan will describe burn unit safety, including potential hazards and mitigations. These precautions can include, but are not limited to, managing individual firefighter safety through proper equipment (including respiration), training, and hydration. Mitigating risks of potential falling live and dead trees or managing vehicle and human traffic within the proximity of the burn will be considered.

Prescribed Burning by Unit

Units will be ignited using approved ignition devices, which can include equipment such as a drip torch or hand-held flare (“fusee”). The Burn Plan will describe the general ignition pattern such as a strip head fire, dot ignition, or other, with discretion given to the burn boss to use the pattern they deem most appropriate given local vegetation and weather conditions.

Mop Up

Mop up is when firefighters extinguish or remove burning material near the control lines. Select snags or trees may need to be taken down because of fire inside their trunk. Logs may need to be trenched to prevent their rolling after an area has burned. Putting out any flames or stirring up a hot spot that is smoking is also done. The work starts as soon as possible along the back or cooler sides of an active fire. Dependent upon multiple factors (i.e., fire behavior, weather forecast), some crew may remain on site for extended periods of time (overnight). Mop up work is generally done all the way around a fire's edge. Mop up will be conducted using hand crews, equipment, hose lays, or other method as described in the unit-level Burn Plan.

Rehabilitation

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 previous cleared lines. This spreads native seed back into the lines to facilitate natural revegetation. It also provides erosion control and discourages the formation of social trails. Because some weed seeds are stimulated by fire or become readily established in post-fire settings, prescribed burn sites will be patrolled by Midpen EDRR crews for 1 to 5 years as needed following a burn event to identify the need for weeding or additional restoration work.

5.6.3 Treatment Types and Methods

Physical Control

The prescribed fire will be controlled using methods and resources described in the unit-level Burn Plan under the direction of the Burn Boss. Control methods can include, but are not limited to, hand crews, fire engines, hose lays, portable pumps, backpack pumps, and hand tools. Aerial support, such as a helicopter with the ability to drop water, on more complex burns may be utilized as well.

Mechanical Pre-Treatment

Burn units may have limited mechanical pre-treatment to improve firelines or operational safety. Treatments may include, but are not limited to mowing, mastication, chipping, falling of snags, and brushing of roads. These treatments will generally follow those described in Chapter 4: Vegetation Management Plan.

Pre-treatment includes:

- Removal of live limbs of trees up to 10 feet above the ground to minimize the potential for fire to spread to the canopy;
- Scattering and/or mastication of accumulated dead and decadent woody brush;
- Top-cutting and on-site scattering of green brush (particularly broom) a minimum of 60 days before the burn event to cure, which facilitates horizontal fire spread during the event and reduces smoke production; and
- Installation of control lines (approximately 1- to 6-foot-wide bands where vegetation has been cleared to expose mineral soil) where natural control lines such as roads, trails, or water bodies are unavailable.

Limbing, scattering, and masticating dead material and top-cutting of green material may occur many months to days prior to the burn event, depending on the larger project goals and site conditions. The work is accomplished with a combination of heavy equipment, power tools, and hand tools. Control line installation occurs within a few weeks or days of the burn event and may be accomplished with heavy equipment or hand tools.

Pile burning may be used to remove cut or dead vegetative material where chipping, hauling, or decomposition are not feasible. Piles can be constructed of vegetative material, covered (to keep dry) and burned when conditions are wet. Pile burning can impact soils directly underneath the pile due to excessive heating. Depending on the surrounding vegetation and under the advice of a Midpen Resource Advisor, the charred remains may be raked out and the site will be allowed to passively revegetate and/or will be directly seeded with native Santa Cruz Mountain plants.

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 at a later date. The composition of piles varies with vegetation type, and could consist of chaparral species, broom, as well as hardwoods and conifer limbs. The total volume of material allowed to be burned in a year will be determined in the future.

Pile burning occurs between November and May under the direction of Midpen staff on days when weather conditions meet the specifications of the BAAQMD permit. Multiple piles may be burned on a single day. Drip torches are used to start ignitions, with fuel use limited to 10 gallons or less per day. Midpen staff remain on-site with fire suppression equipment including a water tender to ensure safety and to extinguish embers by each workday’s end.

Prescribed Burn Types

Ecosystem Restoration Burns

Generally, all prescribed burns will provide ecosystem restoration benefits. In cases where small areas may not passively revegetate, these sites may be seeded with native species, under the advice of a Midpen Resource Advisor.

Cultural Resource Burns

Cultural resource burns may be conducted to protect, restore, or facilitate improved production of or collection of specific plants, trees, or seeds. The use of prescribed burning for cultural resources should be planned and implemented in collaboration with local Tribal Representatives.

Training Burns

Prescribed burns may be used for training by Midpen staff as well as cooperating agencies. Training burns can be conducted without ignitions (i.e., “mock burns”) allowing personnel to coordinate under a unified command, test communications, equipment interoperability, and contingency response prior to conducting live burn activities. Live burn activities can be used to train personnel on wildland fire suppression tactics. Training burns can be done as stand-alone burns or in conjunction with any prescribed burn under the direction of the Burn Boss.

Prescribed Natural Fire
In the case of multiple ignitions, such as multiple lighting fires, Midpen may need to work with an incident management team to prioritize fire suppression activities on Midpen lands. There may be cases where natural resources and fire suppression can benefit from allowing a larger area to burn and utilizing an existing control line (e.g., fuel break or roadway) to suppress and stop the fire. In these cases, there may be an opportunity to have lower priority fires burn for resource benefit so that higher priority fires may be staffed using limited equipment, aircraft, and crews.

5.6.4 Equipment and Personnel

The specific equipment and personnel needed to conduct a burn will be described in the unit-level Burn Plan. General types of equipment would be similar to those listed for the VMP and may include fire engines of different sizes (depending on cooperating agency or contractor equipment), fire hose, hand tools, chainsaws, and approved ignition devices. In some cases, contingency equipment may include a plow, small Bobcat, or bulldozer. Additional aerial equipment may include helicopters of different sizes if needed for implementation or contingency.

5.6.5 Schedule and Timing for Implementation

Midpen anticipates conducting one to two prescribed burns during the first three to five years of the Program. After year five, Midpen may implement as much as three burns a year. Burns will be prioritized based on factors such as location, vegetation type, and complexity, with implementation being dictated by local conditions on the ground. Prescribed burns typically occur from June through November, but other times of year may also be considered. Other considerations could include species protection requirements and permitting restrictions.

5.7 Best Management Practices Incorporated into the Plan

Burn Plans may incorporate additional unit-level BMPs, as needed to address local resource protection or other concerns at the unit level. These BMPs include specific precautionary actions to minimize the potential for erosion following a burn, reduce smoke during a burn, control the burn, and preserve important biological layers that exist at and below the ground surface.

The following prescribed fire BMPs could be included in a Burn Plan (USEPA, 2019):

- Develop and implement a smoke management plan in accordance with current relevant local, CAL FIRE, and BAAQMD guidelines;
- Develop and implement a firing plan that best meets unit-level resource objectives for vegetative cover;
- Utilize existing roads and trails for firebreaks where safe and feasible;
- Build waterbars and stabilize constructed firelines as needed to reduce direct erosion into streams;
- Limit use of mechanical equipment for fireline construction in riparian areas;

- Protect against excessive erosion or sedimentation to the extent practicable;
- Avoid:
  - Using fire-retardant chemicals[3] in riparian zones and over watercourses, and prevent their runoff into watercourses;
  - Applying chemicals in streamside management zones or wetlands;
  - Cleaning application equipment in watercourses or locations that drain into watercourses;
  - Constructing waterbars in firelines that divert surface runoff directly into streams;
- Comply with applicable local, state, and federal regulations regarding the transport, handling, storage, application, and disposal of pesticides, fire retardants, and fertilizers;
- Monitor weather conditions such as rain, wind speed, temperature, and humidity during application to prevent drift, volatilization, and surface water runoff;
- Carefully handle and dispose of oil and fuel for equipment and vehicles. Spills, leaks, empty containers, and filters are potential sources of soil and water contamination if improperly managed; and
- Develop and implement a spill contingency plan identifying all actions to be taken in the event of a chemical spill, including phone numbers for federal, state, and local agencies that must be notified.

[3] Note that fertilizers and fire retardants contain high amounts of both nitrogen and phosphorus. These compounds can accelerate eutrophication (a process whereby water bodies are choked by overabundant plant life and algae due to higher levels of nutrients such as nitrogen and phosphorus).

6 Wildland Fire Pre-Plan/Resource Advisor Maps

6.1 Overview and Background

Wildland Fire Pre-Plans and Resource Advisor Maps are map-based documents that can aid CAL FIRE and other firefighting agencies in their firefighting efforts in the event of a wildland fire. Midpen staff may serve as liaisons or Resource Advisors, working with fire managers during an incident. These plans and maps include the following elements:

- Existing locations for infrastructure, including roads, fuelbreaks, structures, and water sources (hydrants, water tanks, ponds, creeks, and springs);
- Known sensitive natural and cultural resources for fire personnel to avoid if possible, during fire suppression activities;
- Structures that are inhabited or are historically significant that should have resources committed to their defense during a wildland fire;
- Potential locations for fire suppression activities and equipment staging for Midpen lands in the event of a wildland fire;
- Suggested BMPs for wildland fire response and suppression activities.
- Areas where suppression activities should be limited (if feasible); and
- Circulation and emergency access roads, including designated evacuation routes.

The plan presented here also identifies potential BMPs to be implemented during and post fire activity and provides the general guidelines for appropriate rehabilitation measures to address erosion, revegetation, invasive species, trail and road stability, security, public safety, and natural and cultural resources following fires.

6.2 Pre-Plans and Maps

6.2.1 Purpose

The purpose of the Wildland Fire Pre-Plans and Resource Advisor Maps is to provide an appropriately scaled representation of the various access points and resources in all managed lands for use by firefighters and resource managers in the event of a wildland fire. The maps help firefighters better understand the operational environment, including where different types of apparatus can access (e.g., Wildland Type 3 fire engines); potential fire management locations; where firefighting resources are located, such as hydrants, water tanks, and ponds; specific buildings or structures needing protection; and where sensitive resources are located that should be avoided, if possible. Another purpose of the plans and mapping efforts is to identify where additional infrastructure may be needed to support firefighting efforts. The plans will identify critical site-specific information regarding escape routes, including the location of stable bridges, passable roads, gates, and water sources. The pre-plans and maps will identify areas where bulldozer lines could be created that may reduce environmental impacts in the event of an emergency, recognizing that firefighting agencies, in consultation with Midpen as landowner, will need to take the actions they deem necessary to protect human life and property.

6.2.2 Methods for Preparation of Pre-Plans and Maps, Including Outreach Efforts

The process for preparing each pre-plan and map entails both a field mapping effort and an outreach effort to understand the existing resources and resource needs for each OSP and other managed land. Data for each OSP is prepared and stored in GIS format and includes collected field data, as well as digitized data.

Each managed land's pre-plan includes a detailed map over an aerial image of the area, with a legend. The map is accompanied by a short document that describes the roads and trails, the other resources for firefighters, the natural resource protection, the sensitive resources in the managed land, and who maintains the plan. Midpen staff serve as liaisons or Resource Advisors, working with fire managers during an incident.

6.2.3 Schedule for Preparation and Map Management

Tentative Schedule by Managed Land to Prepare Maps

Midpen plans to prepare and complete all maps by 2022. The managed lands covered and the target schedule for preparation is presented below. As each pre-plan and map is prepared, it will be appended to this Program in Appendix E.

Table 6-1 Target Calendar Year of Preparation of Pre-Plans and Maps

Managed Land	Target Field Work Year of Completion	Target Year to Complete Pre-Plans and Maps
Bear Creek Redwoods OSP	2021-2022	2021-2022
Coal Creek OSP	2019	2020
El Corte de Madera Creek OSP	2021-2022	2021-2022
El Sereno OSP	2019	2020
Foothills OSP	2019	2020
Fremont Older OSP	2019	2020
La Honda Creek OSP	2018	2018
Long Ridge OSP	2021-2022	2021-2022
Los Trancos OSP	2019	2020
Miramontes Ridge OSP	2021-2022	2021-2022

Managed Land	Target Field Work Year of Completion	Target Year to Complete Pre-Plans and Maps
Monte Bello OSP	2019	2020
Picchetti Ranch OSP	2019	2020
Pulgas Ridge OSP	2019	2020
Purisima Creek Redwoods OSP	2021-2022	2021-2022
Rancho San Antonio OSP and County Park	2019	2019
Ravenswood OSP	2021-2022	2021-2022
Russian Ridge OSP	2019	2020
Saratoga Gap OSP	2021-2022	2021-2022
Sierra Azul OSP and Easements	2021-2022	2021-2022
Skyline Ridge OSP	2021-2022	2021-2022
St. Joseph's Hill OSP	2021-2022	2021-2022
Stevens Creek Shoreline Nature Study Area	2021-2022	2021-2022
Teague Hill OSP	2021-2022	2021-2022
Thornewood OSP	2020	2020
Tunitas Creek OSP	2021-2022	2021-2022
Windy Hill OSP	2019	2020

Map Management and Frequency of Updates

The pre-plans and maps are maintained by Midpen's GIS staff in digital format. Each plan is also provided to the Midpen staff for each managed area and provided to the local fire department. A copy of all plans is also kept on-site at each field office.

Updates would be performed as needed to ensure the accuracy of the mapping. As additional managed lands or acreages are added and as infrastructure to managed lands is added, maps and the pre-fire plans will be updated.

6.3 Pre-Plan and Resource Advisor Map Template

Each Wildland Fire Pre-Plan includes the following elements:

- **Wildland Fire Management Goal:** "Manage District [Midpen] land to reduce the severity of wildland fire and to reduce the impact of fire suppression activities within District [Midpen] Preserves and adjacent residential areas; manage habitats to support fire as a natural occurrence on the landscape; and promote District

[Midpen] and regional fire management objectives." – Midpen RM Policies, December 2014.

- **Fire Management Planning:** Identifies the purpose of the map and pre-plan, which is primarily focused on fire management and swift response to wildland fire.
  - **Roads and Trails:** Identifies the roads and trails that can be accessed by firefighters and the size of fire engine that can access the roads in the managed land.
  - **Other Resources for Firefighters**
    - **Water Sources:** Includes water tanks, ponds, and pipelines and their capacities.
    - **Potential Fire Management Locations**: Areas where staging can occur.
    - **Landing Zones**: Maintained helicopter landing zones in the managed land.
  - **Natural Resource Protection**
    - **Ponds:** Ponds that may have special-status species that should be avoided, if possible, and surrounding areas for avoidance.
    - **Streams:** Streams that support listed species, such as amphibians or fish that should be avoided, if possible.
    - **Protected Habitat:** Areas with sensitive habitat or habitat that supports a special-status species that should be avoided, if possible.
- **Suggested Best Management Practices During Firefighting Activities:** Describes best management practices that may be applied to protect resources during a fire, but only if practical and feasible. Examples of BMPs are provided in the next section.

6.4 Potential Best Management Practices for Firefighting During Wildland Fire

Firefighting activities have the potential to cause environmental impacts, particularly to soils and water quality. While in an emergency, firefighters must do what is necessary to protect life and property, there may be instances where precautions can be taken to protect the environment and reduce post-fire resource damage due to fire suppression activities. Ultimately the Incident Commander and firefighting staff on scene have the authority to decide how to manage the incident to best protect life and property, and safely contain the fire. Midpen staff may serve as liaisons or Resource Advisors, working with fire managers during an incident. The following are examples of BMPs that Midpen can recommend and encourage firefighters to implement during emergency firefighting activities to reduce environmental damage from firefighting:

- **Discharges Associated with Emergency Firefighting Activities**: To the extent allowed by the circumstances at the scene and without compromising the health and safety of personnel or the public, emergency firefighting activities should be performed in a manner that avoids or minimizes discharges to the stormwater facilities and waterways. BMPs that may be considered during emergency fire-fighting activities include the following: avoid directing firefighting foams and retardant directly on erodible surfaces where runoff will enter receiving waters or stormwater facilities

- **Discharges Associated with Hazardous Materials Spills:** Each fire department operates under a Hazardous Materials Area Plan that describes procedures for the allocation of resources and assigns tasks during hazardous materials emergencies. Fire department and safety personnel are trained to respond to hazardous material spills according to response protocols established for hazardous materials emergencies.
- **Minimizing Drafting of Water from Ponds or Streams with Sensitive Resources:** To protect sensitive amphibian and fish species, if possible, water should not be drafted from facilities that support listed populations. If water must be drawn, it should be done in a way to minimize sedimentation and without drying the facility.
- **Operation of Heavy Equipment:** Heavy equipment (tractors, large trucks, bulldozers, skidders) should be used for fireline construction and other suppression-related activities in a manner that limits disturbance to sensitive habitats, near riparian areas, or open water, where safe and feasible.
- **Staging of Equipment and Storage of Chemicals.** Staging of equipment and supplies, including chemicals, should be in areas that have appropriate buffers of protection from fire, good access, and appropriate drainage, as feasible.
- **Construction of Firelines.** When firelines are required, sensitive habitats as shown in the Resource Advisor Maps, should be avoided. Use natural firebreaks, where possible. Minimize plowing and blading, particularly in sloped areas. Use pre-existing features for fireline (roads, streams, lakes, wetland features, utility rights-of-way) to protect soil and water, and to avoid unnecessary ground disturbance.
- **Mitigating Spread of Weeds**: Provide weed washing stations for vehicles and equipment to limit the introduction and spread of noxious weeds, where possible.

6.5 Post-Fire Rehabilitation Plan Development

If a fire starts within an OSP or other managed land, several measures should be taken once the fire has been contained to reduce environmental impacts, including off-site impacts and to repair infrastructure. A Post-Fire Rehabilitation Plan should be prepared that assesses the potential short- and long-term impacts (and benefits) of a wildland fire and identifies the BMPs to effectively mitigate those impacts. BMPs can be implemented to reduce erosion and water quality impacts, to clean up any residual chemicals or materials from firefighting activities, to potentially remove trees damaged by fire with concurrence of a Midpen biologist, and to rehabilitate the area’s habitat and vegetation, as appropriate.

Examples of potential BMPs that can be included in the Post-Fire Rehabilitation Plan include, but are not limited to (Diagneault, 2014):

- Reclaim and stabilize disturbed areas with vegetation with a focus on stabilization of areas with increased erosion potential or altered drainage patterns from activities, such as fireline construction, and minimize runoff, erosion and sediment delivery to water bodies.
- Install suitable drainage features (wing ditches, broad-based dip, rolling dip, rock berms), as well as sediment traps and sediment basins to promote dispersal of runoff, reduce erosion, and control, collect, or detain stormwater runoff from disturbed or burned areas.
- Mitigate soil compaction from firefighting activities by loosening soils to improve infiltration and promote revegetation.
- Repair and clear debris from water conveyance structures to reduce potential for failures and subsequent erosion.
- Apply groundcover treatments, such as chip or mulch, to promote soil biological activity and stabilize steep or excavated slopes.
- Remove heavily and moderately damaged trees near structures and roads. Remove these trees as soon as possible after a fire to avoid impacts to seedlings and other regenerating vegetation.
- Ensure that any landing areas created to remove dead and/or compromised trees are surrounded by temporary erosion and sediment control practices, such as silt fencing, when conditions may result in soil movement off the site. Maintain erosion control in good working condition.
- Ensure that debris piles and collection areas are at least 200 feet away from water bodies, riparian habitat, and sensitive habitats. Surround debris collection areas with silt fencing to prevent movement of small animals into or runoff of contaminants out of the site.
- Separate man-made debris from woody debris and place man-made debris on a base material that prevents any contaminants or other hazardous materials from penetrating into the soil.
- Dispose of debris in accordance with waste management guidelines and laws.
- Implement infrastructure and structural repairs during the appropriate construction season to avoid impacts to sensitive species such as spotted owl, marbled murrelet, California red-legged frog, San Francisco garter snake, and other species.
- Monitor disturbed areas for potential new noxious weed infestations or existing weed spread.

6.6 Identification, Improvement, and Installation of Infrastructure to Improve Firefighting Capabilities of Local and State Firefighting Agencies

6.6.1 Overview

During the preparation of each Pre-Fire Plan and Resource Advisor Map, and during the subsequent reviews of existing plans and maps, additional infrastructure to improve firefighter response may be identified.

6.6.2 Infrastructure Improvements

Types of New Infrastructure Improvements

Roads and Access

These types of facilities include improvements on existing road rights-of-way or potentially new access roads in areas where adequate access is lacking. Existing access roads may be widened to allow for larger firetrucks, turnarounds created, and road extensions built for improved access. Road surfaces may also be graded, and material placed on the surface, such a composite, to create a safer surface for travel by emergency vehicles.

Water Storage Tanks

Water storage tanks may be built in areas where needed and feasible. Water storage tanks should be sized to store adequate water for firefighting, be accessible, easily connected to the equipment that will use them, and be built using fire-resistant materials. Water tanks may be filled from existing water supply sources, wells, pumps, or water tender trucks, as appropriate for the local conditions. Stored water may be treated to limit growth of mold and algae with tank systems sealed to exclude entry of insects and animals. Water storage tanks may also be filled by trucking in water, where access to water infrastructure is not available.

Water Supply Pipelines, Hydrants, and Pumps

Water supply infrastructure includes underground pipelines that supply water storage tanks or hydrants. All permanent pipelines should be approved for use in fire service systems and designed for the expected water pressures. Where needed, new hydrants on new or existing pipelines may be added as well as permanent or temporary pumping stations to ensure flow from hydrants or pipelines during firefighting activities, where appropriate. Aboveground temporary pipelines or fire hoses may be used to fill water tanks that are not readily accessible by a water tender or water supply lines. Typically, the water would need to be chlorinated or bleached to avoid mold and clogging of pumps.

Staging and Landing Areas

Additional staging/fire management locations and landing areas may be needed in some OSPs or other managed lands. Where possible, these areas should be level, and away from water bodies, sensitive habitats, and riparian corridors. They should be constructed to the size needed for expected staging or landing needs, and the appropriate surface treatment (such as mulch or chip) should be applied. Erosion and drainage control should also be installed as needed.

Planning and Installation of New Infrastructure

The process for planning and installing new infrastructure involves the identification of infrastructure needs, development of detailed design plans, compliance with CEQA, contracting, and implementation. Design plans should include architectural or engineering design drawings and specifications that identify the location, sizing, materials, specifications, and construction methods of the infrastructure. Environmental review may include a Categorical Exemption, or an Initial Study and Mitigated Negative Declaration tiered off the Wildland Fire Resiliency Program EIR. Environmental review will most likely require some additional technical studies for biological and cultural resources. Permits may also be required, depending on the location of the infrastructure. Likewise, monitoring may be required during construction.

6.6.3 Equipment, Personnel, and Schedule

Equipment needed to install new or improved infrastructure could include the following:

- Pickups
- Backhoe/loader
- Bobcat
- Brush hog
- Dump/haul truck
- Water truck
- Tractor-harrow disc
- Concrete truck
- Crane
- Boom truck
- Forklift
- Air compressor
- Portable generators
- Semi-truck with trailer
- Hand tools (shovels, picks)

Workforces and personnel needed will vary by project and likely involve crews of 10 or less members. Additional crew may include biological or cultural resource monitors. The schedule for the work would depend on the jurisdiction within which the work is located and any timing constraints to protect natural resources, such as working outside the nesting season.

7 Monitoring Plan

7.1 Executive Summary of Monitoring Plan

The Monitoring Plan is an important component of the Program. This Monitoring Plan requires monitoring of site conditions before, during, and after treatments or fire events to determine if Program objectives are being met, and if and how vegetation treatment methods should be refined to reach those objectives. Monitoring requirements will vary depending on the activity undertaken and the conditions in the area where the activity is to occur. Monitoring and reporting may also be required as part of the mitigation adopted with the Final EIR for the Program or any permits obtained to perform specific work activities under the Program. Individual monitoring protocols will be determined on a case-by-case basis for each project at the discretion of professional Midpen staff and/or as required by mitigation.

The Monitoring Plan includes the following components and sequencing:

- **Monitoring Scales and Monitoring Parameters**: The Monitoring Plan first describes scales of monitoring and the monitoring parameters that apply to the PFP, the VMP, and post-fire events. Monitoring parameters include biodiversity, habitat, fuel loads, disease presence, invasive species, animal mortality, presence of special-status species, fire intensity and severity, ignitions, water quality, soils, and weather.
- **Methods of Monitoring/Monitoring Protocols**: The Monitoring Plan also describes the monitoring methods for obtaining data to assess the condition of each monitoring parameter. The protocols are based on best practices used by adjacent or regionally based land management agencies (e.g., Federal Geographic Data Committee, National Park Service [NPS], California State Parks) and supported by published research. The protocols address aspects of current condition, trend analysis, and pre-/post-treatment monitoring.
- **Monitoring Prescriptions:** The section describes the objectives for each plan within the Program to be monitored, including identification of the desired conditions as a result of vegetation management treatments, and the monitoring objectives. Monitoring prescriptions are described for each plan or event (e.g., PFP, VMP, post-fire events), the parameters to be monitored, the methods that apply to each monitoring parameter, the monitoring scale, and timing.
- **Reporting and Adaptive Management**: The Monitoring Plan, finally, provides the specifications for reporting and the adaptive management procedures that should be employed to refine future treatments to meet Program objectives, based on

monitoring results. Templates and forms to develop project-specific monitoring implementation plans and conduct annual reporting is provided in Appendix F.

7.2 Scales of Monitoring

7.2.1 Geographic Scales Considered for Monitoring

Monitoring the various indicators described in this Monitoring Plan is possible at multiple scales. The appropriate scale of monitoring should be determined by the information needs. Based on those needs, the geographic scale of monitoring (Section 7.2), the temporal scale of monitoring (Section 7.3), and the indicators to be monitored (Section 7.4) can be defined.

The general geographic scales of monitoring are defined in Table 7-1.

Table 7-1 Geographic Scales of Monitoring for Different Program Elements

Monitoring Unit	Description
By Natural Resource Classifications	
Individual Herbaceous Plants, Trees, Shrubs, Grasses	Individual plants, trees, and grasses that comprise a single organism of a specific taxon down to the species or infraspecific species level (subspecies or variety).
Wildlife Presence and Abundance	Identified down to the species or infraspecific species level (subspecies or variety).
Communities of Herbaceous Plants, Trees, Shrubs, Grasses	A community (or stand) of vegetation that is homogeneous in species composition and structure, and in a uniform habitat (Sawyer et al. 2009). The size of a community will vary by the vegetation type (shrubs, trees, grasses, herbaceous plants).
Animal Population	Usually a population estimate of one or more species to measure abundance pre- and post-treatment(s) and/or to measure if a treatment is having population level impacts (negative or positive).
Natural Vegetation Community	In the context of vegetation science, natural vegetation is defined as vegetation where ecological processes primarily determine species and site characteristics; that is, vegetation comprised of a largely spontaneously growing set of plant species that are shaped by both site and biotic processes (Küchler 1969, Westhoff and van der Maarel 1976). Natural vegetation forms recognizable physiognomic and floristic groupings that can be related to ecological site features (FDGC 2008). The natural vegetation hierarchy consists of eight levels, however, two levels (i.e. Alliance or Association) (FGCD 2008) are the most commonly used classification levels in California for mapping and regulatory purposes.

Monitoring Unit	Description
By Treatment Unit	
Treatment Unit (Planned)	The treatment unit is considered the continuous area contained within exterior boundaries of an intentionally planned and implemented project. This area can include both shaded and non-shaded fuelbreaks, ingress/egress routes, defensible space areas, fuel reduction areas, and other vegetation management actions. For linear features such as disclines, the treatment unit may be considered the disturbed area contained within that discline.
Disturbed Area (Unplanned)	A disturbance is an unplanned (natural) event, which can modify aboveground vegetation, belowground vegetation, soils, human built structures, and potentially topography. Disturbances can include events such as a wildland fire, landslide, flood, and high wind event (leading to windthrow). The disturbed area is considered the area contained within the exterior boundaries of the disturbance event. This area may be continuous for events such as a wildland fire, or discontinuous or patchy, for events such as windthrow. A disturbance may have measurable indirect effects outside of the immediately disturbed area. The geographic scale of monitoring for disturbances is expanded for those indicators that assess areas outside the disturbed area.
By Land Ownership or Jurisdictional Areas	
Individual OSP	An individual OSP includes the land and resources contained within the legal parcel boundaries of that OSP. For the purposes of monitoring, a OSP may be divided into subunits by vegetation type, management type, or other division, with monitoring occurring within that division.
Groups of OSPs	Groups of OSPs may be monitored for specific indicators such as vegetation or aquatic resources that cross adjacent or multiple OSP boundaries.
All OSPs	Monitoring for certain indicators such as vegetation type, vegetation cover, or water quality may occur over all OSPs.
Areas Outside of OSPs	Areas outside of OSPs that may be interest in monitoring include fuel treatments or disturbances on adjacent or nearby, non-Midpen lands or land managed, but not owned by Midpen.
County-Level Monitoring	Monitoring for certain indicators such as vegetation type, vegetation cover, or water quality may occur over entire individual counties or multiple counties as part of larger local and regional monitoring efforts.
By Hydrologic Areas	
Stream (Perennial or Intermittent)	Monitoring for certain indicators over the length of a stream.
Human-Made Watercourse (Irrigation or Drainage Ditch)	Monitoring for certain indicators over the length of an irrigation or drainage ditch.

Monitoring Unit	Description
Hydrologic Unit (HUC-various levels)	Monitoring for certain indicators over an area that identifies a hydrological feature like a river, river reach, lake, drainage basin, or catchment. Hydrologic units of varying types and scales are defined by the United States Geological Survey (https://water.usgs.gov/GIS/huc.html).
Water Body (Lakes or Ponds)	Monitoring for certain indicators in body of water, such as a lake or pond.
Watershed	Monitoring for certain indicators over the area of a watershed.
Other	
Statewide or Other Comparisons	Where available and of interest, conducting monitoring to compare with other local, county, statewide, or reference conditions may be useful to determine quantity or quality of various indicators and/or how they compare with similar indicators measured on other non-Midpen lands.

7.2.2 Temporal Scales Considered for Monitoring

Overview

Lands owned and managed by Midpen are not static. The land has been constantly changing over time under management and cultural influences that span the period of pre-European Contact to the growth of Silicon Valley as a global hub for some of the largest technology companies in existence. Understanding the influence of each of these time periods is important to understanding the conditions on the landscape today, and how these conditions will change in the future. A short summary of each of these time periods and associated vegetation conditions is provided here. This section also identifies the temporal scales of monitoring.

Summary of Historic Conditions in the Region

Understanding the historic condition of various indicators is important in understanding current conditions, trends in conditions, and how those vary from the Historic Range of Variability (HRV) of vegetation cover. For the purposes of this monitoring plan, the periods of history are defined further to align with major changes in human occupation and land use culture occurring prior to the formation of Midpen. The major historical periods include:

- **Pre-Spanish/European Contact Period (Up to 1768):** The first documented exploration of the area by Europeans is in 1769 by Gaspar De Portola, which is assumed to be the first contact between local indigenous persons and Europeans (Portola 1770).
- **Contact through The Mission Era (1769- ~1833):** Father Junipero Sera was documented as traveling with General Portola on his expedition to the region.
- **Post Mission "Ranchero Era" (~1821-1844):** Mexico gained independence from Spain in 1821. Following this independence there was an effort to remove control of the Missions from the Franciscans and distribute land to local indigenous families who lived on those lands. "Although each [indigenous] family was to receive a small allotment from the former mission lands, the few who tried to make

a living from these plots gave up after [a] few years…..Most of the missions' lands were disposed of in large grants to white Californians or recently-arrived, well-connected immigrants from Mexico. In the ten years before the missions were dismantled, the Mexican government had issued only 50 grants for large ranchos. In the dozen years after the missions were secularized, 600 new grants were made.” (Library of Congress 2019). Detailed descriptions of the Mexican ranching industry can be found in Richard Henry Danas’ journal “Two Years Before the Mast” of his experience along the California Coast on a two-year leather trading expedition (Dana 2009).

- **Early United States Exploration and the Gold Rush and Comstock Silver Mining Era (1844-1874):** Early exploration of California followed by the Gold Rush and Comstock Era Silver mining in Nevada brought thousands of people into the San Francisco Bay Area, creating many of the towns that became the major cities seen today.
- **Agricultural/Timber Era (1769 - ~1960s)**: Western agricultural practices arrived with the missions, and the region was an important area for food and timber production into the 20th century. The area was simultaneously growing as a technology hub with the foundation of the Ames Research Center in 1939, followed by major growth during the 1970s with the addition of companies such as Atari, Apple, and Oracle. Today, the region is known less for food production and more for being the home of many established technology companies and startups (Stuart et al. 2017).
- **Midpen Establishment (1972):** Midpen was established in 1972.
- **Since Midpen Acquisition of Individual OSPs (Varies): The** OSPs were acquired at different years. New OSPs may be acquired in the future. As of 2020, Midpen has preserved nearly 65,000 acres on the peninsula.
- **Recent Past Condition (Since 1984):** 1984 is the first year that 30-meter (m) resolution LANDSAT satellite data was available. Using Google Earth Engine (See Section 7.5.1) this imagery can be processed to look at trends in cover by vegetation type from 1984 to the present.

Images that demonstrate the appearance of the landscape through each of these periods is shown in the following graphics in Figure 7-1.

Figure 7-1 Images of the Landscape at Different Historic Time Periods

Pre-Spanish/European Contact Period (Up to 1768)

Depiction of Pruristac, a Ramaytush village in what is now Pacifica in 1769.

Source: Hosa and Yamane 2019

European contact through The Mission Era (1769-~1833) and Post Mission "Ranchero Era" (~1821-1844)

Source: Deppe 1832

Source: Walker 1885

Early United States Exploration and the Gold Rush and Comstock Silver Mining Era (1844-1874)

San Francisco ~1850

Source: Burgess 1878

Agricultural/Timber Era (1769- ~1960s):

Santa Clara Agricultural Landscape

Source: San José Public Library nd.

San Vicente Redwoods near Davenport at the turn of the 20th century.

Source: *Environmental Science Associates 2001*

Temporal Considerations

Temporal considerations used in this Monitoring Plan are described in Table 7-2.

Table 7-2 Temporal Consideration

Time Period	Description
Historic Condition	Describes the condition of the landscape at a particular timeframe in the past.
Current Condition	Describes the condition at the time a baseline monitoring effort is started.
Changes in Condition from Historic to Present or Recent Past to Current	Includes longer term assessments of changes over time.
Changes in Condition Resulting from Planned Treatment	Includes assessments of changes before and/or after treatments, where pre-treatment baseline information is available.
Changes in Condition Resulting from Unplanned Disturbance (fire, landslide, wind throw, mortality)	Includes assessments of changes before and/or after treatments, where pre-disturbance baseline information is available.

7.3 Monitoring Parameters

7.3.1 Overview

This section describes the various monitoring parameters, the indicators that comprise each parameter, why each parameter is important, and the useful input that the parameter provides to assess Program effectiveness and overall ecosystem management and health. Some parameters are specific to certain components of the Program, or specific to a post-fire event. Methods for monitoring these parameters are presented in Section 7.4. The application of each monitoring parameter to each Program component is provided in Section 7.5.

7.3.2 Biodiversity and Wildlife Presence

This monitoring parameter includes wildlife indicator species that can be used to monitor the changes in wildlife presence and overall biodiversity resulting from planned treatments or disturbances, including positive and negative outcomes. The indicators selected for monitoring should be consistent with the scale of the treatment and desired information needs resulting from the monitoring effort.

The key indicator animals for monitoring include woodrats, badgers, avian species, butterfly species, and reptiles and amphibians, which are the most likely species to experience impacts from various vegetation treatments and that can be readily observed either directly or indirectly in the field. Indicator animals should typically be monitored for:

- Species presence and abundance (both pre-, during, and post-treatment);
- Conservation status (understand the need for special permitting or reporting); and

- Species distribution and density.

Monitoring can evaluate presence of the species through middens, droppings, nesting/denning structures, and recording of animal sightings. Existing wildlife camera arrays can also be used to collect this data or can be set up pre- and post-treatment. In some instances, monitoring can be performed through specific surveys, such as for songbirds or woodrats.

This parameter should also include any species of wildlife that begins utilizing an area after treatment or a fire event that may not have been there before or when a whole population has increased after treatments or events.

7.3.3 Wildlife Mortality

This parameter includes identifying any dead wildlife by species and potential cause of mortality, if identifiable, while monitoring areas during Program activities as well as pre- and post-treatments or events. If patterns in mortality emerge for listed species, closer examination and modification of treatment methods will be necessary.

7.3.4 Special-Status Species

Monitoring of special-status species is important by virtue of the fact that these populations are vulnerable. Potential impacts to these species often require additional permitting requirements. Special-status species include:

- Designated (rare, threatened, or endangered) and candidate species for listing by the CDFW.
- Designated (threatened or endangered) and candidate species for listing by the USFWS.
- Species considered to be rare or endangered under the conditions of Section 15380 of the CEQA Guidelines, such as those identified on lists 1A, 1B, and 2 in the 2001 Inventory of Rare and Endangered Plants of California by the CNPS.
- And possibly other species, which are considered sensitive or of special concern due to limited distribution or lack of adequate information to permit listing or rejection for state or federal status, such as those included on list 3 in the CNPS Inventory or identified as animal "California Special Concern" (CSC) species by the CDFW. Species designated as CSC have no legal protective status under the California Endangered Species Act but are of concern to the CDFW.

Special-status species should typically be monitored for:

- Species presence and abundance (both pre-, during, and post-treatment),
- Conservation status (understand the need for special permitting or reporting), and
- Species distribution and density.

Special-status species to be monitored include species such as San Francisco garter snake. Similar to other wildlife, signs and observance of species may be used, but also specific protocol surveys could be conducted, depending on the special-status species to be monitored.

7.3.5 Vegetation and Habitat, and Rare Plants

Monitoring changes in plant cover and diversity is important to understand how treatments or fire events are changing diversity and health of plant populations or of rare plant populations. Some changes may be acceptable. Monitoring can occur through botanical surveys performed before and after treatments or fire events. The indicators described below can be used to monitor the cover, condition, extent, or change in vegetation.

- **Species:** The common name, genus, species, and if applicable sub-species of the herbaceous plant, grass, shrub, or tree(s) being monitored.
- **Conservation Status:** The individual plant taxa as well as certain vegetation communities may have changing conservation status. Individual plant taxa may have been given conservation status by the federal or State Endangered Species Acts, Native Plant Protection Act, by the CNPS, the California Coastal Act, or through various CEQA Guidelines. These taxa may not only be considered rare at a statewide scale, but also locally. The CDFW also assigns conservation status to specific vegetation communities, at the alliance or association level, based on their rarity and endangerment. Midpen also treats specific natural communities as Biologically-Highly Significant.
- **Pyrophytic Plants:** Most often referred to as fire followers, these are early successional plant species that are fire adapted to the point where fire-related effects (smoke, heat, charate, etc.) are required to complete their life cycle. In some vegetation types, fire followers are short-lived on the landscape and often includes species that are considered rare, either locally or statewide. Of the vegetation types in California, fire followers are most often associated with chaparral. Various categories of these species have been defined (i.e., Native Postfire Endemics, Native Postfire Specialists, and Native Postfire Opportunities) (Keeley and Davis 2007). Most often, native plants that meet this criterion are included on county-level locally rare plants lists.

7.3.6 Soils and Erosion

Soils are the substrate for plant growth. Understanding changes to soils can help understand how treatments or fire events may affect vegetation communities and/or create indirect impacts related to erosion. The indicators described below can be used to monitor a range of soil characteristics.

- **Soil Temperature:** The temperature of soil at the surface soil or varying depths of the soil profile.
- **Soil Moisture:** The amount of water stored in the soil. The moisture content can be affected by several variables, including soil type, aspect, slope, vegetative cover, compaction, and disturbance.
- **Compaction (Bulk Density):** Bulk density is an indicator of soil compaction and is the weight of soil in a given volume. Typically, bulk density is reported in units of kilograms per meter cubed (kg/m^3).
- **Sedimentation:** See "Turbidity and Total Suspended Solids" in Section 7.4.4.

- **Infiltration:** The process by which water on the ground surface enters the soil, typically measured in inches per hour or millimeters per hour.

7.3.7 Water-Related Indicators

Impacts to water quality can have effects on plants and animals that populate an area or region. Water quality should also be monitored for the potential to impact human health and safety, and the potential for causing regulatory impairment of waters. It should be noted that some of the water-related indicators listed below may only merit monitoring under certain circumstances.

- **Stream Flow (Hydrology):** Defined as the volume of water moving past a cross-section of a stream over a set time period. Removal of foliage from woody plants and grassland vegetation decreases interception and storage capacity of the watershed along with hydrophobic soils. Reduction in soil permeability can increase runoff and stream flow (Aregai Tecle and Daniel Neary 2015).
- **Water Temperature:** The primary way fire impacts water temperature is via vegetation removal both in the surrounding watershed and in the stream corridor. The exact magnitude of increased water temperature due to fire depends on a multitude of factors, including pre-fire vegetation density, fire intensity and extent, proximity to the water body, volume of water affected, and the degree of mixing with unaffected drainages (Cilimburg, A. C., and K. C. Short 2005).
- **Dissolved Oxygen:** Defined as the amount of oxygen that is present in water. Fire can reduce dissolved oxygen in local drainages in a couple of ways. First, increased nutrients and reduced shade can increase algal blooms, depleting the supply of dissolved oxygen as they decay and are consumed by bacteria. Secondly, the amount of dissolved oxygen may also drop as a result of increased water temperatures as cold water generally holds more oxygen than warm water (as dictated by the laws of thermodynamics).
- **pH:** A measure of the acidity or alkalinity of a solution as determined from the hydrogen ion concentration.
- **Turbidity and Total Suspended Solids:** Turbidity and total suspended solids (TSS) are both used to measure particles suspended in the water column, including organic and inorganic matter. Turbidity uses light scattering as a proxy, while TSS is a direct laboratory measurement of suspended solids. Increased erosion of fine sediments, organic matter, ash, and increased algal blooms following a fire have the potential to increase these values.
- **Metals:** The concentration of total and dissolved metals in solution. The Southern California Coastal Water Research Project (2009) guidance for post-fire water quality monitoring recommends testing of Aluminum (Al), Iron (Fe), Cadmium (Cd), Copper (Cu), Lead (Pb), Manganese (Mn), Nickel (Ni), and Zinc (Zn).
- **Polyaromatic Hydrocarbons:** Organic compounds containing only carbon and hydrogen composed of multiple aromatic rings. Formed by the incomplete combustion of wood and biomass. The Southern California Coastal Water Research

Project (2009) guidance for post-fire water quality monitoring recommends testing for polyaromatic hydrocarbons as part of a successful regional monitoring program.

7.3.8 Fuel Loads

Fuel loads should be monitored to ensure that the desired final conditions of reduced loads are reached from treatments and to better understand growth patterns of fuel loads. The indicators that can be monitored under this parameter include:

- **Status of Vegetation:** Categorize if the individual vegetation specimen being monitored is alive or dead.
- **Surface Fuels:** Includes downed woody material, such as dead twigs, branches, stems, and boles of trees and shrubs that have fallen and lie on or above the ground (Brown et al 1982). These fuels are broken into the categories below and typically reported on a tons per acre basis.
  - ***1-hour fuels:*** very fine fuels (such as needles and leaves) that are easily ignited and burn quickly. Less than 0.25 inch in diameter.
  - ***10-hour fuels:*** larger, less combustible fuels (such as small branches and woody stems). These can readily carry fire when moisture is low. From 0.25 to 1.0 inch in diameter.
  - ***100-hour fuels:*** typically twig and branch material from 1.0 to 3.0 inches in diameter.
  - ***1,000-hour fuels:*** larger limbs and tree boles that are greater than 3.0 inches in diameter and classified as “sound” or “rotten”.
- **Litter:** The top layer of the forest, shrubland, or grassland floor, directly above the duff layer, including freshly fallen leaves, needles, bark flakes, cone scales, fruits (including acorns and cones), dead matted grass and other vegetative parts that are little altered in structure by decomposition. Does not include twigs and larger stems (NPS 2011).
- **Duff:** The fermentation and humus layer of the forest floor material lying below the litter and above mineral soil; consisting of partially decomposed organic matter whose origins can still be visually determined, as well as the fully decomposed humus layer. Does not include the freshly cast material in the litter layer, nor in the postburn environment and ash (NPS 2011).
- **Coarse Woody Debris**: Defined as dead woody debris (limbs, trunks, or stems) detached from the originating trunk or stem. Previous definitions have included material greater than 15 centimeters (cm) in diameter and at least 1 meter in length (Stephens and Moghaddas 2005).
- **Cover**: The area or percent of a fixed area occupied by a vegetation type or species.
- **Height**: The height of an individual tree, shrub, herbaceous plant, or grass.
- **Diameter:** The tree bole diameter at a height of 4.5 feet aboveground; if on a slope, the diameter is measured at 4.5 feet aboveground on the uphill side of the tree. On shrubs, the stem diameter is measured at the stem base.

- **Canopy Cover (Foliar Cover):** The percentage of ground covered by the vertical projection of the outermost perimeter of the natural spread of foliage of plants. Small openings in the canopy are included (Glossary Revision Special Committee 1989).
- **Canopy Closure:** The proportion of the sky hemisphere obscured by vegetation when viewed from a single point.
- **Density:** The number of individuals over a fixed area (per acre, per square meter).
- **Structure (Physiognomy):** For vegetation, (1) the spatial pattern of growth forms in a plant community, especially with regard to their height, abundance, or coverage within the individual layers (Gabriel and Talbot 1984), and (2) the spatial arrangement of the components of vegetation resulting from plant size and height, vertical stratification into layers, and horizontal spacing of plants (Lincoln et al, 1998, Mueller-Dombois and Ellenberg 1974).
- **Age:** The age of an individual or stand in years. Where age cannot be determined by tree rings, it may be estimated by time since past disturbance
- **Above and Belowground Carbon:** The amount of live or dead above and/or belowground carbon in a given area or per acre basis.
- **Presence or Absence by Location(s)**: The presence or absence of a target species within an area, OSP, or other fixed location.

7.3.9 Disease Presence and Invasive Species

The extent and spread of forest diseases and invasive species can greatly impact fuel loads and flammability and have negative impacts on native vegetation and ecosystem health. Monitoring of invasive species and forest disease conditions is important to understand where to focus treatments and to design effective treatments. Disease presence and invasive species parameters should also be monitored to ensure that vegetation treatments are not increasing or exacerbating existing issues or creating new problems.

In conjunction with monitoring as part of the Midpen's Integrated Pest Management Program (IPMP), monitoring of these parameters in areas of vegetation managed under the Program includes:

- Identifying the pest or diseases that are occurring and understanding the life cycle (invasive species) or mode of spread (disease)
- Determining the extent of the problem or infestation
- Evaluating the site conditions and susceptibility to invasive species or forests disease spread

7.3.10 Intensity and Severity of Fire

The indicators described below can be used to assess disturbances such as wildland fire, landslides, or flooding and should also be monitored during prescribed fire to ensure that methods to reduce intensity are effective.

- **Geographic Location and Extent:** The basic geographic location and extent (acres) of a disturbance can be used to determine several potential effects at course scale.
- **Vegetation Burn Severity:** Typically assessed as the percentage of live vegetation or live vegetation canopy cover directly killed by fire.
- **Soil Burn Severity:** The effect of a fire on ground surface characteristics, including char depth, organic matter loss, altered color and structure, and reduced infiltration. The classification of post-fire soil condition is based on fire-induced changes in physical and biological soil properties (Parsons et al. 2010).
- **Frequency:** The number of times a disturbance event happens in a given time period, both in terms of average, historical, and current frequency.

7.3.11 Ignition Sources

Understanding the source and locations of wildland fire ignitions (human, intentional, accidental, or lighting caused) is an important part of mitigating potential future ignitions. This parameter includes identifying and understanding the ignition source and where else on Midpen lands similar ignition sources are found. Understanding these areas of additional risk for wildland fire can help Midpen plan and prioritize fuel treatments that reduce risks. Quality of historical ignition sources can vary but generally human and lighting-caused ignitions since 1970 are available statewide for further analysis.

7.3.12 Weather and Fuel Moisture

The indicators described below can be used to assess weather and fuel moisture typically at multiple time scales (hourly, daily, yearly, point in time). Weather monitoring may be important to better understand when conditions could result in a higher fire threat or when planning post fire erosion control treatments, that may merit taking additional precautions and implementing high fire threat or danger procedures. Weather is also important to monitor during prescribed fires.

- **Temperature**: Air temperature, which can be expressed as a point in time measurement, hourly average, daily average, maximum, or minimum.
- **Relative Humidity:** The amount of water vapor present in air expressed as a percentage of the amount needed for saturation at the same temperature.
- **Windspeed:** The speed of wind at a selected point or over an area. Remote Access Weather Stations typically provide windspeeds at a height of 20 feet averaged over 10 minutes. Windspeeds may also be measured at point in time or lower or higher heights as appropriate.
- **Wind Direction:** The direction the wind is originating from.

- **Precipitation:** The hourly, daily, monthly, or annual amount of fog or rainfall at a given measured point or extrapolated over an area. Precipitation can be reported as a rate (inches/hour) or total.
- **Dead Fuel Moisture:** The moisture content of dead organic fuels, expressed as a percentage of the oven dry weight of the sample, that is controlled entirely by exposure to environmental conditions.
- **Live Fuel Moisture:** Fuel moisture is a measure of the amount of water in a fuel (vegetation) and is expressed as a percent of the dry weight of that specific fuel.

7.4 Methods of Monitoring and Monitoring Protocols

This section describes the methods and protocols that may be applied to monitor the parameters and indicators identified in Section 7.3. These methods and protocols are summarized in Table 7-3. The detailed methods are included in Appendix G. The order of methods described in the table and in Appendix G generally follows the order of the parameters as presented in Section 7.3.

Prior to undertaking any of these protocols, it is essential to first identify the monitoring or research question, the appropriate time and geographic scale(s) for that question, and the indicators that may most efficiently be assessed to provide the desired information. How these monitoring methods are applied to each Program components (e.g., PFP, Vegetation Management Plan, or fire event) is provided in Section 7.5.

Table 7-3 Monitoring Methods and Protocols

Monitoring Parameter		Monitoring Methods and/or Protocols	Sources
Biodiversity and Wildlife Presence	Avian	Point Count	Ralph et al. 1993, Ralph et al 1995, Fancy et al. 2009, Coonan et al. 2011, Coonan and Dye 2016, Hall et al. 2018
		Area Search	Ralph et al. 1993, Loges et al. 2017, Stephens et al. 2010
		Regional Landbird Monitoring	NPS 2018
	Butterfly	Transect Identification	Kadlec et al. 2012
	American Badger	Trapping and radiotelemetry Camera traps and identification	Gould and Harrison 2018, Brehme et al. 2014
	Dusky-footed woodrat	Locating woodrat houses, trapping, and identification	Innes et al. 2007, Sakai and Noon 1993
	Reptile and Amphibians	Time-constrained searches Surveys of coarse woody debris Pitfall trapping	USFS 1990
	Mammals	Trail cameras	--
Wildlife Mortality	--	Mapping using GIS	--
Special-Status Wildlife Species	Numerous	Numerous	CDFW 2018, Kim et al. 2017, USFWS 2005b, Seltenrich and Pool 2002, USFWS 2003, USGS 2006a, USGS 2006b, Gorresen et al. 2008, Weller and Lee 2007, etc.
Vegetation and Habitat, Rare Plants, and Soils	Vegetation and Habitats	Vegetation (Species and Guild) Cover by Plot	Keeley and Davis 2007, Bartosh and Peterson 2014, Corelli and Bartosh 2019, Neubauer 2013, CNPS 2001

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Monitoring Parameter	Monitoring Methods and/or Protocols	Sources
	Relevé Vegetation (Alliances and Associations) Sampling	FDGC 2008, Sawyer et al. 2009, CNPS and CDFW 2019
	Belt Transects for Measuring Fire Severity, Species Richness, and Vegetative (Pyrophtic) Cover	Bartosh and Peterson 2014
Rare Plants and Communities: Rare Annual Plants	Ground or Field-Based Methods	ICF 2012
	Direct Count (Small Area of Occupancy)	--
	Simple Random Coordinate Method (Moderate Sized Area of Occupancy)	Elzinga et al. 1998
	Grid Cell Method (Large Area of Occupancy)	Elzinga et al. 1998
	Remote Sensing Method Using Multispectral Imagery Analysis (Landscape-scale Area of Occupancy)	Nomad 2017
Rare Plants and Communities: Rare Geophyte	Geophyte Population Monitoring	Elzinga et al. 1998
Rare Plants and Communities: Rare Herbaceous Perennial	Rhizomatous Herbaceous Perennial Monitoring	Nomad 2017
	Biennial Monitoring	Elzinga et al. 1998, Nomad 2017
Rare Plants and Communities: Rare Shrub	Aerial Imagery Supported Monitoring	Nomad 2016
	Seedling and Stump Sprout Monitoring	Elzinga et al. 1998

Monitoring Parameter		Monitoring Methods and/or Protocols	Sources
	Rare Plants and Communities: Rare Tree	Seedling and Stump Sprout Monitoring	Elzinga et al. 1998
Soils and Erosion	Hydrology	Stage measurement at gaging stations	Sauer, V.B., and Turnipseed, D.P., 2010
		Discharge measurements at gaging stations	Turnipseed, D.P., and Sauer, V.B., 2010
		V-notch weirs	Rantz, S.E., and others. 1982
		Water Erosion Prediction Project (WEPP)	Elliot et al 2000–2002
		Models	Foltz et al 2009, USDA 2016, Kinoshita et al 2013
	Soil Infiltration	Soil Hydrophobic Conditions	USDA 2016
		Single-ring infiltrometer	Herrick et al. 2005
	Sedimentation	Visual indicators of erosion	Ypsilantis, W.G. 2011
		Erosion bridge	Ypsilantis, W.G. 2011
		Erosion plots	Ypsilantis, W.G. 2011
		Close-range photogrammetry	Ypsilantis, W.G. 2011
		Silt fence catchments	Robichaud, P. R. and R. E. Brown. 2002, Robichaud, P. R. 2005
		Water Erosion Prediction Project (WEPP) Erosion Risk Management Tool (ERMT)	Elliot et al. 2000–2002
		Erosion Risk Management Tool (ERMT)	Robichaud et al. 2006

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Monitoring Parameter		Monitoring Methods and/or Protocols	Sources
	Soil Temperature	Surface and Subsurface Monitoring Using Infrared Thermometer or Soil Thermometer	
	Soil Moisture	Equipment	--
		Soil Moisture Active Passive (SMAP) satellite	--
	Compaction (Bulk Density)	Soil Core Sampler and Weighed	--
		Soil Penetrometer and Statistical Analysis	Moghaddas and Stephens 2008, Moghaddas and Stephens 2007
Water-Related Indicators		Create a water quality sampling plan	OWEB 2000
		Collect water quality data	OWEB 2000, USGS 2019, NRCS 2003 (part 614)
		Post-fire water quality monitoring	SCCWRP 2009
		Data quality, storage, and analysis	OWEB 2000, NRCS 2003 (part 615)
Fuel Loads		Ground-based or Terrestrial LiDAR Systems	-
		Photo Points Monitoring	Hall 2001
	Forest Inventory	Common Stand Exam (CSE) Protocols and Forest Visualization Simulator (FVS)	USDA 2019a, USDA 2019b
	Surface Fuel	Plot-Level Assessments	Brown 1974, Brown and Johnston 1982
	Large Woody Debris	Plot-Level Assessments	Stephens and Moghaddas 2005
	Forest Carbon	--	Climate Action Reserve 2019

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Monitoring Parameter		Monitoring Methods and/or Protocols	Sources
Disease Presence and Invasive Species	Forest Disease	Data Review of Tree Mortality or Aerial Surveys	CAL FIRE 2018
	Invasive and Non-native Species	Early Detection Rapid Response and IPMP	Midpen 2014
Intensity and Severity of Fire	Flame Length	Cameras or Passive Flame Height Sensors	Ryan 1981, Kobziar and Moghaddas 2007
	Fire Detections	Moderate Resolution Imaging Spectroradiometer (MODIS)	NASA 2019
Ignition Sources		Historical Patterns	Keeley and Syphard 2018
		Historical and Recent Ignition Data	FAM 2019
Weather and Fuel Moisture	Weather	Equipment Monitoring	--
		Remote Access Weather Stations (RAWS)	Main et al. 1990, NOAA 2019a
		Windspeeds and Directions	Earth 2019, Windmap 2019
		Fire Danger	USFS 2019b, NOAA 2019b
	Fuel Moistures (Live and Dead)	Field Measurements and Satellite Imagery	USFS 2019a, USFS 2019b, NOAA 2019a

7.5 Monitoring Prescriptions

The following tables provide guidance on how monitoring parameters, and methods and protocols, are applied to each component plan of the Program as follows.

- **Table 7-4. Vegetation Management Plan – Fire Management**: The actions under the Monitoring Plan include vegetation management actions for fire management. These actions include creation and maintenance of shaded and non-shaded fuelbreaks, ingress/egress/evacuation routes, disclines, defensible space, and emergency staging areas and emergency landing zones.
- **Table 7-5. Vegetation Management Plan – Ecosystem Resiliency**: The actions under the Monitoring Plan includes vegetation management and the creation of fuel reduction areas for ecosystem health.
- **Table 7-6. Prescribed Fire Plan:** The Monitoring Plan includes the actions for prescribed fire. Prescribed fire is performed to reduce fuel loads in areas away from roads and structures, and to improve ecosystem health and resiliency.
- **Table 7-7. Unplanned Wildland Fire Event**: The last table is not directly correlated to a plan but describes monitoring actions following an unplanned fire event.

The tables identify how the desired conditions and the monitoring objectives should be established for each relevant monitoring parameter. The monitoring prescriptions include the scales of monitoring, method and protocol to use in monitoring when it should be used, and the timing of monitoring (i.e., before, during, or post activity). It should be noted that additional specific criteria should also be established at the time of monitoring, depending on specific activities and site conditions, and in accordance with the reporting requirements outlined in Section 7.6.

Table 7-4 Vegetation Management Plan – Fire Management Monitoring Prescriptions by Relevant Parameter

Parameter/Indicator	Considerations for Establishing Desired Conditions	Monitoring Objectives	Scale of Monitoring	Method/Protocol	Timing of Monitoring
Wildlife Presence	Creation and maintenance of VMAs will have some effects on the presence and use of the VMAs by wildlife. Woodrats may be more exposed in areas of thinner vegetation and therefore, may not nest as frequently in these areas. Ground nesting birds may experience reduced cover that could affect nesting success. The tolerance for impacts to wildlife should be established based on balancing the benefits of the VMA with potential reduced use of VMA areas by wildlife, including avian species, badgers, and woodrats.	Gather and synthesize data to allow Midpen to better understand if patterns of wildlife use and presence are affected by VMA creation and maintenance.	**Geographic:** Typically, specific to a particular managed area and specific to the treated areas within the managed areas. Monitoring across multiple managed areas and habitats to identify larger patterns would be most beneficial to understand the overall impacts of VMA creation and maintenance on wildlife presence and use of VMAs. **Temporal:** Changes in condition resulting from planned treatments.	**Avian Monitoring** can be implemented periodically or in specific testing areas. **Woodrat Assessments** may also be performed through specific surveys of VMA areas. **Trail Camera Monitoring** to understand different mammalian species' use or migration through treated areas.	Performed on a cyclical and on-going basis.
Wildlife Mortality	Direct wildlife mortality would be avoided through careful use and timing of equipment. Indirect mortality can be tracked through monitoring to determine if adaptive changes need to be made to protect wildlife.	Observe and record any mortality of wildlife during and after treatments and to identify the reason for the mortality.	**Geographic:** At the level of the activity being performed. **Temporal:** Changes in condition resulting from planned treatments.	**Mortality data collection** to understand species killed and how it died.	During and after treatment activity.
Special-Status Wildlife and Plant Species	The tolerance for impacts to special-status wildlife and plant species is low and, generally, impacts should be avoided.	Understand the potential for presence of special-status species prior to performing treatment, ensuring that if any are present, they are not impacted during or after treatments (in accordance with permits or CEQA mitigation).	**Geographic:** At the level of the activity being performed. **Temporal:** Changes in condition resulting from planned treatments.	**Habitat Reconnaissance and in some cases Protocol Surveys** for the special-status species of concern.	Prior to conducting the activity, while the activity is being conducted, and after the activity is completed.
Habitat and Vegetation Types	Changes to vegetation composition will occur from the creation of the various types of VMAs under the Vegetation Management Plan. The desired condition established for each treatment or treatment area to be monitored should minimize loss of diversity of plant species and loss of habitat functions in the larger surrounding areas. Habitat types should remain generally the same and should not transition, except in some cases like for creation of new unshaded fuelbreaks to protect property.	Monitor the surrounding composition of vegetation before and after treatments, and to understand any changes in composition or health as a result of treatments.	**Geographic:** At the level of the activity being performed. **Temporal:** Changes in condition resulting from planned treatments.	**Habitat Reconnaissance Field Surveys and Mapping** to map vegetation community-level changes and specific plant species composition changes. **Remote Sensing, Unmanned Aerial Systems (UAS), and GIS Methods for Monitoring Vegetation Condition, Distribution, and Change,** although use of these techniques would be specific to the smaller scale considerations of habitat impacts from creation of fuelbreaks, defensible space, etc.	Prior to conducting the activity and after it is completed.
Rare Plants	The tolerance for impacts to rare plants is low and, generally, impacts should be avoided.	Understand the potential for presence of rare plants prior to performing treatments, ensuring that if any are present, they are not impacted during or after treatments (in accordance with permits or CEQA mitigation).	**Geographic:** At the level of the activity being performed. **Temporal:** Changes in condition resulting from planned treatments.	**Ground or Field Based Methods for Monitoring Vegetation Condition, Distribution, and Change in Rare Plants**	Prior to conducting the activity, while the activity is being conducted, and after the activity is completed.

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Parameter/Indicator	Considerations for Establishing Desired Conditions	Monitoring Objectives	Scale of Monitoring	Method/Protocol	Timing of Monitoring
Soils and Erosion	The desired conditions should include minimization of soil and erosion impacts through the use of best management practices.	Verify the effectiveness of erosion control measures implemented.	**Geographic:** At the level of the activity being performed. **Temporal:** Changes in condition resulting from planned treatments.	**Sedimentation Monitoring Methods**	Prior to conducting the activity, while the activity is being conducted, and after the activity is completed.
Fuel Loads	The desired conditions will reflect the type of fuelbreak or defensible space created and must reduce fuel loads to meet the specification of the VMA type. Desired conditions may also be established for carbon stock as a result of treatments. Generally, carbon stock losses should be neutral in VMA areas, but may take time to reach such a condition.	Understand the fuel loads before and after treatment to ensure that the specifications of the VMA are achieved and to understand the timeframe for retreatment as fuel loads regrow	**Geographic:** At the level of the activity being performed. Monitoring across multiple managed areas and habitats to identify larger patterns would be most beneficial to understand the overall impacts of VMA creation and maintenance on habitats and vegetation. **Temporal:** Changes in condition resulting from planned treatments.	**Common Stand Exam Protocols** to understand changes at a small scale. **Photo Points** **Browns Methods and CDW Methods** **Forest Carbon Inventory** to understand changes in carbon stock.	Before treatments, after treatments, and on a cyclical and on-going basis to understand trends.
Invasive Species	The desired condition should reflect control, reductions, or removal of invasive species and avoidance of expanded invasive species populations.	Understand where invasive species are found before initiating work to minimize potential for spread. To verify that work completed has not resulted in increases in invasive species over the long-term.	**Geographic:** At the level of the activity being performed if it is forested. Monitoring across multiple managed areas to identify larger patterns would be most beneficial to understand the overall impacts of VMA creation and maintenance on forest disease spread or where forest diseases are spreading. **Temporal:** Changes in condition resulting from planned treatments.	**Habitat Reconnaissance Field Surveys for Invasive Species** **EDRR**	Before treatments and on-going basis to understand if invasive species are spreading.
Forest Disease	The desired conditions should reflect reductions in forest diseases and restoration of diseased areas to resilient tree types.	Understand locations of forest disease to focus treatments to these areas and ensure that activities and treatments are not resulting in the spread of forest diseases.	**Geographic:** At the level of the activity being performed if it is forested. Monitoring across multiple managed areas to identify larger patterns would be most beneficial to understand the overall impacts of VMA creation and maintenance on forest disease spread or where forest diseases are spreading. **Temporal:** Changes in condition resulting from planned treatments.	**Tree mortality maps available via the California Tree Mortality Task Force** **UAV Monitoring of smaller areas (<250 acres)**	Cyclical and on-going basis to understand trends in disease spread at a larger scale.

Table 7-5 Vegetation Management Plan – Ecosystem Resiliency Monitoring Prescriptions by Relevant Parameter

Parameter/Indicator	Considerations for Establishing Desired Conditions	Monitoring Objectives	Scale of Monitoring	Method/Protocol	Timing of Monitoring
Wildlife Presence	Creation and maintenance of FRAs could have some effects on the presence and use of these areas by wildlife, but impacts are expected to be minor. FRAs include reducing fuel loads, but to a lesser degree than is performed to create other types of VMAs.	Gather and synthesize data to allow Midpen to better understand if patterns of wildlife use and presence are affected by FRA creation and maintenance.	**Geographic:** Typically, specific to a particular managed area and specific to the treated areas within the managed areas. Monitoring across multiple managed areas and habitats to identify larger patterns would be most beneficial to understand the overall impacts of FRA creation and maintenance on wildlife presence. **Temporal:** Changes in condition resulting from planned treatments.	**Avian Monitoring** can be implemented periodically or in specific testing areas. **Woodrat Assessments** may also be performed through specific surveys of VMA areas. **Trail Camera Monitoring** to understand different mammalian species' use or migration through treated areas.	Performed on a cyclical and on-going basis.
Wildlife Mortality	Direct wildlife mortality would be avoided through careful use and timing of equipment. Indirect mortality can be tracked through monitoring to determine if adaptive changes need to be made to protect wildlife.	Observe and record any mortality of wildlife during and after treatments and to identify the reason for the mortality.	**Geographic:** At the level of the activity being performed. **Temporal:** Changes in condition resulting from planned treatments.	**Mortality data collection** to understand species killed and how it died.	During and after treatment activity.
Special-Status Wildlife and Plant Species	The tolerance for impacts to special-status wildlife and plant species is low and, generally, impacts should be avoided.	Understand the potential for presence of special-status species prior to performing treatment, ensuring that if any are present, they are not impacted during or after treatments (in accordance with permits or CEQA mitigation).	**Geographic:** At the level of the activity being performed. **Temporal:** Changes in condition resulting from planned treatments.	**Habitat Reconnaissance and in some cases Protocol Surveys** for the special-status species of concern.	Prior to conducting the activity, while the activity is being conducted, and after the activity is completed.
Habitat and Vegetation Types	Changes to broader surrounding vegetation composition are not anticipated with the creation of FRAs. Habitat types should remain generally the same and should not transition.	Monitor the composition of surrounding vegetation before and after treatments, and to understand any changes in composition or health as a result of treatments.	**Geographic:** At the level of the activity being performed. **Temporal:** Changes in condition resulting from planned treatments.	**Habitat Reconnaissance Field Surveys and Mapping** to map vegetation community-level changes and specific plant species composition changes. **Remote Sensing, Unmanned Aerial Systems (UAS), and GIS Methods for Monitoring Vegetation Condition, Distribution, and Change,** although use of these techniques would be specific to the smaller scale considerations of habitat impacts from creation of fuelbreaks, defensible space, etc.	Prior to conducting the activity and after it is completed.
Rare Plants	The tolerance for impacts to rare plants is low and, generally, impacts should be avoided.	Understand the potential for presence of rare plants prior to performing treatments, ensuring that if any are present, they are not impacted during or after treatments (in accordance with permits or CEQA mitigation).	**Geographic:** At the level of the activity being performed. **Temporal:** Changes in condition resulting from planned treatments	**Ground or Field Based Methods for Monitoring Vegetation Condition, Distribution, and Change in Rare Plants**	Prior to conducting the activity, while the activity is being conducted, and after the activity is completed.

Parameter/Indicator	Considerations for Establishing Desired Conditions	Monitoring Objectives	Scale of Monitoring	Method/Protocol	Timing of Monitoring
Fuel Loads	The desired conditions reflect a reduced fuel load, reduced forest disease, and reduced invasive species. Desired conditions may also be established for carbon stock as a result of treatments. Generally, carbon stock losses should be neutral in VMA areas, but may take time to reach such a condition.	Understand the fuel loads before and after treatment to ensure that the specifications of the FRA are achieved and to understand the timeframe for retreatment as fuel loads regrow.	**Geographic:** At the level of the activity being performed. Monitoring across multiple managed areas and habitats to identify larger patterns would be most beneficial to understand the overall impacts of FRA creation and maintenance on habitats and vegetation. **Temporal:** Changes in condition resulting from planned treatments.	**Common Stand Exam Protocols** to understand changes at a small scale. **Photo Points** **Browns Methods and CDW Methods** **Forest Carbon Inventory** to understand changes in carbon stock.	Before treatments, after treatments, and on a cyclical and on-going basis to understand trends.
Invasive Species	The desired condition should reflect control, reductions, or removal of invasive species and avoidance of expanded invasive species populations.	Understand where invasive species are found before initiating work to minimize potential for spread. To verify that work completed has not resulted in increases in invasive species over the long-term.	**Geographic:** At the level of the activity being performed if it is forested. Monitoring across multiple managed areas to identify larger patterns would be most beneficial to understand the overall impacts of FRA creation and maintenance on forest disease spread or where forest diseases are spreading. **Temporal:** Changes in condition resulting from planned treatments.	**Habitat Reconnaissance Field Surveys for Invasive Species** **EDRR**	Before treatments and on-going basis to understand if invasive species are spreading.
Forest Disease	The desired conditions should reflect reductions in forest diseases and restoration of diseased areas to resilient tree types.	Understand locations of forest disease to focus treatments to these areas and ensure that activities and treatments are not resulting in spread of forest diseases.	**Geographic:** At the level of the activity being performed if it is forested. Monitoring across multiple managed areas to identify larger patterns would be most beneficial to understand the overall impacts of VMA creation and maintenance on forest disease spread or where forest diseases are spreading. **Temporal:** Changes in condition resulting from planned treatments.	**Tree mortality maps available via the California Tree Mortality Task Force** **UAV Monitoring of smaller areas (<250 acres)**	On-going basis to understand trends in disease spread at a larger scale.

Table 7-6 Prescribed Fire Plan – Monitoring Prescriptions by Relevant Parameter

Parameter/Indicator	Considerations for Establishing Desired Conditions	Monitoring Objectives	Scale of Monitoring	Method/Protocol	Timing of Monitoring
Wildlife Presence	Prescribed fire could have some effects on the presence and use of these areas by wildlife. Areas subject to prescribed fire are expected to experience some changes in forage and cover, and some changes in usage patterns by wildlife is expected in the short term. Over the long-term usage of these areas by wildlife should increase with improvements in ecosystem health through the use of prescribed fire.	Gather and synthesize data to allow Midpen to better understand if patterns of wildlife use and presence are affected positively or negatively by areas where prescribed fire is used and to understand the duration of impacts.	**Geographic:** Typically, specific to a particular managed area and specific to the treated areas within the managed areas. Monitoring across multiple managed areas and habitats to identify larger patterns would be most beneficial to understand the overall impacts of prescribed fire on wildlife presence. **Temporal:** Changes in condition resulting from planned treatments.	**Avian Monitoring** can be implemented periodically or in specific testing areas. **Woodrat Assessments** may also be performed through specific surveys of treated areas. **Trail Camera Monitoring** to understand different mammalian species' use or migration through treated areas.	Performed on a cyclical and on-going basis.
Wildlife Mortality	Direct wildlife mortality would be avoided through careful use and timing of equipment. Indirect mortality can be tracked through monitoring to determine if adaptive changes need to be made to protect wildlife.	Observe and record any mortality of wildlife during and following prescribed fire treatments and to identify the reason for the mortality.	**Geographic:** At the level of the activity being performed. **Temporal:** Changes in condition resulting from planned treatments.	**Mortality data collection** to understand species killed and how it died.	During treatment activity.
Special-Status Wildlife Species	The tolerance for impacts to special-status wildlife species is low and, generally, impacts should be avoided.	Understand the potential for presence of special-status species prior to performing treatment, ensuring that if any are present, they are not impacted during or after prescribed fire treatments (in accordance with permits or CEQA mitigation).	**Geographic:** At the level of the activity being performed. **Temporal:** Changes in condition resulting from planned treatments.	**Habitat Reconnaissance and in some cases Protocol Surveys** for the special-status species of concern.	Prior to conducting the activity, while the activity is being conducted, and after the activity is completed.
Vegetation and Habitat Types	Changes to vegetation densities are expected from prescribed fire and should be positive over a longer period by reducing invasive species, increasing the health of native species, and supporting the re-emergence of fire-dependent native species and rare plants.	Monitor the composition of vegetation before and after treatments, and to understand any changes in composition or health as a result of prescribed fire.	**Geographic:** At the level of the activity being performed. **Temporal:** Changes in condition resulting from planned treatments	**Habitat Reconnaissance Field Surveys and Mapping** to map vegetation community-level changes and specific plant species composition changes. **Remote Sensing, Unmanned Aerial Systems (UAS), and GIS Methods for Monitoring Vegetation Condition, Distribution, and Change,** for larger-scale areas in particular. **Aerial LiDAR**	Prior to conducting the activity and after it is completed.

Parameter/Indicator	Considerations for Establishing Desired Conditions	Monitoring Objectives	Scale of Monitoring	Method/Protocol	Timing of Monitoring
Rare Plants	Impacts to some rare plants is expected to be positive, but others may have low tolerance for fire and impacts to these species should be avoided.	Understand the potential for presence of rare plants prior to performing a prescribed fire, ensuring that if any are present, they are not impacted during or after treatments (in accordance with permits or CEQA mitigation). Another component of monitoring of rare plants is to understand how prescribed fire may improve populations of fire-following species.	**Geographic:** At the level of the activity being performed. **Temporal:** Changes in condition resulting from planned treatments	**Ground or Field Based Methods for Monitoring Vegetation Condition, Distribution, and Change in Rare Plants**	Prior to conducting the activity, while the activity is being conducted, and after the activity is completed.
Soils and Erosion	The desired conditions should include minimization of soil and erosion impacts from prescribed fire, through the use of best management practices, pre-treatments, and planning.	Verify the effectiveness of erosion control measures implemented and to determine if additional measures need to be taken to reduce erosion.	**Geographic:** At the level of the activity being performed. **Temporal:** Changes in condition resulting from planned treatments	**Sedimentation Monitoring Methods**	Prior to conducting the activity, while the activity is being conducted, and after the activity is completed.
Water Quality	The desired condition is to have minimal impacts on water quality after prescribed fire.	Ensure that downstream waterways are not impacted by prescribed fire, including for various constituents that could impact water quality or public health.	**Geographic:** At the level of the activity being performed. **Temporal:** Changes in condition resulting from planned treatments	**Water Quality Sampling Methods**	Cyclical or on-going basis, only if other indicators suggest impacts to water quality downstream of a prescribed fire has occurred.
Fuel Loads	The desired conditions reflect a reduced fuel load, reduced forest disease, and reduced invasive species. Desired conditions may also be established for an expanded carbon stock as a result of prescribed fire.	Understand the fuel loads before and after treatment to evaluate the effectiveness of the prescribed fire. To understand the treatment interval needed to maintain desired conditions.	**Geographic:** At the level of the activity being performed. Monitoring across multiple managed areas and habitats to identify larger patterns would be most beneficial to understand the overall benefits of prescribed fire. **Temporal:** Changes in condition resulting from planned treatments but potentially also as compared with historic conditions.	**Common Stand Exam Protocols** to understand changes at a small scale. **Photo Points** **Forest Carbon Inventory** to understand changes in carbon stock. **Plot Level Vegetation Monitoring Using Terrestrial LiDAR Systems** **Common Stand Exam Protocols**	Before treatments and on a cyclical and on-going basis to understand fuel loads.

Parameter/Indicator	Considerations for Establishing Desired Conditions	Monitoring Objectives	Scale of Monitoring	Method/Protocol	Timing of Monitoring
Invasive Species	The desired condition should reflect reductions in invasive species through prescribed fire.	Understand where invasive species are found before initiating work to minimize potential for spread. To verify that the prescribed fire has not resulted in increases in invasive species over the long-term.	**Geographic:** At the level of the activity being performed if it is forested. Monitoring across multiple managed areas to identify larger patterns would be most beneficial to understand the overall impacts of prescribed burning on forest disease spread or where forest diseases are spreading. **Temporal:** Changes in condition resulting from planned treatments.	**Habitat Reconnaissance Field Surveys for Invasive Species** **EDRR**	Before treatments and on-going basis to understand if invasive species are spreading.
Forest Disease	The desired conditions should reflect reductions in forest diseases, where possible.	Understand locations of forest disease in general and how disease may be reduced through prescribed fire.	**Geographic:** At the level of the activity being performed if it is forested. Monitoring across multiple OSPs to identify larger patterns would be most beneficial to understand the overall impacts of prescribed fire on forest disease. **Temporal:** Changes in condition resulting from planned treatments.	**Tree mortality maps available via the California Tree Mortality Task Force** **UAV Monitoring of smaller areas (<250 acres)**	Cyclical and on-going basis to understand trends in disease spread at a larger scale.
Intensity and Severity of Fire	The desired condition is a controlled fire with lower intensity. Use of pre-treatments, firelines, and planning should reduce intensity of prescribed fire.	Understand and adapt in the field to prevent a fire from escaping or burning out of control.	**Geographic:** At the level of the activity being performed. **Temporal:** During event.	**Fire Severity can be monitoring using the Relative Differenced Normalized Burn Ratio (RdNBR)** **Fire intensity (flame length) can be measured using stationary cameras, passive flame height sensors, and field observations during wildland fires or prescribed fires**	During treatment activity.
Weather and Fuel Moisture	The desired condition is to only perform a prescribed fire during the appropriate weather conditions	Ensure that weather conditions are appropriate to prevent a fire from escaping or burning out of control.	**Geographic:** At the level of the activity being performed. **Temporal:** During event.	**Point in Time Measures of Weather Indicators** **Fuel Moistures (Live and Dead)** **Remote Access Weather Stations (RAWS)** **Fire Weather Forecast** **Fire Danger and Related Metrics** **Windmap**	Before and during treatment activity.

Table 7-7 Unplanned Wildland Fire Event – Monitoring Prescriptions by Relevant Parameter

Parameter/Indicator	Considerations for Establishing Desired Conditions	Monitoring Objectives	Scale of Monitoring	Method/Protocol	Timing of Monitoring
Wildlife Presence	N/A	Understand how wildlife use burned areas.	**Geographic:** The area of the wildland fire. **Temporal:** Changes in Condition Resulting from Unplanned Disturbance.	**Reconnaissance Surveys for Wildlife** **Trail Camera Monitoring** to understand different mammalian species' use or migration through treated areas.	Cyclical and on-going basis.
Wildlife Mortality	N/A	Identify the extent of wildlife mortality.	**Geographic:** In the area of the wildland fire, if forested. **Temporal:** Changes in Condition Resulting from Unplanned Disturbance.	**Mortality data collection** to understand species/individuals killed.	After the wildland fire event.
Special-Status Wildlife Species	N/A	Understand the degree of impacts to special-status wildlife habitat or individuals.	**Geographic:** The area of the wildland fire. **Temporal:** Changes in Condition Resulting from Unplanned Disturbance.	**Habitat Reconnaissance and in some cases Protocol Surveys** for the special-status species of concern.	After the wildland fire event and potentially on an on-going and cyclical basis as part of recovery efforts.
Habitat and Vegetation Types	N/A	Identify the degree of impacts to habitat and vegetation.	**Geographic:** The area of the wildland fire. **Temporal:** Changes in Condition Resulting from Unplanned Disturbance.	**Habitat Reconnaissance Field Surveys and Mapping** to map vegetation community-level changes and specific plant species composition changes. **Remote Sensing, Unmanned Aerial Systems (UAS), and GIS Methods for Monitoring Vegetation Condition, Distribution, and Change,** for larger-scale areas in particular. **Aerial LiDAR**	After the wildland fire event.
Rare Plants	N/A	Understand how the wildland fire may improve populations of fire-following species.	**Geographic:** The area of the wildland fire. **Temporal:** Changes in Condition Resulting from Unplanned Disturbance.	**Ground or Field Based Methods for Monitoring Vegetation Condition, Distribution, and Change in Rare Plants**	After the wildland fire event and potentially on an on-going and cyclical basis as part of recovery efforts.
Soils and Erosion	To reduce erosion after a wildland fire event, where possible.	Understand the potential cause and extent of erosion, to put in place erosion control measures, if feasible.	**Geographic:** The area of the wildland fire. **Temporal:** Changes in Condition Resulting from Unplanned Disturbance.	**Sedimentation Monitoring Methods**	After the wildland fire event.

Parameter/Indicator	Considerations for Establishing Desired Conditions	Monitoring Objectives	Scale of Monitoring	Method/Protocol	Timing of Monitoring
Water Quality	To reduce impacts on water quality after a wildland fire event, where possible.	Understand impacts on water quality and take actions, as feasible, to reduce any impacts detected.	**Geographic:** The area of the wildland fire. **Temporal:** Changes in Condition Resulting from Unplanned Disturbance.	**Water Quality Sampling Methods**	After the wildland fire event.
Invasive Species	To prevent spread of invasive species after a wildland fire event, where possible.	Monitor recovery in burned areas to ensure that invasive species do not take hold and spread.	**Geographic:** The area of the wildland fire. **Temporal:** Changes in Condition Resulting from Unplanned Disturbance.	**EDRR**	After the wildland fire event.
Forest Disease	N/A	Understand locations of forest disease in general and how disease may spread or reduce as a result of wildland fire.	**Geographic:** The area of wildland fire impact, if forested. **Temporal:** Changes in condition resulting from planned treatments.	**Tree mortality maps available via the California Tree Mortality Task Force** **UAV Monitoring of smaller areas (<250 acres)**	Cyclical and on-going basis to understand trends in disease spread at a larger scale.
Ignition	To reduce the likelihood of a future fire elsewhere form a similar ignition source.	Understand the source of ignition.	**Geographic:** In the area of wildland fire. **Temporal:** N/A	**Investigative Methods**	After the wildland fire event.
Intensity and Severity of Fire	N/A	Understand the extent of impacts from the intensity of the wildland fire.	**Geographic:** In the area of wildland fire. **Temporal:** N/A	**Fire Severity can be monitoring using the Relative Differenced Normalized Burn Ratio (RdNBR)** **Fire intensity (flame length)** can be measured using stationary cameras, passive flame height sensors, and field observations during wildland fires or prescribed fires	After the wildland fire event and on a cyclical and on-going basis to reduce risks of similar ignitions in other areas.
Weather and Fuel Moisture	N/A	Understand how weather affected the fire behavior.	**Geographic:** In the area of wildland fire. **Temporal:** N/A	**Point in Time Measures of Weather Indicators** **Fuel Moistures (Live and Dead)** **Remote Access Weather Stations (RAWS)** **Fire Weather Forecast** **Fire Danger and Related Metrics** **Windmap**	After an event and on an on-going and cyclical basis.

7.6 Reporting and Adaptive Management

7.6.1 Development of Monitoring Plans for Each Project/Activity

This Monitoring Plan identifies the tools needed to create a specific monitoring plan for each project or activity undertaken, as well as to define on-going and cyclical monitoring activities that will help Midpen better understand the wildland fire risks and ecosystem health of the OSPs on a larger scale. Monitoring results will be used to understand the effectiveness of the activities undertaken across multiple parameters and to refine the activities to achieve the desired conditions.

Table 7-4 through Table 7-7 should be utilized to develop an individual monitoring plan for each project or activity. Forms and templates are provided in Appendix F to streamline the process for developing these monitoring plans. The individual monitoring plan should address the species, habitats, methods, and protocols specific to the area where the monitoring is to occur. The monitoring plans should also address the qualifications of the required monitors.

7.6.2 Results Reporting

Reporting will be performed on a project-by-project basis and also in an annual report to the Board of Directors. Individual reports should be prepared after each project or activity is complete. The annual report will be a synthesis of individual monitoring reports over the calendar year, fire event monitoring (if occurred), and reporting on larger-scale, on-going, or cyclical monitoring. Adaptive management recommendations should be made in the annual report. An Annual Report template is provided in Appendix F.

7.6.3 Adaptive Management Based on Monitoring Results

The Monitoring Plan will identify areas where Midpen needs to proactively seek out information. Similarly, Midpen will need to be continually responsive to changes in laws and regulations pertaining to endangered species protections, noxious species quarantines, greenhouse gas emissions, and wildland fire treatments. Midpen also needs to conduct enough monitoring of both its natural resources and the effects of its actions to detect and respond to critical changes, optimize its activities, and ensure that overall goals are being met.

Adaptive management is comprised of the following actions:

- **Monitoring biological stressor indicators.** Recognizing that large-scale changes, such as SOD and global climate change, are occurring, Midpen will study these macro-processes to develop and adopt appropriate long-term management strategies.
- **Monitoring management activities and, if warranted, revise approaches or actions.** Through the reporting described in this Monitoring Plan, each individual activity will include a monitoring component. The results of each monitoring effort will be described. At the individual and annual reporting phase, Midpen staff will

identify whether the activities being undertaken are meeting the overall objectives of the work and will make recommendations to modify methods in the planning of future activities. For example, if monitoring identifies that erosion persists as a result of an activity, the recommendation may be to increase the erosion control efforts and/or to avoid certain areas that have systematically shown erosion problems after certain types of treatments. Another example is if monitoring shows reduced usage of certain treatment areas by woodrats, additional measures may be taken in how the treated areas are maintained or to move woodrat nests in these areas in the future.

- **Continuing to work with surrounding land management agencies and the public to foster education, research, and volunteer efforts**. Midpen has an active volunteer program, and coordinates with many sister agencies and organizations regarding vegetation management and wildland fire risk reduction. Midpen will continue to improve regional ecosystem health and reduce wildland fire risks.
- **Utilizing new methods and technologies that increase efficiency, reduce costs, and reduce impacts on the environment from fuel management activities**. Midpen will adapt the Program over time through adoption of new methods and technologies.

8 Maximum Acreage of Annual Treatment

This chapter identifies the anticipated maximum treatment acres in any one year of Program implementation. Actual annual acreages of fuel treatment projects that are included as part of Midpen's annual capital improvement and action plan will depend on annual staffing capacity, funding availability, partnerships, and other resources and must also consider other priorities and projects that further the mission and the Board's strategic goals and objectives. Table 8-1 shows the maximum acres of treatment per activity that may be performed in any given year. Up to 1,230 acres of new land could be treated in a single year and an additional up to 1,400 acres of previously treated areas could be maintained. This maximum envelope allowed is likely much greater than the amount that will be actually treated, given the circumstances of need, funding, and staffing in any one year.

Midpen will prepare an Annual Work Plan identifying those areas to be created and maintained in each coming year, with consideration for the higher prioritization areas. The objective is to gradually increase annual treatment areas, depending on funding sources and availability of work crews, while minimizing negative impacts to the natural resources. The total areas treated annually will vary based on the aforementioned factors but will not exceed the maximum annual treatment by activity, as indicated in the table, below.

Chapter 7: Monitoring Plan identifies the monitoring and reporting under the Program that would occur to understand the effectiveness of the work. Through the evaluation of work performed in previous years, Midpen will continuously improve methods and approaches over time. If changes to the maximum acreages or methods are needed, an addendum to this Program may be prepared.

Table 8-1 Maximum Annual Treatment Areas

Activity	Tools	Unit	Create New or Maintain Existing	Maximum Annual Treatments
Shaded Fuelbreaks	Manual, mechanical, herbicide, pile burn, prescribed herbivory	Acre	New	50
			Maintain	100
Non-Shaded Fuelbreaks	Mechanical, pile burn, prescribed herbivory	Acre	New	5
			Maintain	80
Evacuation Routes, Critical Infrastructure, Fire Management Logistics Fuelbreaks	Manual, mechanical, herbicide, pile burn, prescribed herbivory	Acre	New	400
			Maintain	400
Target Hazards Fuelbreaks		Acre	New	20

8 MAXIMUM ACREAGES OF ANNUAL TREATMENT

Activity	Tools	Unit	Create New or Maintain Existing	Maximum Annual Treatments
	Manual, mechanical, herbicide, pile burn, prescribed herbivory		Maintain	20
Fire Agency New Recommended Fuelbreaks	Manual, mechanical, herbicide, pile burn, prescribed herbivory	Acre	New	100
			Maintain	N/A
Ingress/Egress Route Fuelbreaks	Mechanical, herbicide, pile burn, prescribed herbivory	Acre	New	25
			Maintain	25
Disclines	Mechanical, herbicide	Acre	New	10
			Maintain	60
Midpen Structures and Facilities Defensible Space	Manual, mechanical, herbicide, pile burn	Acre	New	As needed
			Maintain	175
Emergency Staging Areas, Emergency Landing Zones, and Other Fire Management Logistics Areas	Manual, mechanical	Acre	New	100
			Maintain	30
Eucalyptus and Acacia Removal	Manual, mechanical, herbicide	Acre	New	20
			Maintain	10
Fuel Reduction Areas	Manual, mechanical, herbicide, pile burn, prescribed herbivory	Acre	New	500
			Maintain	500
Total			**New**	**1,230 acres**
			Maintain	**1,400 acres**

Note: Monitoring actions will be determined by Midpen staff annually. Prescribed burning units and maximum burns per year will be defined through development of the PFP.

9 Document Preparation

This section lists those individuals who either prepared or participated in the preparation of this Program.

Table 9-1 Primary Authors

Contributor	Role/Section
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APPENDIX A

Policy Report

Attachment 2

Midpeninsula Regional Open Space District

Wildland Fire Resiliency Program Resource Management Policies Analysis and Recommendations

March 2020

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ENVIRONMENTAL, INC.

Midpeninsula Regional Open Space District

Wildland Fire Resiliency Program

Resource Management Policies Analysis and Recommendations

March 2020

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Attachment 2

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1 Introduction

1.1 Midpeninsula Regional Open Space District's Mission and Lands

Midpeninsula Regional Open Space District ("Midpen" or "District") is a public agency in the San Francisco Bay Area that has preserved a regional greenbelt system of over 63,000 acres of public land and manages 26 open space preserves. Midpen's mission is:

"To acquire and preserve a regional greenbelt of open space land in perpetuity, protect and restore the natural environment, and provide opportunities for ecologically sensitive public enjoyment and education."

While implementing the District's overall mission of open space land preservation, resource management, and low-intensity recreation, the District's mission for the Coastal Annexation Area as defined by the Service Plan is:

"To acquire and preserve in perpetuity open space land and agricultural land of regional significance, protect and restore the natural environment, preserve rural character, encourage viable agricultural use of land resources, and provide opportunities for ecologically sensitive public enjoyment and education."

Midpen's Resource Management Mission Statement is that:

"The District will protect and restore the diversity and integrity of its resources and ecological processes for their value to the environment and to people and will provide for the use of the preserves consistent with resource protection."

1.2 Wildland Fire Resiliency Program Development

Midpen is in the process of preparing a Wildland Fire Resiliency Program ("program"). Wildland fire prevention, preparation, and response are central to Midpen's land stewardship under the District Mission and Resource Management Mission.

The term "resiliency" describes a landscape that can generally resist damage and recover quickly from disturbances such as wildfire, allowing the continuation of the landscapes' function and structure over time, or allowing the landscape to adapt to the new conditions but maintain a healthy ecosystem. The program will allow Midpen to take a comprehensive approach to wildfire management and landscape resiliency by:

- Expanding vegetation management practices to reduce wildfire-related risks;
- Improving pre-wildfire planning

- Incorporating prescribed fire into the land management toolbox to improve ecosystem health, indigenous/traditional management using fire, and reduce fuels;
- Developing monitoring and adaptive management strategies to respond to changes in conditions and technology and responding after wildfire; and
- Fostering and supporting cooperative relationships with neighbors, fire agencies, regional fire safe councils, and other stakeholders on fire prevention, preparedness, and risk mitigation efforts.

1.3 Midpen's Resource Management Policies

Midpen maintains Board of Directors' approved Resource Management Policies (RMPs). The RMPs are policies and practices used by Midpen to protect and manage resources on District lands. Resources covered under the policies include plants, animals, water, soil, terrain, and geologic formations and historic, scenic, and cultural features. The purpose of the RMPs is to:

- Set the framework for Midpen's resource management program;
- Provide general guidance for issue-specific and site-specific planning;
- Provide staff and the Board a tool for informed, consistent, and effective resource management decision making;
- Inform the public of the purpose and intent of Midpen's resource management program; and
- Provide a basis for evaluating Midpen's progress in reaching its resource management objectives.

Resource management plans and programs (such as the Wildland Fire Resiliency Program) are developed based on the guiding principles set forth in the polices and implementing actions. The Wildland Fire Resiliency Program, therefore, will need to be consistent and supported by the RMPs related to wildland fire. Chapter XV of the RMPs document addresses wildland fire management. Part of the process of program development, therefore, includes a review and potential revisions to or expansion of the RMPs to support the program objectives and goals.

1.4 Purpose of this Report

A policy review and analysis has been undertaken by Midpen's consultants, Spatial Informatics Group (SIG) and Panorama Environmental, Inc. (Panorama). The consultants reviewed Midpen's and other agencies' policies related to fire ecology, fire management, prescribed fire, suppression activities, vegetation management and ecosystem resiliency, and post-fire response. The purpose of this report is to present the methods and results of the policy review undertaken by the consultants and to provide their recommendations for revised and additional policies and implementing actions to be adopted by Midpen's Board of Directors in their RMPs document that will support the overarching objectives and goals of Midpen's Wildland Fire Resiliency Program.

2 Policy Review Methods

2.1 Objectives and Components of the Program

The program is being developed by Midpen to document and permit the various planning efforts needed to meet the District's objectives for establishing wildland fire resiliency on their lands. The program will serve as a planning and implementation document that fully describes and integrates the following plans:

- **Vegetation Management Plan (VMP):** Addresses creation and maintenance of fuelbreaks, fuel management zones, and defensible space zones using vegetation management techniques addressed in Midpen's Integrated Pest Management Program
- **Prescribed Fire Plan:** Addresses the methods and implementation of prescribed fire to manage fuel and improve ecosystem health
- **Wildland Fire Pre-Fire Plan:** Provides resource advisory maps for each preserve and identifies the existing conditions and infrastructure and resources constraints needed by emergency personnel in the event of a fire
- **Monitoring Plan:** Establishes the plan to establish pre-project conditions, vegetation treatment response (including prescribed fire), fuels inventories, and adaptive management techniques

The program will guide Midpen's activities over the next decade or more and will be periodically updated, as needed, to adapt it to changing conditions and improved knowledge. The program will also serve as the basis of a Program Environmental Impact Report (EIR) pursuant to the California Environmental Quality Act (CEQA).

The primary objectives of the program are important and must be fully supported by the RMPs. The objectives of the program are as follows:

1. Manage vegetation and infrastructure on District lands to reduce wildfire risks, improve wildfire fighting capabilities and coordination, and improve safety to reduce the harmful effects of wildfire on people, property, and natural resources.
2. Manage vegetation to establish healthy, resilient, fire-adapted ecosystems to further Midpen's mission to protect and restore the diversity and integrity of the ecological processes on District lands and to facilitate post-fire recovery.
3. Provide an adaptive framework for the periodic review and revision of implementation decisions in response to changing climate but also to improved knowledge and improved technology.

2.2 Policy Review Methods

The methodology for the policy review started with a compilation of existing Midpen policies, with a focus on policies related to wildland fire management, vegetation management, forest management, ecological succession, climate change, and scenic and aesthetic resources. The primary focus was on the Board approved RMPs, but other sources were also consulted for guidance or language related to vegetation management and fuels treatment. The following additional sources provide guidance that was considered in this analysis:

- Integrated Pest Management
- Regulations for Use of Midpeninsula Open Space District Lands
- Midpen's Defensible Space Permit Program
- Good Neighbor Policy Brochure
- La Honda Creek Open Space Preserve Master Plan
- Bear Creek Redwoods Preserve Plan
- San Mateo Coastal Annexation Area – Service Plan

Surrounding jurisdictions, the California Department of Forestry and Fire (CAL FIRE), and local fire safe councils have their own policies and practices related to wildland fire management. The policies of these agencies were similarly compiled. The following agencies' policies were included in this analysis:

- CAL FIRE
- San Mateo County Parks and Recreation Commission
- San Mateo County Planning
- Santa Clara County Planning
- State of California Government
- Woodside Fire Protection District
- California Board of Forestry and Fire Protection

Fire safe councils are grassroots community-based organizations that share the objective of making California's communities less vulnerable to catastrophic wildfire. Fire safe councils accomplish this objective through education programs and projects such as shaded fuel breaks or firebreaks to protect area residents against an oncoming wildfire and to provide fire fighters with a place to fight the oncoming fire. The first fire safe councils started in the early 1990s, and there are now over 100 around the state. Local fire safe councils usually include representatives from:

- Fire agencies, including the California Department of Forestry and Fire Protection (CDF or CAL FIRE), the US Forest Service, the Bureau of Land Management, and/or local fire protection districts as appropriate
- Local governments, such as city and/or county
- Businesses, especially insurance
- Other agencies, such as Resource Conservation Districts
- The public

- Tribes

All local fire safe councils are independent entities. Some are organized as non-profit 501(c)(3) corporations; others operate under a memorandum of understanding with a county, city, and/or local fire protection district; some have no formal structure at all. Fire Safe San Mateo County, Santa Clara County Fire Safe Council, and the South Skyline Fire Safe Council are the fire safe councils in the program area. All of these fire safe councils provide for public and private partnerships for education and fuel reduction. The fire safe councils do not operate under specific policies and regulations but, as entities, provide numerous resources for defensible space, homeowners' fire risk reduction, fire codes, fire crews, information on invasive species, shaded fuelbreaks, fire history, chipper programs, and more. Community Wildfire Protection Plans (CWPPs) are also developed under local fire safe councils. The CWPP for San Mateo and Santa Cruz County was published in April 2018 and the Santa Clara County CWPP was published in August 2016. Midpen currently coordinates with the fire safe councils. . Midpen also participated in the development of both CWPPs and was a signatory to the Santa Clara County CWPP.

Neither CWPP includes specific policies, but each summarizes policies and strategies of the entities and agencies within its coverage areas and provides overarching strategies and guidance on many aspects of fuel management and wildfire preparedness that would be relevant to Midpen's program. The considerations of the CWPPs were, therefore, included in this policy analysis.

2.3 Process for Making Recommendations

Recommendations for RMP additions and revisions were made by evaluating the program objectives and general components of the program against existing policies for consistency and compatibility. The policies of other jurisdictions were then evaluated to determine if they were already included in Midpen's policies or if they provide important guidance that should be incorporated into new or existing RMPs for Board adoption. The CWPPs were also evaluated to ensure that existing policies encompass the important tenets of the program.

3 Policy Analysis and Recommendations

3.1 Midpen's Stated Goal for Wildland Fire Management

Wildland fire management is primarily addressed in the Board-approved RMPs in Chapter XV. The stated goal in the RMPs document is to:

"Manage District lands to reduce the severity of wildland fire and to reduce the impact of fire suppression activities within the District Preserves and adjacent residential areas; manage habitats to support fire as a natural occurrence on the landscape; and promote District and regional fire management activities."

The pre-amble to the existing goal in the RMPs document appropriately acknowledges the effects of historic fire suppression, the health and human threats from catastrophic wildland fire, and the need to limit those risks through vegetation management activities that can in turn reduce the severity of wildland fire should it occur. The focus on the wildland–urban interface (WUI) is emphasized, reflecting the social value placed on protection of human assets in closest proximity to wildlands.

The existing goal aligns with the Wildland Fire Resiliency Program and generally encapsulates the concepts of wildfire resiliency that are central to the program although it does not currently use the term "resiliency." The goal could be modified to incorporate Midpen's concept of resiliency, including how to define, quantify, assess, and measure how management actions achieve wildfire resiliency. Specific recommendations are presented in Section 4.

Midpen's goal, additionally, is broad enough to incorporate the program's anticipated tools for managing habitats, for establishing acceptable levels of ecological and social change within the important aspects of the landscape (e.g., water quality, human health, threatened and endangered species, aesthetics, and recreation) and for defining resiliency.

3.2 Consistency of Program Objectives with Existing Policies and Analysis of Gaps

3.2.1 Overview

This section identifies each of the existing RMPs related to the program, including policies from other chapters in addition to Chapter XV: Wildland Fire Management. The table provides an assessment of the compatibility of each policy with the program.

This section then compares the policies to goals to identify any gaps where additional policies may be needed. Policies identified here are only those directly related to wildland fire management approaches. It should be noted that numerous RMPs will need to be considered during the environmental analysis of the program as they pertain to preservation of special status species, cultural resources, water quality, aesthetic value, and others.

3.2.2 Existing RMPs, Compatibility, and Analysis of Policy Gaps

Table 3.1-1 identifies the existing RMPs that relate to wildland fire and their compatibility with the program goals, objectives, and content.

Table 3.2-1 Existing Midpen RMPs Related to Wildland Fire and Program Compatibility

Policy	Summary of Actions Under Policy	Program Compatibility	Gaps in Policy or Actions
Wildfire Management			
Policy Wildfire (WF)-1: Implement necessary fire and fuel management practices to protect public health and safety, protect natural resources, and reduce the impacts of wildland fire	• Prepare wildland fire management plans that address public safety • Identify and maintain emergency access • Identify the need for additional firefighting infrastructure • Work with CAL FIRE and other agencies, organizations, and tribal organizations to implement prescribed burning • Maintain fire clearances • Prohibit activities that have a high risk of sparks • Close preserve areas of particular concern during extreme fire weather • Seek grants and partnerships for fuel management and monitoring	• The Pre-Fire Plans/Resource Advisory Maps component of the program addresses several actions under this policy, including wildland fire management plans, emergency access, and fire clearances. • The Prescribed Fire Plan addresses using prescribed burning in coordination with other agencies. • The VMP addresses maintenance of fire clearances. • The program will allow for application for additional grant funding.	• Actions under policy do not address expansion of fuelbreaks and fuel reduction zones, even though these actions are an integral part of fire and fuel management practices.

Policy	Summary of Actions Under Policy	Program Compatibility	Gaps in Policy or Actions
Policy WF-2: Aggressively support the immediate suppression of all unplanned fires that threaten human life, private property or public safety.	• Respond to fires with fire agencies • Prioritize and prepare preserve-specific wildland fire response plans • Indicate areas identified in the response plans for bulldozer actions to minimize disturbance • Develop guidelines for rehabilitation measures following fires	• The Pre-Fire Plans/Resource Advisory Maps component of the program addresses agency coordination and wildfire response plans and response to suppress dangerous wildfires. •	• Guidelines for rehabilitation belong under a separate policy for wildfire recovery and restoration. • The policy should address strategic locations that limit a fire's spread but may allow for more acreage to burn where it does not threaten human life or private property and how to prioritize suppression.
Policy WF-3: Work with adjacent landowners and fire agencies to maintain adequate fire clearance around qualifying structures.	• Maintain a permit system for homeowners to maintain defensible space • Work with fire agencies and local governments to develop requirements for new development to maintain required fire clearance distance from District land wherever possible. Focus fuel management in areas adjacent to development, essential facilities, emergency routes, essential fuelbreaks, and sensitive biological and cultural areas • Investigate alternative funding • Work with fire agencies to ensure adequate evacuation and locations where community and regional fire protection infrastructure is practical	• The VMP addresses maintenance of fire clearances and fuel management to protect facilities and resources. • The Pre-Fire Plans/Resource Advisory Maps component of the program addresses several actions under this policy including evacuation and regional fire protection infrastructure.	• The action that states where to focus fuel management should clarify that vegetation management should be focused on these areas. • The action should also require that Midpen maintain defensible space around Midpen's own structures • Ensuring evacuations and locations of fire protection should be moved to WF-2

Policy	Summary of Actions Under Policy	Program Compatibility	Gaps in Policy or Actions
Policy WF-4: Manage District vegetation communities to reduce the risk of catastrophic fire and to maintain biological diversity.	• Promote restoration and development of late-seral forest communities • Evaluate potential for reduced fuel loading • Use and expand conservation grazing • Manage forest disease such as Sudden Oak Death (SOD) • Manage scrub, shrub, and chaparral communities to maintain a mosaic of habitats and reduce fuel loads	• The policy and actions are compatible with the Vegetation Management Plan	• This policy does not address the concepts of ecological resiliency and acceptable change from fuels management to maintain habitat functions. Where concepts are covered under the Ecological Succession RMPs, they should be cross-referenced. • The policy actions do not incorporate prescribed fire, which will be important to the establishment of resiliency. • The policy actions do not identify other methods of fuel load reduction, including through thinning in fuel reduction zones.
Policy WF-5: Conduct prescribed burns to re-introduce fire into native ecosystems and maintain natural ecological processes on District lands	• Continue to utilize fire as a resource management tool to reduce fuels and reestablish fire • Continue to utilize prescribed fire to prevent unwanted fire damage • Conduct prescribed burns in an ecologically sound manner to mimic natural fire regimes • Conduct public outreach on prescribed fire	• The policy and actions are addressed in the Prescribed Fire Plan.	• The actions do not address establishment of burn units and prioritization that would be supported by the Prescribed Fire Plan. • The actions should note that fire has been used historically on the landscape as a management tool by Indigenous people, and can be again by the Amah Mutsun Native Stewards in traditional territory and that “natural” encompassed cultural and ecological fire regimes • The actions do not address prescribed fire safety.

Policy	Summary of Actions Under Policy	Program Compatibility	Gaps in Policy or Actions
Policy WF-6: Foster and maintain interagency fire management partnerships	• Annually coordinate fire management with other agencies • Participate in Fire Safe Councils and CWPP • Train with fire agencies • Distribute all available up-to-date maps of fire infrastructure; distribute additional maps as they become available	• The policy and most of the identified actions will be addressed in the Pre-Fire Plans/Resource Advisory Maps component of the program. • The VMP, Monitoring Plan and the Prescribed Fire Plan will address training with fire agencies.	• In the last three years, CWPPs have been published for areas covering Midpen's preserves, and no policies address integration and support of those CWPPs. • The policy should also identify that coordination should also include tribal groups for prescribed fire
Policy WF-7: Conduct research and monitoring to refine fire management practices.	• Monitor pre-project vegetation, soil, erosion, and water quality to establish baseline conditions • Monitor post-fire and vegetation management practices • Monitor consistent with other land management agencies • Foster relationships with institutions and seek grants • Integrate wildland fire management into education programs	• The Monitoring Plan will address these components of the policy's actions.	• This policy does not address the overall concept of adaptive management, nor does it emphasize the decision-making flexibility needed to respond to ecological feedback. • The actions only address monitoring but not evaluation of monitoring results and adaptation of actions. • The policy and actions do not acknowledge the need to incorporate changing technology and knowledge into management methods. • The policy should also state that relationships should be fostered with tribes.

Policy	Summary of Actions Under Policy	Program Compatibility	Gaps in Policy or Actions
Policy WF-8: Wildland Fire management actions on District lands in the Coastside Protection Area will be in accordance with the policies established in the Service Plan for the San Mateo Coastal Annexation Area	• Determine whether construction of dry hydrants is feasible in coordination with County of San Mateo Environmental Services Department • Select native plant materials and/or seed mixes for fire resistance • Locate trails to also allow for emergency access • Develop mutual aid agreements • Consult with fire agencies in developing fuel modifications • Prohibit smoking, firearms, fireworks, and off-road vehicles and limit trail use, picnicking, and camping to designated activities • Develop and maintain staging areas and trailheads in accordance with the wildland fire hazard mitigation measures	• The Pre-Fire Plans/Resource Advisory Maps component of the program can incorporate these requirements.	• None, noting that this policy is intentionally focused on just the Coastside Protection Area and the service plan for that area. Other more fire-prone areas are addressed by the other policies in this section.
Forest Management			
Policy FM-1: Inventory and assess District forest and woodland	• Inventory Midpen forest to assess fuel loads and forest structure related to fire. Identify access issues and Midpen and community/regional fire concerns	• The policy and actions are compatible with the VMP, and access issues will be integrated into the Pre-Fire Plans/Resource Advisory Maps	• None

Policy	Summary of Actions Under Policy	Program Compatibility	Gaps in Policy or Actions
Policy FM-5: Provide necessary fire and fuel management practices to protect forest resources and public health and safety	• Maintain essential roads for emergency fire access and forest management activities undertaken to reduce fire hazard • Maintain adequate fire clearance around Midpen structures and facilities • Encourage neighboring property owners to maintain adequate fire clearance around existing development • Evaluate the potential to reduce forest fuel loading through the removal of smaller trees to reduce forest floor fuel buildup and ladder fuels • Coordinate with fire agencies and local communities to define locations where fire protection infrastructure is practical • Reintroduce fire as a resource management tool to reduce forest floor fuels and reestablish fire for ecosystem health where stand conditions, access, and public safety permit; coordinate with other agencies for planning and implementation • Seek grant opportunities and partnerships for fuel management projects and monitoring	• The policy and all actions are compatible and support all aspects of the program, including through the Pre-Fire Plans/Resource Advisory Maps, VMP, Prescribed Fire Plan, and the Monitoring Plan. • The program will allow for Midpen to seek partnerships and grants for fuels management.	• This policy should define “essential roads” to focus vegetation maintenance activities. • The policy should also identify coordination with tribal entities
Policy FM-6: Protect forest health from intense wildfire, pests, and pathogens with high potential to cause damage.	• Evaluate potential for forest loss to intense wildfire, pests, and pathogens where effective methods are available and justified	• The program is being prepared to address this policy and action.	• None

Policy	Summary of Actions Under Policy	Program Compatibility	Gaps in Policy or Actions
Climate Change			
Policy CC-3: Increase carbon sequestration in vegetation and soils and minimize carbon release from wildfire	• Manage conifer forests to sustain and encourage the development of late-seral habitat conditions. Evaluate the potential to reduce forest fuel loading through the removal of smaller trees to reduce fuel buildup and ladder fuels • Manage vegetation communities to reduce the risk of catastrophic fire and to maintain biological diversity; conduct prescribed burns	• The program is compatible with the policy as its objective is to reduce wildfire.	• The actions should address allowing for trade-offs between carbon sequestration losses from fuel load removal and tree thinning and emissions from prescribed fire, given the overwhelming benefits of reduced risks of catastrophic wildland fire.
Policy CC-4: Prepare for climate change impacts and promote resilience for both natural and built environments.	• Prioritize ecosystem function, resilience, and ecological diversity focused on multiple species benefits rather than aiming to prevent ecological change or return to past conditions • Support ecological functions and ecosystem services that protect the built environment from climate change impacts, such as flooding and increased wildland fire frequency and intensity • Evaluate, study, and implement additional land management strategies to promote ecosystem resilience	• The program is compatible with this policy and fully supports its intent regarding resilience.	• This policy elaborates on the central tenets of ecological resiliency and should also be included or cross-referenced in the Wildland Fire Management policies chapter. • The policy should state that Midpen should establish goals for biodiversity and ecosystem structure and function to identify the types of diversity future conditions can support.

Policy	Summary of Actions Under Policy	Program Compatibility	Gaps in Policy or Actions
Ecological Succession			
Policy ES-3: Facilitate regeneration of disturbance-dependent special status, rare, or unique plants.	• Research, document, and implement site-specific fire prescriptions to improve regeneration of fire-adapted and special status vegetation in fire-dependent ecosystems where feasible. • Develop and implement an alternative management protocol to encourage seedling establishment of special status and disturbance-adapted species in aging stands when regeneration by fire is not feasible	• The program is compatible with this policy through the Prescribed Fire Plan and resiliency.	• This policy should be cross-referenced in the Wildland Fire Management policies chapter.
Scenic and Aesthetic Resources			
Policy SA-2: Maintain significant landscapes or features that were formerly maintained by natural processes.	• Control encroaching vegetation where it adversely affects significant scenic, historic, or habitat resources • Control vegetation to create or maintain important scenic viewpoints and vistas • Require Midpen tenants to maintain landscapes and improvements to acceptable visual standards that do not detract from a visitor's experience or adversely impact wildlife	• The program is generally consistent with this policy since it requires the maintenance of vegetation, particularly through prescribed fire which could mimic former natural processes.	• The actions under this policy do not necessarily allow for habitat changes associated with control of vegetation for fuelbreaks, disc lines, and prescribed burns.

3.3 Guidance from Other Midpen Planning Documents

While not a part of the RMPs, other Midpen documents were reviewed for relevant objectives and approaches that could support the program. Documents reviewed include Midpen's:

- Good Neighbor Policy Brochure
- Defensible Space Permit Program
- Regulations for Use of Midpeninsula Open Space District Lands
- Integrated Pest Management
- La Honda Creek Open Space Preserve Master Plan
- Bear Creek Redwoods Preserve Plan
- FY 2019-20 Strategic Plan Goals and Objectives (Goal 1, Objective 6)

The guidance of these documents is provided in Table 3.4-1.

3.4 Other Jurisdictions' Approaches to Policies Related to Wildland Fire

The next step in the analysis was to identify policies and approaches taken by other agencies to identify if any of the gaps in the RMPs, as identified in Table 3.4-2, are addressed in other policies that Midpen should incorporate. The following table summarizes several different policies and actions of other agencies, including:

- CAL FIRE
- CAL FIRE Resource Conservation District
- San Mateo County Parks and Recreation Commission
- San Mateo County
- Santa Clara County
- State of California
- California Board of Forestry and Fire Protection
- Woodside Fire Protection District

Policies or actions that provide information that would be useful to add to the RMPs are noted in bold and blue highlight. Most helpful were the actions and policies of CAL FIRE's 2018 Strategic Fire Plan.

Table 3.4-1 Summary of Guidance from Other Midpen Planning Documents

Document/Source	Guidance Text	Compatibility with Program and Existing RMPs
Good Neighbor Policy, Policy Provision 13	The District shall develop a Good Neighbor Brochure and shall update it regularly and distribute it to property owners with land adjoining District Preserves. The Brochure shall contain the following information: 1. Emergency contact information for District and other agencies by nature of emergency (fire, flooding, medical, illegal activity, abandoned vehicles, etc.) 2. District contact for resource management (weed abatement, feral animal control, restoration and re-vegetation, etc.) 3. District contact for fire and hazard prevention (fuel management, information regarding fire-safe practices, fallen or hazardous trees, etc.) 4. District contact for conflicts between neighbors and Preserve visitors (trespass, parking, noise, etc.) 5. District contact for general questions regarding use and management of Preserves 6. How to make a suggestion or file a complaint regarding use and management of District Preserves or the District's operation in general (phone, write, e-mail, in person) • Contact information for Ombudsperson • Management and Board of Director contact information • Website mailbox • Office hours and location • Board meeting dates and times 7. Copy of the Good Neighbor Policies	The existing RMPs include provisions for public outreach through WF-3. The program generally supports this policy and the implementing actions.
Good Neighbor Policy Brochures, Fire Safety	Create a 100' clearance around your home, where first 30' is "a lean, clean, and green zone." Remaining 70' is a "reduced fuel zone," where ladder fuels are reduced and horizontal spacing of plants is maintained. Trim trees at least 15' from power lines, and 10' from chimneys. Encourage neighbors to utilize Midpen's defensible space permit program to secure permission to create a 100' clearance around their homes where the 100' is on Midpen lands.	Language should be added to WF-3 for Midpen to maintain defensible space around Midpen's own structures.
Fuels Reduction Permits	Fuels reduction will generally be permitted to extend up to 100 feet from occupied structures Trees up to 6 inches in diameter or shrubs up to 4 inches in diameter may be cut or removed Removal of non-native vegetation shall take priority over removal of native vegetation All vegetative debris must be removed from District property, or chipped and left onsite No burning of material is allowed on District property	RMP WF-3 requires the permit system. The program is compatible with the guidelines of the permit system.
Regulations for Use of Midpeninsula Open Space District Lands, Section 404.1	General. No person shall light, build, maintain, or attempt to light, build, or maintain, a fire of any nature on District Lands, except in permanent fixed barbecues, camp stoves or fireplaces established and authorized by the District. A fire shall include, but not be limited to any campfire, ground fire, warming fire, signal fire, charcoal fire, stove, gas lantern, punk, candle, smudge stick, flare, fusee, or any other incendiary device. This shall not apply to the permitted use of gas camp stoves or gas lanterns when used in Designated Area specified for camping.	The program is compatible with these requirements. The guidance or requirements listed here should be considered when developing the Pre-Fire Plans/Resource Advisory Maps. Policy WF-8 addresses these concerns in the San Mateo Coastal Annexation Area.
Regulations for Use of Midpeninsula Open Space District Lands, Section 404.2	Smoking. No person shall smoke on District Lands, except in Designated Areas.	The program is compatible with these requirements. The guidance or requirements listed here should be considered when developing the Pre-Fire Plans/Resource Advisory Maps.
Regulations for Use of Midpeninsula Open Space District Lands, Section 409.1	Fireworks. No person shall possess, deposit, give, sell, discharge, set off, or cause to be discharged, on or into any portion of District Lands any firecrackers, missiles, rockets, fireworks, explosives, or explosive devices.	The program is compatible with these requirements. The guidance or requirements listed here should be considered when developing the Pre-Fire Plans/Resource Advisory Maps.

Document/Source	Guidance Text	Compatibility with Program and Existing RMPs
Regulations for Use of Midpeninsula Open Space District Lands, Section 801.1	Restrictions. No person shall park a motor vehicle, except an authorized emergency vehicle, or when in compliance with the directions of a peace officer, ranger, or District employee, in any of the following places: a) In areas where prohibited by “NO PARKING,” or other posted signs; b) On or obstructing any fire road or fire lane; c) On or obstructing any trail; d) In such a place or manner as would block or obstruct any gate, entrance, or exit; e) In such a place or manner as to take up more than one marked parking space in any authorized parking area; f) In such a place or manner as to block or obstruct the free flow of traffic or to obstruct the ability to remove a parked vehicle; g) Within 15 feet of a fire hydrant; h) Adjacent to any curb painted red; I) In any other place on District Lands not designated by the District as an authorized area.	The program is compatible with these requirements. The guidance or requirements listed here should be considered when developing the Pre-Fire Plans/Resource Advisory Maps.
Regulations for Use of Midpeninsula Open Space District Lands, Section 805	District employees may make temporary or regular closures of a portion of District Lands to the general public for public safety, or to deal with an immediate or ongoing management need	The program is compatible with these requirements. The guidance or requirements listed here should be considered when developing the Pre-Fire Plans/Resource Advisory Maps.
Integrated Pest Management	Preventive treatment actions include temporary trail closures or adjustment in equipment use during some high fire hazard conditions.	This guidance is supported by the plan. The requirements have been adopted into the IPM RMPs.
Integrated Pest Management	In addition, the following actions may also be considered to prevent vegetation from becoming a fire risk: • Focus fuel management activities in WUI areas adjacent to neighborhood communities, structures, and other at-risk assets. • Work with local fire organizations to amplify results by encouraging neighbors to also manage adjoining properties for fire (reduce fuel loads) within the WUI. • Conduct visitor and neighbor outreach and education about wildfire dangers on and near District preserves. • Eliminate any redundant, unnecessary, or high maintenance roads and trails that are determined to be not necessary on individual District preserves. • Continue to control flammable invasive plants such as French broom in established fuel management areas. • Encourage the establishment of native plant communities (which are more resistant to wildfires than invasive plants such as French broom).	This guidance is supported by the plan. The requirements have been adopted into the IPM RMPs.
Integrated Pest Management	The following management approach is recommended to help promote high diversity natural vegetation communities that are relatively fire safe. • Focus vegetation biomass reduction on non-native vegetation and avoid damaging native grasses, and mature shrublands and forests wherever possible. Where active treatment is needed, seek to break the vertical fuel ladder connection between the ground and the canopy layer, and create some horizontal physical separation between plants where possible. Prioritize projects where invasive plant removal alone can result in fire-safe landscapes. • Implement fuel management projects with low impact tools and methods such as hand cutting and pruning rather than vegetation removal or soil disturbance with hand methods or machines. Although managing woody plant communities can reduce fuel volume, increased disturbance resulting from the active management can counteract the process by promoting the establishment of invasive plants and reducing native plant diversity (Lavin et al. 2013, Keeley 2002). Hand cutting and pruning is not feasible on a large scale because it takes too long across large areas and can result in injuries to staff doing this kind of work over extended periods of time. • Prioritize leaving forest duff and organic soil layers undisturbed in all fuel management actions. • Avoid removing/thinning the canopy layer in mature, established forests and woodlands to maximize shading (thereby promoting shade and related increased moisture under the canopy level) and increase resistance to non-native plant invasion.	This guidance is supported by the plan. The requirements have been adopted into the IPM RMPs.
Integrated Pest Management - Grasslands	Annual mowing in summer to reduce fuel loads, especially near likely ignition sources (trails, roads, recreational facilities, and parking lots)	This guidance is compatible with and will be covered in the program. It supports WF-1.

Document/Source	Guidance Text	Compatibility with Program and Existing RMPs
Integrated Pest Management - Shrublands	Thin brush and mow tall grasses to reduce fuel loads and break fuel ladders. In shrublands, increase spacing between shrub clusters.	This guidance is compatible with and will be covered in the program. It supports WF-1.
Integrated Pest Management - Forests	Limb up trees to a height of 8 to10 feet, thin brush, and mow tall grasses to reduce fuel loads and break fuel ladders.	This guidance is compatible with and will be covered in the program. It supports WF-1.
Integrated Pest Management – Agricultural Landscapes	Mowing and brush thinning along roads that could provide ignition sources for adjacent natural areas. Discing along borders of agricultural and rangeland properties to ensure fires do not spread beyond different management units. Conservation grazing reduces fuel loads.	This guidance is compatible with and will be covered in the program. Several RMPs address grazing.
La Honda Creek Open Space Preserve Master Plan – Goal MO-1	Goal MO-2: Reduce fire risk Obj MO-2.1: Implement practices to manage wildland fuels and reduce fire hazards Obj MO-2.2: Protect and manage natural resources by modifying vegetation/fuel Obj MO-2.3: Facilitate wildland fire response and suppression Obj MO-2.4: Prepare a Wildland Fire Response Plan	These objectives are integrated into the program.
La Honda Creek Open Space Preserve Master Plan – Ignition Reduction	Roadsides are the most common ignition sites in California; approximately 80 percent of all wildfire ignitions occur within 10 feet of a road. The California Department of Transportation (CalTrans) is the primary agency responsible for maintenance of Highways 84 and 35, including roadside vegetation management. The District will continue to facilitate CalTrans' efforts to manage vegetation along the stretch of highway that fronts the Preserve. The District will also manage vegetation at other high-risk ignition locations within the interior of the Preserve, such as parking areas, to bolster fire prevention.	This requirement will be integrated into the program. Policy WF-1 could be bolstered to specifically address roadside ignitions, quicker response to roadside ignitions, and maintenance and coordination with CalTrans.
La Honda Creek Open Space Preserve Master Plan – Trail Closures During Red Flag Days	In accordance with the Coastside Protection Area Service Plan, trail access points within the Coastside Protection Area shall be closed on predicted high fire response level days (red flag days) to reduce fire hazards.	This requirement will be integrated into the Program. It is supported by WF-8.
La Honda Creek Open Space Preserve Master Plan – Brush Encroachment Reduction	the District intends to continue and expand conservation grazing throughout the larger grasslands in the Preserve and employ other vegetation management practices. This action will not only preserve grassland habitat, but also control brush encroachment into grassland areas and reduce fuel loads. .... The District will also aim to limit the encroachment of coyote brush into grassland areas along forested edges to reduce ladder fuels at the transition between grasslands and forest.	WF-4 addresses conservation grazing. Grazing will be included in the program.
La Honda Creek Open Space Preserve Master Plan – Emergency Vehicle Access	Fuels will be maintained to reduce flame length to 2 feet along fire response roads in the following areas: • Within 10 feet of the road edge where flames are predicted to be 0-8 feet in length (generally grassy locations and in oak woodlands) • Within 30 feet of the road edge where flames are predicted to be over 8 feet in length (generally brushy locations and where understory shrubs are developed in woodlands)	Recommendations for fuel maintenance around emergency access and roads are compatible with the program and will be incorporated. RMPs generally address fuel maintenance in defensible space, but a focus on emergency access roads could be added.
Bear Creek Redwood Preserve Plan – General Vegetation-Related Provisions	Management of invasive species following the Bear Creek Redwoods Integrated Pest Management Plan to address noxious weeds and restoration. Manage Sudden Oak Death (SOD)by tracking diseased trees as budget permits, sharing data with the California Oak Mortality Task Force, removing California by trees or their branches within 15 feet of the trunks of high value oaks, and spot treating mature oaks of value with pest control sprays.	These actions are integrated into the program and covered under other existing Midpen programs.

Document/Source	Guidance Text	Compatibility with Program and Existing RMPs
Bear Creek Redwood Preserve Plan – Fire and Fuels Management	Standard District fire management practices will continue to be implemented at the Preserve. These standard practices include maintenance of defensible space within 100 feet of structures, working cooperatively with CAL FIRE to maintain fuelbreaks, vegetation management in high ignition risk areas (such as roadsides and parking areas), conducting regular staff training in fire response, and maintaining emergency access roads, turnarounds, and landing zones. If a fire occurs on or is threatening District lands, District staff helps establish Incident Command if first on scene, evacuates or closes the Preserves for visitor safety, performs initial attack when safe and effective to do so, provides logistical assistance given staff knowledge of the property, monitors and attacks spot fires, and supplies additional water for primary agency engines. Specific projects to reduce fire risk will also be implemented. As part of the Bear Creek Stables new long-term lease, the District will work with the tenant to develop a Fire Management and Emergency Evacuation and Protection Plan. At a minimum it will address maintenance of defensible space, procedure for evacuating horses when a wildland fire is threatening the area, as well as procedures for protecting horses in a situation when time does not permit evacuation. The plan also will address measures necessary to protect individuals attempting to help evacuate and/or protect horses from fire. Water tanks will be appropriately sized and located according Santa Clara County standards to provide water sources for fire suppression.	These actions will be integrated into the program and applied to other preserves, where relevant. Existing policies generally support these actions, including WF-1.

Table 3.4-2 Analysis of Policies of Other Jurisdictions

Agency	Policy Name	Policy Text	Policies Source	Addressed by Existing Midpen Policy?	Which Policy	Recommended Added?	Notes
CAL FIRE	Recommendation #1	Work with other public agencies, landowners, and the communities themselves to implement these projects ASAP.	Community Wildfire Prevention and Mitigation Report (CWPMR)	Yes	FM-5; WF-1	N/A	
CAL FIRE	**Recommendation #2**	**Authorize incident response to implement rapid treatment of fuels**	**Community Wildfire Prevention and Mitigation Report (CWPMR)**	**No**	**N/A**	**Yes**	**This policy could be incorporated into a post-fire response policy.**
CAL FIRE	**Recommendation #4**	**Suspend regulatory requirements as necessary to protect public safety through the priority fuels reduction projects identified by CAL FIRE in this report**	**Community Wildfire Prevention and Mitigation Report (CWPMR)**	**No**	**N/A**	**Yes**	**This policy is not specific to Midpen; however, Midpen's support of these projects where they overlap Midpen lands, and CAL FIRE process could be identified.**
CAL FIRE	Recommendation #6	Align community education campaigns across all state and local entities	Community Wildfire Prevention and Mitigation Report (CWPMR)	Yes	Good Neighbor Policy Brochure	N/A	
CAL FIRE	Recommendation #8	Identify options for retrofitting homes to new Wildland Urban Interface standards.	Community Wildfire Prevention and Mitigation Report (CWPMR)	No	N/A	No	Actions for protection of private property or homes owned by Midpen are not directly addressed by the Wildland Fire Resiliency Program.
CAL FIRE	Recommendation #9	Create incentives for fuels reduction on private lands	Community Wildfire Prevention and Mitigation Report (CWPMR)	Yes	Fuels Reduction Permits	N/A	
CAL FIRE	Recommendation #10	Continue developing methodology to assess communities at risk	Community Wildfire Prevention and Mitigation Report (CWPMR)	Yes	FM-1	N/A	
CAL FIRE	Recommendation #12	Develop mobile data collection tool for project reporting.	Community Wildfire Prevention and Mitigation Report (CWPMR)	Yes	FM-1; FM-7; GM-3; WF-7	N/A	

Agency	Policy Name	Policy Text	Policies Source	Addressed by Existing Midpen Policy?	Which Policy	Recommended Added?	Notes
CAL FIRE	**Recommendation #13**	**Coordinate with air quality regulators to enable increased use of prescribed fire.**	**Community Wildfire Prevention and Mitigation Report (CWPMR)**	**Partly**	**WF-1**	**Yes**	**Air quality regulators not specifically called out in existing policies and actions but including this action would support the beneficial use of prescribed fire.**
CAL FIRE	**Recommendation #14**	**Develop technology tools to enable real time prescribed fire information sharing.**	**Community Wildfire Prevention and Mitigation Report (CWPMR)**	**No**	**N/A**	**Yes**	**Actions to support prescribed fire and general wildfire information based on technology should be adopted into the RMPs.**
CAL FIRE	Recommendation #16	Develop a scientific research plan for wildfire management and mitigation, with funding recommendations	Community Wildfire Prevention and Mitigation Report (CWPMR)	Yes	WF-7 (generally)	N/A	
CAL FIRE	Recommendation #17	Provide technical assistance to local governments to enhance or enable fire hazard planning.	Community Wildfire Prevention and Mitigation Report (CWPMR)	Yes	CC-5; WF-4	N/A	
CAL FIRE	Recommendation #18	CAL FIRE should update codes governing defensible space and forest and rangeland protection	Community Wildfire Prevention and Mitigation Report (CWPMR)	Yes	FM-5; WF-3	N/A	
CAL FIRE	Goal 4	Increase fire prevention awareness, knowledge and actions implemented by individuals and communities to reduce human loss, property damage, and impacts to natural resources from wildland fires.	2018 Strategic Fire Plan	Yes	FM-5; WF-1	N/A	
CAL FIRE	**Goal 4; Objective b)**	**Educate landowners, residents, fire safe councils, and business owners to understand that fire prevention is more than defensible space, including why structures ignite, the role embers play in such ignitions, and the importance of fire safe building materials, designs, and retrofits.**	**2018 Strategic Fire Plan**	**Partly**	**FM-5; WF-1; Good Neighbor Policy Brochure**	**Yes**	**Specific cause not called out: building materials – this goal can be integrated into the RMPs actions.**
CAL FIRE	**Goal 4; Objective I)**	**Analyze trends in fire cause, and focus prevention and education efforts to modify human behavior and reduce ignitions.**	**2018 Strategic Fire Plan**	**No**		**Yes**	**This action may be an important part of education that should be supported by the RMPs and should be added to the Public Interpretation and Environmental Education chapter of the RMPs.**
CAL FIRE	Goal 5; Objective a)	Promote efforts to restore the ecological role of prescribed and managed fire in areas and upon jurisdictions where doing so is consistent with local land management objectives and does not present an unacceptable risk to human health and safety or security of adjacent ownerships.	2018 Strategic Fire Plan	Yes	CC-3; CC-4; WF-1; WF-5, ES-3	N/A	
CAL FIRE	**Goal 5; Objective c)**	**Work to streamline or remove regulatory or policy barriers that limit fuels reduction activities.**	**2018 Strategic Fire Plan**	**Partly**	**WF-1**	**Yes**	**Work to reduce regulatory hurdles and cost of regulatory compliance to support program efforts should be added to the RMPs.**

Agency	Policy Name	Policy Text	Policies Source	Addressed by Existing Midpen Policy?	Which Policy	Recommended Added?	Notes
CAL FIRE	**Goal 5; Objective d)**	**Promote and develop programmatic documents to increase the pace and scale of fuels treatment activities**	**2018 Strategic Fire Plan**	**No**		**Yes**	**Such a policy or action would support the program and should be included in the RMPs.**
CAL FIRE	Goal 5; Objective f)	Promote forest and rangeland health and resilience through fuels reduction, and sustainable commercial forest management. Improve markets for and utilization of all forest products, including dead trees, waste, and biomass.	2018 Strategic Fire Plan	Partly	CC-3	No	Use of waste/commercial forest management is not discussed.
CAL FIRE	Goal 5; Objective g)	Increase public education and awareness in support of ecologically sensitive and economically efficient vegetation management activities, including prescribed fire, grazing, forest thinning, and other fuels treatment projects.	2018 Strategic Fire Plan	Yes	WF-5; Good Neighbor Policy Brochure	N/A	
CAL FIRE	**Goal 6**	**Determine the level of resources necessary to effectively identify, plan and implement fire prevention using adaptive management strategies.**	**2018 Strategic Fire Plan**	**No**		**Yes**	**This policy or action supports the Pre-Fire Plan/Resource Advisory Maps.**
CAL FIRE	**Goal 6; Objective c)**	**Develop a process and criteria for determining prevention resource levels and allocation based on goals and on current projected needs.**	**2018 Strategic Fire Plan**	**Partly**	**WF-1**	**Yes**	**Specifics from this policy or action could be added to the RMPs.**
CAL FIRE	**Goal 6; Objective e)**	**Review data, conduct analysis and implement adaptive management related to fire prevention activities.**	**2018 Strategic Fire Plan**	**Partly**	**ES-1**	**Yes**	**Specifics from this policy or action could be added to the RMPs.**
CAL FIRE	Goal 8	Implement post-fire assessments and programs for the protection of life, property, and natural resource recovery.	2018 Strategic Fire Plan	Yes	FM-7	N/A	
CAL FIRE	**Goal 8; Objective a)**	**Encourage rapid post-fire assessment, when and where appropriate, to determine values at risk within and downstream of the fire perimeter from flooding, debris flows, and excessive surface erosion. Provide preliminary emergency protection measures that can be implemented in a timely manner and help coordinate project implementation with appropriate agencies.**	**2018 Strategic Fire Plan**	**Partly**	**WF-2; WF-7**	**Yes**	**This action or policy could support the post-fire recovery efforts that are currently not addressed by the RMPs.**
CAL FIRE	**Goal 8; Objective d)**	**Assess the effects of pre- and post-fire treatments to refine best management practices.**	**2018 Strategic Fire Plan**	**Partly**	**FM-7; GM-3; WF-7**	**Yes**	**This action supports the adaptive management part of program, which will be defined in the Monitoring Plan.**

Agency	Policy Name	Policy Text	Policies Source	Addressed by Existing Midpen Policy?	Which Policy	Recommended Added?	Notes
CAL FIRE, Resource Conservation District	**General Recommendations**	**Roadside vegetation should be reduced to a level that allows ease of access for emergency response personnel and equipment, reduces the number of roadside fire starts and ensures the safety of fire suppression personnel using roads as fire control lines.** **...this work was accomplished through a combination of chemical and mechanical means. In recent years, however, there has been increasing public pressure to eliminate the use of chemicals as a roadside treatment. Therefore, most of the recent work has been completed with mechanical mowers and masticators.** **Both local and state fire codes specify clearing of at least 10-feet on each side of a road or driveway and up to 15-feet of vertical clearance above. Unfortunately, the specifications are inconsistent across the numerous county jurisdictions. A priority should be set to attempt standardization for these requirements across each county.**	**San Mateo - Santa Cruz Community Wildfire Protection Plan 2018**	**Yes**	**Section 801.1; FM-5; WF-1**	**Yes**	**The RMPs do not currently, but should, acknowledge consideration of actions and priorities in CWPPs.**
CAL FIRE, Resource Conservation District	General Recommendations	A shaded fuel break refers to "thinning" of vegetation in a specific area with the remaining vegetation shading the ground. The widths of roadside shaded fuel breaks generally range from 10 feet up to 50 feet, with 75 to 100 feet a more effective, but less popular target prescription. Strategic fuel breaks can be as wide as 400 feet. Shaded fuel breaks can be placed around individual structures, communities or neighborhoods identified to be at risk. Roadside fuel breaks are typically between 10 and 40 feet wide. The exact distance should be based on fuel type, slope, aspect, and environmental feasibility.	San Mateo - Santa Cruz Community Wildfire Protection Plan 2018	Partly	SA-1; IPM	No	The program will address the types of fuelbreaks, but policy and actions do not need to state specifics – only that CWPP actions should be supported.
CAL FIRE, Resource Conservation District	General Recommendations	Specific vegetation removal treatment methods are provided	San Mateo - Santa Cruz Community Wildfire Protection Plan 2018	Partly	IPM	No	The program will address the types of vegetation management activities, but policy and actions do not need to state specifics – only that CWPP actions should be supported.

Agency	Policy Name	Policy Text	Policies Source	Addressed by Existing Midpen Policy?	Which Policy	Recommended Added?	Notes
CAL FIRE, Resource Conservation District	Reducing Structural Ignitability	Property owners living in State Responsibility Areas (SRA) are required by Public Resource Code (PRC) 4291 to maintain clearance of flammable vegetation around their property. A property owner's clearance responsibility is limited to 100 feet from his or her structure(s) or to the property line, whichever is closer, and is limited to their lands. However, coordination with adjacent landowners to achieve maximum defensible space is encouraged. Similar constraints have been developed for areas outside the SRA, sithin and adjacent to the WUI. Maintain a firebreak by removing and clearing away all flammable vegetation within 30 feet of each structure. Single specimens of trees or other vegetation may be retained provided they are well-spaced and well-pruned, in order to avoid spread of fire to other vegetation or to the structure. In the area from 30 to 100 feet from structures, dead and dying woody surface fuels and aerial fuels should be removed. Horizontal and vertical clearance between fuels should be maintained. Downed logs, when embedded in the soil may be retained.	San Mateo - Santa Cruz Community Wildfire Protection Plan 2018	Yes	IPM; Good Neighbor Policy Brochure; WF-4	N/A	
CAL FIRE	Engineering and Structure Ignitability	Fire Apparatus access roads shall have an unobstructed width of not less than 20 feet except for approved security gates in accordance with Section 503.6 of Title 24, and an unobstructed vertical clearance of not less than 13 feet 6 inches. There are exceptions, contrary to State Fire Code, outside of the Urban Services Line as established by the County of Santa Cruz. In these locations access roads shall be a minimum of 18 feet wide for all access roads or driveways serving more than two habitable structures, and 12 feet for an access road or driveway serving two or fewer habitable structures. Where it is environmentally inadvisable to meet these criteria (due to excessive grading, tree removal or other environmental impacts), a 12-foot wide all-weather surface access road with 12-foot wide by 35-foot long turnouts located approximately every 500 feet may be provided with the approval of the fire code official. Title 19 of the California Administrative Code requires that access roads from every state governed building to a public street shall be all-weather hard-surface (suitable for use by fire apparatus) roadway not less than 20 feet in width. Such roadway shall be unobstructed and maintained only as access to the public street. Vertical clearance may be reduced; provided such reduction does not impair access by fire apparatus and approved signs are installed and maintained indicating the established vertical clearance when approved by the fire code official. It is important to note this is for new construction and that many roads, both public and private, in the county do not comply with the standard.	2018 - CZU Unit Strategic Fire Plan	Partly	Section 801.1; FM-5; WF-1	No	Emergency access is covered in existing RMPs; details should be included in the program.

Agency	Policy Name	Policy Text	Policies Source	Addressed by Existing Midpen Policy?	Which Policy	Recommended Added?	Notes
CAL FIRE	Information and Education	Education is arguably the most valuable tool available to reach this goal of reduced ignitions and large fires. Each year, the Unit distributes educational materials through a variety of methods: direct mailing, at defensible space inspections and at public events.	2018 - CZU Unit Strategic Fire Plan	Yes	Good Neighbor Policy Brochure, PI-2, PI-3, FM-8, WF-7	N/A	
San Mateo County Parks and Recreation Commission	6.23.1	Trails shall be temporarily closed when conditions become unsafe or environmental resources are severely impacted. Such conditions could include soil erosion, flooding, fire hazard, environmental damage, or failure to follow the specific trail management plan.	San Mateo County 2001 Trails Plan	Yes	IPM; Section 805; WF-1	N/A	
San Mateo County Parks and Recreation Commission	D.G. 1.11 Wildland Fire	Wildland fire hazards shall be considered when siting new trails. When individual trails are being designed, the CDF Fire Hazard Severity Zone Maps shall be reviewed as well as the Hazards Map in the County of San Mateo General Plan. Areas of high fire hazard shall be avoided or trail closure shall occur when fire hazard is deemed high.	San Mateo County 2001 Trails Plan	Yes	IPM; Section 805; WF-1	N/A	
San Mateo County Parks and Recreation Commission	D.G. 4.11 Wildland Fire Suppression	During preparation of design plans for specific trail alignments, the County Parks Division shall: • Review, in conjunction with the local fire protection services, available water sources. • Select indigenous plant materials and/or seed mixes utilized at staging areas or along trails for their low maintenance and drought and fire resistant characteristics to minimize additional fuel available to wildland fires to the maximum extent feasible.	San Mateo County 2001 Trails Plan	Yes	ES-3; WF-8; IPM	N/A	
San Mateo County	15.37 Support Efforts to Reduce the Extent of the Fire Hazards	Support public and private efforts to reduce the potential of fire hazards through methods including but not limited to controlled burning programs reduction of fuel loading, construction and maintenance of fire breaks and other appropriate methods.	County of San Mateo General Plan	Yes	IPM, WF-6	N/A	
Santa Clara County	Policy R-HS 23	Areas for which inadequate access is a general concern, either due to lack of secondary access, dead-end roads of excessive length, and substandard road design or conditions, should be examined to determine if there are means by which to remedy the inadequacies. Such means may include: a. specific local area circulation plans to establish alternative access; b. specific roadway improvements to remedy hazardous situations, financed by those most benefited by the improvements; and c. traffic routing and controls to discourage the use of such roads by non-residents.	Santa Clara County General Plan	Yes	WF-1; WF-3; RM-5	N/A	
Santa Clara County	Policy R-HS 33	For areas where it may be appropriate, fire protection agencies and districts should utilize controlled burns and other forms of vegetation management to reduce the build up of vegetative matter and the potential fire hazard within an area.	Santa Clara County General Plan	Yes	CC-3; ES-1	N/A	

Agency	Policy Name	Policy Text	Policies Source	Addressed by Existing Midpen Policy?	Which Policy	Recommended Added?	Notes
County of San Mateo Parks and Recreation Department	Objective 9: Actively Manage Forests to Reduce Fire Fuels and Increase Forest Health	• Census forests to determine hazardous fuel areas; • Develop a GIS database of hazardous tree locations (in forested and other areas) and update it regularly; • Thin underbrush; • Educate adjacent landowners about the need to maintain defensible space between their properties and parklands; • Inspect and remove hazard trees; • Detect and treat diseased plants, contain spread of disease; and • Manage fire breaks to decrease erosion and the spread of invasive plants.	Decision-Making Guidelines for Vegetation Management San Mateo County Parks	Partly	RC-1; WF-3; WF-7; VM-4; FM-1; FM-5; FM-6; Good Neighbor Policy Brochure; IPM	Yes	The RMPs would benefit from an action that includes developing a database or methods of tracking tree management areas or a "Tree Management Zone."
County of San Mateo Parks and Recreation Department	Fuel Load and Fire Management	Assessing the degree of fire hazard is dependent upon at least three factors. These include the degree of human use and occupancy of the wildland area, the level and ability of public services to respond to fires, and the natural setting of the wildland areas. In addition to weather factors and slope characteristics, one of the key components in measuring fire hazard severity is the type and quantity of flammable vegetation within a given unit of land area. This factor is known as "fuel loading characteristics". Fuel management is important for fire hazard reduction. Three basic methods are commonly used to manage the spread of wildfires: firebreaks, fuel reduction areas and ornamental landscaping. A firebreak eliminates all vegetation and combustible growth to prevent fires from spreading. A fuel reduction area reduces the fuel mass of flammable vegetation and combustible growth, thereby limiting the intensity of fire and slowing its rate of spread. Landscaping with fire resistant plants provides a third option for slowing the spread of wildfires [Refer to plan for more specifics and details]	Decision-Making Guidelines for Vegetation Management San Mateo County Parks	Partly	IPM	Yes	RMP WF actions may benefit from specifics identified here related to fuel reduction areas.

Agency	Policy Name	Policy Text	Policies Source	Addressed by Existing Midpen Policy?	Which Policy	Recommended Added?	Notes
State of California	Chapter 5	Section 503 (Fire Apparatus Access Roads) 503.1.1 Buildings and facilities. Approved fire apparatus access roads shall be provided for every facility, building or portion of a building hereafter constructed or moved into or within the jurisdiction. Section 503.1.2 (Additional Access) The fire code official is authorized to require more than one fire apparatus access road based on the potential for impairment of a single road by vehicle congestion, condition of terrain, climatic conditions or other factors that could limit access. Section 503.2.1 (Dimensions) Fire apparatus access roads shall have an unobstructed width of not less than 20 feet (6096 mm), exclusive of shoulders, except for approved security gates in accordance with Section 503.6, and an unobstructed vertical clearance of not less than 13 feet 6 inches (4115 mm). Sections 503.2.2 (Authority to require modifications to the required access width) The fire code official shall have the authority to require or permit modifications to the required access widths where they are inadequate for fire or rescue operations or where necessary to meet the public safety objectives of the jurisdiction.	California Fire Code	Partly	Good Neighbor Policy Brochure	No	Fire code is law and therefore must be implemented. Separate policies to follow the code are unnecessary. Details should be incorporated into the program.
State of California	Appendix D	D102.1 Access and loading. D103.1 Access road width with a hydrant D103.2 Grade D103.3 Turning radius D103.4 Dead ends D103.5 Fire apparatus access road gates D103.6 Signs D103.6.1 Roads 20 to 26 feet in width D103.6.2 Roads more than 26 feet in width	California Fire Code	Partly	Good Neighbor Policy Brochure	No	Fire code is law and therefore must be implemented. Separate policies to follow the code are unnecessary. Details should be incorporated into the program.
State of California	Public Resources Code Section 4291	(1) Maintain defensible space of 100 feet from each side and from the front and rear of the structure, but not beyond the property line except as provided in paragraph (2). The amount of fuel modification necessary shall take into account the flammability of the structure as affected by building material, building standards, location, and type of vegetation. Fuels shall be maintained in a condition so that a wildfire burning under average weather conditions would be unlikely to ignite the structure. This paragraph does not apply to single specimens of trees or other vegetation that are well-pruned and maintained so as to effectively manage fuels and not form a means of rapidly transmitting fire from other nearby vegetation to a structure or from a structure to other nearby vegetation. The intensity of fuels management may vary within the 100-foot perimeter of the structure, the most intense being within the first 30 feet around the structure. Consistent with fuels management objectives, steps should be taken to minimize erosion. For the purposes of this paragraph, "fuel" means any combustible material, including petroleum-based products and wildland fuels	Public Resources Code	Partly	Good Neighbor Policy Brochure	No	Fire code is law and therefore must be implemented. Separate policies to follow the code are unnecessary. Details should be incorporated into the program.

Agency	Policy Name	Policy Text	Policies Source	Addressed by Existing Midpen Policy?	Which Policy	Recommended Added?	Notes
State of California	Public Resources Code Section 4260	The board shall adopt regulations implementing minimum fire safety standards related to defensible space that are applicable to state responsibility area lands under the authority of the department, and to lands classified and designated as very high fire hazard severity zones	Public Resources Code	Partly	Good Neighbor Policy Brochure	No	Fire code is law and therefore must be implemented. Separate policies to follow the code are unnecessary. Details should be incorporated into the program.
Woodside Fire Protection District	Defensible Space: 2016 CFC sec.304.1.2 and 2015 IWUIC sec.604	Weeds, grass, vines or other growth that is capable of being ignited and endangering property, shall be cut down and removed by the owner or occupant of the premises, Nonfire-resistive vegetation or growth shall be kept clear, 50-100 feet or to the property line, of buildings and structures in such a manner to provide a clearance for fire suppression operations. Trees are allowed within the defensible space, provided limbs located less than 6 feet above the ground have been removed a he horizontal distance between crowns of adjacent trees, structures, overhead electrical facilities and unmodified fuel is not less than 10 feet. Deadwood and liter shall be regularly removed from trees. Ornamental vegetative fuels or cultivated ground cover can be within the designated defensible space provided they do not form a means of transmitting fire from native growth to any structure.	Woodside Fire Protection District Fire Code	Yes	Good Neighbor Policy Brochure; IPM	No	This level of detail is not required in RMPs or actions, but details should be incorporated into the program.
Woodside Fire Protection District	Perimeter Property Line Clearance: 2016 CFC sec.304.1.1.A	Persons owning, controlling or leasing structures and/or property are required to remove, a minimum of 30 feet from the perimeter of the property line, hazardous vegetation specifically, flashy fuels consisting of weeds and annual grasses as well as dead vegetative material and litter that is capable of being easily ignited and endangering property as determined by the Fire Marshal.	Woodside Fire Protection District Fire Code	Yes	Good Neighbor Policy Brochure	No	This level of detail is not required in RMPs or actions, but details should be incorporated into the program.
Board of Forestry and Fire Protection	Title 14 State Responsibility Area Fire Safe Regulations	These regulations have been prepared and adopted for the purpose of establishing minimum wildfire protection standards in conjunction with building, construction and development in SRA.	California Code of Regulations	Partly	Good Neighbor Policy Brochure	No	Fire code is law and therefore must be implemented. Separate policies to follow the code are unnecessary. Details should be incorporated into the program.

4 Recommendations

4.1 Summary of Policy and Implementing Measure Gaps and Recommended Additions and Revisions

The policy analysis revealed that the goals and components of Midpen's Wildland Fire Resiliency Program are generally supported by the RMPs. Key aspects of the program, however, would benefit from the provision of additions or modifications to the existing policies and implementation measures. These recommended additions and/or modifications to existing policies and implementation measures can be summarized as follows:

- Creation or augmentation of existing policy to define and support programmatic planning efforts for wildland fire resiliency activities and removal of regulatory barriers
- Creation or augmentation of existing policy to acknowledge consideration of the adopted CWPPs for San Mateo and Santa Clara Counties and implementation of actions identified within where consistent with Midpen practices
- Addition of ecosystem resiliency to the Wildfire Management policies and a recommendation to identify acceptable levels of change to the environment that allow for establishment and maintenance of resiliency at the landscape level
- Augmentation of existing policies to incorporate the definition and importance of adaptive management and decision-making flexibility needed to respond to ecological feedback
- Expansion of actions to identify the focus of vegetation management actions versus prescribed fire actions
- Addition to existing policy and implementation methods to acknowledge the need to adopt new technology into management methods
- Addition to existing policy for understanding indigenous use of fire, coordinating with tribes on prescribed burning practices, and incorporating cultural practices of prescribed fire for desired outcomes
- Addition to existing policy to address post-fire restoration and response
- Allowance for landscape visual changes for fuels management under Scenic and Aesthetic Resource policies
- Addition and modification of Climate Change policies to allow for trade-offs between some carbon sequestration loss and greenhouse gas emissions for fuel reduction projects and prescribed burns and development of ecological resiliency

The following table provides a summary of the policies and implementation measures that were identified in this report as having gaps, and the table also provides some of the policies and actions from other agencies that have been used to revise the RMPs. Section 4.2 provides the full text of the recommended revised policies and implementation measures.

Table 4.1-1 Summary of Gaps in Policies or Implementation Measures, and Policies and Actions from Other Agencies that Could Fill Gaps

Policy	Summary of Actions Under Policy	Gaps in Policy or Actions	Actions that can be Added from Other District and Other Agency Policies and Actions
Wildfire Management			
Policy Wildfire (WF)-1: Implement necessary fire and fuel management practices to protect public health and safety, protect natural resources, and reduce the impacts of wildland fire	• Prepare wildland fire management plans • Identify and maintain emergency access • Identify the need for additional firefighting infrastructure • Work with CAL FIRE and other agencies to implement prescribed burning • Maintain fire clearances • Prohibit activities that have a high risk of sparks • Close preserves during extreme fire weather • Seek grants and partnerships for fuel management and monitoring	• Actions under policy do not address assessment of degree of fire hazard and expansion of fuelbreaks and fuel reduction zones even though these actions are an integral part of fire and fuel management practices. • Actions are very generic with respect to fire clearances.	Decision-Making Guidelines for Vegetation Management San Mateo County Parks: • Assess the degree of fire hazard by evaluating the degree of human use and occupancy of the wildland area, the level and ability of public services to respond to fires, and the natural setting of the wildland area • Identify fuel reduction areas that reduce the fuel mass of flammable vegetation and combustible growth, thereby limiting the intensity of fire and slowing its rate of spread. San Mateo - Santa Cruz Community Wildfire Protection Plan 2018 • Reduce roadside vegetation to a level that allows ease of access for emergency response personnel and equipment, reduces the number of roadside fire starts and ensures the safety of fire suppression personnel using roads as fire control lines. • Set a priority to work with the counties to standardize clearing widths on each side of roads and driveways.

Policy	Summary of Actions Under Policy	Gaps in Policy or Actions	Actions that can be Added from Other District and Other Agency Policies and Actions
Policy WF-2: Aggressively support the immediate suppression of all unplanned fires that threaten human life, private property or public safety.	• Respond to fires with fire agencies • Prioritize and prepare preserve-specific wildland fire response plans • Direct bulldozer actions to areas identified in the response plans to minimize disturbance • Develop guidelines for rehabilitation measures following fires	• Guidelines for rehabilitation belong under a separate policy or added to this policy for wildfire recovery and restoration. • The policy should address an option to allow for natural ignitions to burn where they do not threaten human life and private property and how to prioritize suppression.	2018 CALFIRE Strategic Fire Plan Objectives a and d) • Encourage rapid post-fire assessment, when and where appropriate, to determine values at risk within and downstream of the fire perimeter from flooding, debris flows, and excessive surface erosion. Provide preliminary emergency protection measures that can be implemented in a timely manner and help coordinate project implementation with appropriate agencies. • Assess the effects of pre- and post-fire treatments to refine best management practices. Community Wildfire Prevention and Mitigation Report (CWPMR) Recommendation #2 • Authorize incident response to implement rapid treatment of fuels.

4 RECOMMENDATIONS

Policy	Summary of Actions Under Policy	Gaps in Policy or Actions	Actions that can be Added from Other District and Other Agency Policies and Actions
Policy WF-3: Work with adjacent landowners and fire agencies to maintain adequate fire clearance around qualifying structures.	• Maintain a permit system for homeowners to maintain defensible space • Work with fire agencies and local governments to develop requirements for new development to maintain required fire clearance distance from District land wherever possible.Focus fuel management in areas adjacent to development, essential facilities, emergency routes, essential fuelbreaks, and sensitive biological and cultural areas • Investigate alternative funding • Work with fire agencies to ensure adequate evacuation and where infrastructure is practical	• The action that states where to focus fuel management should clarify that the focus is for vegetation management.	CAL FIRE 2018 Strategic Fire Plan Goal 4; Objective b) and Goal 4; Objective l) • Educate landowners, residents, fire safe councils, and business owners to understand that fire prevention is more than defensible space, including why structures ignite, the role embers play in such ignitions, and the importance of fire safe building materials, designs, and retrofits. • Analyze trends in fire cause, and focus prevention and education efforts to modify human behavior and reduce ignitions.

Policy	Summary of Actions Under Policy	Gaps in Policy or Actions	Actions that can be Added from Other District and Other Agency Policies and Actions
Policy WF-4: Manage District vegetation communities to reduce the risk of catastrophic fire and to maintain biological diversity.	• Promote restoration and development of late-seral forest communities • Evaluate potential for reduced fuel loading • Use and expand conservation grazing • Manage forest disease like Sudden Oak Death (SOD) • Manage scrub, shrub, and chaparral communities to maintain a mosaic of habitats and reduce fuel loads	• The policy does not address the concepts of ecological resiliency and acceptable change to maintain habitat functions. • The policy actions do not incorporate prescribed fire, which will be important to the establishment of resiliency. • The policy actions do not identify other methods of fuel load reduction including through thinning in fuel reduction zones. • The policy does not identify environmental review and planning needed.	2018 CALFIRE Strategic Plan Goal 5; Objective d) and c) • Promote and develop programmatic documents to increase the pace and scale of fuels treatment activities • Work to streamline or remove regulatory or policy barriers that limit fuels reduction activities. Community Wildfire Prevention and Mitigation Report (CWPMR) Recommendation #13 • Coordinate with air quality regulators to enable increased use of prescribed fire.
Policy WF-5: Conduct prescribed burns to re-introduce fire into native ecosystems and maintain natural ecological processes on District lands	• Continue to utilize fire as a resource management tool to reduce fuels and reestablish fire • Continue to utilize prescribed fire to prevent unwanted fire damage • Conduct prescribed burns in an ecologically sound manner to mimic natural fire regimes • Conduct public outreach on prescribed fire	• The actions do not address establishment of burn units and prioritization that would be supported by the Prescribed Fire Plan. • The actions do not address prescribed fire safety.	• None

Policy	Summary of Actions Under Policy	Gaps in Policy or Actions	Actions that can be Added from Other District and Other Agency Policies and Actions
Policy WF-6: Foster and maintain interagency fire management partnerships	• Annually coordinate fire management with other agencies • Participate in Fire Safe Councils and CWPP • Train with fire agencies • Distribute all available up-to-date maps of fire infrastructure; distribute additional maps as they become available	• In the last three years, CWPPs have been published for areas covering Midpen's preserves, and policies or actions should address integration and support of those CWPPs more specifically.	• None
Policy WF-7: Conduct research and monitoring to refine fire management practices.	• Monitor pre-project vegetation, soil, erosion, and water quality to establish baseline conditions • Monitor post-fire and vegetation management practices • Monitor consistent with other land management agencies • Foster relationships with institutions and seek grants • Integrate wildland fire management into education programs	• The policy does not address the overall concept of adaptive management, nor does it emphasize the decision-making flexibility needed to respond to ecological feedback. • The actions only address monitoring but not evaluation of monitoring results and adaptation of actions. • The policy and actions do not acknowledge the need to incorporate changing technology and knowledge into management methods.	Decision-Making Guidelines for Vegetation Management San Mateo County Parks • Census forests to determine hazardous fuel areas; • Develop a GIS database of tree management zones (in forested and other areas) and update it regularly; • Thin underbrush; • Educate adjacent landowners about the need to maintain defensible space between their properties and parklands; • Inspect and remove hazard trees; • Detect and treat diseased plants, contain spread of disease; and • Manage fire breaks to decrease erosion and the spread of invasive plants. CAL FIRE Recommendation #14 • Develop technology tools to enable real time prescribed fire and general wildfire information sharing.

Policy	Summary of Actions Under Policy	Gaps in Policy or Actions	Actions that can be Added from Other District and Other Agency Policies and Actions
			2018 CALFIRE Strategic Fire Plan Goal 6 • Determine the level of resources necessary to effectively identify, plan and implement fire prevention using adaptive management strategies. • Develop a process and criteria for determining prevention resource levels and allocation based on goals and on current projected needs. • Review data conduct analysis and implement adaptive management related to fire prevention activities.
Policy WF-8: Wildland Fire management actions on District lands in the Coastside Protection Area will be in accordance with the policies established in the Service Plan for the San Mateo Coastal Annexation Area	• Determine whether construction of dry hydrants is feasible in coordination with County of San Mateo Environmental Services Department • Select native plant materials and/or seed mixes for fire resistance • Locate trails to also allow for emergency access • Develop mutual aid agreements • Consult with fire agencies in developing fuel modifications • Prohibit smoking, firearms, fireworks, and off-road vehicles and limit trail use, picnicking, and camping to designated activities • Develop and maintain staging areas and trailheads in accordance with the wildland fire hazard mitigation measures	• None	• None

Policy	Summary of Actions Under Policy	Gaps in Policy or Actions	Actions that can be Added from Other District and Other Agency Policies and Actions
Climate Change			
Policy CC-3: Increase carbon sequestration in vegetation and soils and minimize carbon release from wildfire	• Manage conifer forests to sustain and encourage the development of late-seral habitat conditions. Evaluate the potential to reduce forest fuel loading through the removal of smaller trees to reduce fuel buildup and ladder fuels • Manage vegetation communities to reduce the risk of catastrophic fire and to maintain biological diversity; conduct prescribed burns	• The actions should address allowing for trade-offs between carbon sequestration losses from fuel load removal and tree thinning and emissions from prescribed fire, given the overwhelming benefits of reduced risks of catastrophic wildland fire.	• None
Policy CC-4: Prepare for climate change impacts and promote resilience for both natural and built environments.	• Prioritize ecosystem function, resilience, and ecological diversity focused on multiple species benefits, rather than aiming to prevent ecological change or return to past conditions. • Support ecological functions and ecosystem services that protect the built environment from climate change impacts, such as flooding and increased wildland fire frequency and intensity • Evaluate, study, and implement additional land management strategies to promote ecosystem resilience	• The policy elaborates on the central tenets of ecological resiliency and should also be included in the Wildland Fire Management policies chapter.	• None

Policy	Summary of Actions Under Policy	Gaps in Policy or Actions	Actions that can be Added from Other District and Other Agency Policies and Actions
Ecological Succession			
Policy ES-3: Facilitate regeneration of disturbance-dependent special status, rare, or unique plants.	• Research, document, and implement site specific fire prescriptions to improve regeneration of fire-adapted and special status vegetation in fire-dependent ecosystems where feasible. • Develop and implement an alternative management protocol to encourage seedling establishment of special status and disturbance-adapted species in aging stands when regeneration by fire is not feasible	• The policy's actions should be cross-referenced in the Wildland Fire Management policies chapter	• None
Scenic and Aesthetic Resources			
Policy SA-2: Maintain significant landscapes or features that were formerly maintained by natural processes.	• Control encroaching vegetation where it adversely affects significant scenic, historic, or habitat resources • Control vegetation to create or maintain important scenic viewpoints and vistas • Require Midpen tenants to maintain landscapes and improvements to acceptable visual standards that do not detract from a visitor's experience or adversely impact wildlife	• The actions under this policy do not necessary allow for habitat changes associated with control of vegetation for fuelbreaks, disc lines, and prescribed burns	• None

Policy	Summary of Actions Under Policy	Gaps in Policy or Actions	Actions that can be Added from Other District and Other Agency Policies and Actions
Research and Information Goals, Policies, and Implementation Measures			
Policy RC-1: Maintain resource information files for each preserve and resource subject	• Gather information from appropriate agencies • Maintain filing system of spatial data and information by location and resource type • Facilitate reporting • Respond to public information requests and promote release of non-sensitive information • Recruit interns and volunteers	• Add a cross reference in WF-7 to this policy as it pertains to GIS mapping.	• None

4.2 Recommendations for Goal, Policy, and Implementing Measure Additions and Revisions to Support the Program

4.2.1 Overview

This section provides the suggested text revisions based on the policy analysis. The exact text from the RMPs document is included here with recommended deletions shown in ~~strikeout~~ and additions shown in <u>underline</u>.

4.2.2 Revisions to XVII. Glossary

Add:

Adaptive management - A systematic process for continually improving management policies and practices by learning from the outcomes of previously employed policies and practices

Ecological diversity - The variety and abundance of species in different habitats and communities.

Ecological resiliency - A landscape that can generally resist damage and recover quickly from disturbances such as wildfire, allowing the continuation of the landscapes' function and structure over time.

Essential roads – These are roads important to community and visitor ingress/egress and emergency access.

Fuel reduction zones - An area in which vegetation, debris, and other types of combustible fuels have been treated, cleared, or reduced to slow the spread of fire, to modify habitat, or for other reasons with the outcome of natural or cultural resources benefit.

4.2.3 Revisions to XV. Wildland Fire Management

Goal: Manage District lands <u>under the concepts of ecological resiliency</u> to reduce the severity of wildland fire and to reduce the impact of fire suppression activities within the District Preserves and adjacent residential areas; manage habitats to support fire as a natural occurrence on the landscape; and promote District and regional fire management activities.

Policy WF-1 Implement necessary fire and fuel management practices to protect public health and safety, protect natural resources, and to reduce the impacts of wildland fire.

- Prepare wildland fire management plans for District lands that address, at a minimum, public safety, District staff and firefighter safety, District infrastructure including residences and roads, natural resource protection (particularly special status species), cultural resources, and vegetation management for fire protection and fire behavior and hazardous fuels modification.

- Assess the degree of fire hazard by evaluating the degree of human use and occupancy of the wildland area, the level and ability of public services to respond to fires, and the natural setting of the wildland area.
- Identify, with input from responsible fire agencies and neighboring public agencies, essential roads for wildland fire access. Maintain designated roads for fire access and patrol purposes, and improve with surfacing, additional turnouts and safety zones when necessary and reduce roadside vegetation to a level that allows ease of access for emergency response personnel and equipment, improves public safety in the event of an evacuation, reduces the number of roadside fire starts, allows for quicker response, and ensures the safety of fire suppression personnel. Set a priority to work with neighboring public agencies, including the California Department of Transportation (Caltrans), county roads departments and local municipalities to standardize clearing widths on each side of roads and driveways.
- Coordinate with fire agencies and local communities to identify locations where additional fire infrastructure is desirable and practical (e.g. hydrants, water tanks, helicopter zones, safety zones, fuel breaks, consistent with the incident command system (ICS). Work cooperatively with these groups to permit as appropriate installation and maintenance of new ~~needed~~ infrastructure.
- Work with Cal Fire, ~~and~~ other appropriate fire management and regulatory agencies, and tribal entities to develop and carry out plans that use prescribed burns to maintain and restore natural and cultural systems.
- Maintain adequate fire clearance around District structures and facilities. (See FM-5 and WF-4: Measure 5)
- Expand fuelbreak systems and identify fuel reduction areas that reduce the fuel mass of flammable vegetation and combustible growth, thereby limiting the intensity of fire and slowing its rate of spread.
- Require lessees of District land or structures to maintain fire hazard reduction measures as directed.
- Prohibit activities that have a high risk of sparking fires during periods of extreme fire hazard.
- Close Preserve areas of particular concern during extreme fire weather, as appropriate, and increase patrol levels where appropriate.
- Seek grant opportunities and partnerships for fuel management and monitoring projects.

Policy WF-2: Aggressively support the immediate suppression of all unplanned fires that threaten human life, private property or public safety and develop a response plan that, in the event of wildfire, allows the District to reduce post-fire impacts and initiate habitat restoration

- Identify a Resource Advisor as the District contact in the event of an unplanned fire on District lands.

- Respond to wildland and structure fires on District lands in coordination with responding fire agencies.
- Prioritize and prepare Preserve specific wildland fire response plans that identify appropriate fire suppression activities for District lands in the event of a wildland fire. Plans should include detailed maps of infrastructure such as roads, fuel breaks, structures, water sources (hydrants, water tanks, ponds), as well as sensitive natural and cultural resources to be avoided during fire suppression activities.
- Direct bulldozer actions to areas identified in wildland fire response plans to minimize and reduce ground disturbance, erosion, and rehabilitation efforts wherever possible.
- Develop guidelines for appropriate rehabilitation measures to address erosion, revegetation, invasive species, trail and road stability, security, public safety, and natural and cultural resources following fires.
- <u>Encourage rapid post-fire assessment, when and where appropriate, to determine values at risk within and downstream of the fire perimeter from flooding, debris flows, and excessive surface erosion. Provide preliminary emergency protection measures that can be implemented in a timely manner and help coordinate project implementation with appropriate agencies. (See also GS-2)</u>
- <u>Assess the effects of pre- and post-fire treatments to refine best management practices and address rapid treatment of fuels in high-priority areas.</u>
- <u>Consider allowing unplanned ignitions to burn to predesignated areas for resource benefit where there is no clear threat to life, property, or safety and when considering how to prioritize the suppression of multiple ignitions.</u>
- <u>Encourage and, where appropriate, partner with fire agencies and residential communities so that adequate evacuation routes and vegetation clearance around structures are maintained on adjacent non-District lands. Coordinate with fire agencies and local communities to define locations where community and regional fire protection infrastructure is desirable and practical.</u>

Policy WF-3: Work with adjacent landowners and fire agencies to maintain adequate fire clearance around qualifying structures. (See FM-5 and WF-1: Measure 5)

- Maintain a permit system that enables adjacent landowners to maintain defensible space clearance surrounding homes and other qualifying structures across property boundaries and onto District land as long as the activity is recommended by the local fire agency and is consistent with the District's resource management policies, including protection of environmentally sensitive habitat.
- <u>Implement fire clearance recommendations and defensible space around District-owned structures, as appropriate.</u>
- <u>Collaborate with and support fire departments and fire scientists in educating landowners, residents, fire safe councils, and business owners to understand that fire prevention is more than defensible space, including why structures ignite, the</u>

role embers play in such ignitions, and the importance of fire safe building materials, designs, and retrofits. (See also PI-3)

- Seek fire agency guidance on understanding trends in fire cause and focus prevention and education efforts to modify human behavior and reduce ignitions.
- Work with fire agencies and local governments to develop requirements for new development to maintain required fire clearance distance from District land wherever possible.
- Focus non-prescribed fire fuel management activities in areas adjacent to development, essential facilities and improvements, major egress and emergency routes, essential fuel breaks, and sensitive natural and cultural areas.
- Investigate alternative funding sources in conjunction with fire agencies and residential communities within the WUI adjacent to District Preserves to fund and implement fire hazard reduction projects.
- ~~Work with fire agencies and residential communities to ensure that adequate evacuation routes and vegetation clearance around structures are maintained on adjacent non-District lands.~~
- ~~Coordinate with fire agencies and local communities to define locations where community and regional fire protection infrastructure is desirable and practical.~~

Policy WF-4 Manage District vegetation communities to reduce the risk of catastrophic fire, ~~and~~ to maintain biological diversity, and to promote resilience. (See VM-1, ~~and~~ FM-6, and CC-4)

- Prioritize ecosystem function, resilience, and ecological diversity focused on multiple species benefits rather than aiming to prevent ecological change or return to past conditions.
- Evaluate, study, and implement additional land management strategies to promote ecosystem resilience.
- Promote the restoration and development of late-seral forest communities.
- Evaluate the potential to reduce forest fuel loading in accordance with a Vegetation Management Plan that includes ~~through the~~ removal of smaller trees to reduce forest floor fuel buildup and ladder fuels, development of additional fuelbreaks, and identification of fuel reduction zones. Manage scrub, shrub, and chaparral communities to maintain a mosaic of ages and species within strategic management corridors on roads, on ridgetops, and near residential development or other critical infrastructure to compartmentalize preserves and reduce fuel loads. Manage forest diseases such as Sudden Oak Death (SOD) to improve forest health and resiliency and to reduce fuel loads.
- Continue to utilize and expand the District's conservation grazing program to reduce grassland fuels, brush encroachment, and encourage the vigor of native grass and forb species.
- ~~Manage forest diseases such as Sudden Oak Death (SOD).~~
- ~~Manage scrub, shrub, and chaparral communities to maintain a mosaic of ages and species within strategic management corridors on roads, ridgetops, and near~~

~~residential development or other critical infrastructure to compartmentalize preserves and reduce fuel loads.~~

- Use prescribed fire to address multiple management objectives such as: training opportunities, public safety through fuels reduction, cultural-ecological enhancement with Native American tribes, and improved natural resource response to fire and rangeland resources.

Policy WF-5: Utilize programmatic documentation to increase the pace and scale of fuel treatments, ensuring that they are performed with the appropriate considerations for biological, cultural, and other natural resource constraints and to reduce regulatory hurdles to implementation.

- Perform fuel management activities under an approved Wildland Fire Resiliency Program that defines vegetation management, prescribed fire, pre-fire plans, and monitoring.
- Work to streamline or remove regulatory or policy or cost barriers that limit fuels reduction activities through the use of the programmatic documentation and defined mitigation, and CEQA exemptions, where feasible.
- Coordinate with air quality regulators to enable increased use of prescribed fire and to allow unplanned ignitions to burn to predesignated areas for resource benefit.

Policy WF-~~5~~6: Conduct prescribed burns to re-introduce fire into native ecosystems and maintain natural ecological processes on District lands.

- Continue to utilize fire as a resource management tool to reduce fuels and reestablish fire for resource benefit where vegetation conditions, access, and public safety permit. Coordinate with other agencies and tribes for planning and implementation, and perform prescribed burns following defined safety processes and protocols.
- Continue to utilize prescribed fire to reduce and prevent unwanted fire damage resulting from excessive fuel load and altered plant community structure and to control invasive species
- Conduct prescribed burns in an ecologically sound manner which mimic natural fire regimes and/or traditional cultural uses, and to promote biodiversity. Consider how traditional, indigenous fire management for food, fiber, and all forms of subsistence are different management tools and outcomes than defensible space, thinning, and prescribed fire, for example. Document/monitor the impact of traditional fire management on biodiversity, water yield and quality, and ecosystem resiliency.
- Develop burn units based on science and implement site-specific fire prescriptions to improve regeneration of fire-adapted and special status vegetation and to improve habitat conditions for special status wildlife in fire-dependent ecosystems where feasible (see ES-3).

- Develop and implement an alternative management protocol to encourage seedling establishment of special status and disturbance-adapted species in aging stands when regeneration by fire is not feasible
- Conduct public outreach to recreational users, adjacent landowners and the general public through mailings, web site postings and press releases related to the benefits of prescribed fire and other fire management activities and inform the public of the District's safety protocols and processes associated with prescribed burns.

Policy WF-~~6~~7: Foster and maintain interagency fire management partnerships

- Annually coordinate with fire management and other resource agencies to discuss pre-fire planning conditions and needs in advance of the fire season, and also coordinate with tribes regarding feedback on prescribed burning plans and goals
- Participate in county Fire Safe Councils ~~and Community Wildfire Protection Plan (CWPP) efforts.~~
- Incorporate and include the recommendations of the Community Wildfire Protection Plans (CWPPs) adopted for San Mateo and Santa Clara Counties into the District's vegetation management practices, as appropriate and where they align with the District's practices.
- Train with fire agencies and participate in training burns when possible.
- Complete and distribute to fire agencies up-to-date maps of Preserve infrastructure including existing road network available for wildland fire management, helicopter landing zones, safety zones, evacuation routes, and other pertinent information, as the maps become available.

Policy WF-~~7~~8: Conduct research and monitoring to refine fire management practices (See also RC)

- ~~Census and m~~Map in geographic information systems (GIS) databases forest and fuel conditions, including hazardous fuel areas, treatment areas and zones, tree hazard management zones or areas, and other hazards and update regularly (also see RC-1)
- Monitor pre-project vegetation, soil, erosion, and water quality to establish baseline conditions for post project analysis.
- Monitor post fire and vegetation management projects to assess the achievement of project objectives and to identify potential impacts to vegetation, soil, erosion, and water quality. Implement adaptive management to respond to ecological feedback from monitoring efforts to optimize future fuel treatments and to determine the level of resources necessary to effectively identify, plan, and implement fire management activities. Manage fire breaks to decrease erosion and the spread of invasive plants.
- Conduct monitoring in a manner consistent with other land management agencies to obtain comparable data. Implement dynamic/interactive mapping and other

methods to actively share information with surrounding and partner agencies and jurisdictions and information technology infrastructure allows.

- Utilize the latest technology to monitor weather and other real-time conditions on the preserves to improve response in the event of wildfire.
- Integrate the latest research, techniques, and technology on fire resiliency and risk into the District's forest health and vegetation monitoring, forestry practices, and fuels management practices, as part of the adaptive management strategy. \
- Foster relationships with educational institutions, scientists, tribal entities, and other land management professionals to inform District land management decisions based upon sound, current science, and to create opportunities for continuing research. Seek grants and pursue partnerships for research and monitoring.
- Integrate wildland fire management into District interpretation and education programs.
- Collaborate with local fire departments and safe fire councils to educate adjacent landowners about the need to: maintain defensible space between their properties and parklands; inspect and remove hazard trees; detect and treat diseased plants; and contain spread of disease.
- Collaborate with the tribes on cultural practices for prescribed fire

Policy WF-~~8~~9: Wildland Fire management actions on District lands in the Coastside Protection Area will be in accordance with the policies established in the Service Plan for the San Mateo Coastal Annexation Area

- In consultation with the County of San Mateo Environmental Services Department and fire agencies, determine whether the construction of dry hydrants on specific lands acquired is feasible in order to provide additional remote area water supplies for fire suppression activities.
- Select native plant materials and/or seed mixes utilized at staging areas or along trails for their low maintenance and drought and fire resistant characteristics to minimize additional fuel available to wildland fires to the extent feasible.
- Where compatible with other trail characteristics, planners shall locate trail alignments and access points to allow trails to also serve as emergency access routes for patrol or emergency medical transport. Where feasible for more remote areas, emergency helicopter landing sites shall be provided.
- Coordinate with appropriate agencies, such as the County and Cal Fire to formalize mutual aid agreements.
- Consult with fire agencies in developing site-specific fuel modification and management programs for specific lands acquired as part of its Use and Management planning process, in addition to continuing the current District fuel management practices.
- Prohibit smoking, firearms, fireworks and off-road vehicle use and limit trail use, picnicking, and camping to designated ~~activities~~ areas.

- Develop and maintain staging areas and trail heads in accordance with the wildland fire hazard mitigation measures established in the Service Plan for the Coastside Protection Area.

4.2.4 Revisions to XVI. Climate Change

BACKGROUND
The Carbon Cycle

The carbon cycle is a natural process by which carbon moves between different stores or reservoirs, such as the atmosphere, oceans, sedimentary rocks, soils, and plant biomass. When burning fossil fuels, humans move a massive amount of carbon from the ground to the atmosphere, putting the carbon cycle out of balance and causing climate change. The two key approaches to solving climate change are 1) to avoid adding any more carbon to the atmospheric store and 2) to move carbon from the atmospheric store to safer stores, such as plant biomass and soils. Humans can avoid adding more carbon to the atmospheric store by reducing greenhouse gas emissions from fossil fuels and preventing the release of carbon in plants and soils. Wildfire poses a considerable threat to the carbon stock of forests and open space areas. Reducing the risks of catastrophic wildfires also helps to maintain existing carbon stores. Humans can facilitate the movement of carbon from the atmosphere into plant biomass and soils, also known as carbon sequestration, through land conservation and management. The District ~~stewards~~ has ~~over 63,000 acres~~ preserved nearly 65,000 acres of open space lands, including redwood forests, which store large amounts of carbon in trees, other vegetation, and soils.

The management of open space lands should include actively addressing and working to increase carbon sequestration while also reducing or mitigating the risk of loss of enormous quantities of existing carbon stock in catastrophic wildfire. Vegetation management should be performed carefully with the goal to reduce the risks of carbon loss through wildfire, while carefully balancing fuel reduction needs with managing the landscape for long-term increases in carbon storage.

Policy CC-3 Increase carbon sequestration in vegetation and soils and minimize carbon release from wildfire

- Manage conifer forests to sustain and encourage the development of late-seral habitat conditions (FM-4). Evaluate the potential to reduce forest fuel loading through the removal of smaller trees to reduce fuel buildup and ladder fuels (See FM-5).
- Manage vegetation communities to reduce the risk of catastrophic fire and to maintain biological diversity (WF-4). Conduct prescribed burns to re-introduce fire into native ecosystems and maintain natural ecological processes on District lands (See WF-5).
- Evaluate, study, and implement additional land management strategies to increase carbon sequestration in vegetation and soils.

- Improve data on carbon sequestration in District lands with a goal to pursue and maximize opportunities.
- Evaluate opportunities to create and sell carbon offsets on the California Cap and Trade market or other voluntary offset markets.
- Consider trade-offs between carbon sequestration losses from fuel load reduction and emissions from prescribed fire to establish ecological resiliency in the face of wildfire, given the overwhelming benefits of reduced risks of catastrophic wildland fire on climate change.

Policy CC-4: Prepare for climate change impacts and promote resilience for both natural and built environments.

- Prioritize ecosystem function, resilience, and ecological diversity focused on multiple species benefits, rather than aiming to prevent ecological change or return to past conditions.
- Establish goals for biodiversity and ecosystem structure and function to identify the types of diversity future conditions can support
- Incorporate climate change impacts on natural resources such as species range and phenology changes into restoration and monitoring activities. Utilize an adaptive management framework to adjust resource management methods and priorities as impacts start to occur and climate change knowledge and response options continue to increase (See GM-3).
- Support ecological functions and ecosystem services that protect the built environment from climate change impacts, such as flooding and increased wildland fire frequency and intensity.
- Incorporate climate change impacts to infrastructure, such as flooding, drought, and sea level rise, into planning, project design, and other relevant activities.
- Evaluate, study, and implement additional land management strategies to promote ecosystem resilience.

4.2.5 Revisions to VII. Scenic and Aesthetic Resources

Policy SA-2 Maintain significant landscapes or features that were formerly maintained by natural processes.

- Control encroaching vegetation where it adversely affects significant scenic, historic or habitat resources (See Vegetation Management, Cultural Resources, and Integrated Pest Management policies).
- Control vegetation to create or maintain important scenic viewpoints and vistas (See Vegetation Management and Integrated Pest Management policies).
- Require District tenants to maintain landscapes and improvements to acceptable visual standards that do not detract from a visitor's experience or adversely impact wildlife.

- <u>Allow for habitat changes associated with control of vegetation for fuelbreaks, disc lines, and prescribed burns under the concepts of ecological resiliency to reduce larger-scale aesthetic impacts of catastrophic wildfire.</u>

APPENDIX B

Vegetation Management Maps

APPENDIX B, PART 1

Existing and Potential Treatments (Overlaid on Topographic Maps)

Table of Contents

OSP's & Managed Properties	Page Number
Miramontes Ridge	1
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Sierra Azul	22
Sierra Azul	23
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Existing Treatments

- Defensible Space 30-foot
- Defensible Space 100-foot
- Fuelbreak 200-foot
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Wildland Type 3 Ingress/Egress
- Discline

Potential Fuels Treatments

- Defensible Space 30-foot
- Defensible Space 100-foot
- Fuelbreak 200-foot
- Fuelbreak 300-foot
- Eucalyptus and Acacia Removal
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Fuel Reduction Area
- Fire Agency Recommended
- Discline
- Wildland Type 3 Ingress/Egress

Critical Infrastructure

- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- R Communication
- E Evacuation Center
- F Fire Station
- B ICP
- M Medivac Site
- SIP Shelter-in-Place
- Water Collection Point
- Water Tank

Target Hazards

- Assisted Living Facility
- Camp Site
- H Hospital
- Community Center
- School
- Mobile Home Park

Fire Management Logistics

- H Helispot
- Lookout
- Safety Zone
- S Staging

Non-Midpen Treatments

- Potential Non-Midpen Projects
- Existing & Proposed Non-Midpen Treatments
- CWPP Priority Areas

OSP & Managed Properties

- Boundary
- Bear Creek Redwoods
- Coal Creek
- El Corte de Madera Creek
- El Sereno
- Felton Station
- Foothills
- Fremont Older
- La Honda Creek
- Long Ridge
- Los Trancos
- Miramontes Ridge
- Monte Bello
- Picchetti Ranch
- Pulgas Ridge
- Purisima Creek Redwoods
- Rancho San Antonio
- Rancho San Antonio County Park
- Ravenswood
- Russian Ridge
- Saratoga Gap
- Sierra
- Skyline Ridge
- St. Joseph's Hill
- Stevens Creek Shoreline Nature Study Area
- Teague Hill
- Thornewood
- Tunitas Creek
- Windy Hill

Buildings

- Buildings Near Preserves

Elevation Contour

- 40ft Interval

These maps are for reference only. Although every effort has been made to ensure the accuracy of information, errors and conditions originating from physical sources used to develop the data may be reflected on this map. Midpeninsula Regional Open Space District shall not be liable for any errors, omissions, or damages that result from inappropriate use of this document.

Vegetation management on easements over Midpen lands is the responsibility of the easement holder unless there is a cost-share agreement in place.

Existing and Potential Treatments
Miramontes Ridge

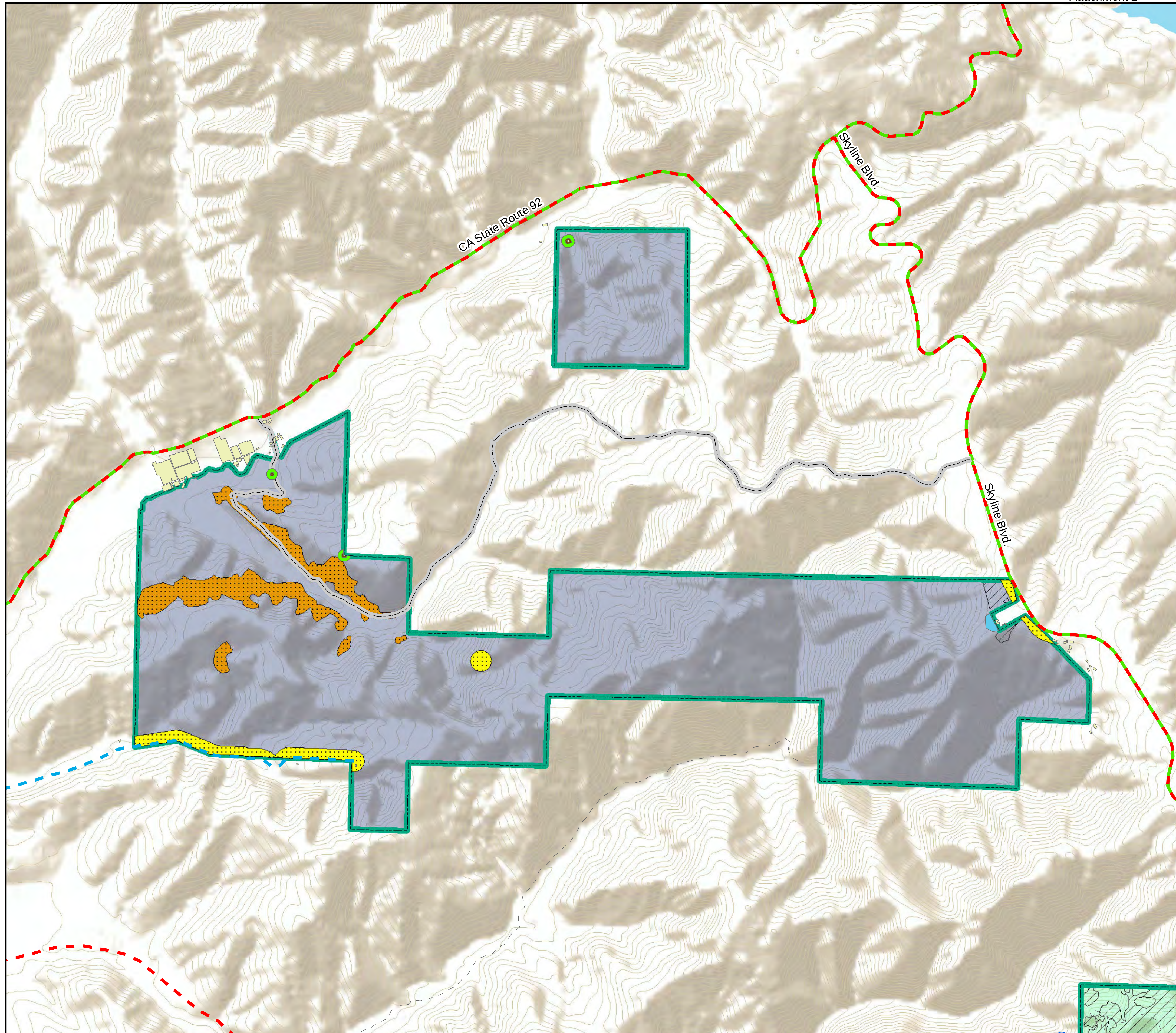
Existing Treatments
- Defensible Space 30-foot
- Defensible Space 100-foot
- Non-Shaded Fuelbreak

Potential Fuels Treatments
- Fuelbreak 200-foot
- Eucalyptus and Acacia Removal
- Fuel Reduction Areas
- Wildland Type 3 Ingress/Egress

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail

Fire Management Logistics
- Helispot

OSP & Managed Properties
- Boundary
- Miramontes Ridge
- Purisima Creek Redwoods



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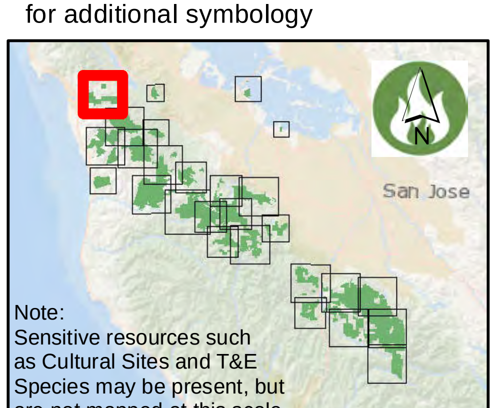


Note:
Sensitive resources such as Cultural Sites and T&E Species may be present, but are not mapped at this scale.

0 0.25 0.5 Miles

Date Printed: 3/10/2020

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Existing and Potential Treatments
Pulgas Ridge

Existing Treatments

- Defensible Space 30-foot
- Fuelbreak 200-foot
- Non-Shaded Fuelbreak
- Discline

Potential Fuels Treatments

- Fuelbreak 200-foot
- Fuelbreak 300-foot
- Eucalyptus and Acacia Removal
- Shaded Fuelbreak
- Fire Agency Recommended
- Fuel Reduction Areas

Critical Infrastructure

- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- R Communication
- F Fire Station
- Water Collection Point

Target Hazards

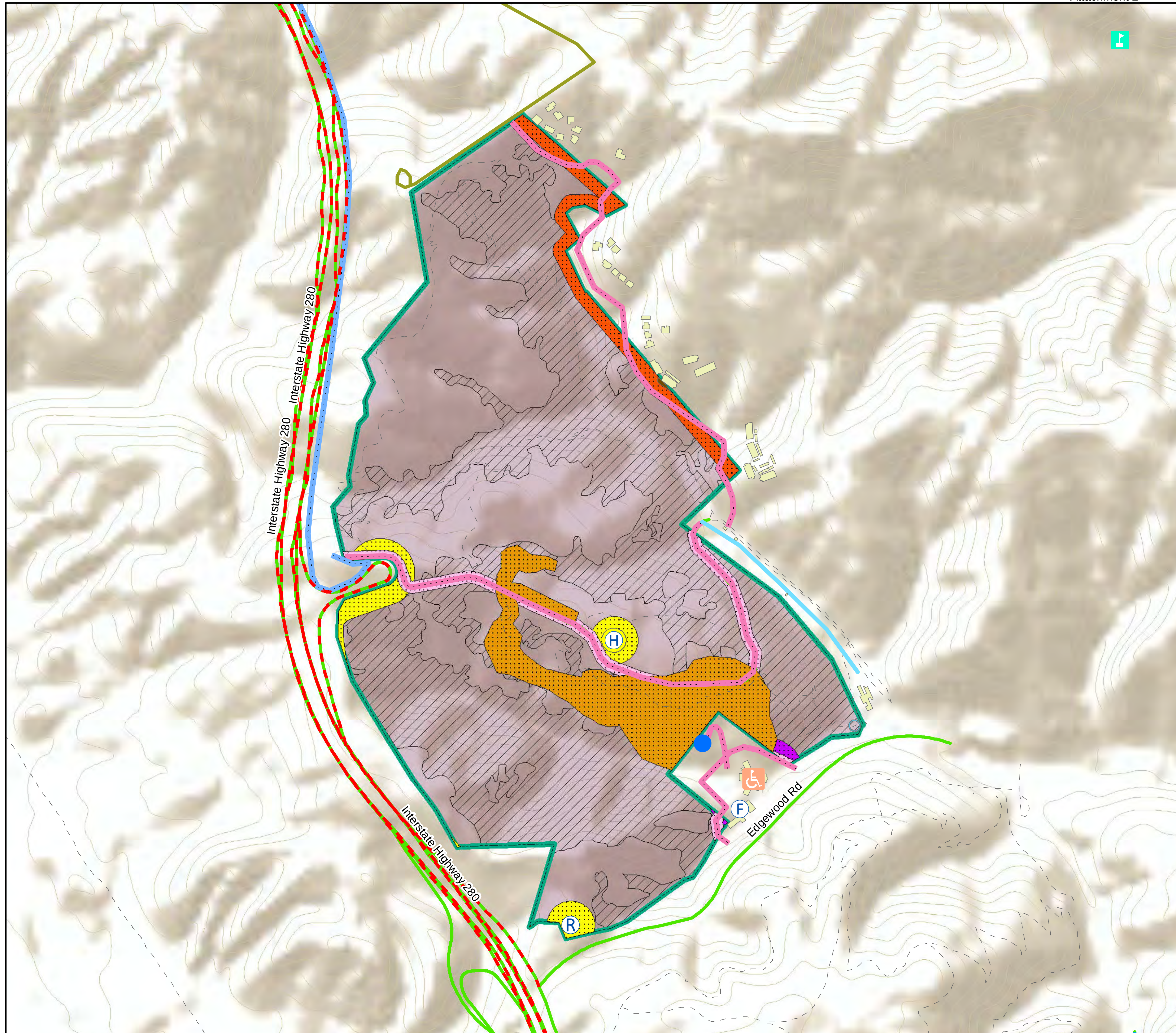
- Assisted Living Facility
- School

Fire Management Logistics

- H Helispot

OSP & Managed Properties

- Boundary
- Pulgas Ridge



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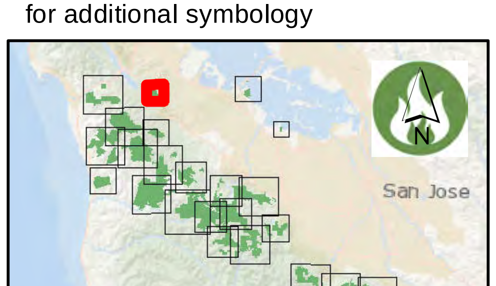

Note:
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0 0.25 0.5 Miles

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Existing and Potential Treatments
Purisima Creek Redwoods

Existing Treatments
- Defensible Space 30-foot
- Defensible Space 100-foot
- Fuelbreak 200-foot
- Non-Shaded Fuelbreak
- Shaded Fuelbreak

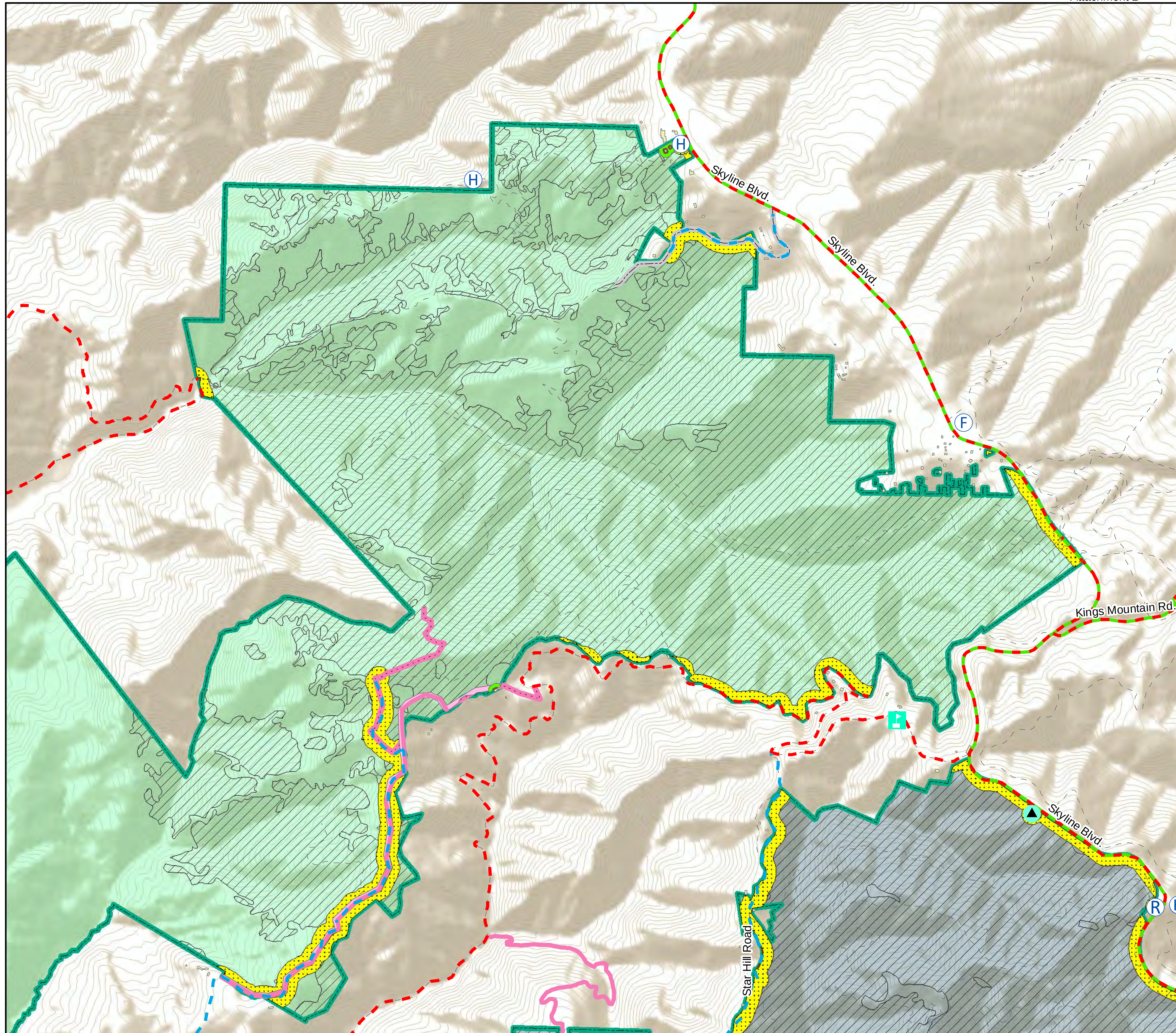
Potential Fuels Treatments
- Fuelbreak 200-foot
- Shaded Fuelbreak
- Fuel Reduction Areas
- Wildland Type 3 Ingress/Egress

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- Communication
- Fire Station
- Water Tank

Target Hazards
- School

Fire Management Logistics
- Helispot

OSP & Managed Properties
- Boundary
- El Corte de Madera Creek
- Purisima Creek Redwoods



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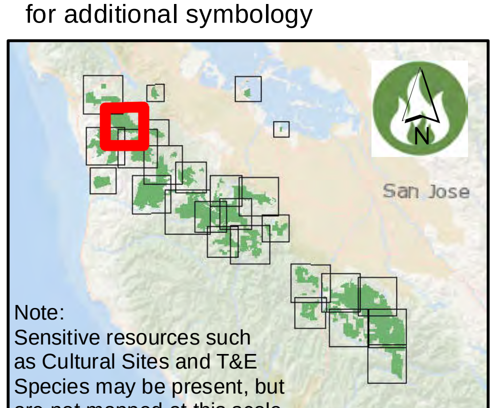


0 0.25 0.5 Miles

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

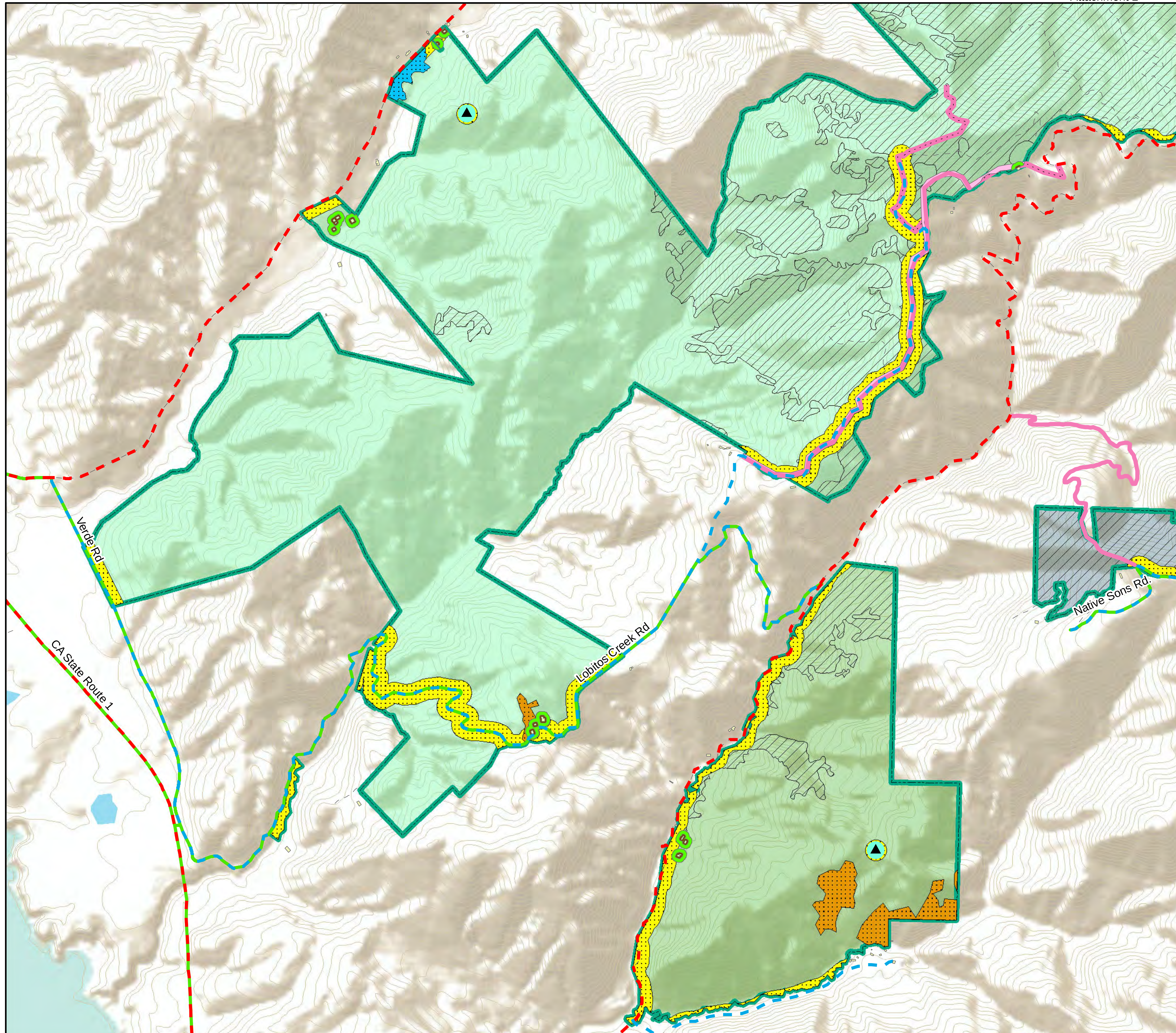
Existing and Potential Treatments
Purisima Creek/Tunitas Creek

Existing Treatments
- Defensible Space 30-foot
- Defensible Space 100-foot
- Shaded Fuelbreak

Potential Fuels Treatments
- Fuelbreak 200-foot
- Eucalyptus and Acacia Removal
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Fuel Reduction Areas

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- Water Tank

OSP & Managed Properties
- Boundary
- El Corte de Madera Creek
- Purisima Creek Redwoods
- Tunitas Creek



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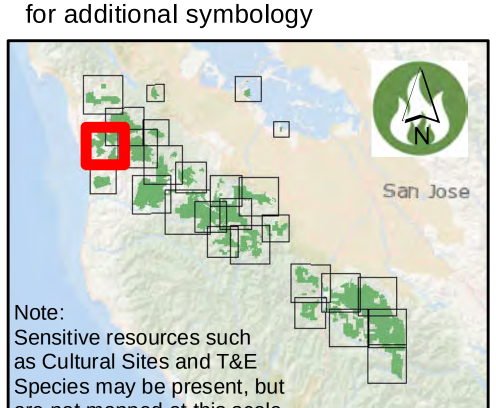


0 0.25 0.5 Miles

Date Printed: 3/10/2020

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

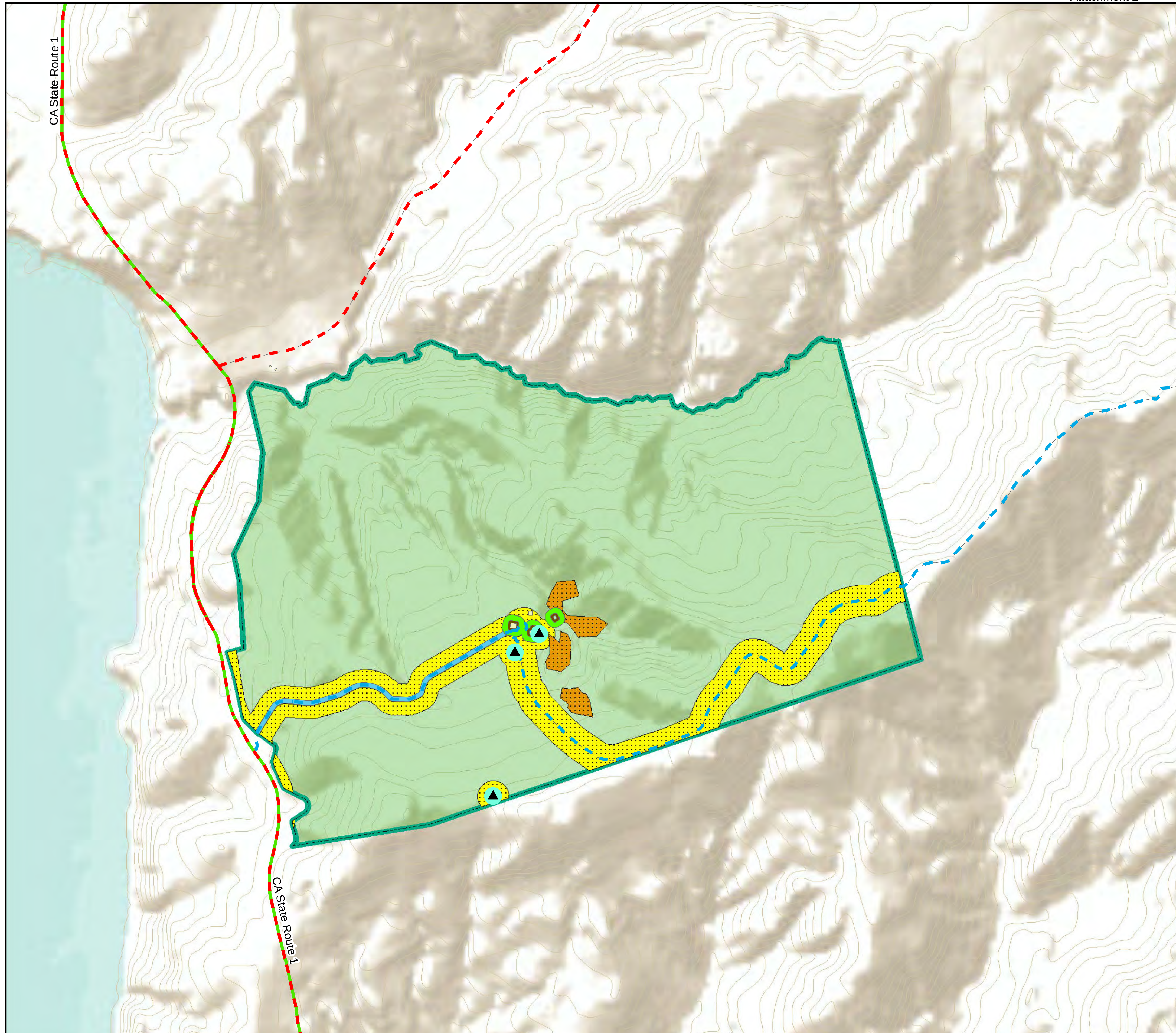
Existing and Potential Treatments
Tunitas Creek

Existing Treatments
- Defensible Space 30-foot
- Defensible Space 100-foot
- Non-Shaded Fuelbreak

Potential Fuels Treatments
- Fuelbreak 200-foot
- Eucalyptus and Acacia Removal

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- Water Tank

OSP & Managed Properties
- Boundary
- Tunitas Creek



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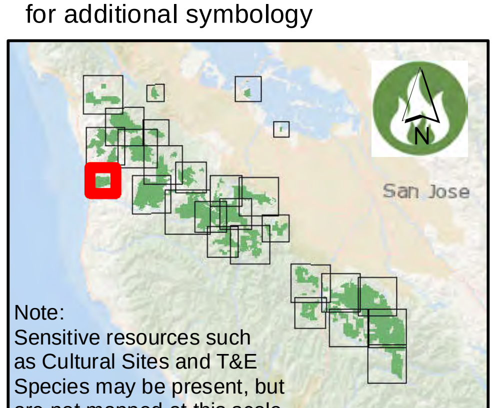

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Date Printed: 3/10/2020

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Existing and Potential Treatments
Teague Hill

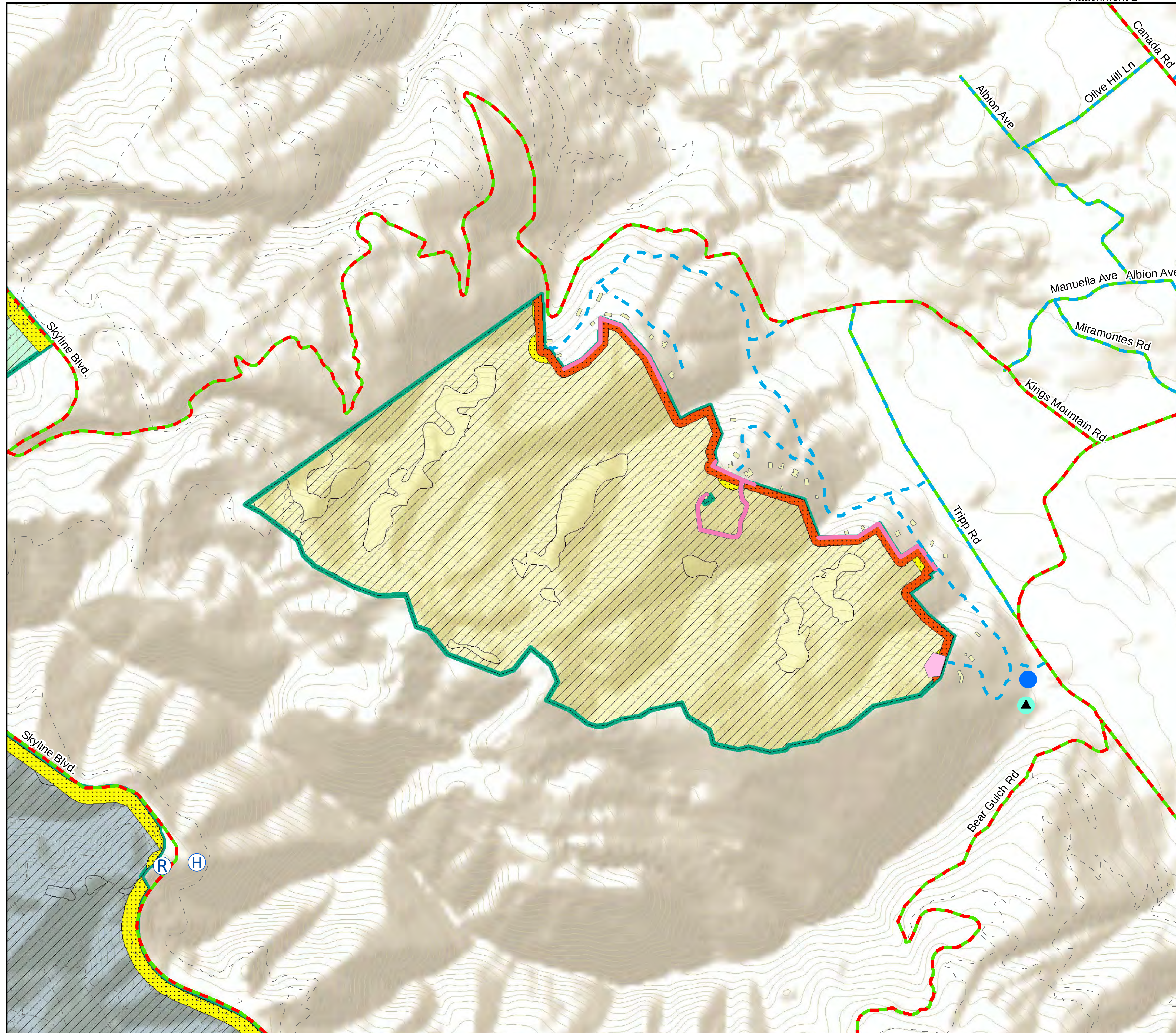
Existing Treatments
- Defensible Space 100-foot
- Shaded Fuelbreak

Potential Fuels Treatments
- Fuelbreak 200-foot
- Fire Agency Recommended
- Fuel Reduction Areas

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- Communication
- Water Collection Point
- Water Tank

Fire Management Logistics
- Helispot

OSP & Managed Properties
- Boundary
- El Corte de Madera Creek
- Purisima Creek Redwoods
- Teague Hill



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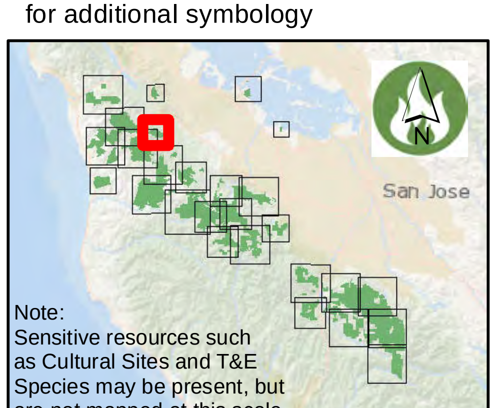


Note:
Sensitive resources such as Cultural Sites and T&E Species may be present, but are not mapped at this scale.

0 0.25 0.5 Miles

Date Printed: 3/10/2020

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Existing and Potential Treatments
El Corte de Madera Creek

Existing Treatments
- Defensible Space 30-foot
- Defensible Space 100-foot
- Fuelbreak 200-foot
- Non-Shaded Fuelbreak
- Shaded Fuelbreak

Potential Fuels Treatments
- Fuelbreak 200-foot
- Eucalyptus and Acacia Removal
- Shaded Fuelbreak
- Fire Agency Recommended
- Fuel Reduction Areas
- Wildland Type 3 Ingress/Egress

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- Communication
- Water Tank

Target Hazards
- School

Fire Management Logistics
- Helispot

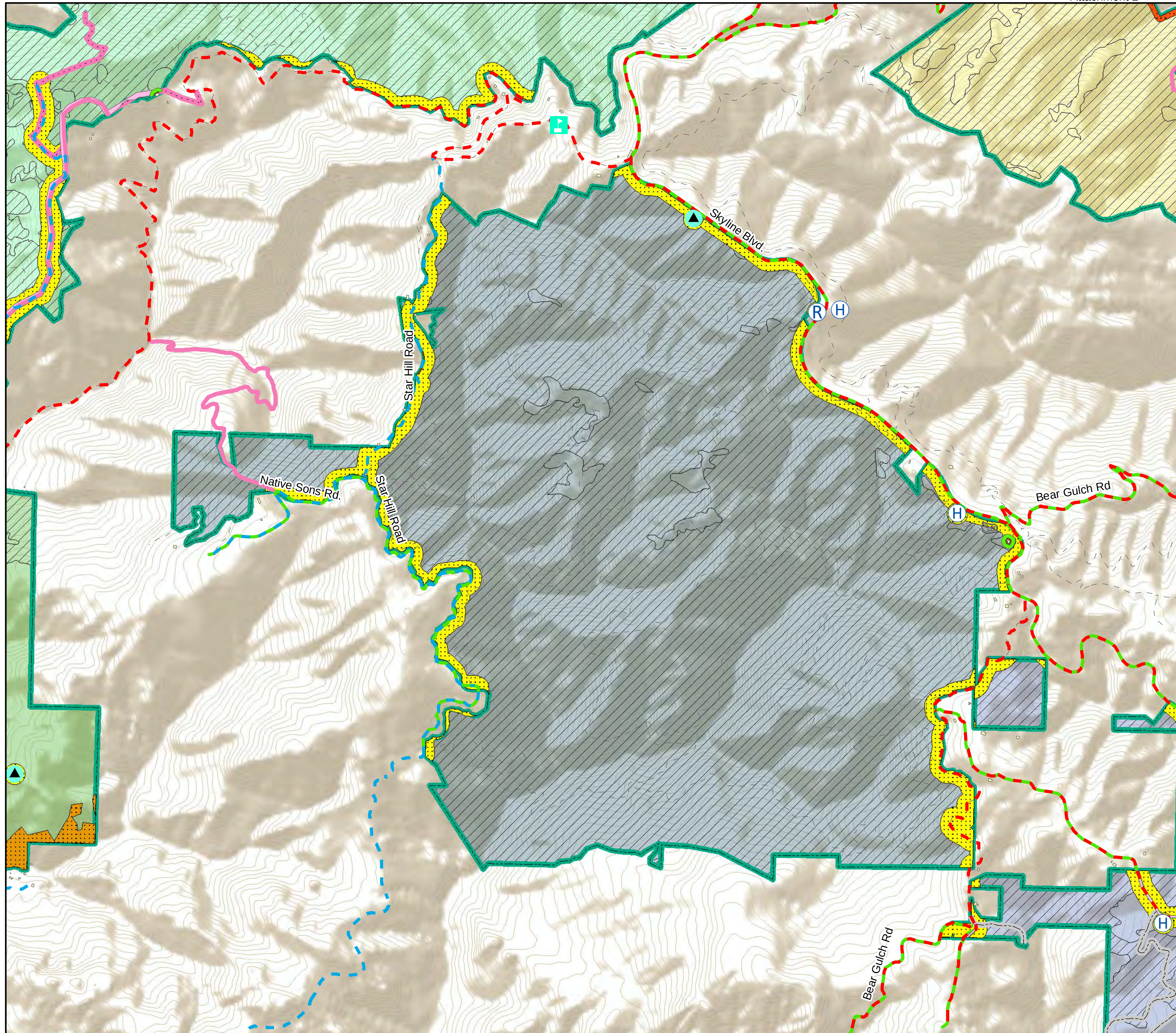
OSP & Managed Properties
- Boundary
- El Corte de Madera Creek
- La Honda Creek
- Purisima Creek Redwoods
- Teague Hill
- Tunitas Creek

* See Table of Contents page for additional symbology

Note:
Sensitive resources such as Cultural Sites and T&E Species may be present, but are not mapped at this scale.

0 0.25 0.5 Miles

Attachment 2



Date Printed: 3/10/2020

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Existing and Potential Treatments
La Honda Creek/Thornewood

Existing Treatments
- Defensible Space 30-foot
- Defensible Space 100-foot
- Fuelbreak 200-foot
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Discline

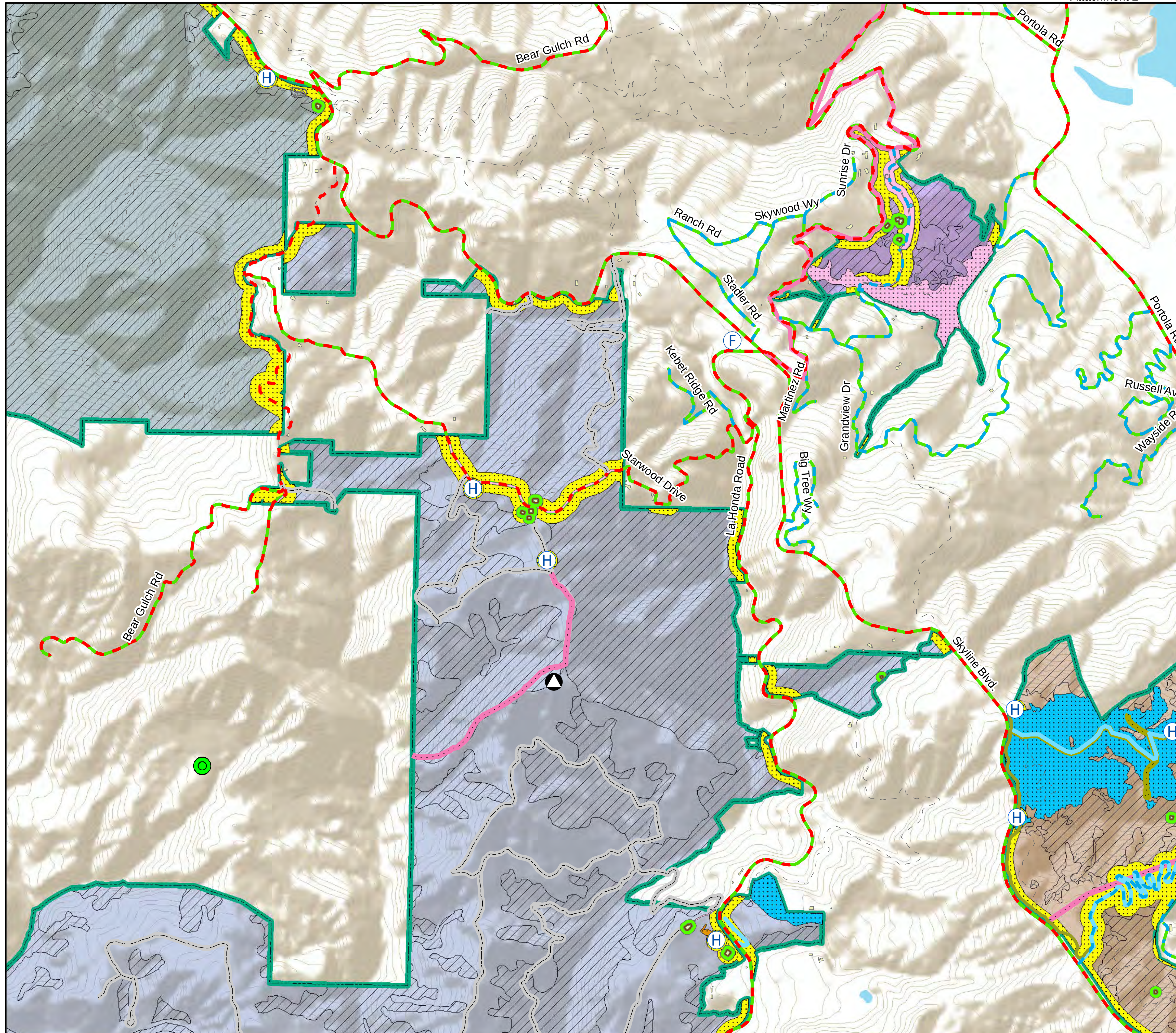
Potential Fuels Treatments
- Fuelbreak 200-foot
- Eucalyptus and Acacia Removal
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Fuel Reduction Areas
- Discline
- Wildland Type 3 Ingress/Egress

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- Fire Station

Target Hazards
- Community Center

Fire Management Logistics
- Helispot
- Lookout

OSP & Managed Properties
- Boundary
- El Corte de Madera Creek
- La Honda Creek
- Thornewood
- Windy Hill



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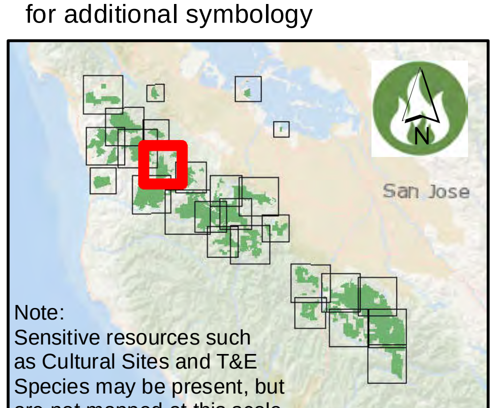


0 0.25 0.5 Miles

Date Printed: 3/10/2020

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Existing and Potential Treatments
La Honda Creek

Existing Treatments
- Defensible Space 30-foot
- Defensible Space 100-foot
- Fuelbreak 200-foot
- Non-Shaded Fuelbreak
- Shaded Fuelbreak

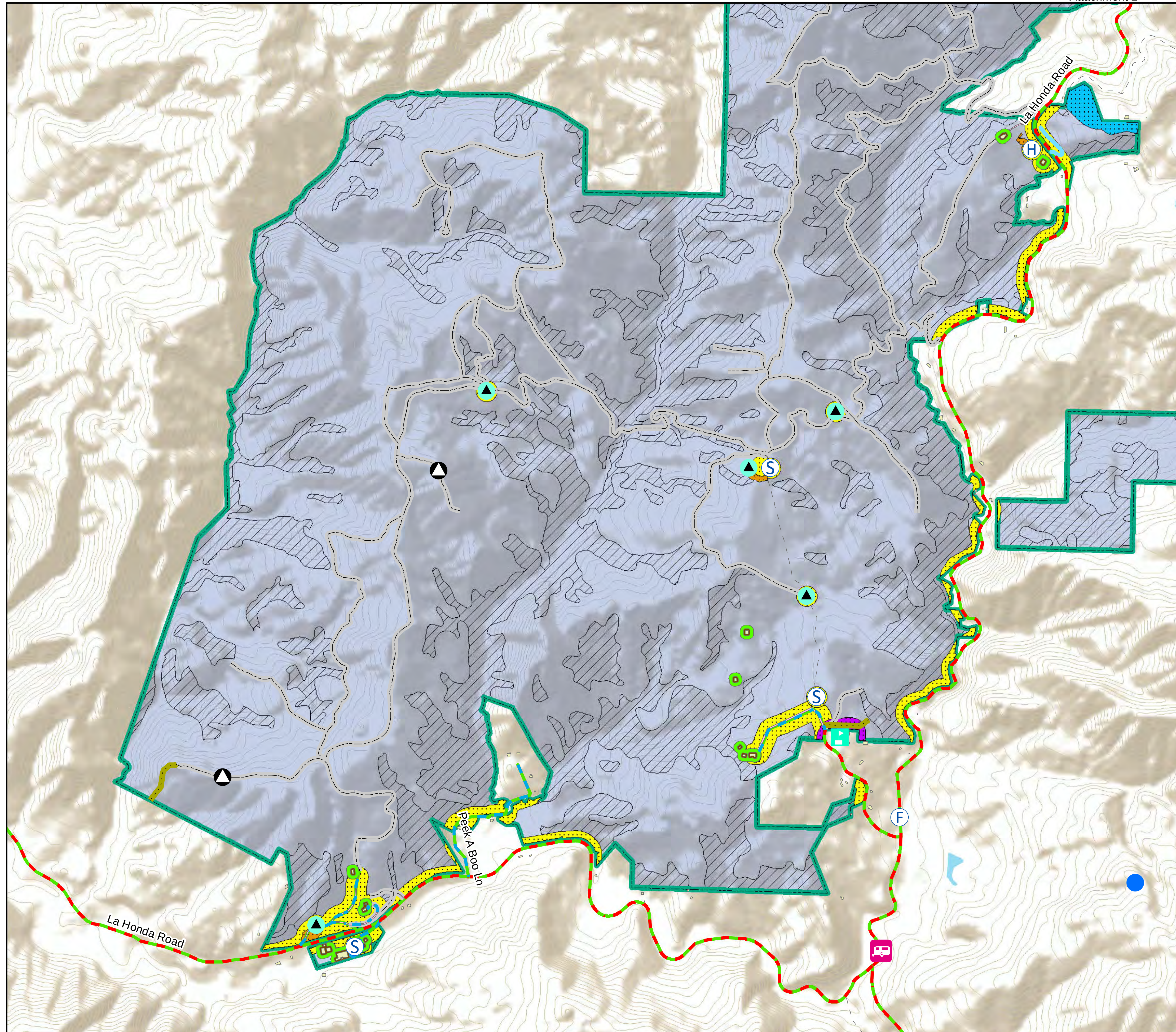
Potential Fuels Treatments
- Fuelbreak 200-foot
- Fuelbreak 300-foot
- Eucalyptus and Acacia Removal
- Non-Shaded Fuelbreak
- Fuel Reduction Areas
- Discline
- Wildland Type 3 Ingress/Egress

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- Fire Station
- Water Collection Point
- Water Tank

Target Hazards
- School
- Mobile Home Park

Fire Management Logistics
- Helispot
- Lookout
- Staging Area

OSP & Managed Properties
- Boundary
- La Honda Creek



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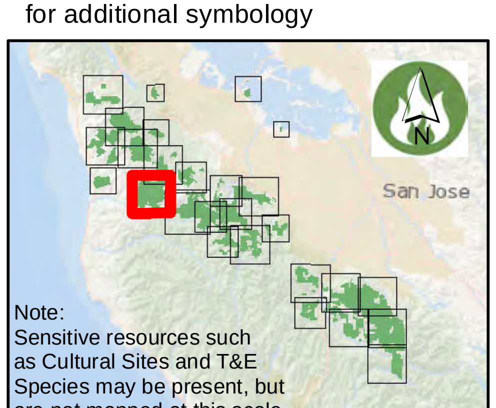


0 0.25 0.5 Miles

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Existing and Potential Treatments
Windy Hill

Existing Treatments
- Defensible Space 30-foot
- Defensible Space 100-foot
- Fuelbreak 200-foot
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Discline

Potential Fuels Treatments
- Fuelbreak 200-foot
- Fuelbreak 300-foot
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Fuel Reduction Areas
- Discline
- Wildland Type 3 Ingress/Egress

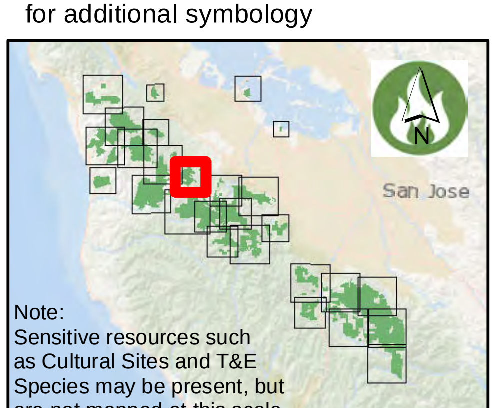
Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- Fire Station
- SIP Shelter-in-Place
- Water Collection Point

Target Hazards
- Assisted Living Facility
- School

Fire Management Logistics
- Helispot

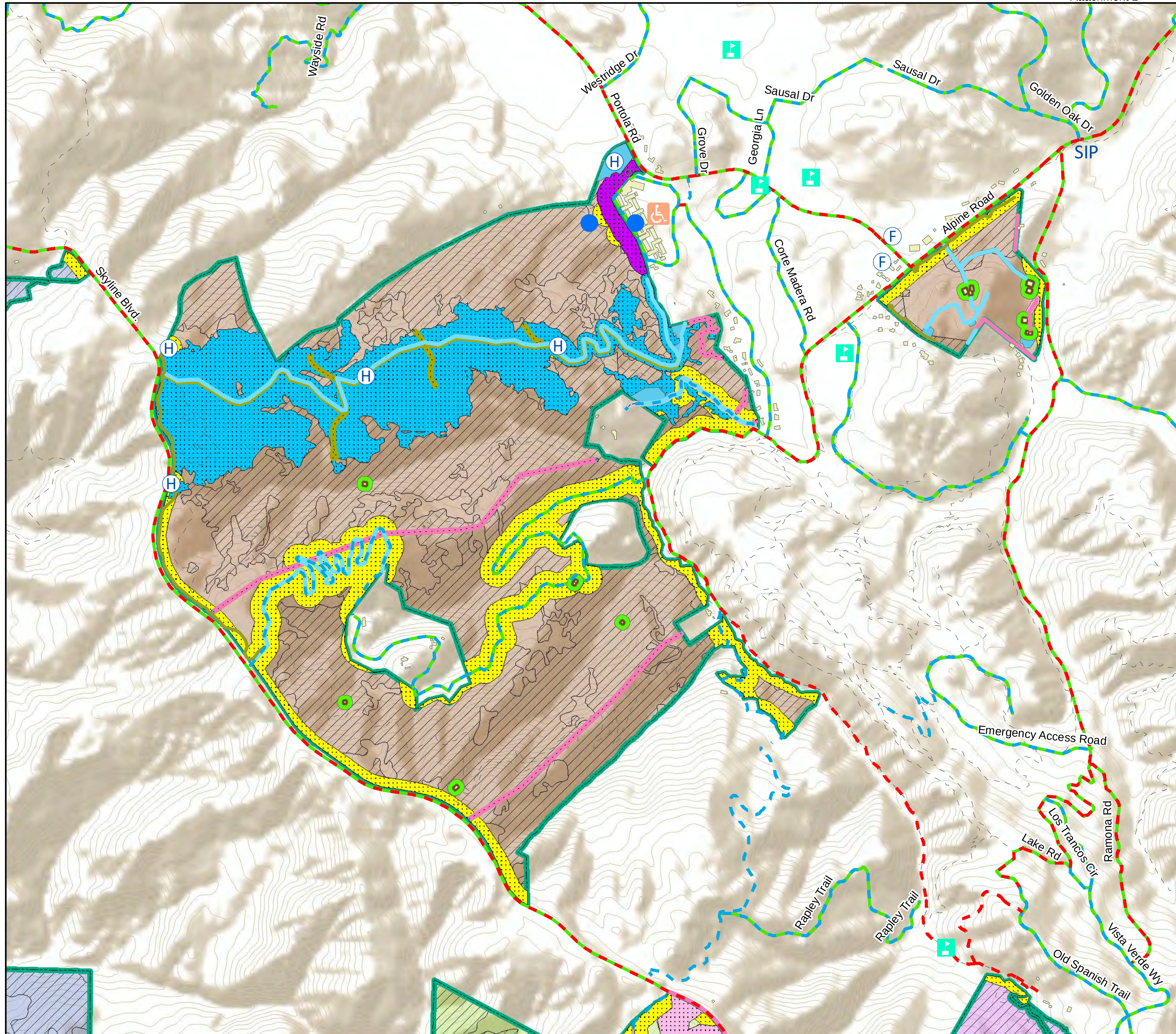
OSP & Managed Properties
- Boundary
- Coal Creek
- La Honda Creek
- Russian Ridge
- Windy Hill

* See Table of Contents page for additional symbology



0 0.25 0.5 Miles

Attachment 2



Date Printed: 3/10/2020

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Existing and Potential Treatments
Russian Ridge/Coal Creek

Attachment 2

Existing Treatments
- Defensible Space 30-foot
- Defensible Space 100-foot
- Fuelbreak 200-foot
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Discline

Potential Fuels Treatments
- Fuelbreak 200-foot
- Fuelbreak 300-foot
- Eucalyptus and Acacia Removal
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Fire Agency Recommended
- Fuel Reduction Areas
- Wildland Type 3 Ingress/Egress

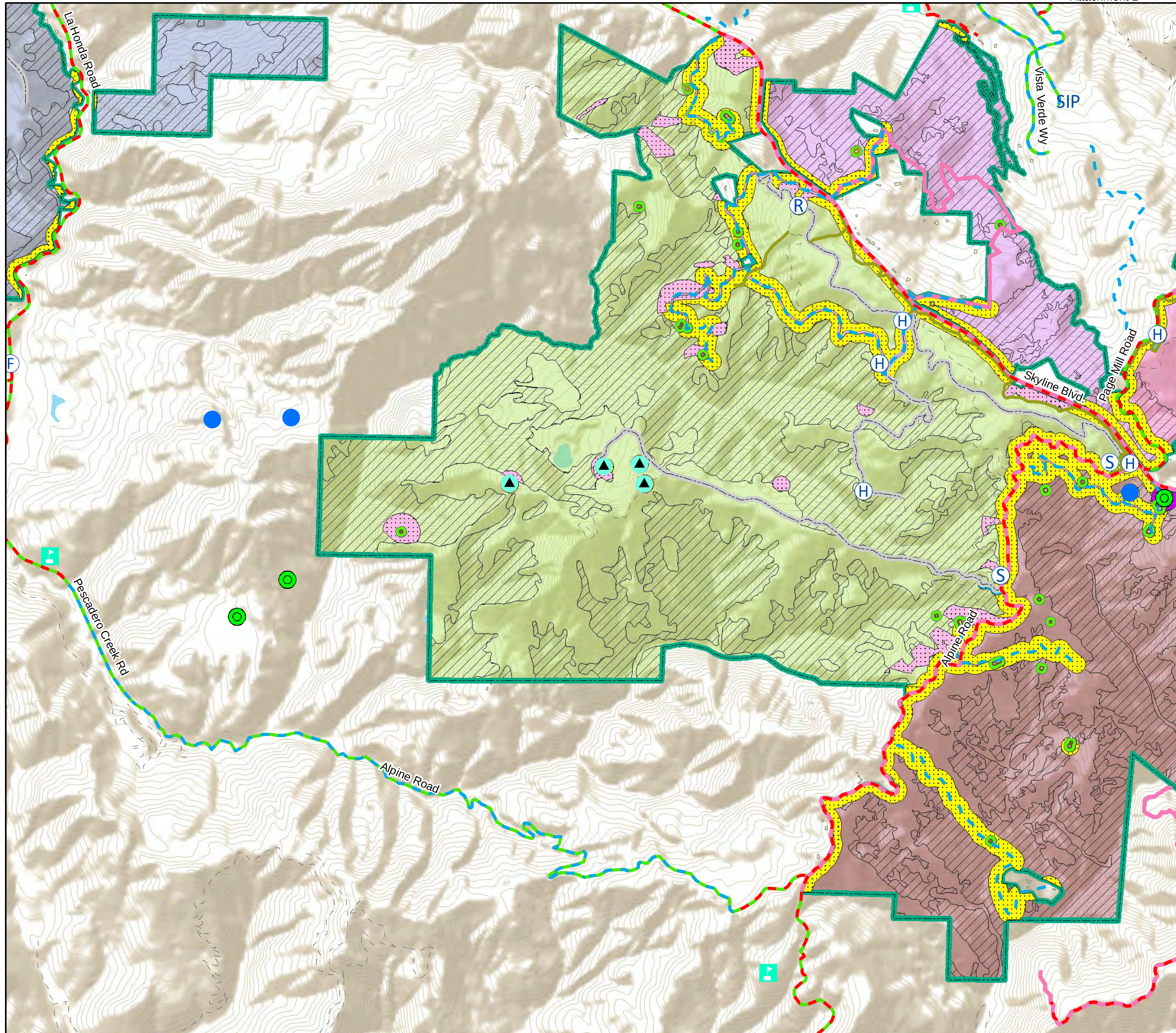
Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- Communication
- Fire Station
- Shelter-in-Place
- Water Collection Point
- Water Tank

Target Hazards
- Community Center
- School

Fire Management Logistics
- Helispot
- Staging Area

OSP & Managed Properties
- Boundary
- Coal Creek
- La Honda Creek
- Los Trancos
- Monte Bello
- Russian Ridge
- Skyline Ridge

* See Table of Contents page for additional symbology



Note:
Sensitive resources such as Cultural Sites and T&E Species may be present, but are not mapped at this scale.

0 0.25 0.5 Miles

Date Printed: 3/10/2020

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Existing and Potential Treatments
Foothills/Los Trancos

Existing Treatments
- Defensible Space 30-foot
- Defensible Space 100-foot
- Fuelbreak 200-foot
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Discline

Potential Fuels Treatments
- Fuelbreak 200-foot
- Fuelbreak 300-foot
- Eucalyptus and Acacia Removal
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Fuel Reduction Areas
- Wildland Type 3 Ingress/Egress

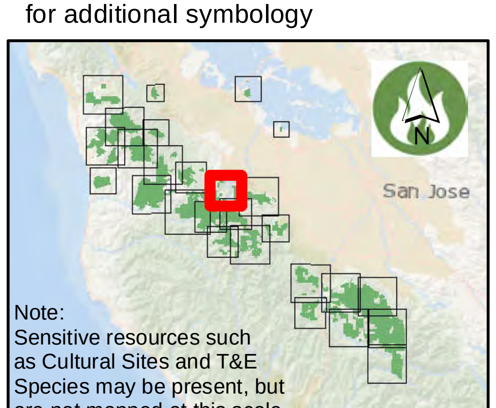
Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- R Communication
- SIP Shelter-in-Place
- Water Tank

Target Hazards
- Community Center

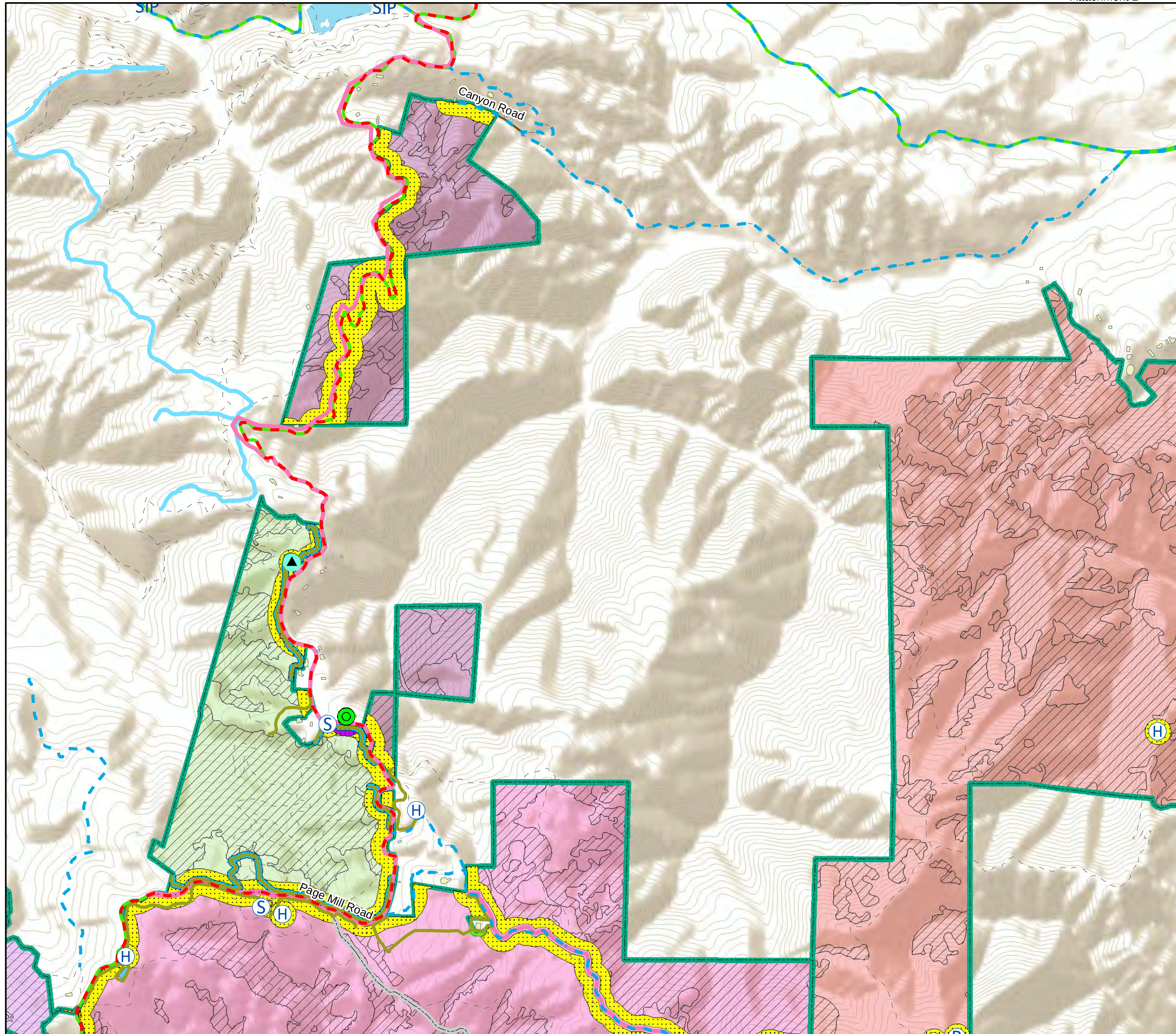
Fire Management Logistics
- H Helispot
- S Staging

OSP & Managed Properties
- Boundary
- Coal Creek
- Foothills
- Los Trancos
- Monte Bello
- Rancho San Antonio

* See Table of Contents page for additional symbology



0 0.25 0.5 Miles



Date Printed: 3/10/2020

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Existing and Potential Treatments
Rancho San Antonio

Existing Treatments
- Defensible Space 30-foot
- Defensible Space 100-foot
- Fuelbreak 200-foot
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Discline

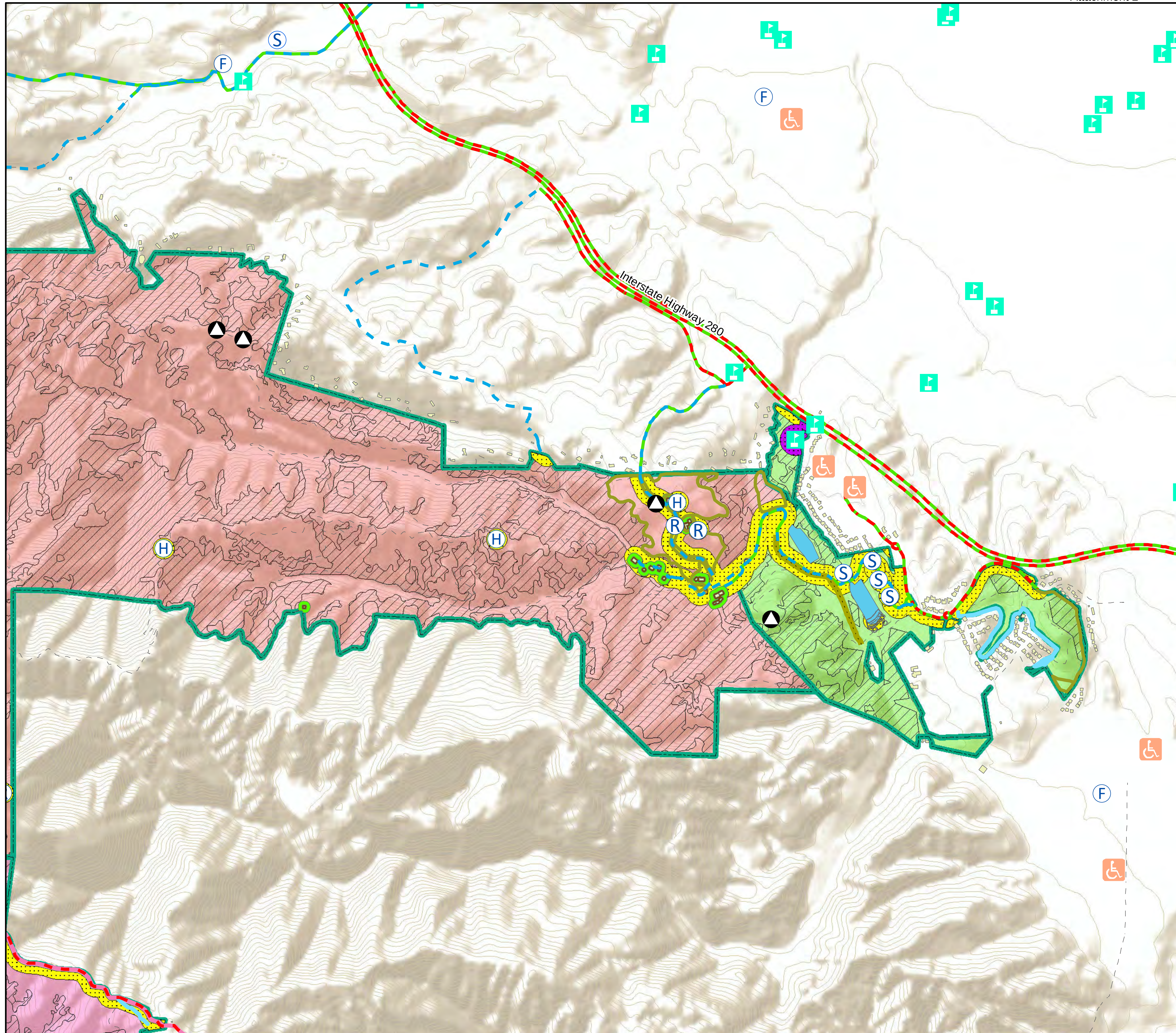
Potential Fuels Treatments
- Fuelbreak 200-foot
- Fuelbreak 300-foot
- Eucalyptus and Acacia Removal
- Non-Shaded Fuelbreak
- Fuel Reduction Areas
- Discline

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- Communication
- Fire Station

Target Hazards
- Assisted Living Facility
- School

Fire Management Logistics
- Helispot
- Lookout
- Staging

OSP & Managed Properties
- Boundary
- Monte Bello
- Rancho San Antonio
- Rancho San Antonio County Park



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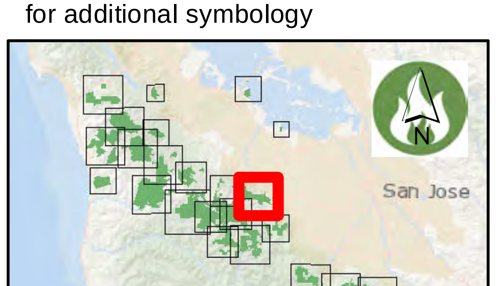


Note:
Sensitive resources such as Cultural Sites and T&E Species may be present, but are not mapped at this scale.

0 0.25 0.5 Miles

Date Printed: 3/10/2020

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Existing and Potential Treatments
Monte Bello/Skyline Ridge

Existing Treatments
- Defensible Space 30-foot
- Defensible Space 100-foot
- Fuelbreak 200-foot
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Discline

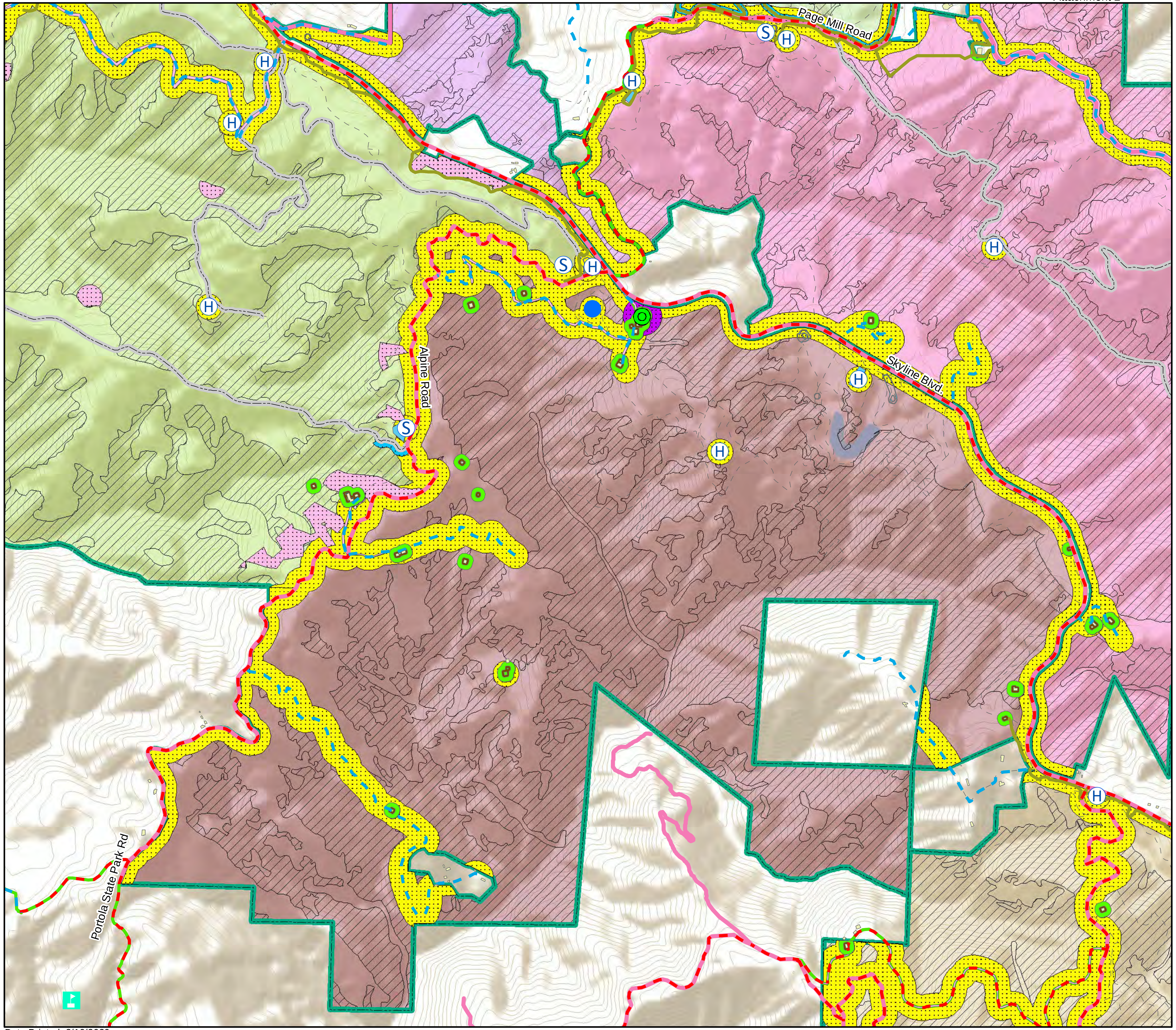
Potential Fuels Treatments
- Fuelbreak 200-foot
- Fuelbreak 300-foot
- Eucalyptus and Acacia Removal
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Fire Agency Recommended
- Fuel Reduction Areas
- Wildland Type 3 Ingress/Egress

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- Water Collection Point

Target Hazards
- Community Center
- School

Fire Management Logistics
- Helispot
- Staging Area

OSP & Managed Properties
- Boundary
- Coal Creek
- Long Ridge
- Los Trancos
- Monte Bello
- Russian Ridge
- Skyline Ridge



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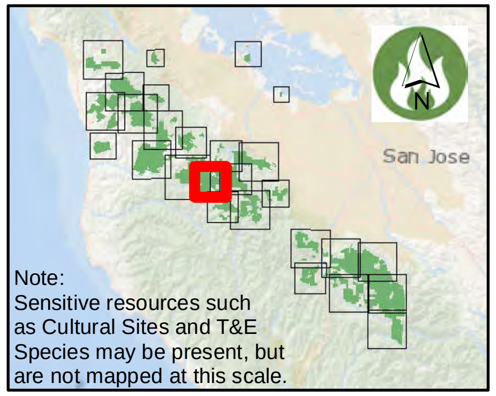


0 0.25 0.5 Miles

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Existing and Potential Treatments
Monte Bello/Long Ridge

Existing Treatments
- Defensible Space 30-foot
- Defensible Space 100-foot
- Fuelbreak 200-foot
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Discline

Potential Fuels Treatments
- Fuelbreak 200-foot
- Fuelbreak 300-foot
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Fuel Reduction Areas
- Wildland Type 3 Ingress/Egress

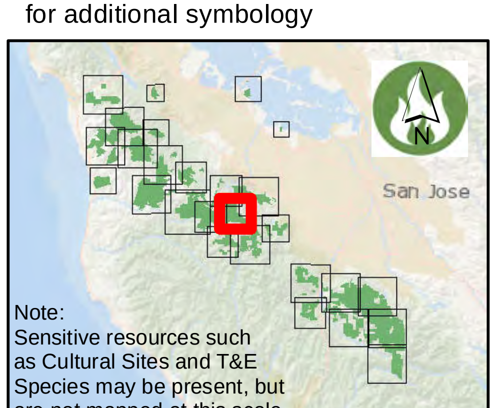
Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- Communication
- SIP Shelter-in-Place
- Water Collection Point

Target Hazards
- Camp Site

Fire Management Logistics
- Helispot
- Lookout

OSP & Managed Properties
- Boundary
- Foothills
- Long Ridge
- Los Trancos
- Monte Bello
- Rancho San Antonio
- Skyline Ridge

* See Table of Contents page for additional symbology



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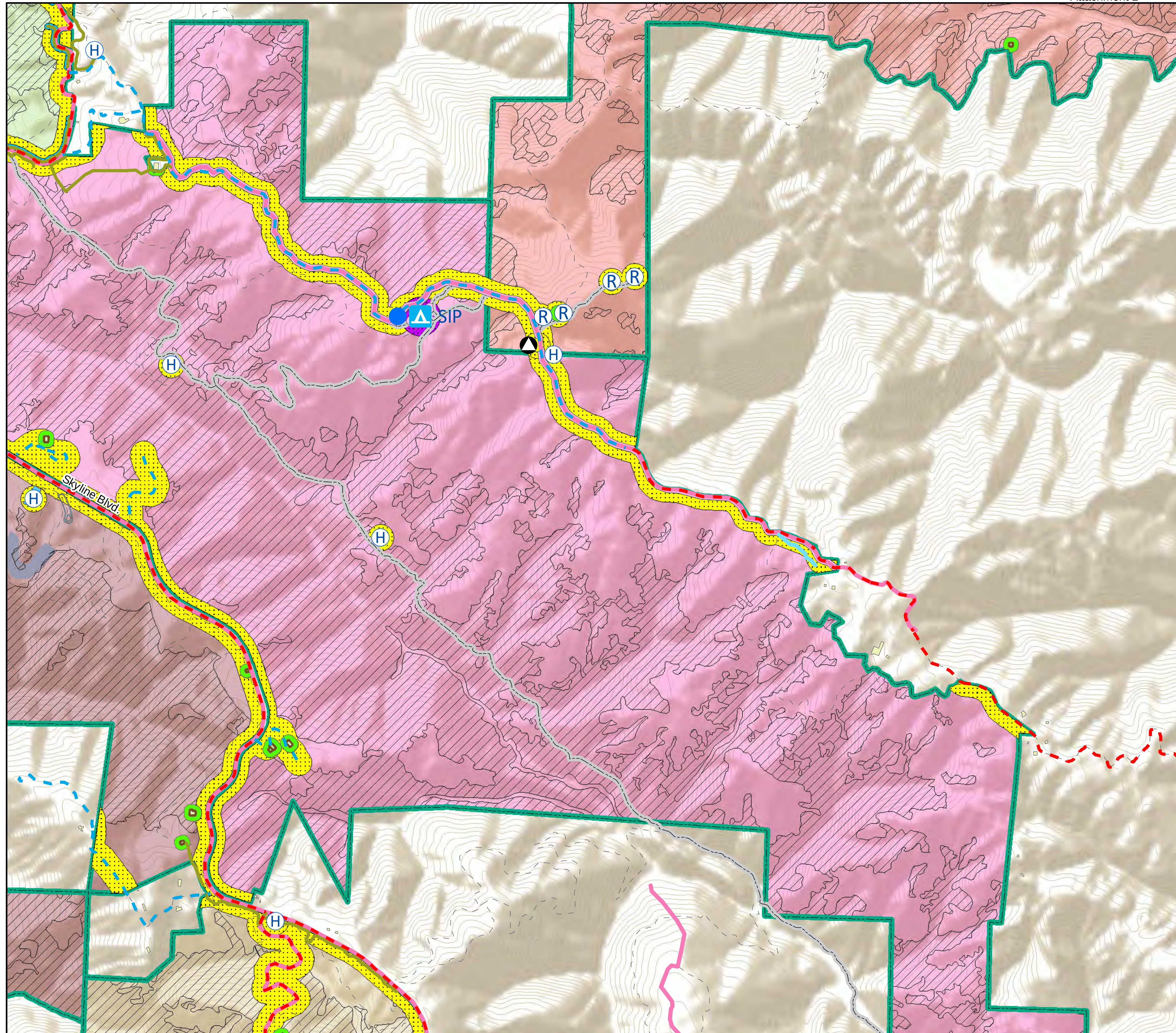
Attachment 2



Date Printed: 3/10/2020

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Existing and Potential Treatments
Long Ridge

Existing Treatments

Defensible Space 30-foot

Defensible Space 100-foot

Fuelbreak 200-foot

Non-Shaded Fuelbreak

Shaded Fuelbreak

Discline

Potential Fuels Treatments

Fuelbreak 200-foot

Fuelbreak 300-foot

Fuel Reduction Areas

Critical Infrastructure

Primary Evacuation Route

Secondary Evacuation Route

Structure Type 1 (Tender)

Road or Trail

Target Hazards

Community Center

Fire Management Logistics

Helispot

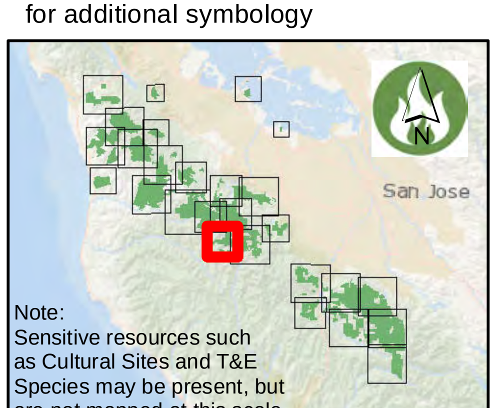
OSP & Managed Properties

Boundary

Long Ridge

Skyline Ridge

* See Table of Contents page for additional symbology



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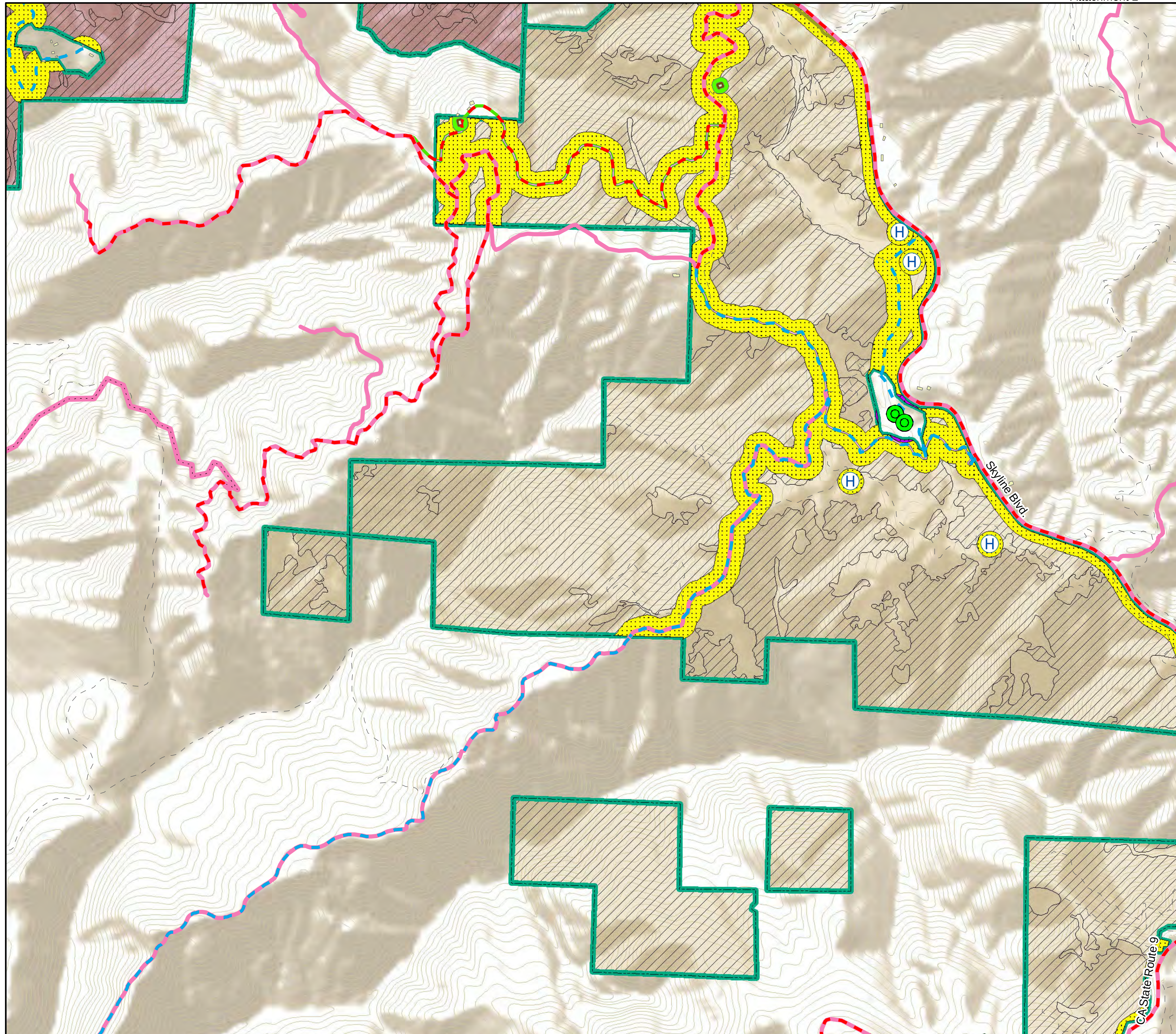


Date Printed: 3/10/2020

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Existing and Potential Treatments
Saratoga Gap/Monte Bello/Long Ridge

Existing Treatments
- Defensible Space 30-foot
- Defensible Space 100-foot
- Fuelbreak 200-foot
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Discline

Potential Fuels Treatments
- Fuelbreak 200-foot
- Fuelbreak 300-foot
- Eucalyptus and Acacia Removal
- Fuel Reduction Areas
- Wildland Type 3 Ingress/Egress

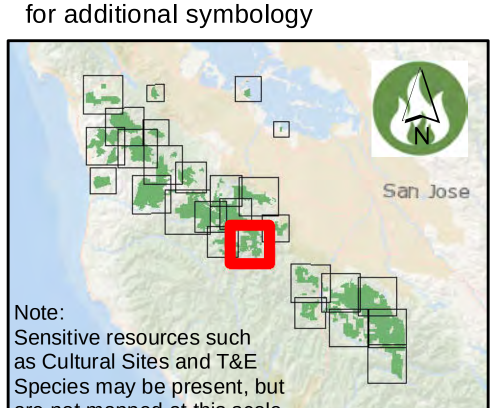
Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- Communication
- Fire Station

Target Hazards
- Community Center
- School

Fire Management Logistics
- Helispot

OSP & Managed Properties
- Boundary
- Long Ridge
- Monte Bello
- Picchetti Ranch
- Saratoga Gap

* See Table of Contents page for additional symbology



Note:
Sensitive resources such as Cultural Sites and T&E Species may be present, but are not mapped at this scale.

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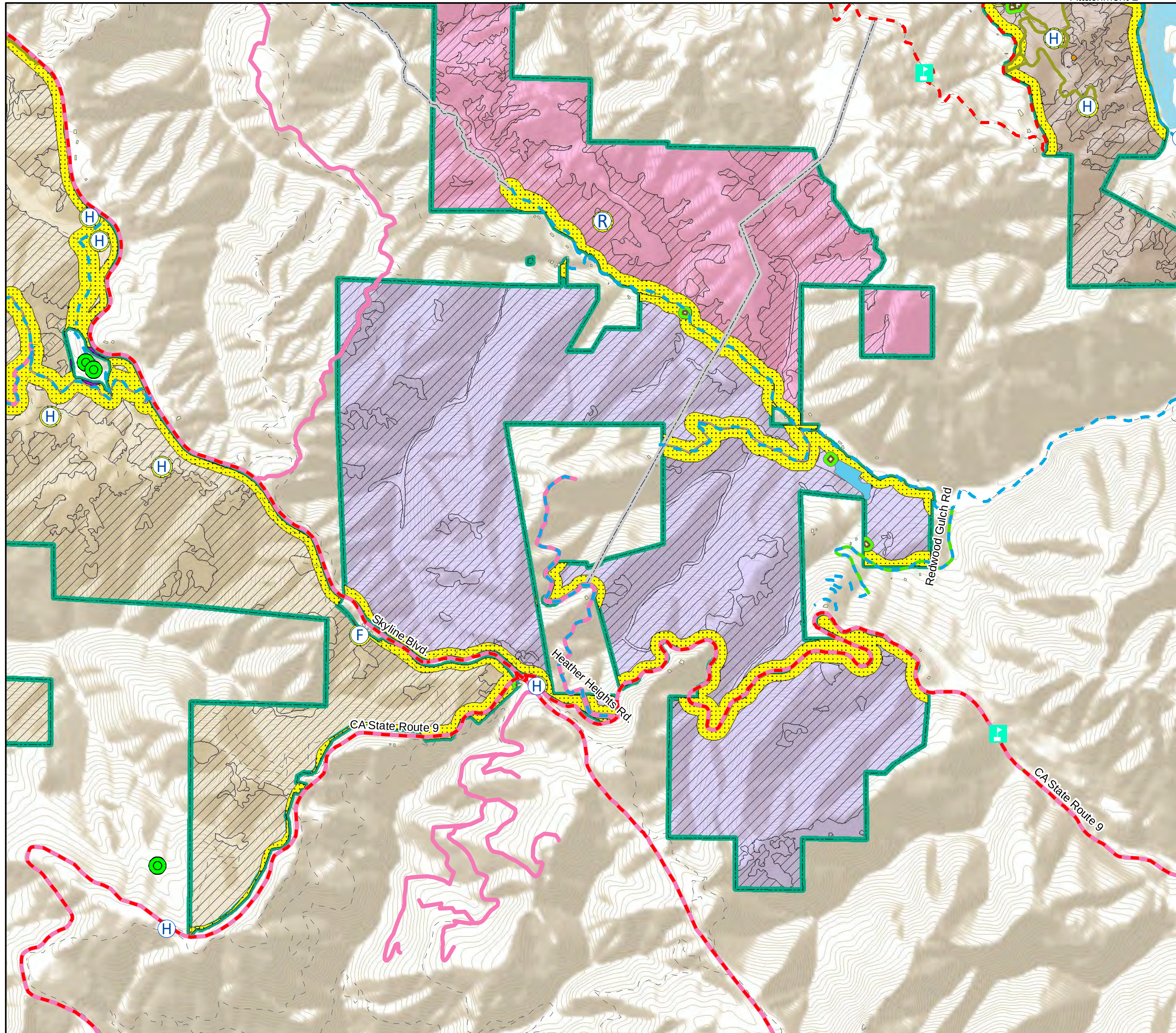


Date Printed: 3/10/2020

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Attachment 2

Existing and Potential Treatments
Fremont Older/Picchetti Ranch

Existing Treatments
- Defensible Space 30-foot
- Defensible Space 100-foot
- Fuelbreak 200-foot
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Discline

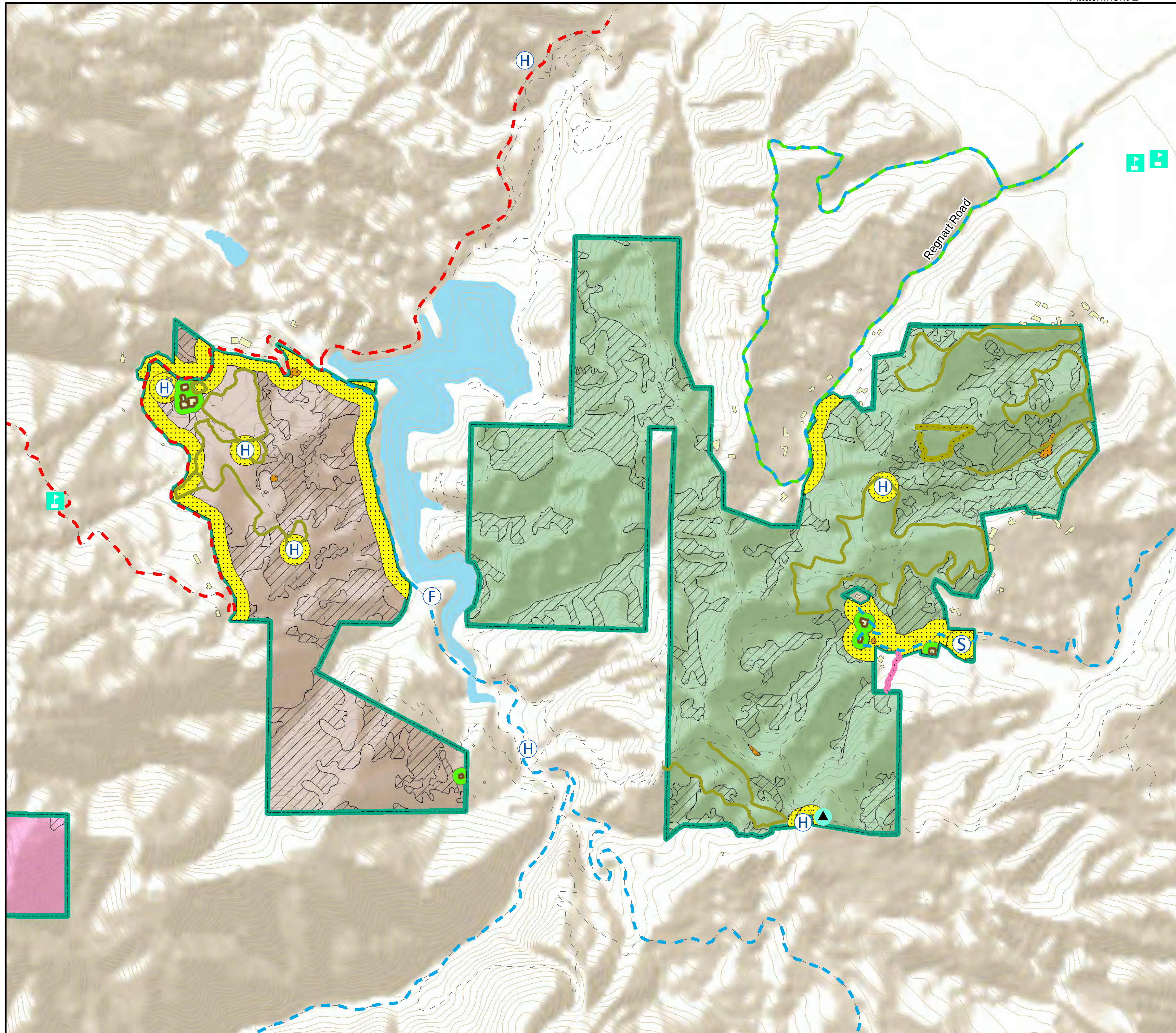
Potential Fuels Treatments
- Fuelbreak 200-foot
- Eucalyptus and Acacia Removal
- Shaded Fuelbreak
- Fuel Reduction Areas
- Discline

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- Fire Station
- Water Tank

Target Hazards
- School

Fire Management Logistics
- Helispot
- Staging Area

OSP & Managed Properties
- Boundary
- Fremont Older
- Monte Bello
- Picchetti Ranch



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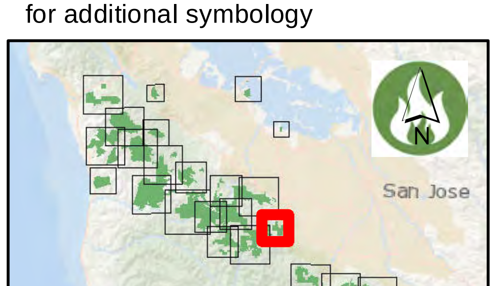


Note:
Sensitive resources such as Cultural Sites and T&E Species may be present, but are not mapped at this scale.

0 0.25 0.5 Miles

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Existing and Potential Treatments
El Sereno/Felton Station/St. Joseph's Hill

Existing Treatments
- Defensible Space 30-foot
- Defensible Space 100-foot
- Fuelbreak 200-foot
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Discline

Potential Fuels Treatments
- Fuelbreak 200-foot
- Eucalyptus and Acacia Removal
- Shaded Fuelbreak
- Fuel Reduction Areas
- Wildland Type 3 Ingress/Egress

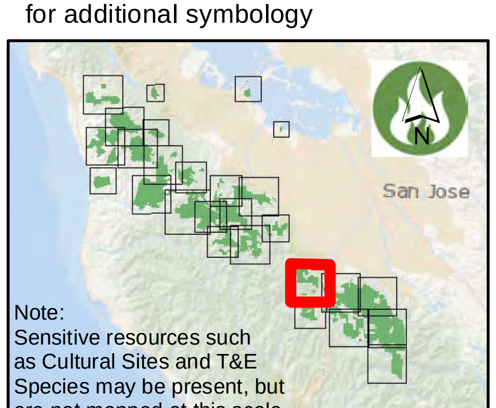
Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- Evacuation Center
- Fire Station

Target Hazards
- Assisted Living Facility
- School

Fire Management Logistics
- Helispot
- Staging Area

OSP & Managed Properties
- Boundary
- Bear Creek Redwoods
- El Sereno
- Felton Station
- Sierra Azul
- St. Joseph's Hill

* See Table of Contents page for additional symbology



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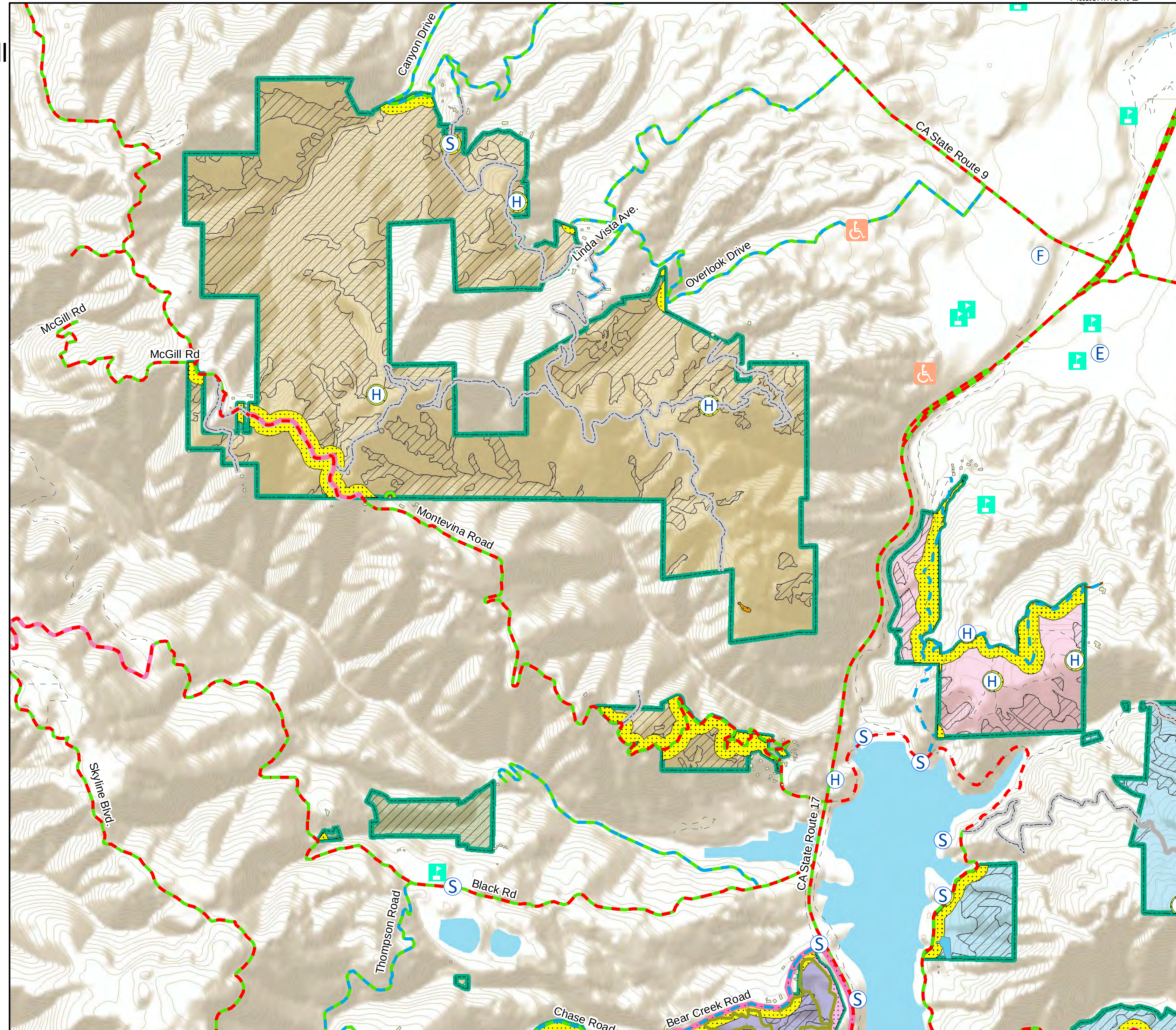


Date Printed: 3/10/2020

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Existing and Potential Treatments Bear Creek Redwoods

Existing Treatments

- Defensible Space 30-foot
- Defensible Space 100-foot
- Fuelbreak 200-foot
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Discline

Potential Fuels Treatments

- Fuelbreak 200-foot
- Eucalyptus and Acacia Removal
- Shaded Fuelbreak
- Fuel Reduction Areas
- Wildland Type 3 Ingress/Egress

Critical Infrastructure

- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- E Evacuation Center
- F Fire Station
- B ICP
- M Medivac Site
- SIP Shelter-in-Place

Target Hazards

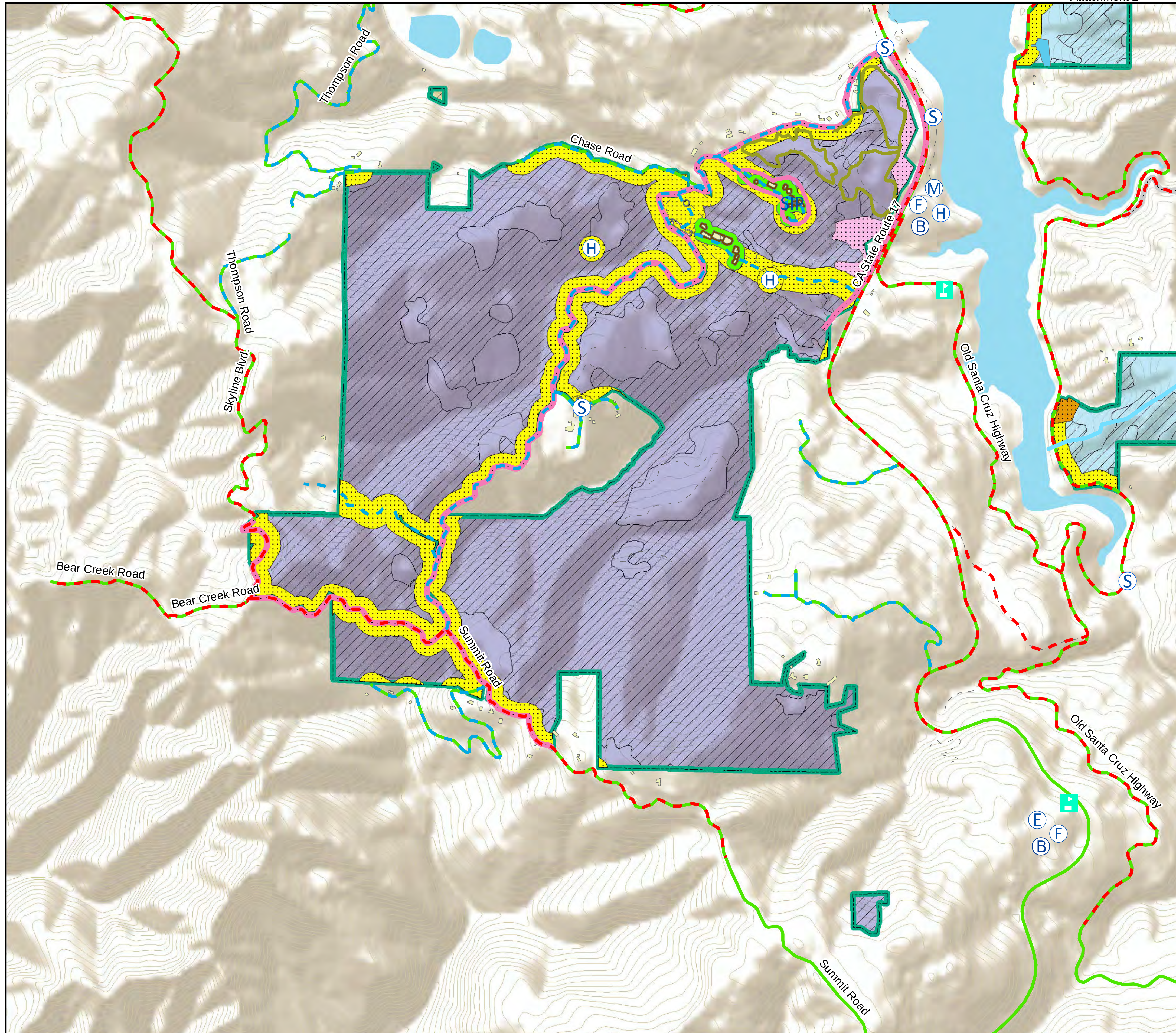
- School

Fire Management Logistics

- H Helispot
- S Staging Area

OSP & Managed Properties

- Boundary
- Bear Creek Redwoods
- El Sereno
- Sierra Azul



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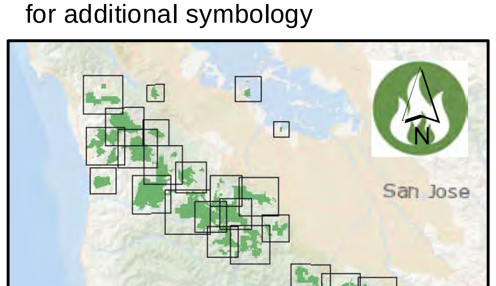


Note:
Sensitive resources such as Cultural Sites and T&E Species may be present, but are not mapped at this scale.

0 0.25 0.5 Miles

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Existing and Potential Treatments
Sierra Azul

Existing Treatments
- Defensible Space 30-foot
- Defensible Space 100-foot
- Fuelbreak 200-foot
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Discline

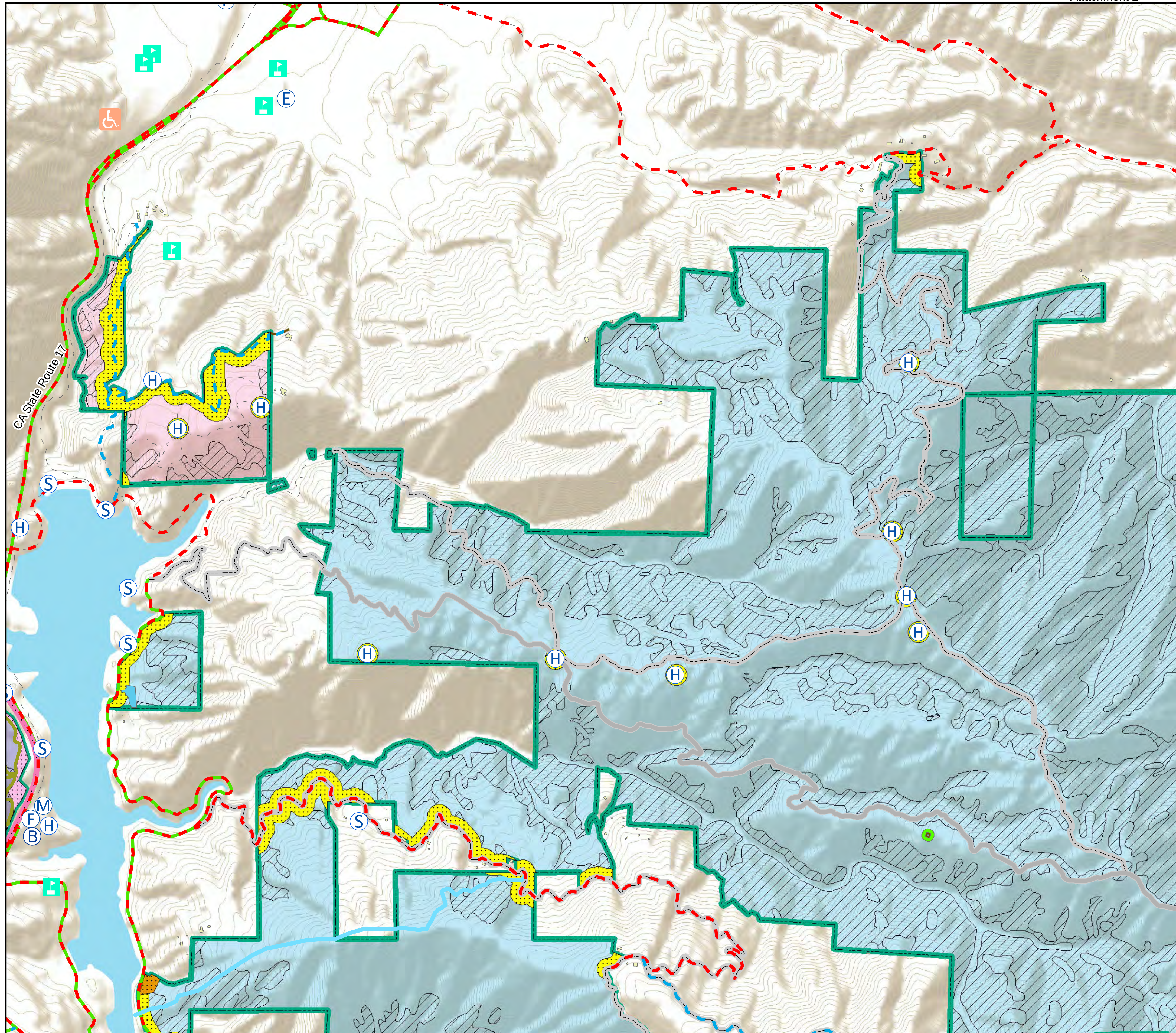
Potential Fuels Treatments
- Fuelbreak 200-foot
- Eucalyptus and Acacia Removal
- Shaded Fuelbreak
- Fuel Reduction Areas
- Wildland Type 3 Ingress/Egress

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- E Evacuation Center
- F Fire Station
- B ICP
- M Medivac Site

Target Hazards
- Assisted Living Facility
- School

Fire Management Logistics
- H Helispot
- S Staging Area

OSP & Managed Properties
- Boundary
- Bear Creek Redwoods
- Sierra Azul
- St. Joseph's Hill



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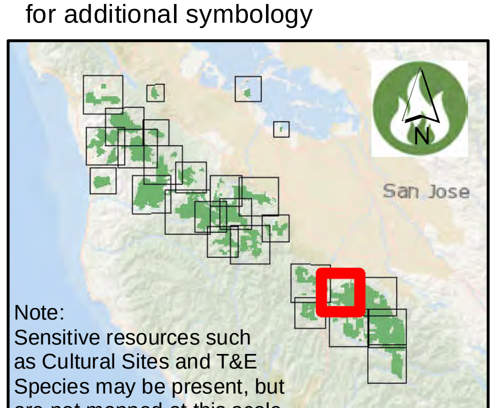


0 0.25 0.5 Miles

Date Printed: 3/10/2020

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Existing and Potential Treatments
Sierra Azul

Existing Treatments
- Defensible Space 30-foot
- Defensible Space 100-foot
- Fuelbreak 200-foot
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Discline

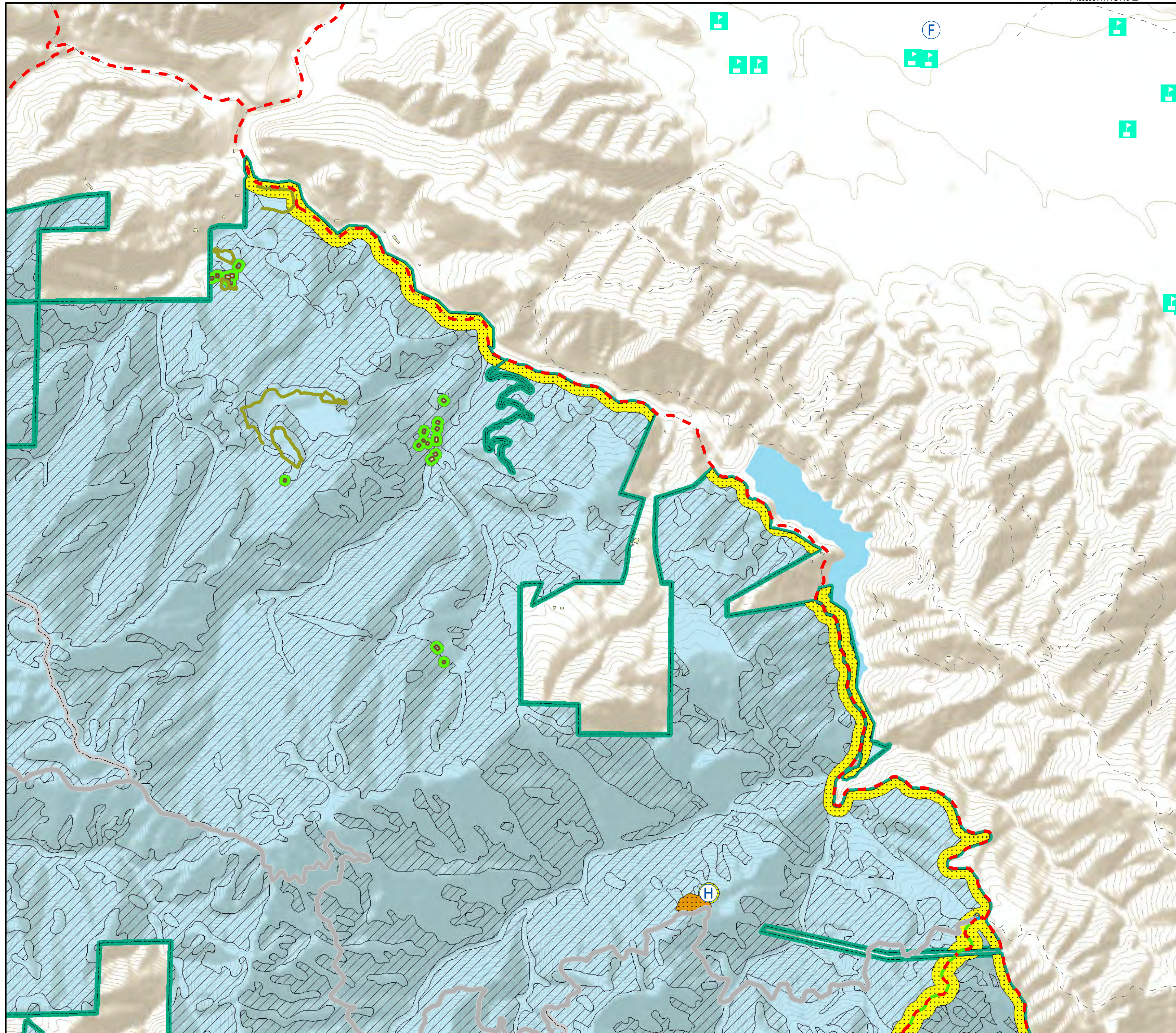
Potential Fuels Treatments
- Fuelbreak 200-foot
- Eucalyptus and Acacia Removal
- Fuel Reduction Areas
- Wildland Type 3 Ingress/Egress

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- Fire Station

Target Hazards
- School

Fire Management Logistics
- Helispot

OSP & Managed Properties
- Boundary
- Sierra Azul



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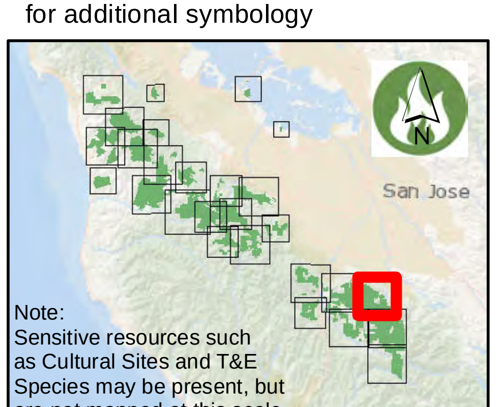


0 0.25 0.5 Miles

Date Printed: 3/10/2020

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Existing and Potential Treatments
Sierra Azul

Existing Treatments
- Defensible Space 30-foot
- Defensible Space 100-foot
- Fuelbreak 200-foot
- Non-Shaded Fuelbreak
- Shaded Fuelbreak

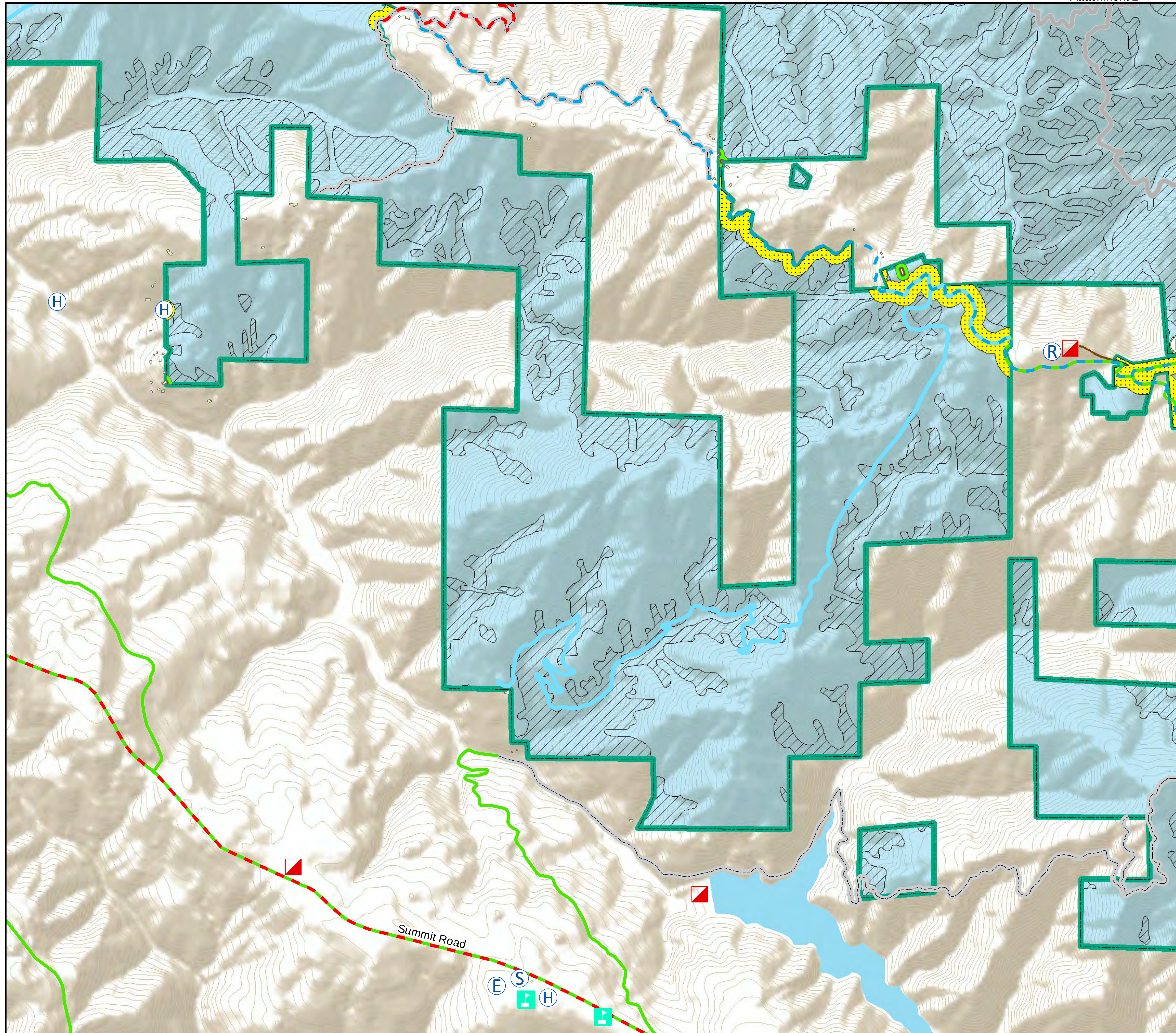
Potential Fuels Treatments
- Fuelbreak 200-foot
- Fuel Reduction Areas
- Wildland Type 3 Ingress/Egress

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- Communication
- Evacuation Center

Target Hazards
- School

Fire Management Logistics
- Helispot
- Safety Zone
- Staging Area

OSP & Managed Properties
- Boundary
- Sierra Azul



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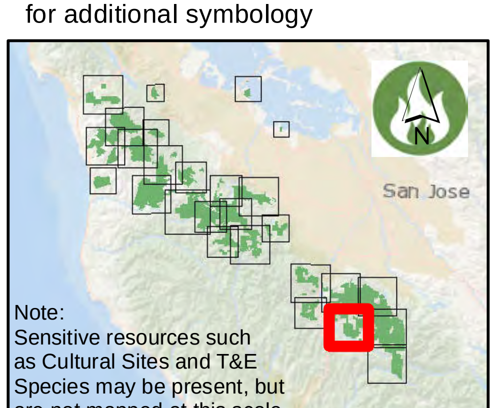


0 0.25 0.5 Miles

Date Printed: 3/10/2020

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Existing and Potential Treatments
Sierra Azul

Existing Treatments
- Defensible Space 30-foot
- Defensible Space 100-foot
- Fuelbreak 200-foot
- Non-Shaded Fuelbreak
- Shaded Fuelbreak
- Wildland Type 3 Ingress/Egress

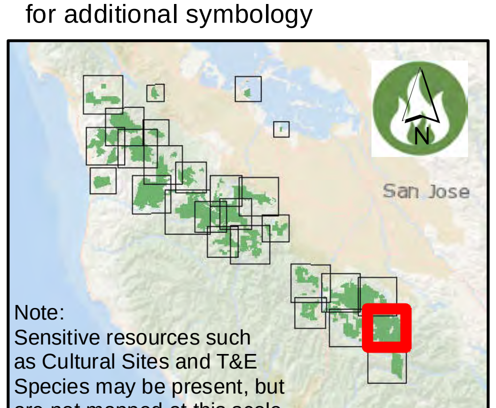
Potential Fuels Treatments
- Fuelbreak 200-foot
- Eucalyptus and Acacia Removal
- Shaded Fuelbreak
- Fire Agency Recommended
- Fuel Reduction Areas
- Wildland Type 3 Ingress/Egress

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail
- Communication

Fire Management Logistics
- Helispot
- Safety Zone
- Staging

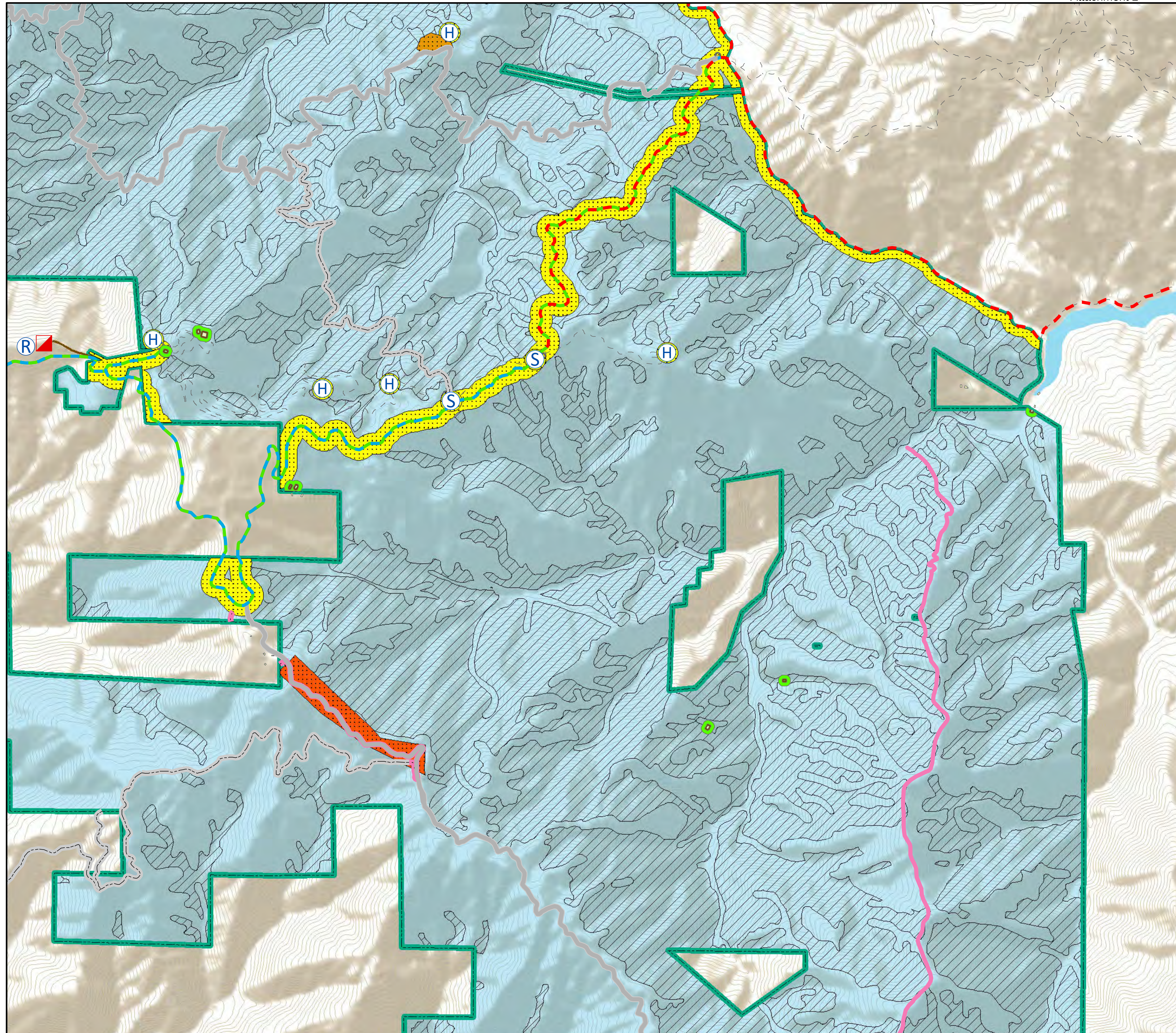
OSP & Managed Properties
- Boundary
- Sierra Azul

* See Table of Contents page for additional symbology



Note:
Sensitive resources such as Cultural Sites and T&E Species may be present, but are not mapped at this scale.

0 0.25 0.5 Miles



Date Printed: 3/10/2020

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Existing and Potential Treatments
Sierra Azul

Existing Treatments

- Defensible Space 30-foot
- Defensible Space 100-foot
- Shaded Fuelbreak
- Wildland Type 3 Ingress/Egress

Potential Fuels Treatments

- Fuelbreak 200-foot
- Fuel Reduction Areas
- Wildland Type 3 Ingress/Egress

Critical Infrastructure

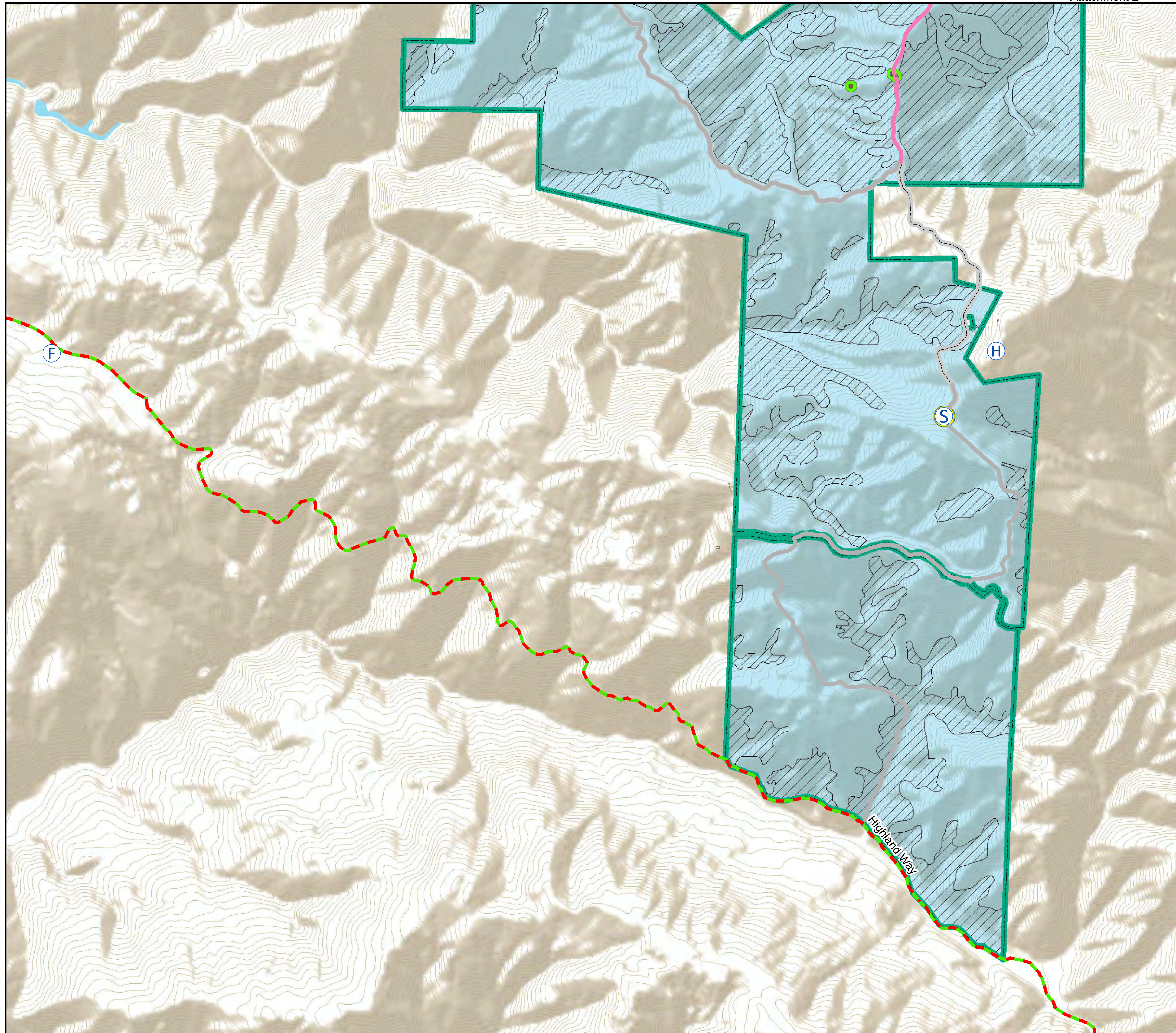
- Primary Evacuation Route
- Structure Type 1 (Tender)
- F Fire Station

Fire Management Logistics

- H Helispot
- S Staging Area

OSP & Managed Properties

- Boundary
- Sierra Azul



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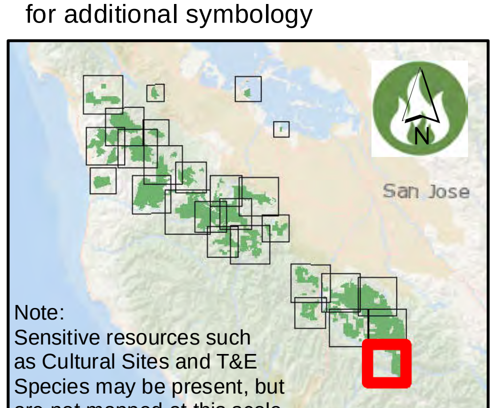


0 0.25 0.5 Miles

Date Printed: 3/10/2020

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

Existing and Potential Treatments
Ravenswood

Existing Treatments

- Non-Shaded Fuelbreak

Potential Fuels Treatments

- Fuelbreak 200-foot

Critical Infrastructure

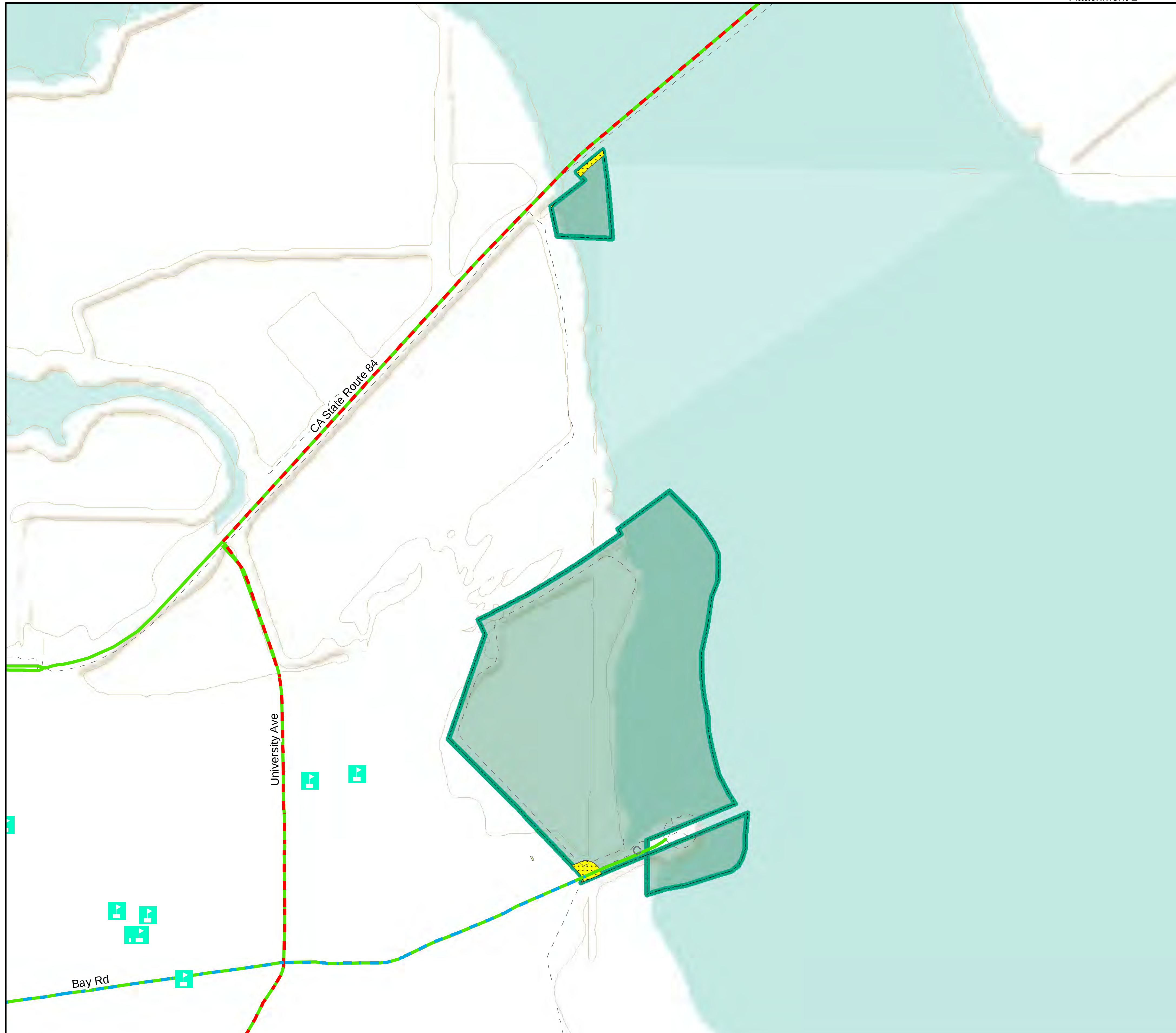
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail

Target Hazards

- School

OSP & Managed Properties

- Boundary
- Ravenswood



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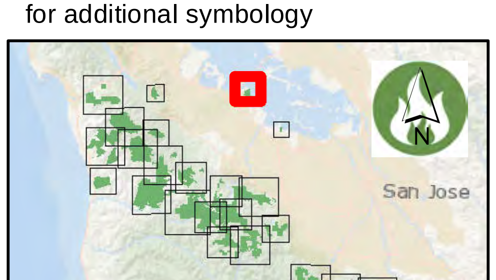


Note:
Sensitive resources such as Cultural Sites and T&E Species may be present, but are not mapped at this scale.

0 0.25 0.5 Miles

Date Printed: 3/10/2020

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

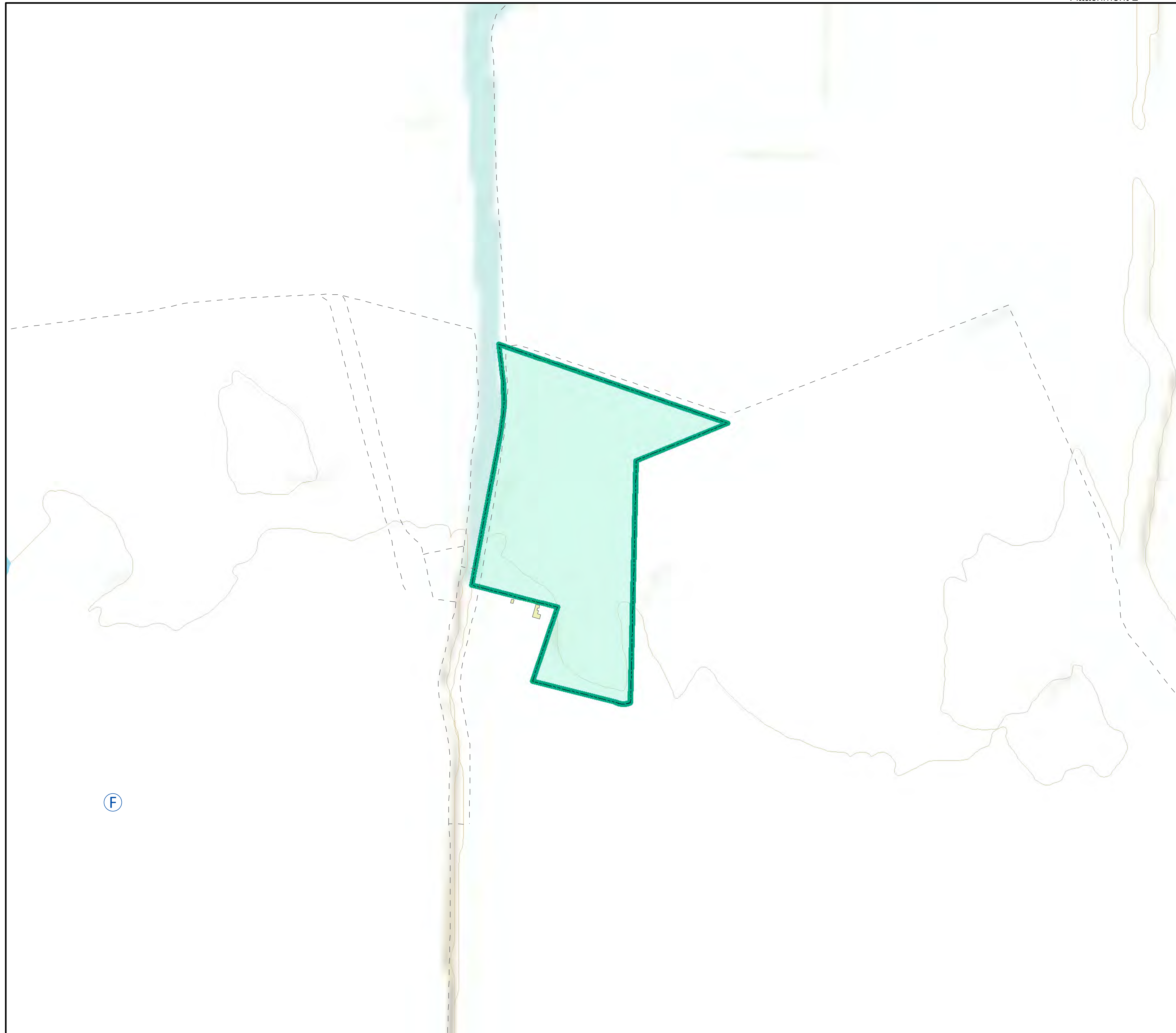
Existing and Potential Treatments
Stevens Creek Shoreline NSA

Road or Trail
Fire Station

OSP & Managed Properties

Boundary

Stevens Creek Shoreline Nature Study Area



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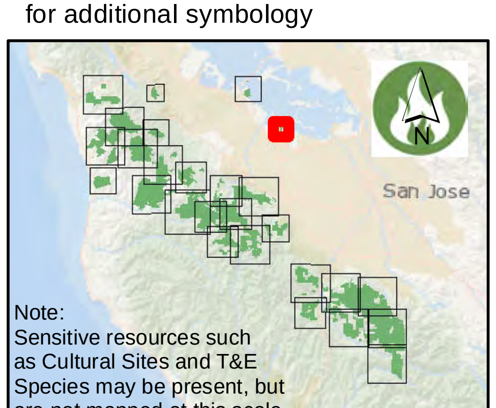

0 | 0.25 | 0.5 Miles

Date Printed: 3/10/2020

Fuel break widths are maximums. Fuelbreaks may be constructed at any width up to the maximum width.

APPENDIX B, PART 2

Tier 1 and Tier 2 Prioritized Treatments (Overlaid on Topographic Maps)

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These maps are for reference only. Although every effort has been made to ensure the accuracy of information, errors and conditions originating from physical sources used to develop the data may be reflected on this map. Midpeninsula Regional Open Space District shall not be liable for any errors, omissions, or damages that result from inappropriate use of this document.

Vegetation management on easements over Midpen lands is the responsibility of the easement holder unless there is a cost-share agreement in place.

Treatment Priority Areas

- Tier 1
- Tier 2

Target Hazards

- Assisted Living Facility
- Camp Site
- Hospital
- Community Center
- School
- Mobile Home Park

Fire Management Logistics

- Helispot
- Lookout
- Safety Zone
- Staging Area

Critical Infrastructure

- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Wildland Type 3
- Road or Trail
- Communication
- Evacuation Center
- Fire Station
- ICP
- Medivac Site
- SIP Shelter-in-Place
- Water Collection Point
- Water Tank
- Existing & Proposed Non-Midpen Treatments
- CWPP Priority Areas

Buildings

- Buildings Near Preserves

Elevation Contour

- 40ft Interval

OSP & Managed Properties

- Boundary
- Bear Creek Redwoods
- Coal Creek
- El Corte de Madera Creek
- El Sereno
- Felton Station
- Foothills
- Fremont Older
- La Honda Creek
- Long Ridge
- Los Trancos
- Miramontes Ridge
- Monte Bello
- Picchetti Ranch
- Pulgas Ridge
- Purisima Creek Redwoods
- Rancho San Antonio
- Rancho San Antonio County Park
- Ravenswood
- Russian Ridge
- Saratoga Gap
- Sierra Azul
- Skyline Ridge
- St. Joseph's Hill
- Stevens Creek Shoreline Nature Study Area
- Teague Hill
- Thornewood
- Tunitas Creek
- Windy Hill

Attachment 2

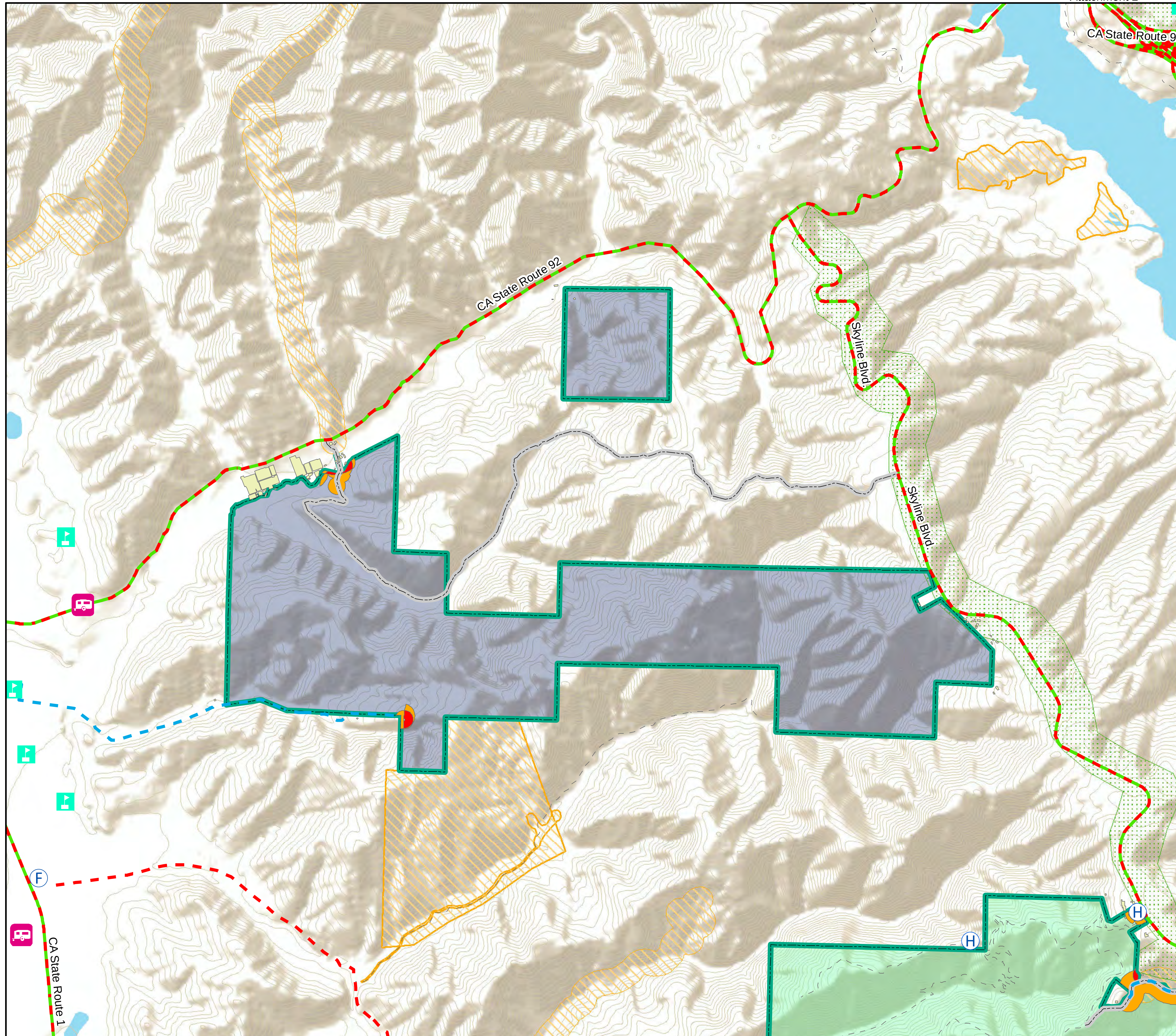
Treatment Priorities
Miramontes Ridge

Priority
- Tier 1
- Tier 2

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Wildland Type 3
- Road or Trail

Target Hazards
- School
- Mobile Home Park

OSP & Managed Properties
- Boundary
- Miramontes Ridge
- Purisima Creek Redwoods



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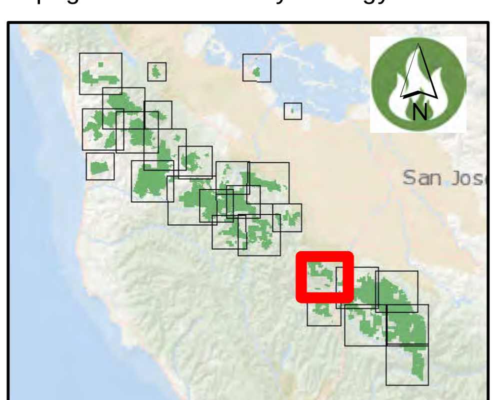

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Page: 1

Date Printed: 3/10/2020

Treatment Priorities
Pulgas Ridge

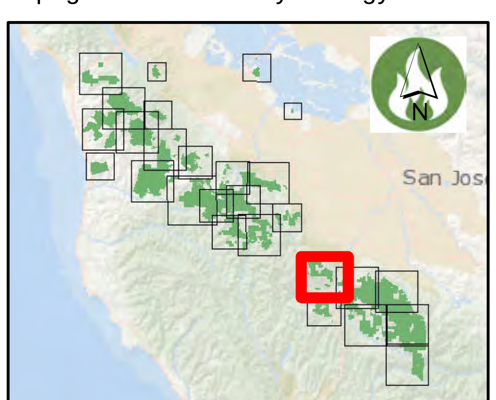
Priority Areas
- Tier 1
- Tier 2

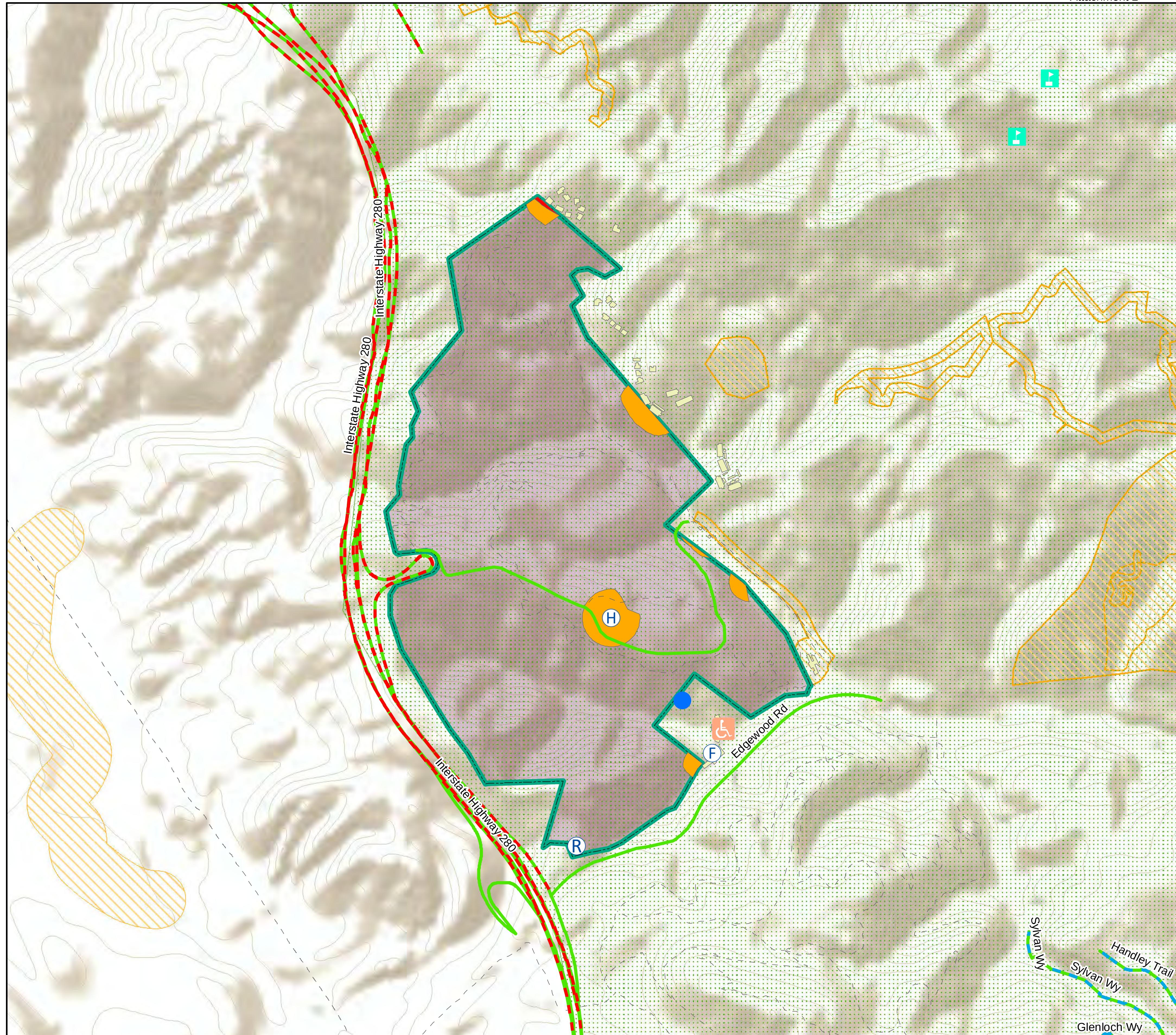
Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail

Target Hazards
- Assisted Living Facility
- School

OSP & Managed Properties
- Boundary
- Pulgas Ridge

* See Legend on Table of Contents page for additional symbology





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Treatment Priorities
Purisima Creek Redwoods

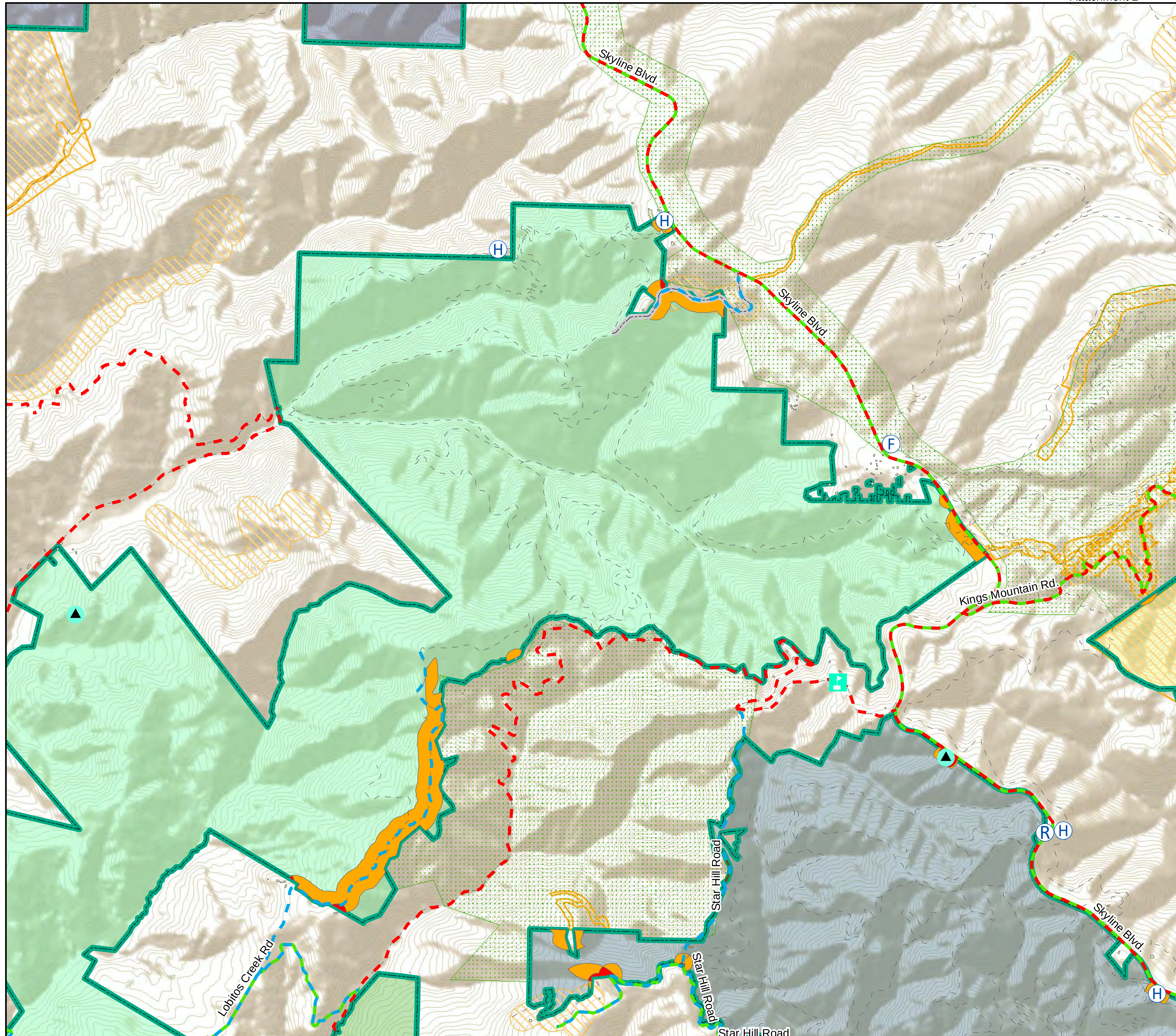
Priority Areas
- Tier 1
- Tier 2

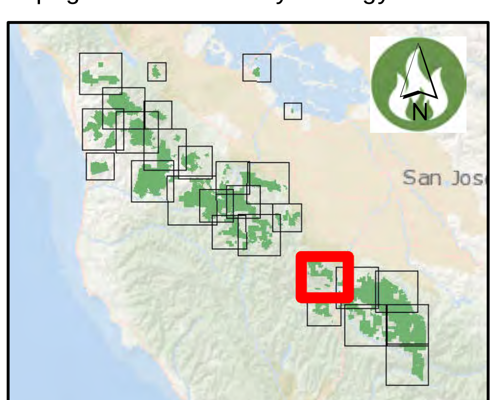
Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Wildland Type 3
- Road or Trail

Target Hazards
- School

OSP & Managed Properties
- Boundary
- El Corte de Madera Creek
- Miramontes Ridge
- Purisima Creek Redwoods
- Teague Hill
- Tunitas Creek

* See Legend on Table of Contents page for additional symbology





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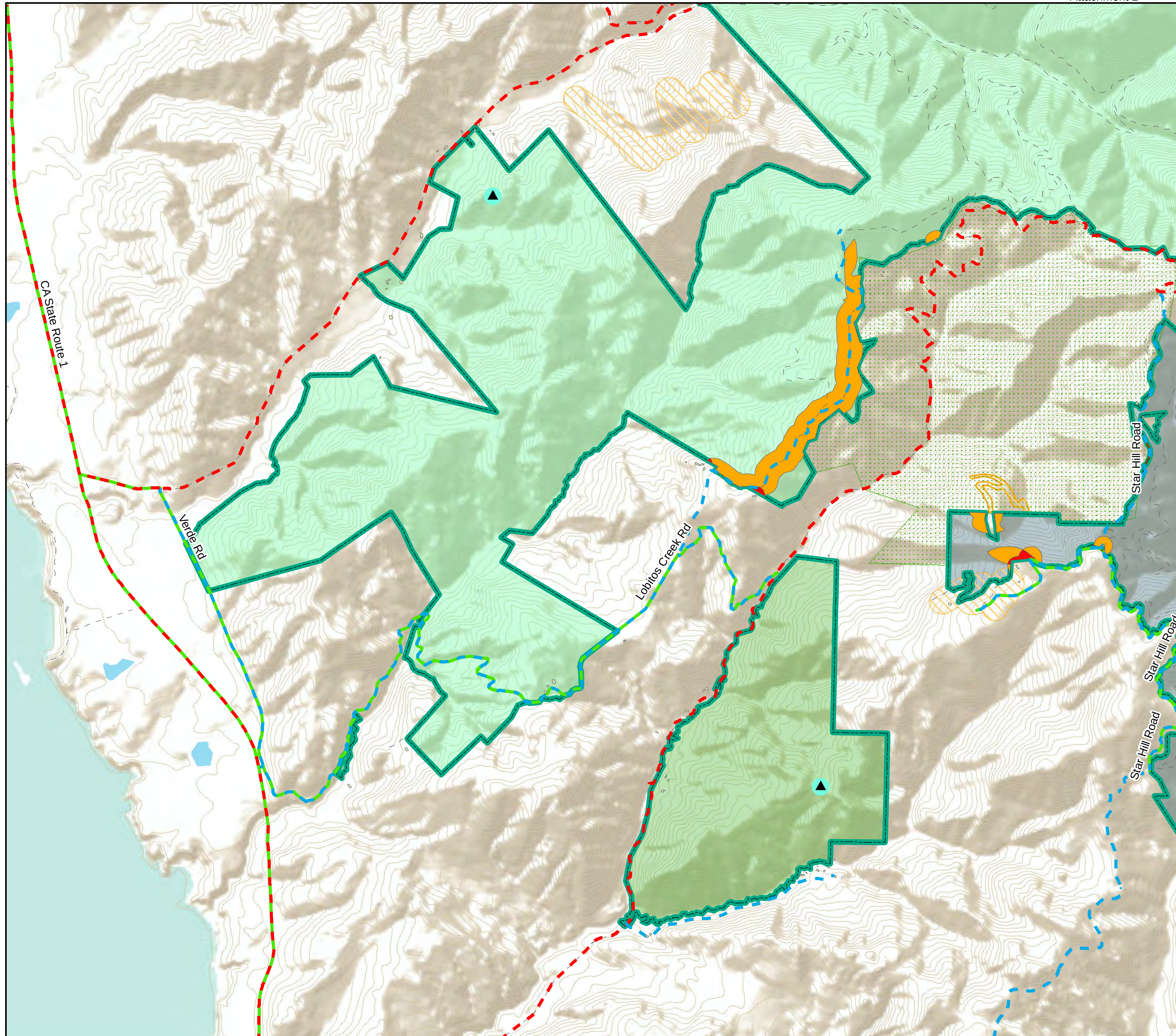
Treatment Priorities
Purisima Creek/Tunitas Creek

Priority Areas
- Tier 1
- Tier 2

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail

OSP & Managed Properties
- Boundary
- El Corte de Madera Creek
- Purisima Creek Redwoods
- Tunitas Creek



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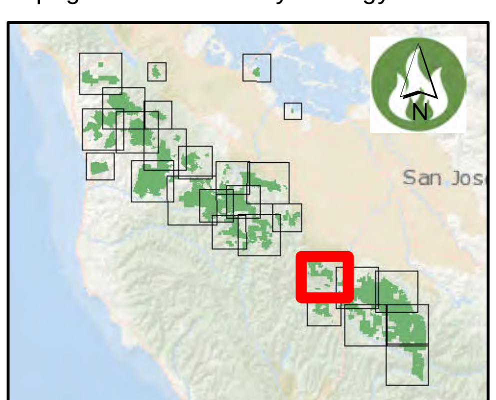

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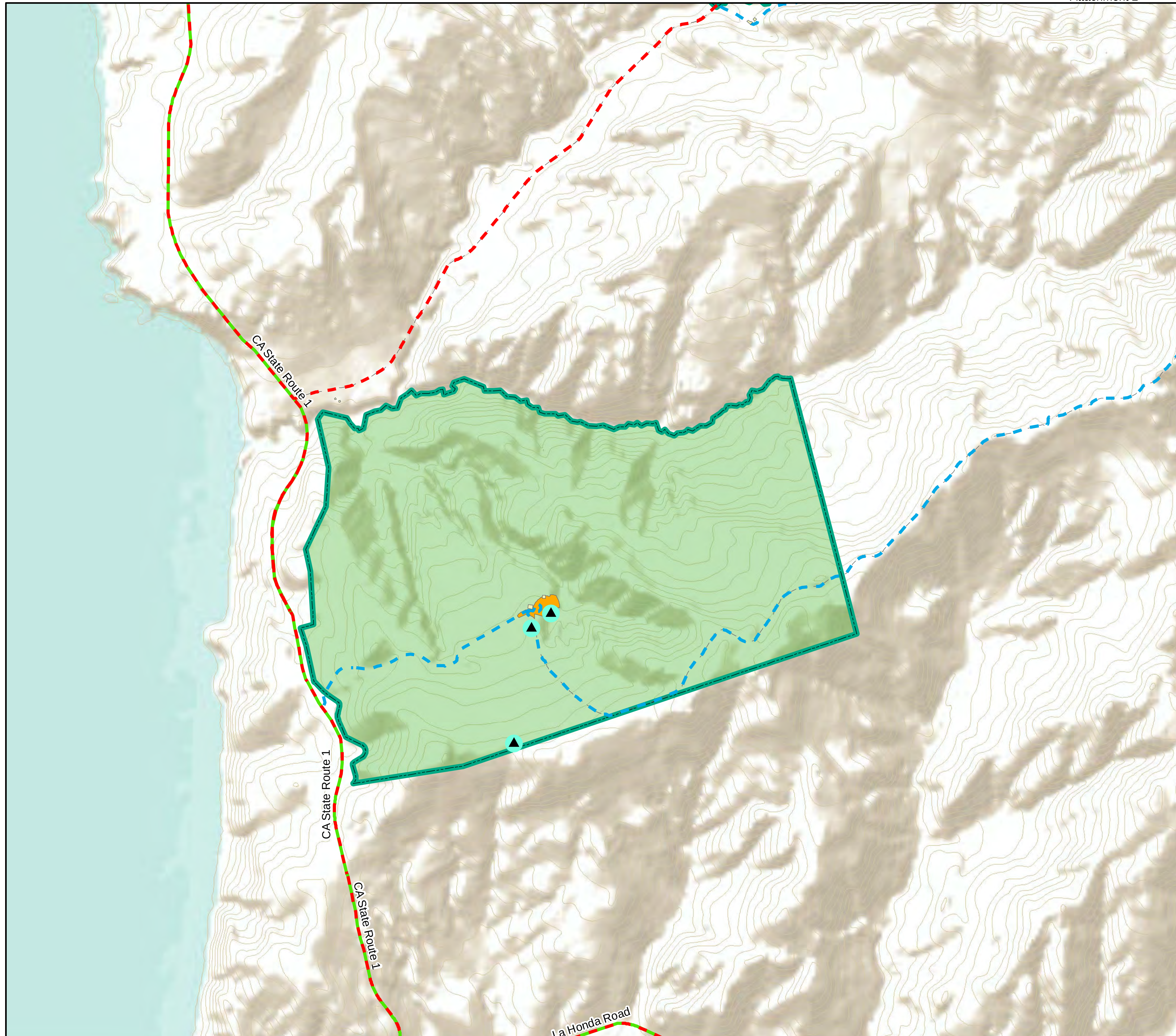
Treatment Priorities
Tunitas Creek

Priority Areas
Tier 2

Critical Infrastructure
Primary Evacuation Route
Secondary Evacuation Route
Structure Type 1 (Tender)
Road or Trail

OSP & Managed Properties
Boundary
Tunitas Creek



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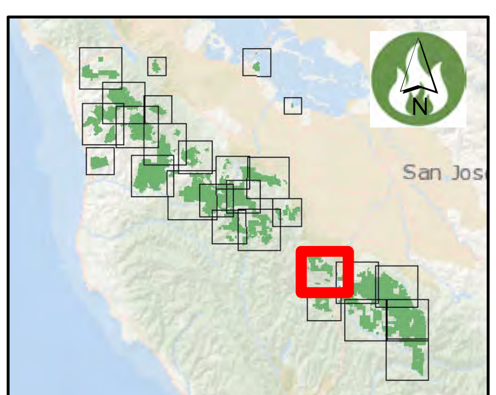

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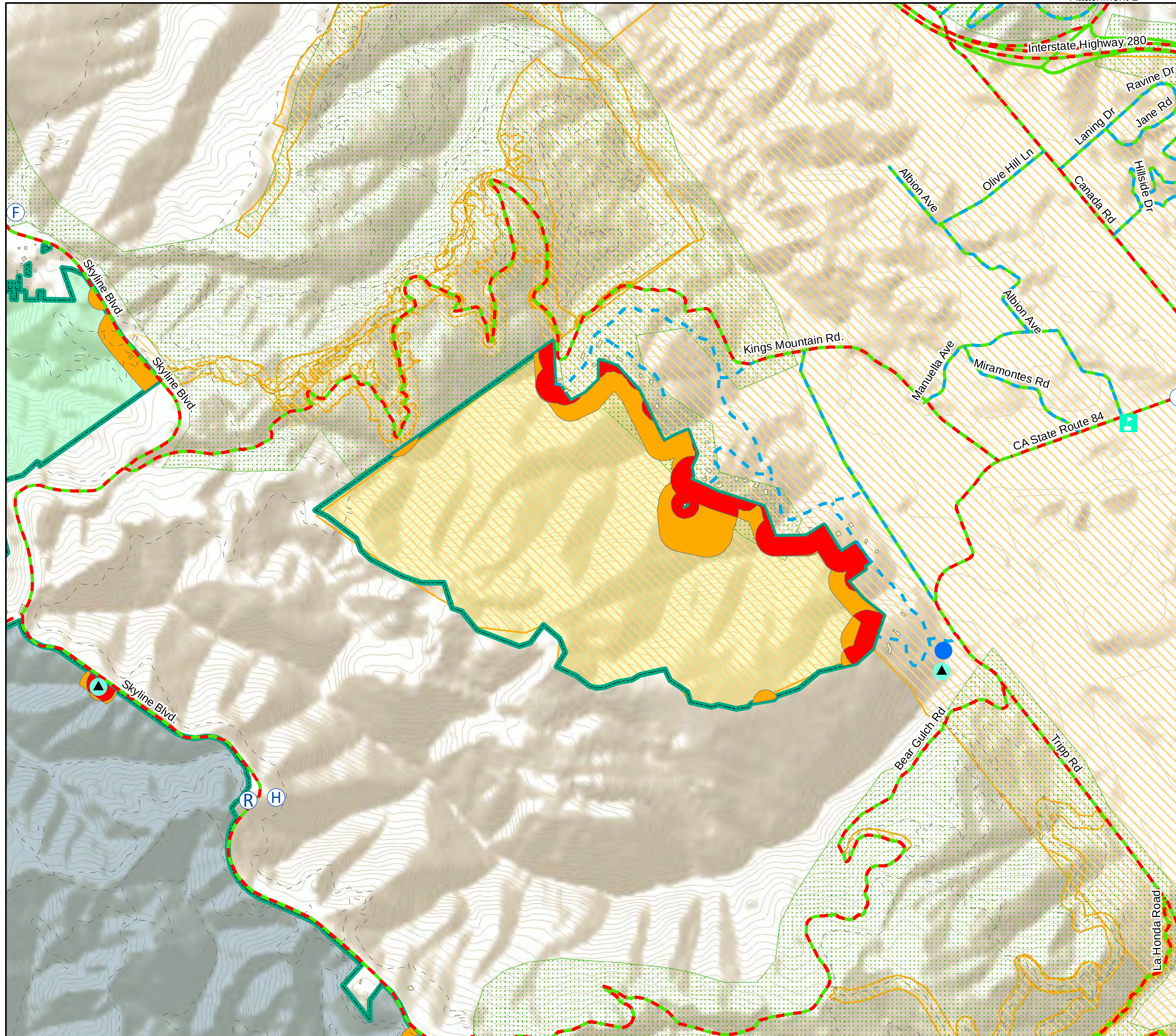
Treatment Priorities
Teague Hill

Priority Areas
- Tier 1
- Tier 2

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail

Target Hazards
- School

OSP & Managed Properties
- Boundary
- El Corte de Madera Creek
- Purisima Creek Redwoods
- Teague Hill



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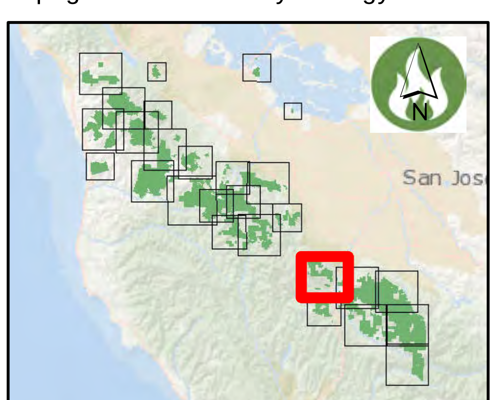

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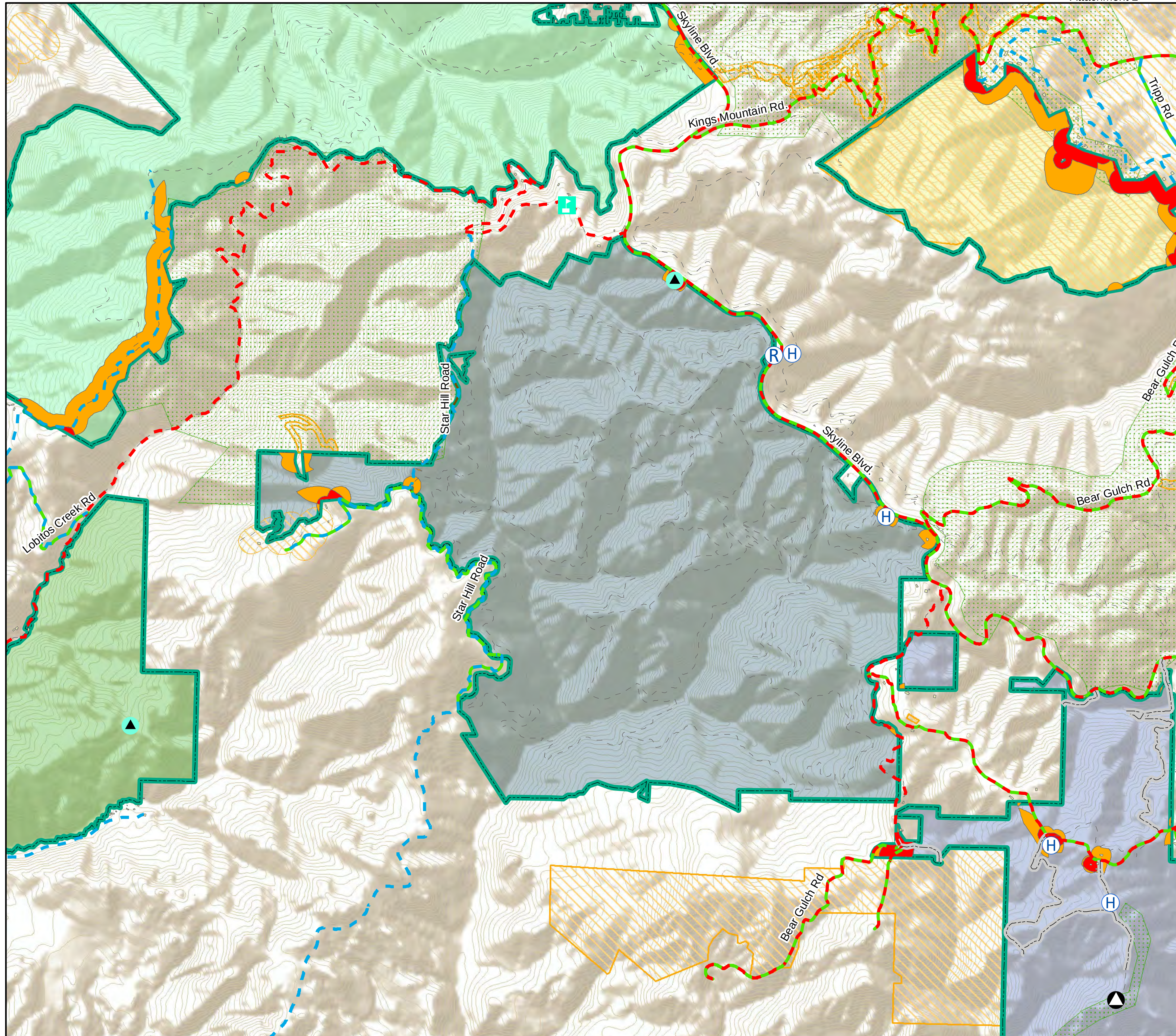
Treatment Priorities
El Corte de Madera Creek

Priority Areas
- Tier 1
- Tier 2

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Wildland Type 3
- Road or Trail

Target Hazards
- School

OSP & Managed Properties
- Boundary
- El Corte de Madera Creek
- La Honda Creek
- Purisima Creek Redwoods
- Teague Hill
- Tunitas Creek



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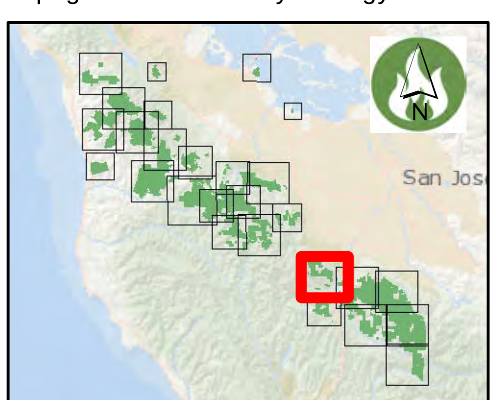

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Treatment Priorities
La Honda Creek/Thornewood

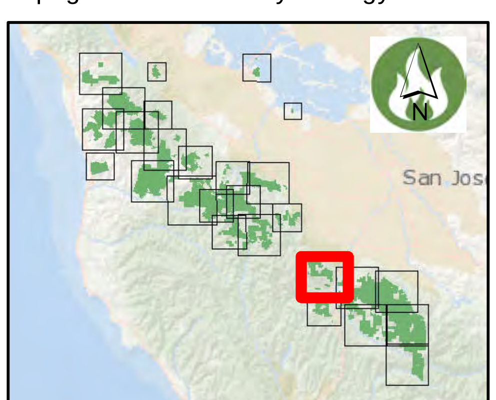
Priority Areas
- Tier 1
- Tier 2

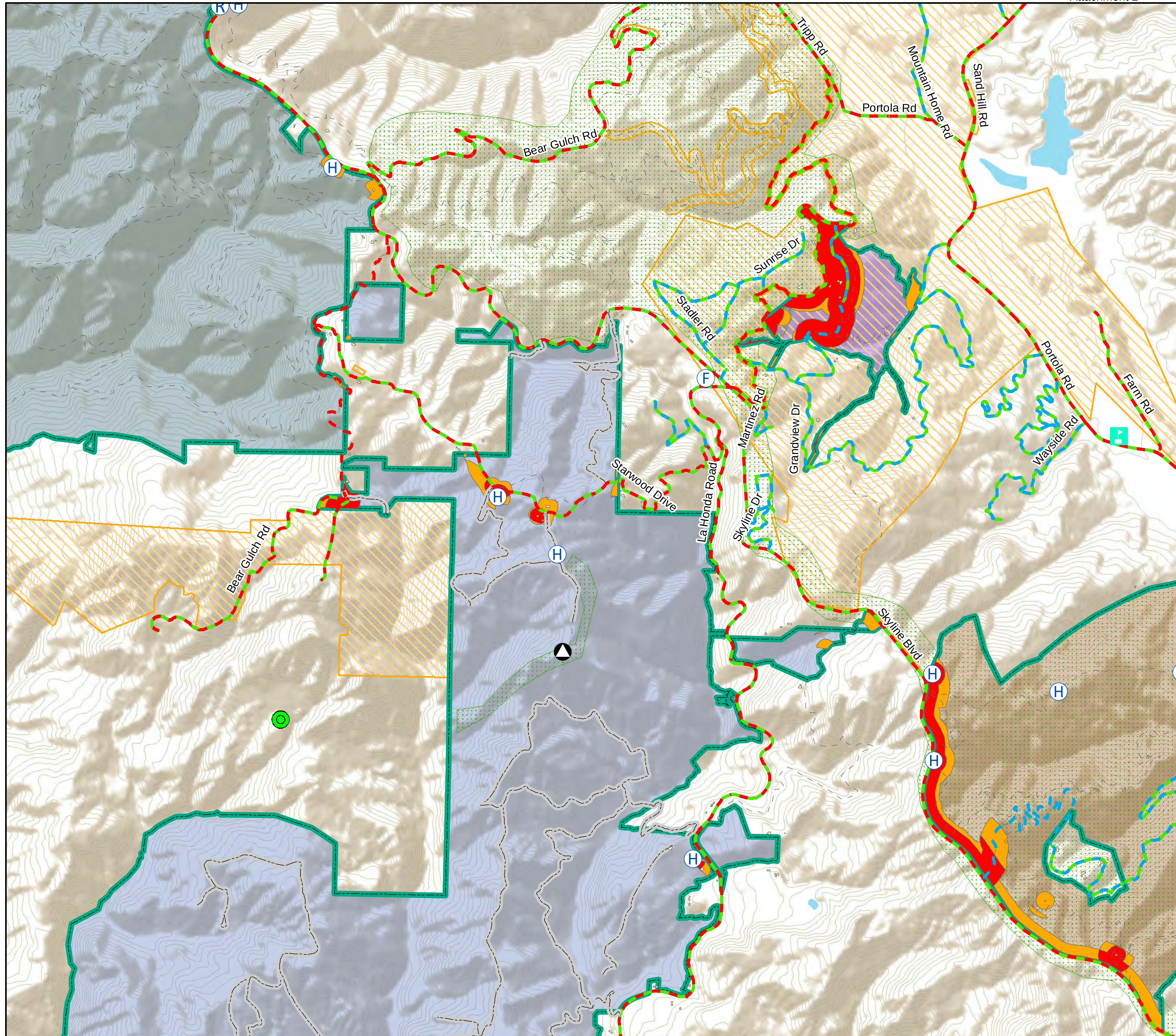
Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Wildland Type 3
- Road or Trail

Target Hazards
- Community Center
- School

OSP & Managed Properties
- Boundary
- El Corte de Madera Creek
- La Honda Creek
- Thornewood
- Windy Hill

* See Legend on Table of Contents page for additional symbology





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Treatment Priorities
La Honda Creek

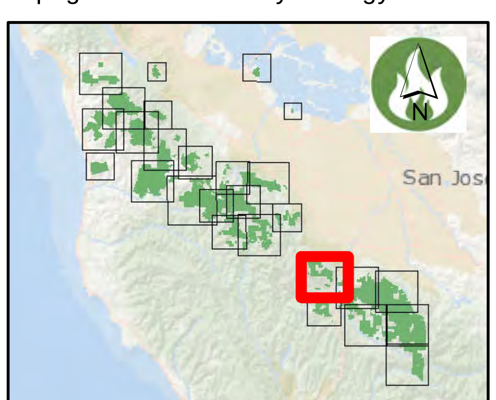
Priority Areas
- Tier 1
- Tier 2

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Wildland Type 3
- Road or Trail

Target Hazards
- Community Center
- School
- Mobile Home Park

OSP & Managed Properties
- Boundary
- La Honda Creek
- Russian Ridge
- Windy Hill

* See Legend on Table of Contents page for additional symbology



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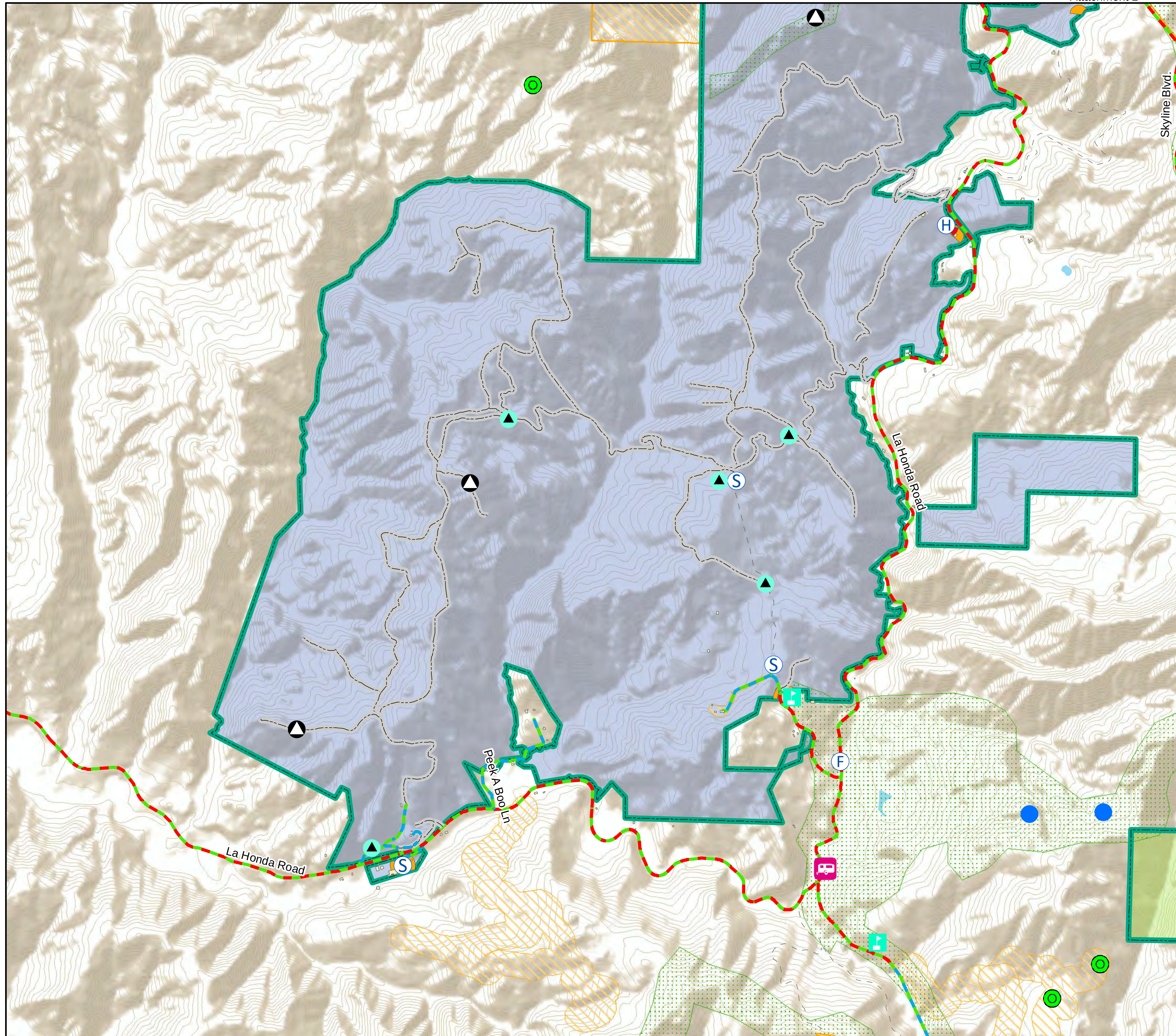

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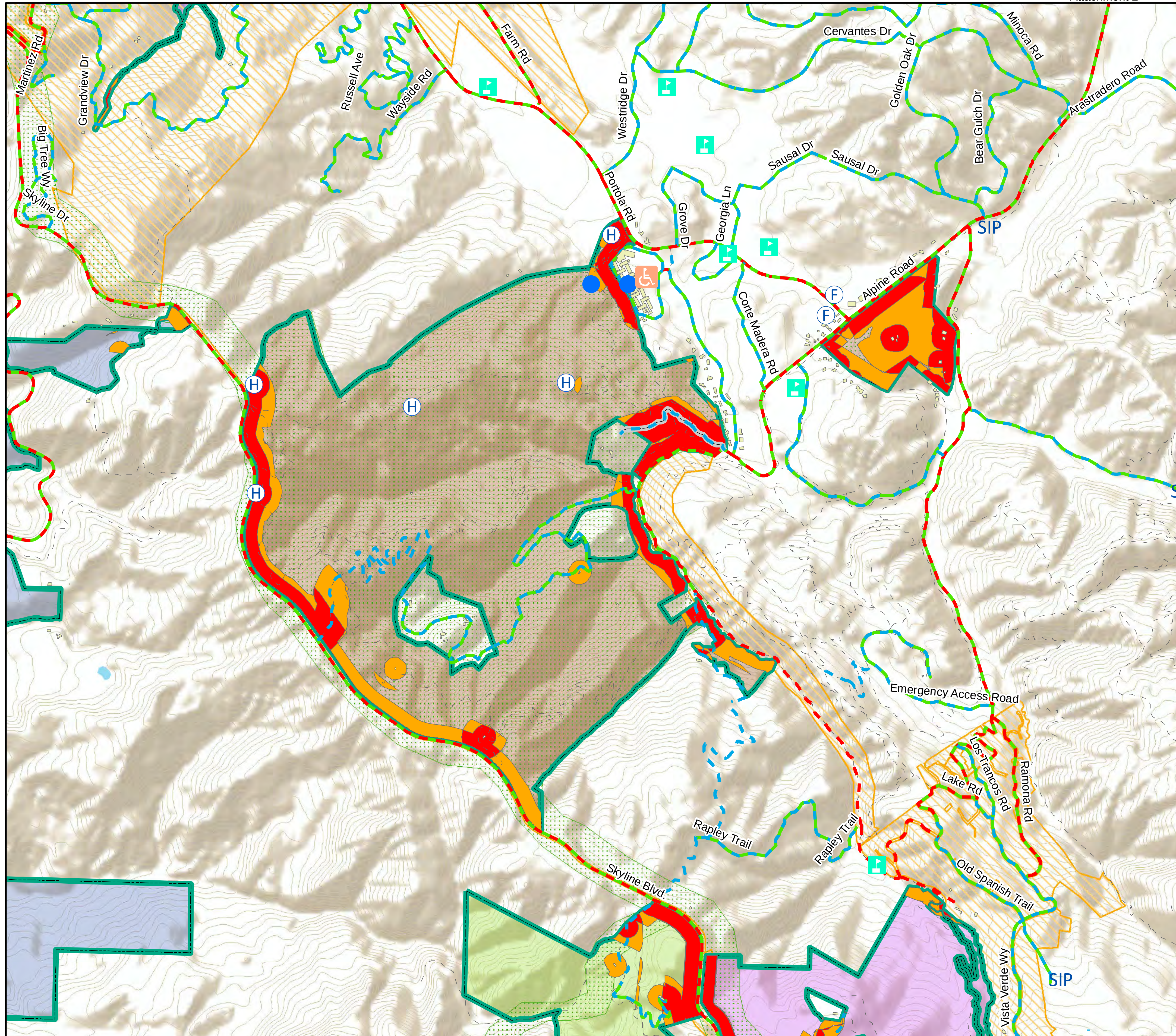
Treatment Priorities
Windy Hill

Priority Areas
- Tier 1
- Tier 2

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Wildland Type 3
- Road or Trail

Target Hazards
- Assisted Living Facility
- School

OSP & Managed Properties
- Boundary
- Coal Creek
- La Honda Creek
- Russian Ridge
- Thornewood
- Windy Hill



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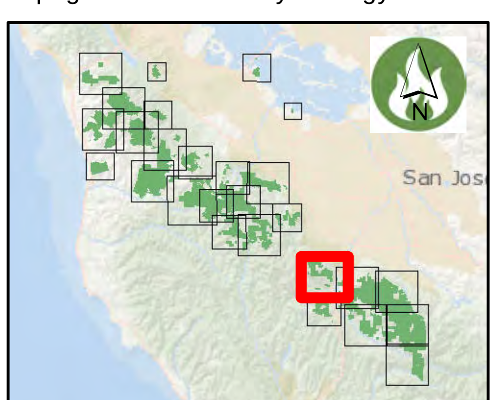

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Treatment Priorities
Russian Ridge/Coal Creek

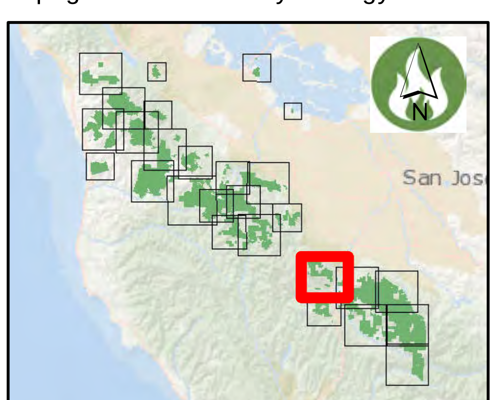
Priority Areas
- Tier 1
- Tier 2

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Wildland Type 3
- Road or Trail

Target Hazards
- Community Center
- School
- Mobile Home Park

OSP & Managed Properties
- Boundary
- Coal Creek
- Foothills
- La Honda Creek
- Long Ridge
- Los Trancos
- Monte Bello
- Russian Ridge
- Skyline Ridge
- Windy Hill

* See Legend on Table of Contents page for additional symbology



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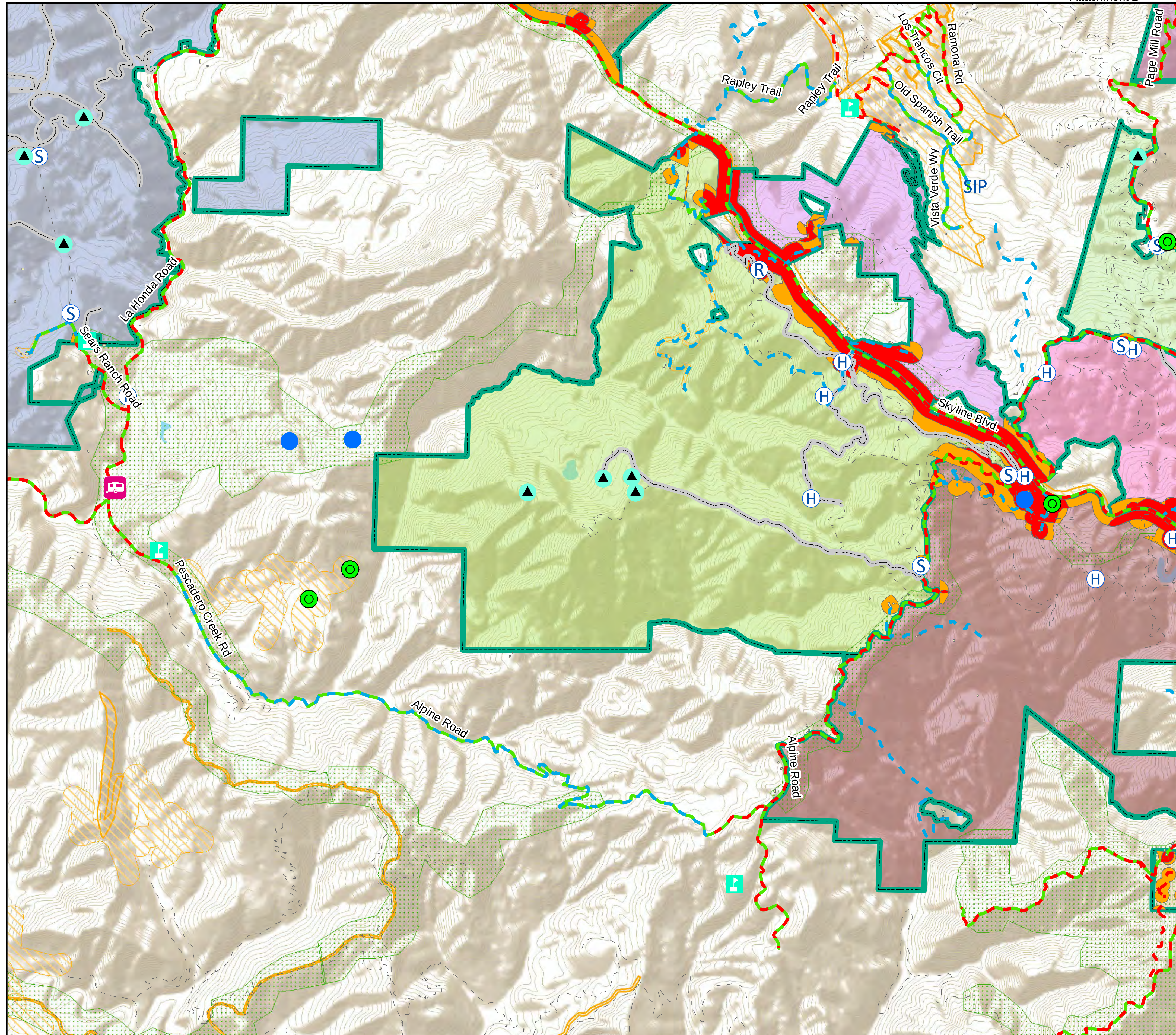

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Attachment 2

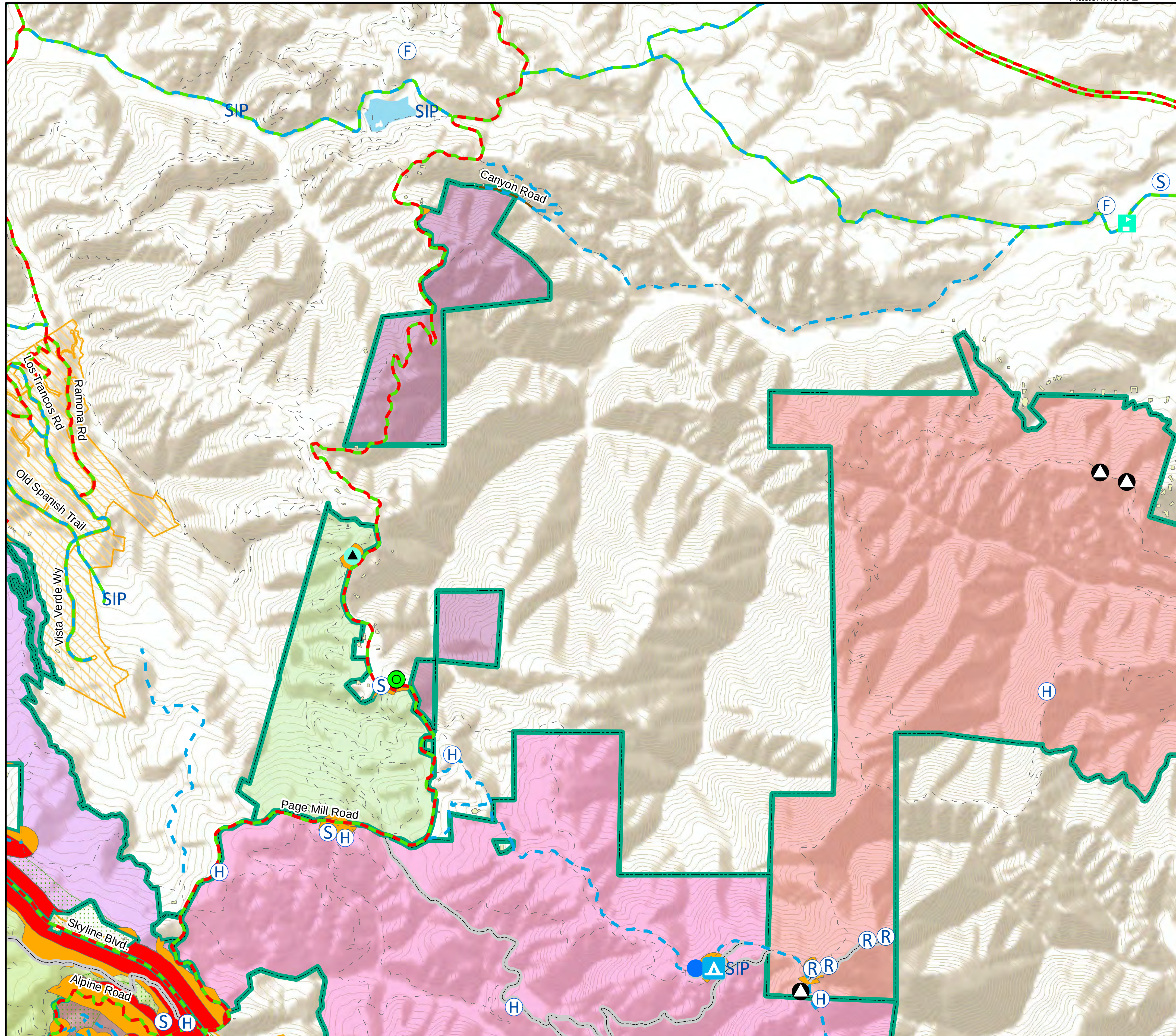
Treatment Priorities
Foothills/Los Trancos

Priority Areas
- Tier 1
- Tier 2

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Wildland Type 3
- Road or Trail

Target Hazards
- Camp Site
- Community Center
- School

OSP & Managed Properties
- Boundary
- Coal Creek
- Foothills
- Los Trancos
- Monte Bello
- Rancho San
- Russian Ridge
- Skyline Ridge



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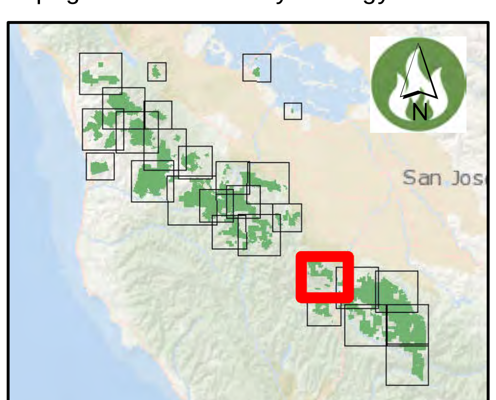

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Attachment 2

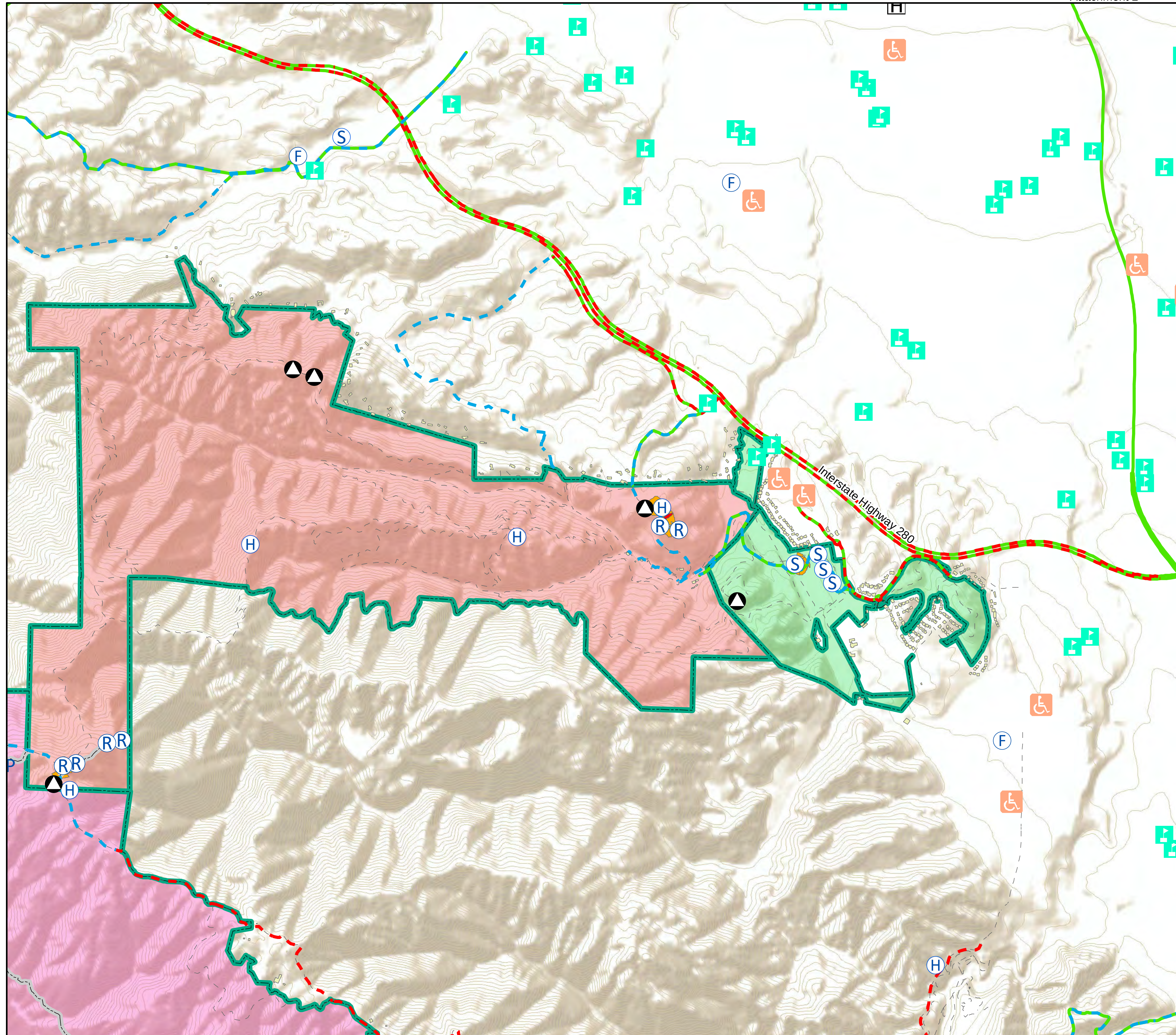
Treatment Priorities
Rancho San Antonio

Priority Areas
- Tier 1
- Tier 2

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Wildland Type 3
- Road or Trail

Target Hazards
- Assisted Living Facility
- Hospital
- School

OSP & Managed Properties
- Boundary
- Monte Bello
- Rancho San
- Rancho San Antonio County Park



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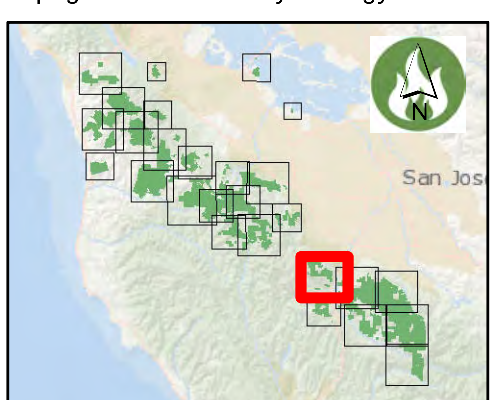

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Treatment Priorities
Monte Bello/Skyline Ridge

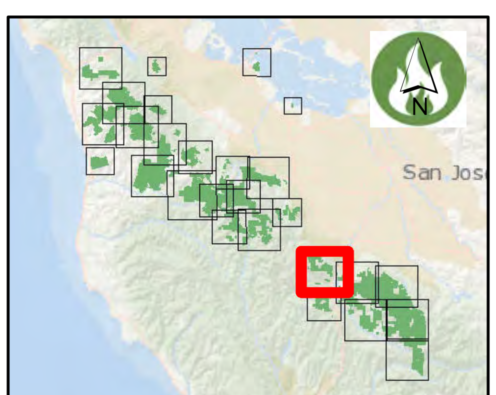
Priority Areas
- Tier 1
- Tier 2

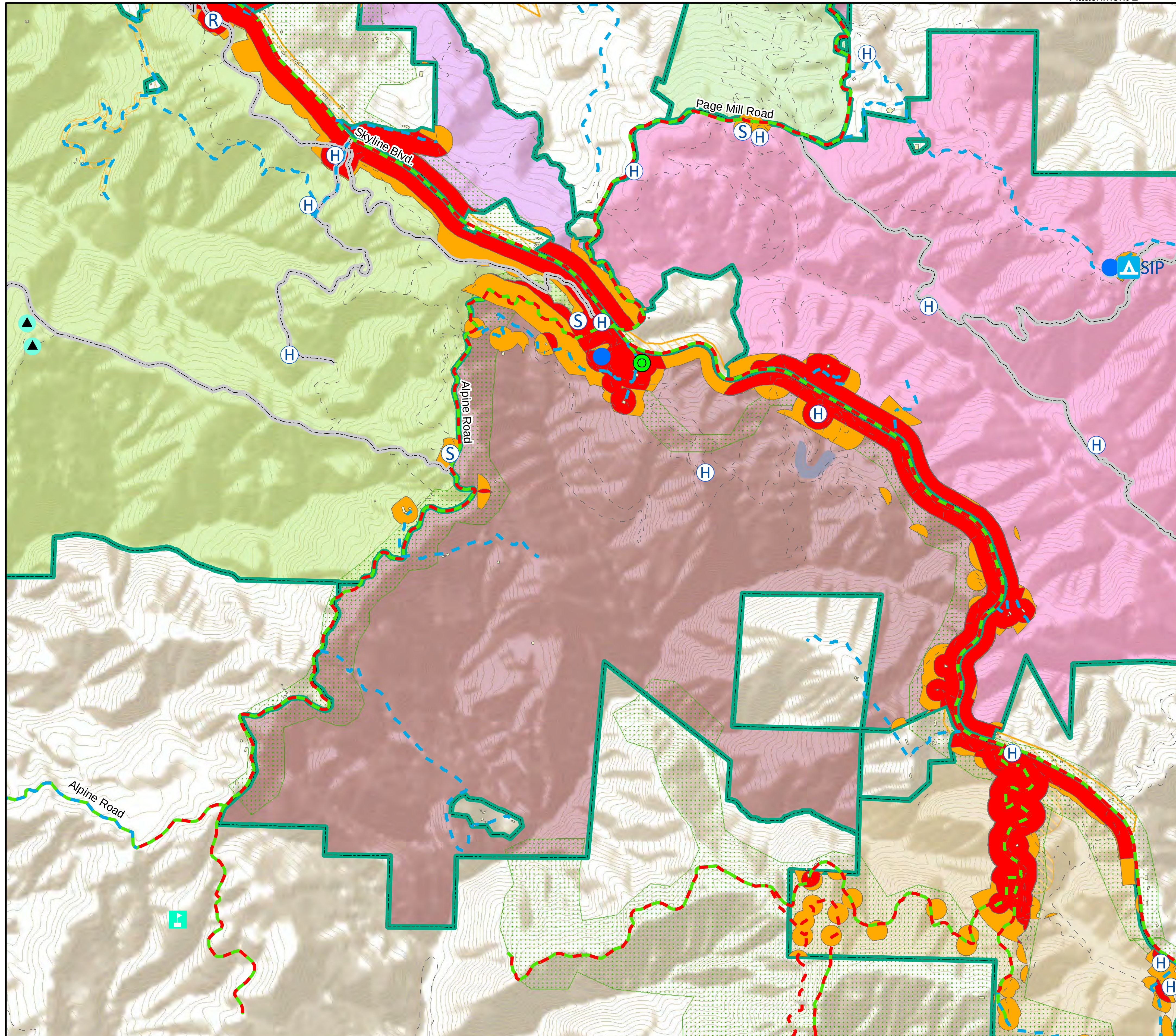
Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Wildland Type 3
- Road or Trail

Target Hazards
- Camp Site
- Community Center
- School

OSP & Managed Properties
- Boundary
- Coal Creek
- Foothills
- Long Ridge
- Los Trancos
- Monte Bello
- Rancho San
- Russian Ridge
- Skyline Ridge

* See Legend on Table of Contents page for additional symbology





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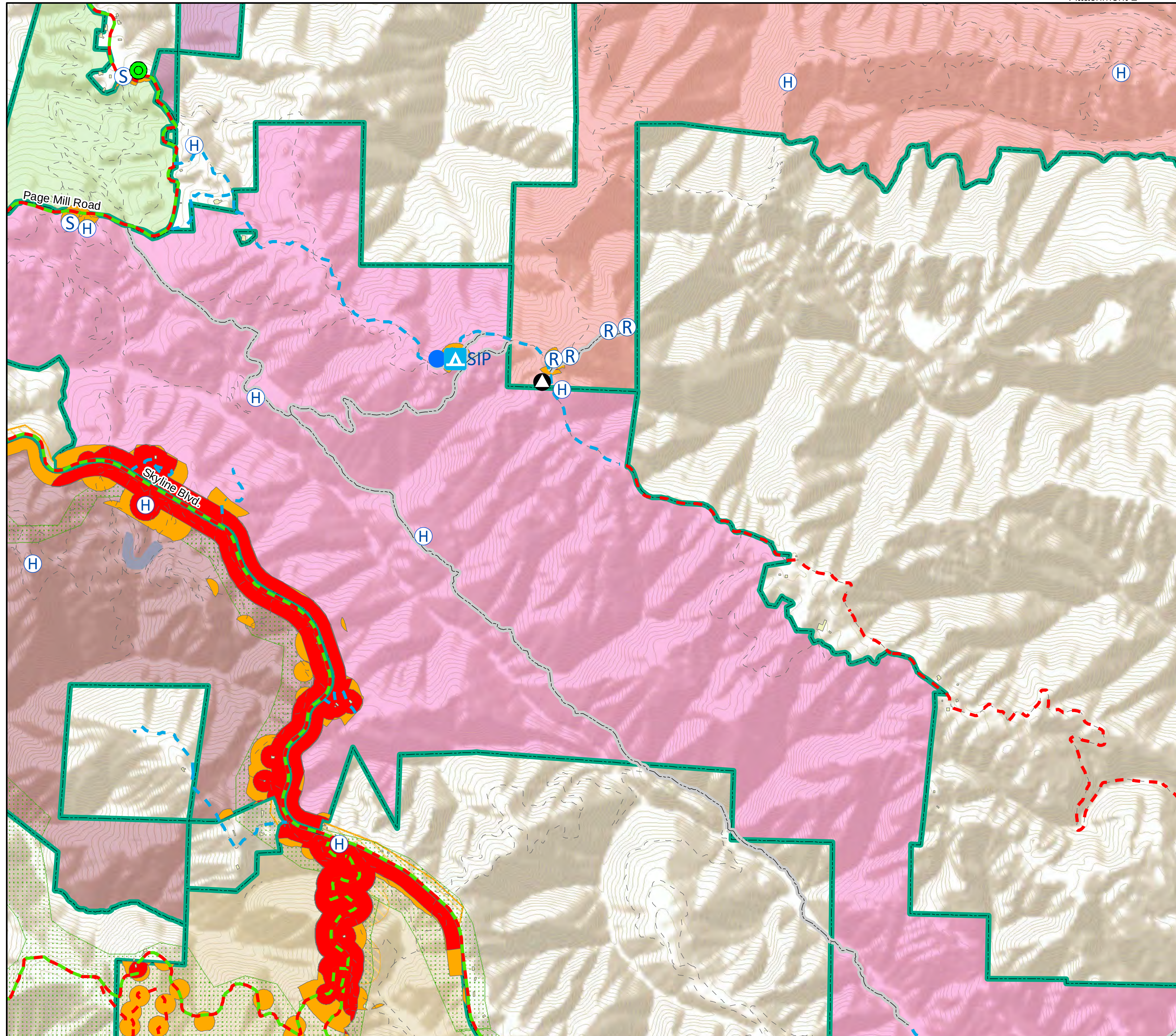
Treatment Priorities
Monte Bello/Long Ridge

Priority Areas
- Tier 1
- Tier 2

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Wildland Type 3
- Road or Trail

Target Hazards
- Camp Site
- Community Center

OSP & Managed Properties
- Boundary
- Foothills
- Long Ridge
- Los Trancos
- Monte Bello
- Rancho San
- Skyline Ridge



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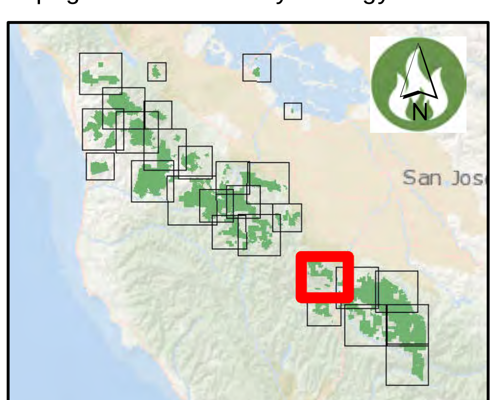


Date Printed: 3/10/2020

Treatment Priorities
Long Ridge

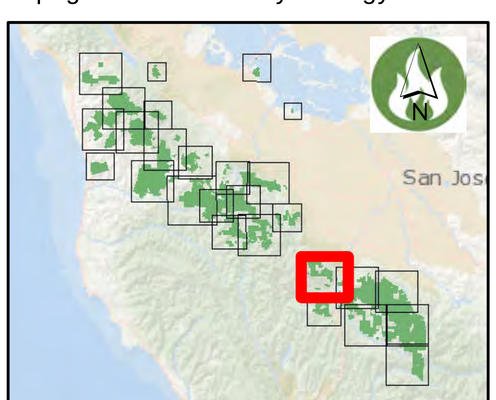
Priority Areas
- Tier 1
- Tier 2

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Wildland Type 3
- Road or Trail

Target Hazards
- Community Center

OSP & Managed Properties
- Boundary
- Long Ridge
- Monte Bello
- Saratoga Gap
- Skyline Ridge

* See Legend on Table of Contents page for additional symbology



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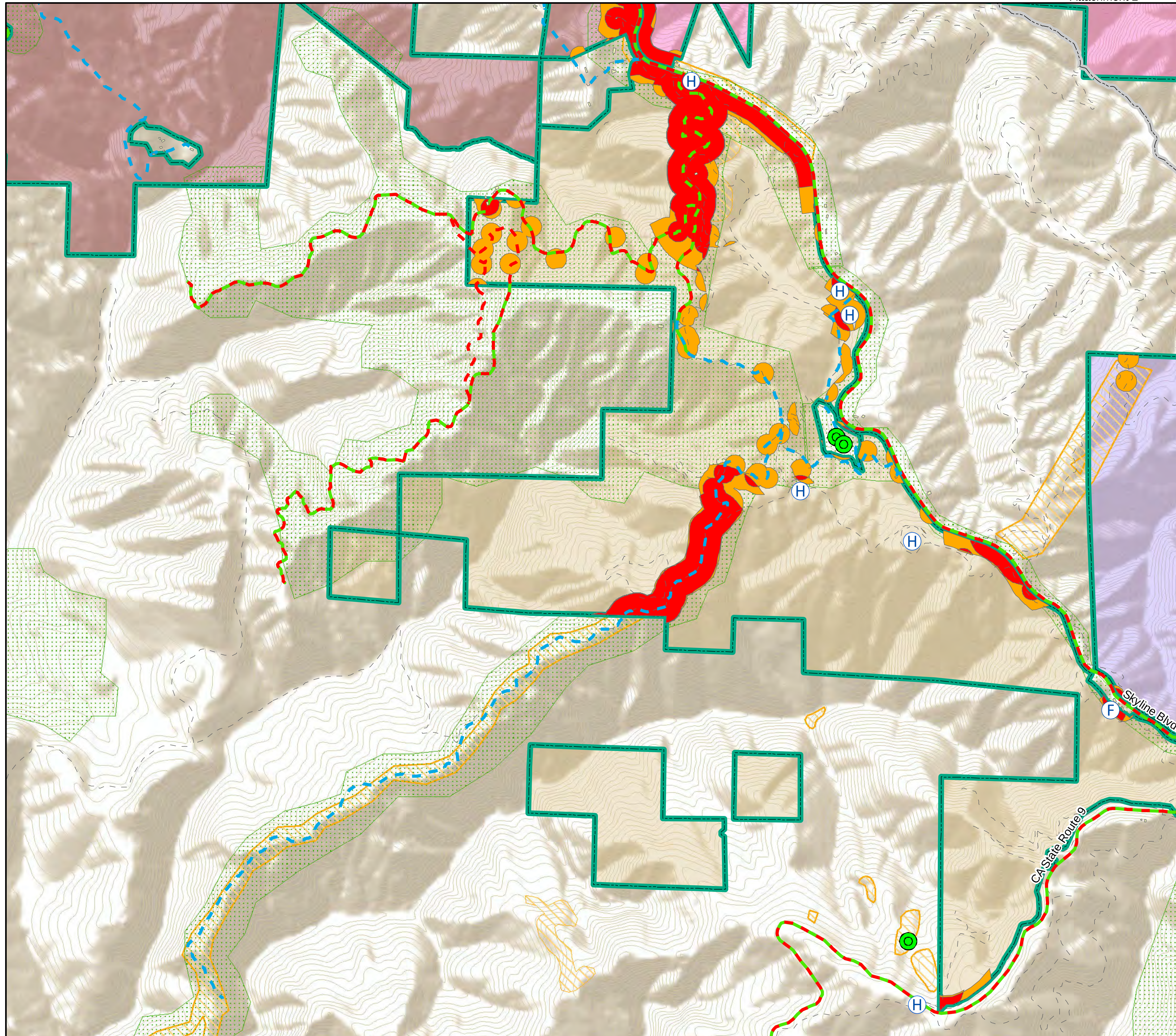

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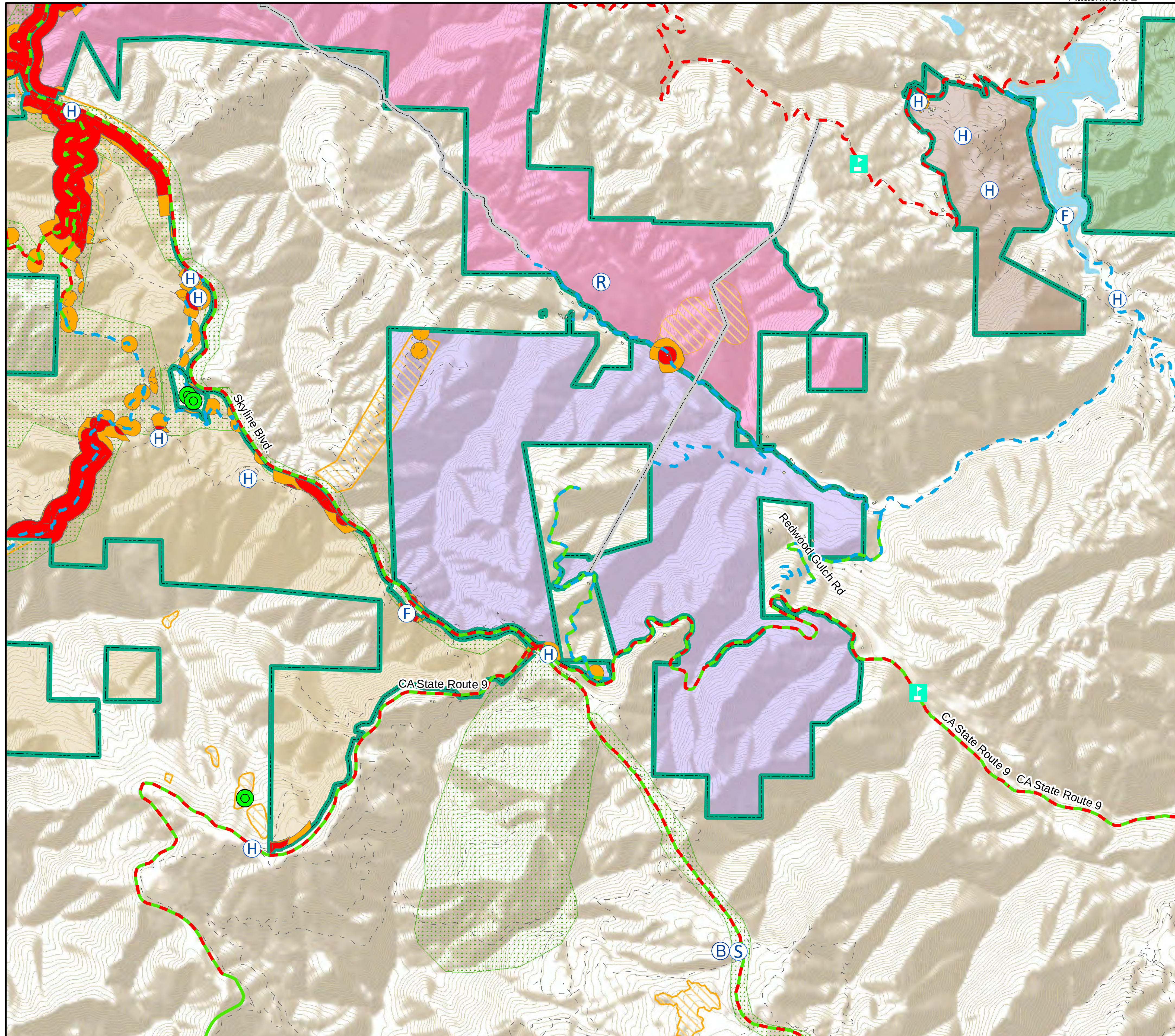
Treatment Priorities
Saratoga Gap/Monte Bello/Long Ridge

Priority Areas
- Tier 1
- Tier 2

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Wildland Type 3
- Road or Trail

Target Hazards
- Community Center
- School
- Mobile Home Park

OSP & Managed Properties
- Boundary
- Fremont Older
- Long Ridge
- Monte Bello
- Picchetti Ranch
- Saratoga Gap
- Skyline Ridge



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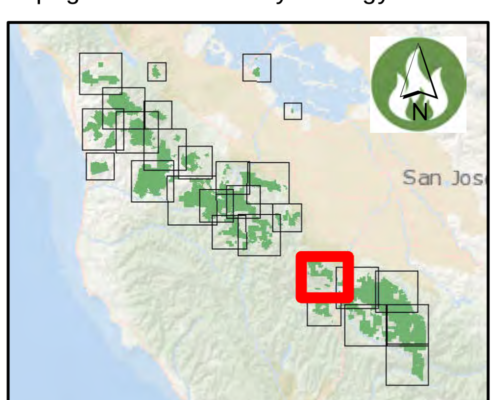

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Attachment 2

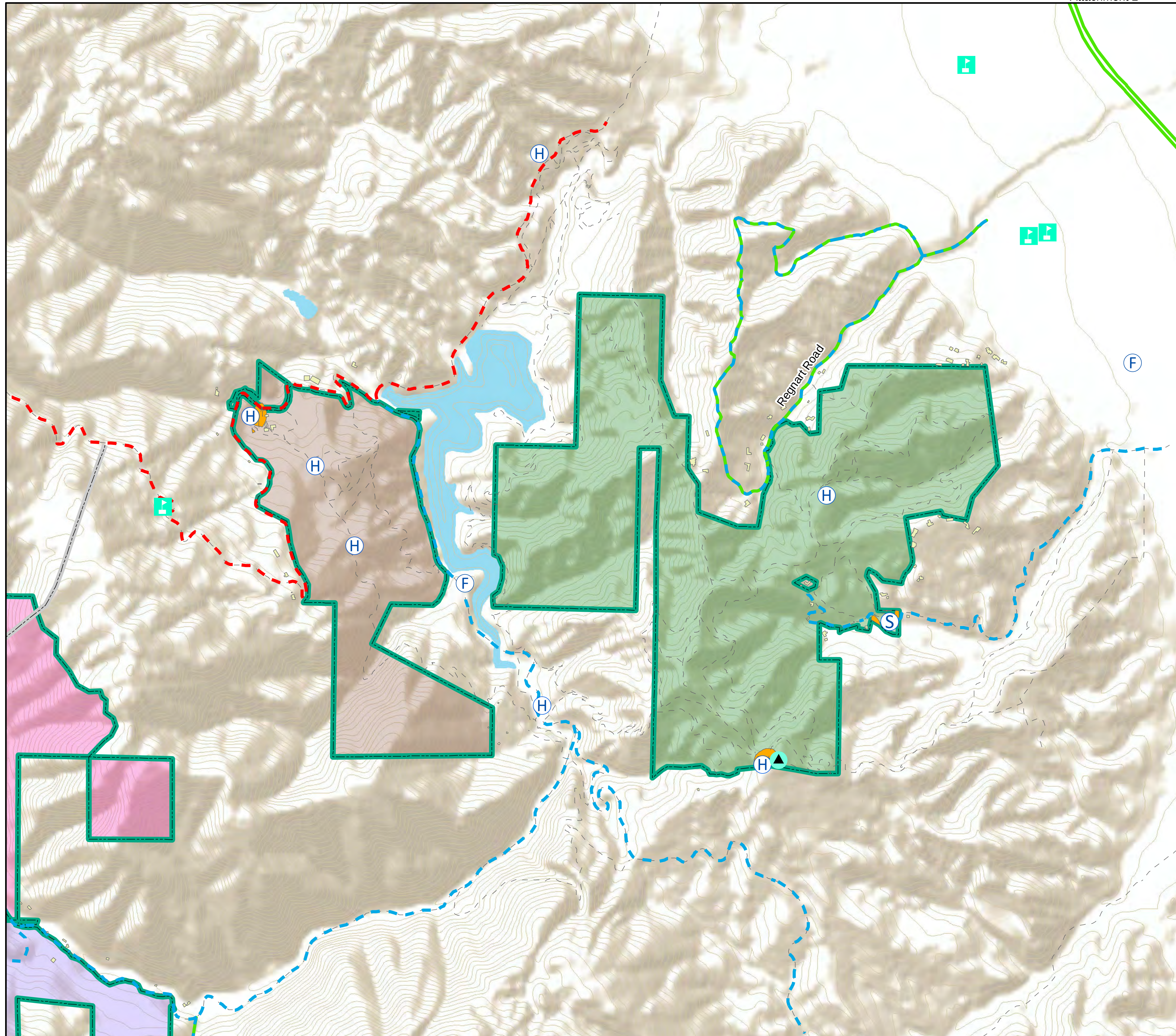
Treatment Priorities
Fremont Older/Picchetti Ranch

Priority Areas
- Tier 2

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Wildland Type 3
- Road or Trail

Target Hazards
- School

OSP & Managed Properties
- Boundary
- Fremont Older
- Monte Bello
- Picchetti Ranch
- Saratoga Gap



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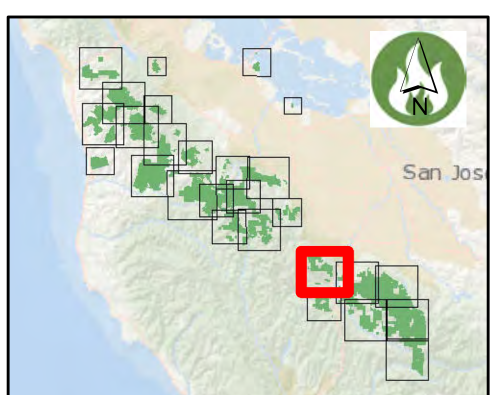

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Attachment 2

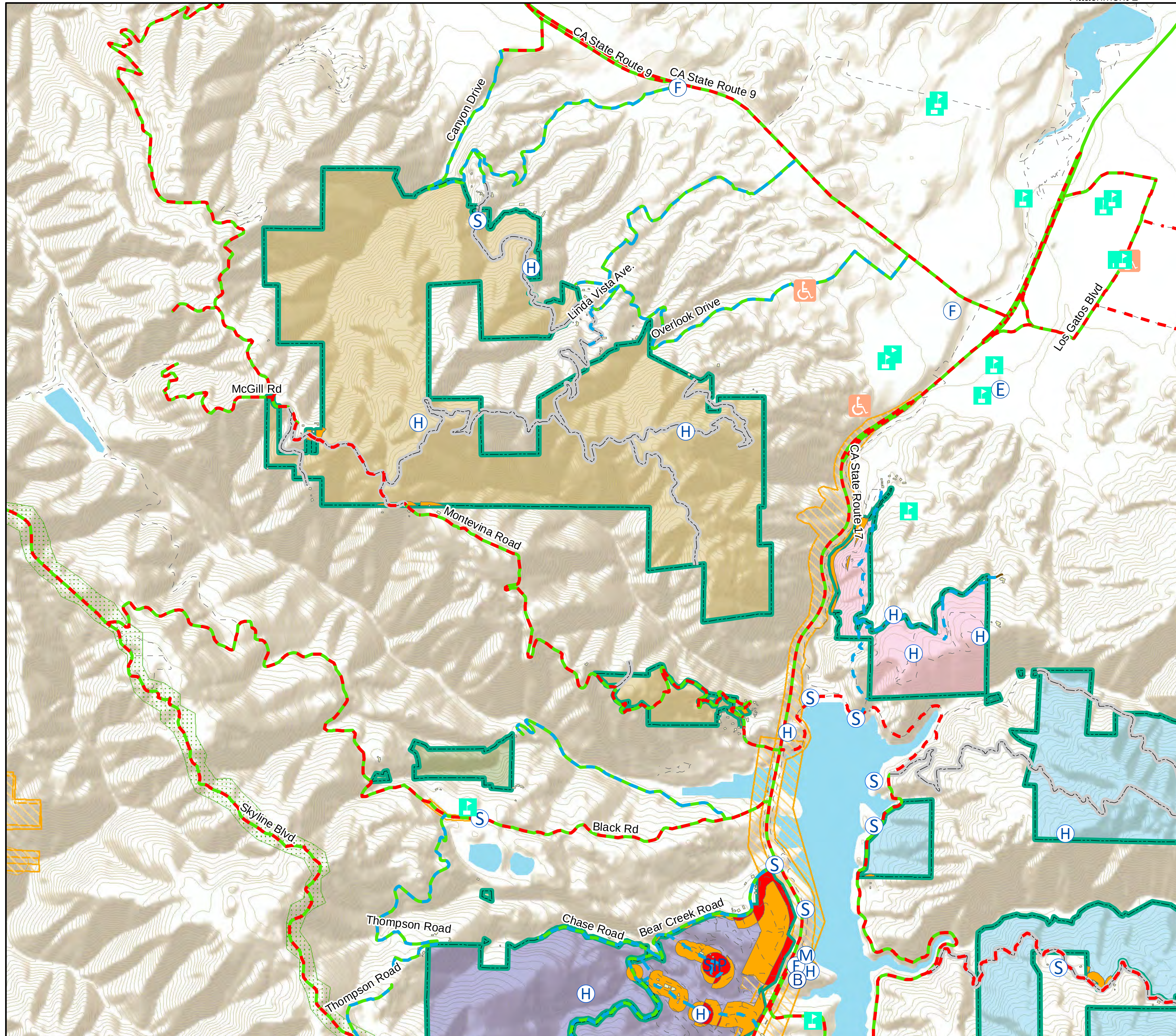
Treatment Priorities
El Sereno/Felton Station/St. Joseph's Hill

Priority Areas
- Tier 1
- Tier 2

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Wildland Type 3
- Road or Trail

Target Hazards
- Assisted Living Facility
- School

OSP & Managed Properties
- Boundary
- Bear Creek Redwoods
- El Sereno
- Felton Station
- Sierra
- St. Joseph's Hill



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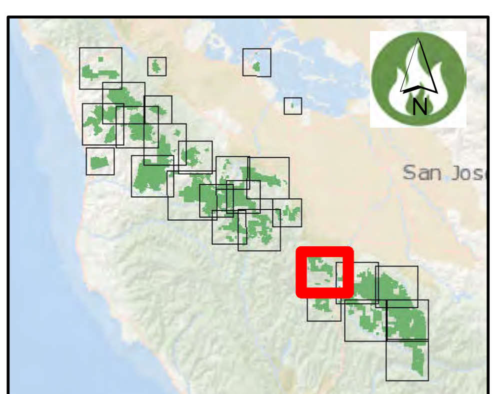

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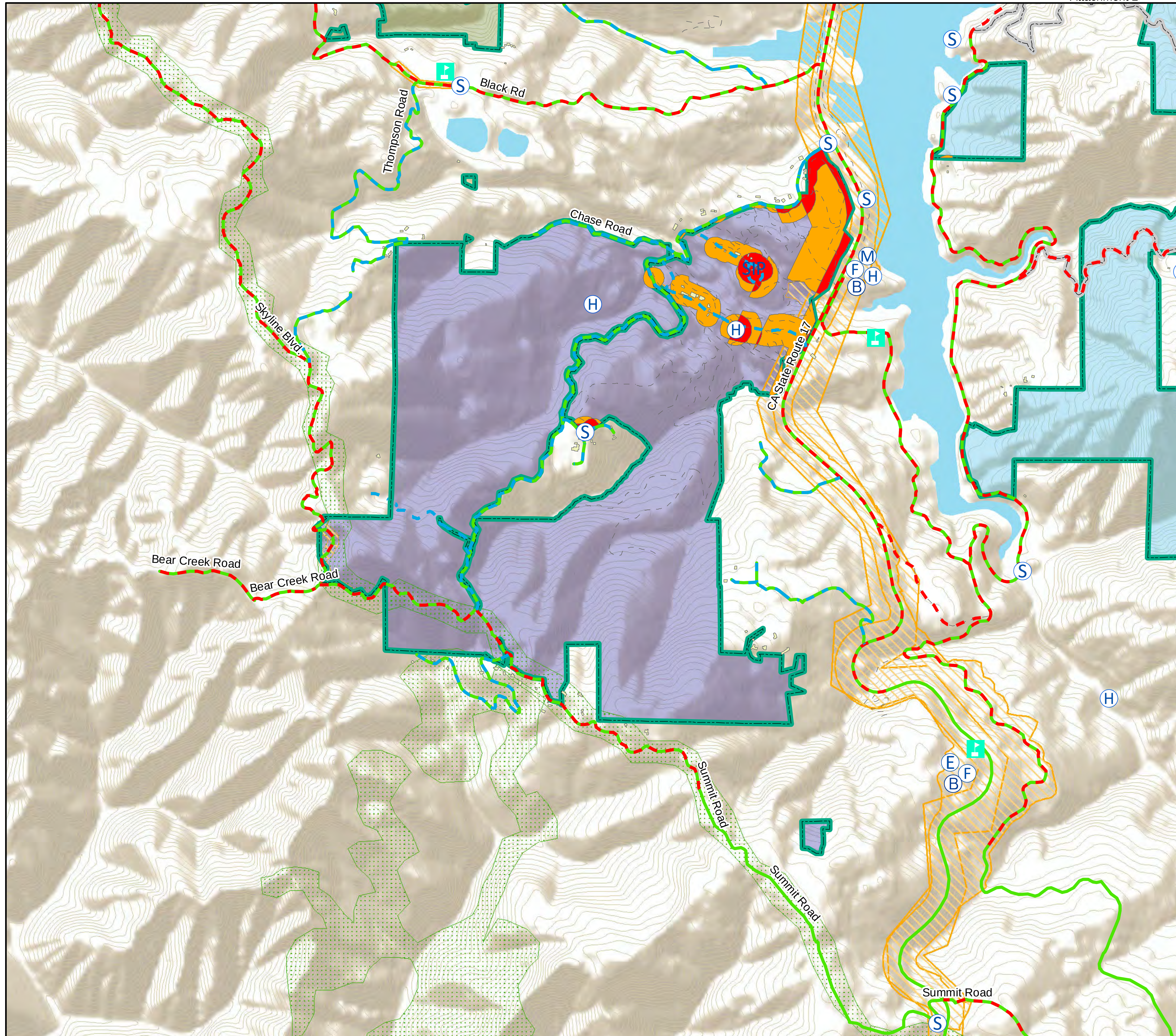
Treatment Priorities
Bear Creek Redwoods

Priority Areas
- Tier 1
- Tier 2

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Wildland Type 3
- Road or Trail

Target Hazards
- School

OSP & Managed Properties
- Boundary
- Bear Creek Redwoods
- El Sereno
- Felton Station
- Sierra Azul



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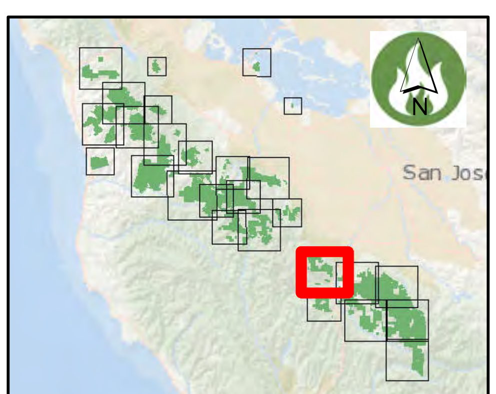


Date Printed: 3/10/2020

Treatment Priorities
Sierra Azul

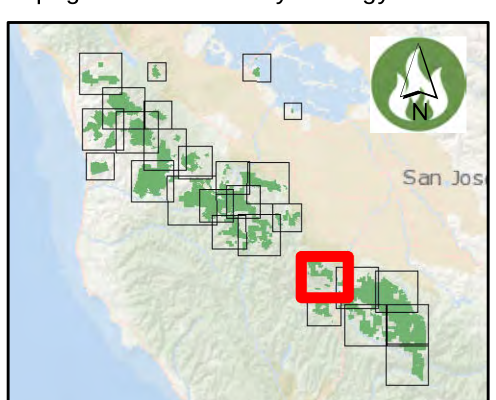
Priority Areas
- Tier 1
- Tier 2

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Wildland Type 3
- Road or Trail

Target Hazards
- Assisted Living Facility
- School

OSP & Managed Properties
- Boundary
- Bear Creek Redwoods
- El Sereno
- Sierra Azul
- St. Joseph's Hill

* See Legend on Table of Contents page for additional symbology



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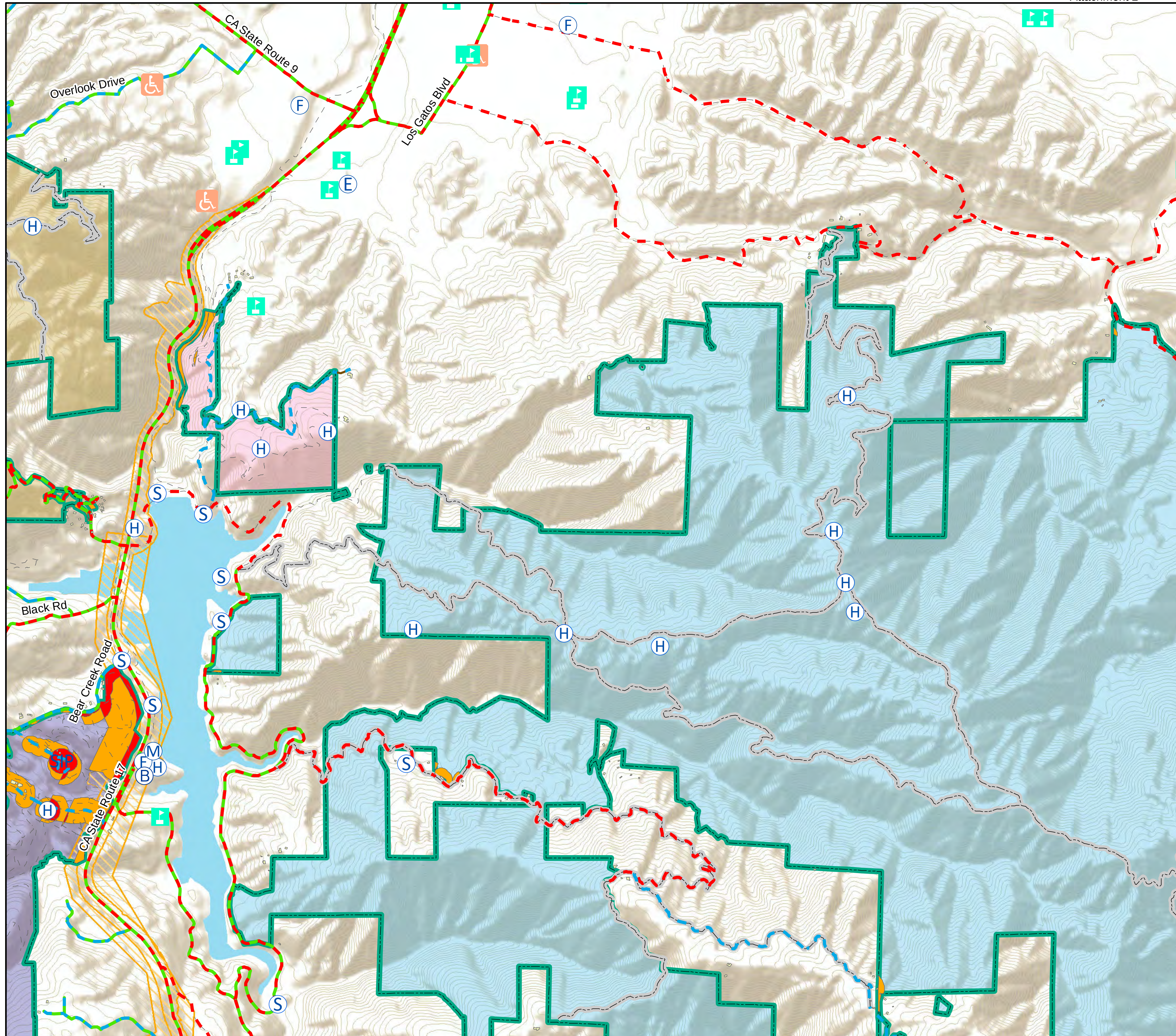

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Attachment 2

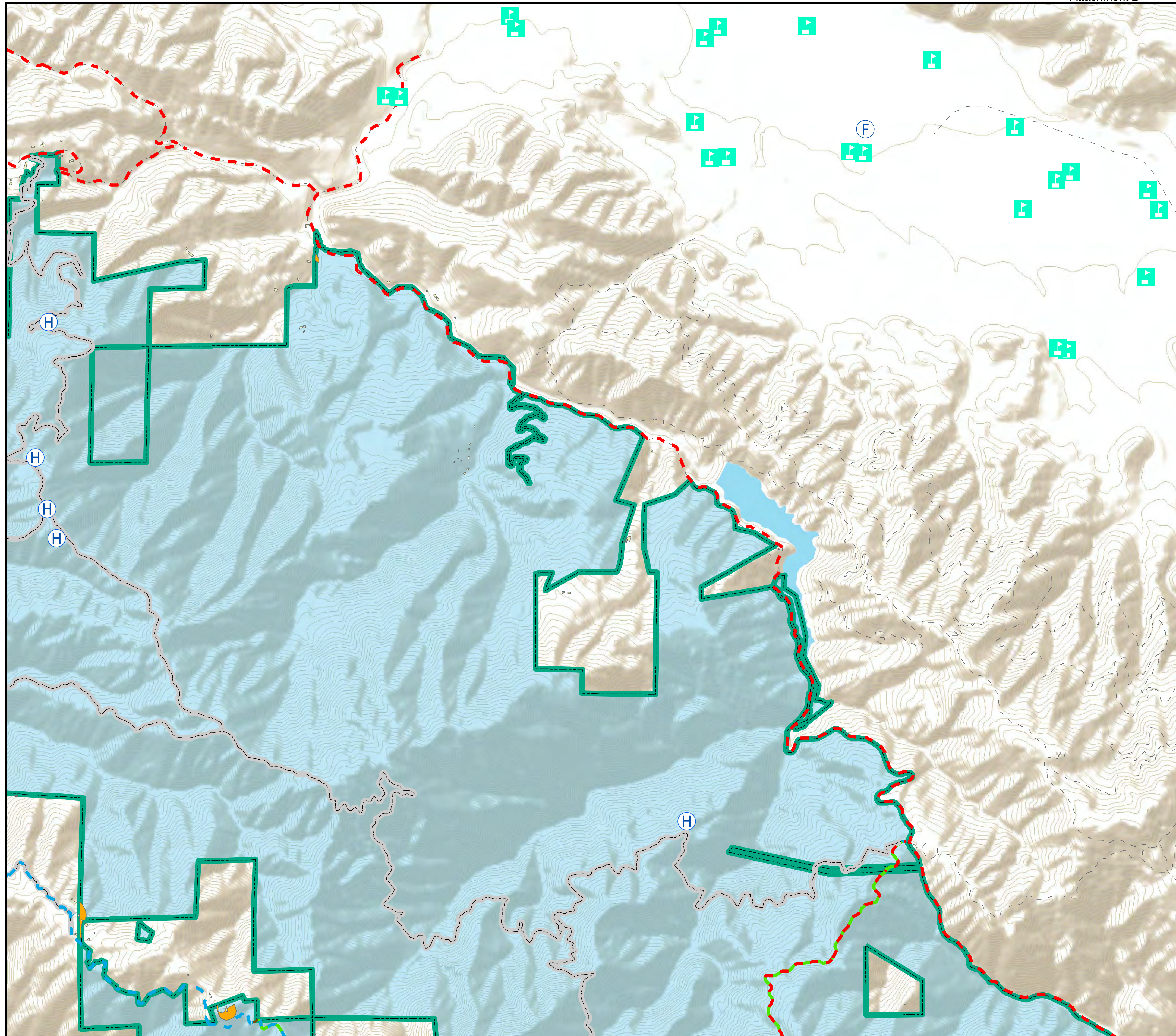
Treatment Priorities
Sierra Azul

Priority Areas
- Tier 2

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Wildland Type 3
- Road or Trail

Target Hazards
- School

OSP & Managed Properties
- Boundary
- Sierra Azul



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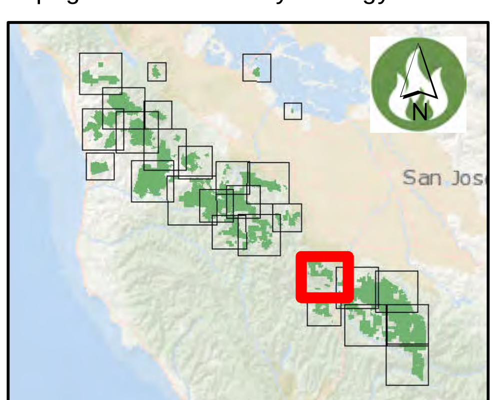

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Treatment Priorities
Sierra Azul

Priority Areas
- Tier 1
- Tier 2

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Wildland Type 3
- Road or Trail

Target Hazards
- School

OSP & Managed Properties
- Boundary
- Sierra Azul

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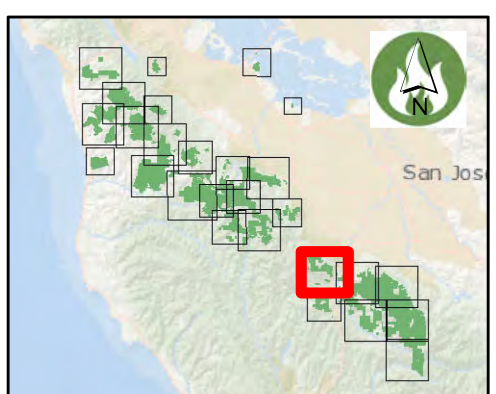

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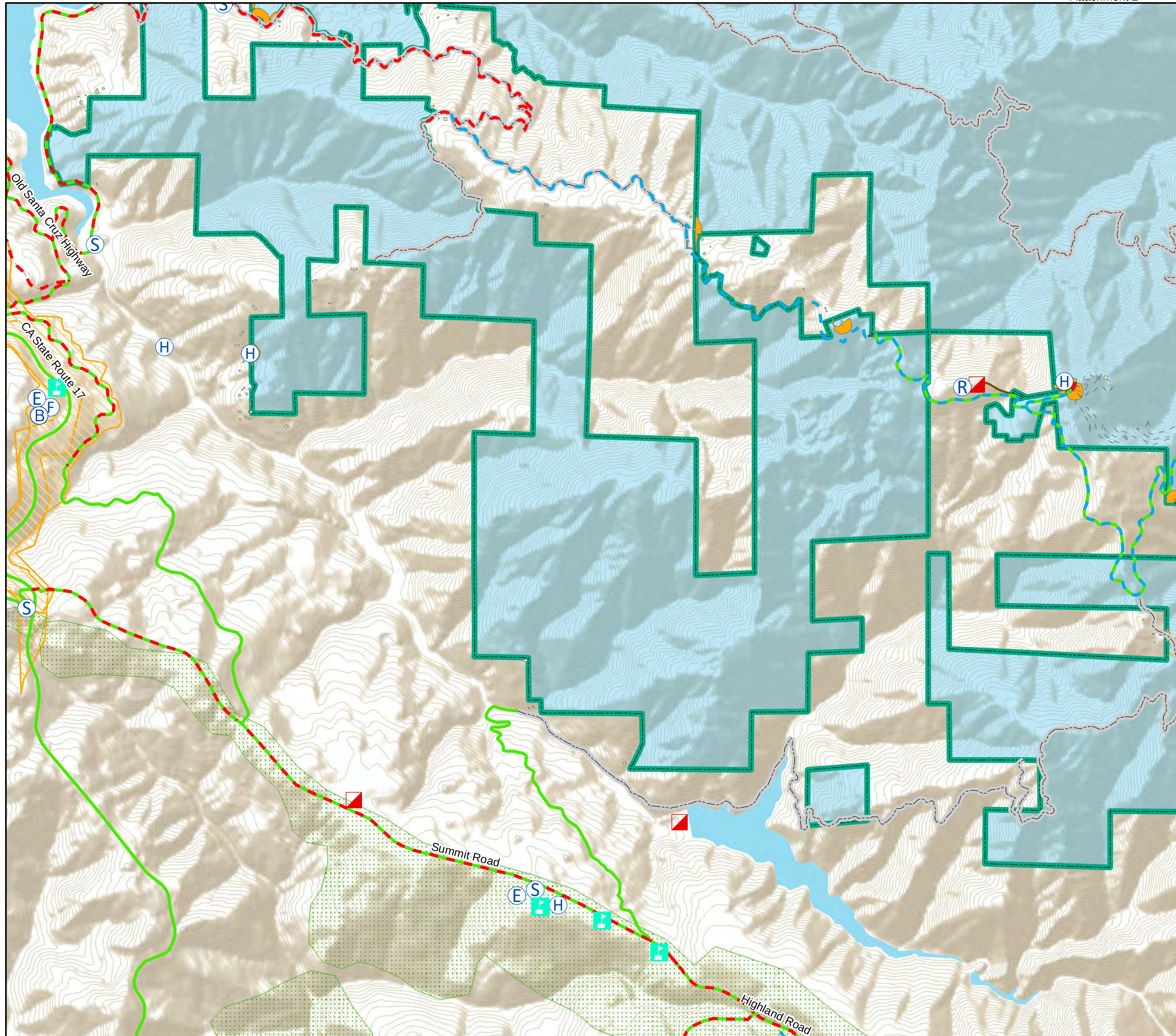

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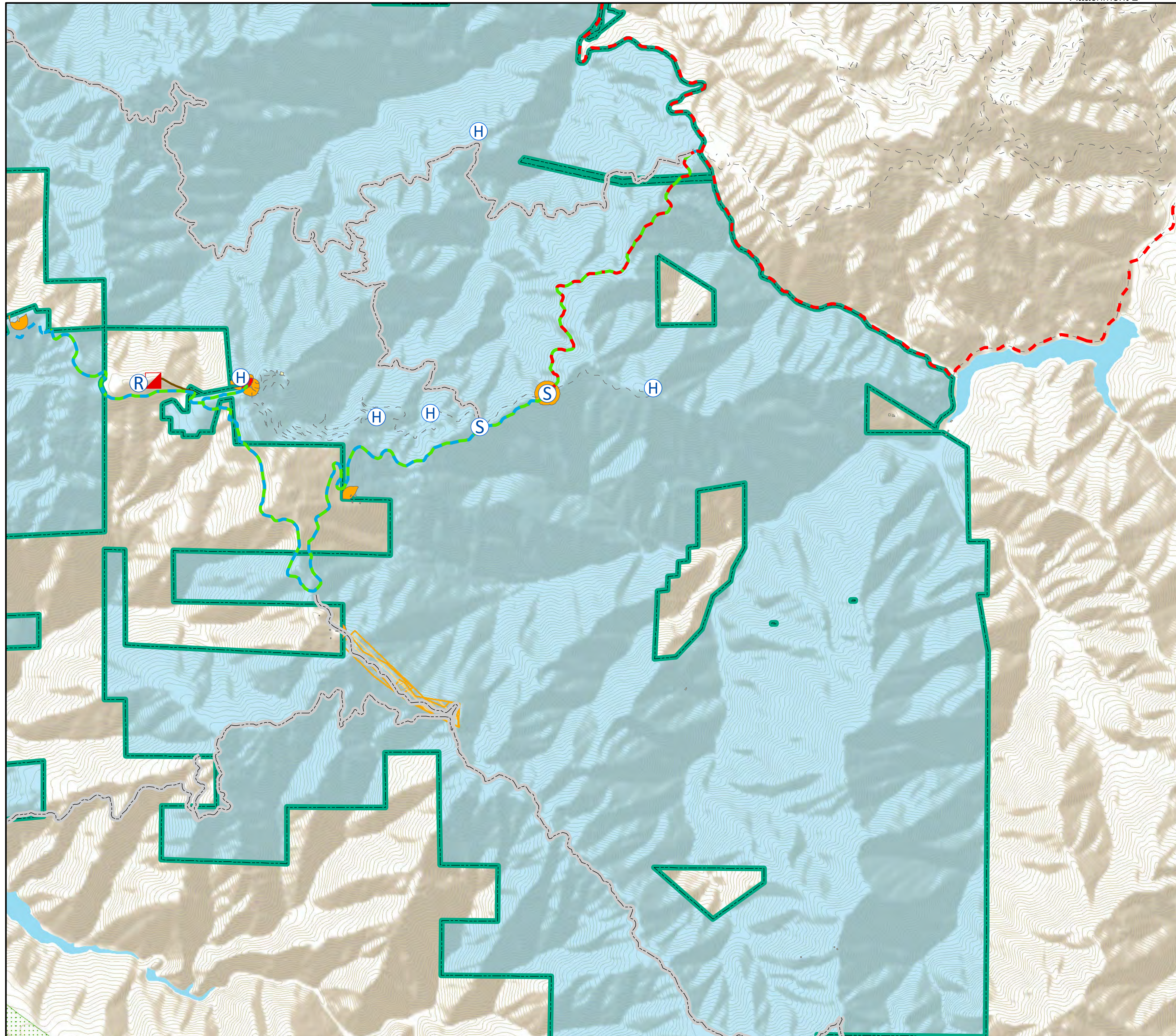
Treatment Priorities
Sierra Azul

Priority Areas
- Tier 1
- Tier 2

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Wildland Type 3
- Road or Trail

OSP & Managed Properties
- Boundary
- Sierra Azul



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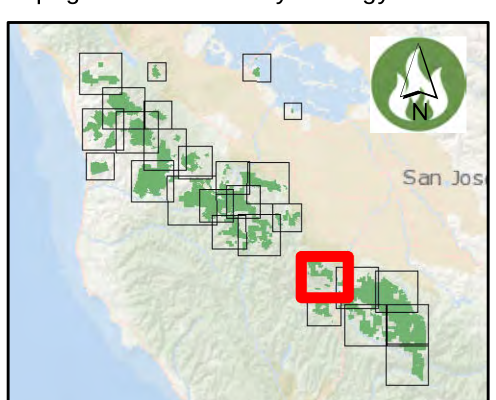

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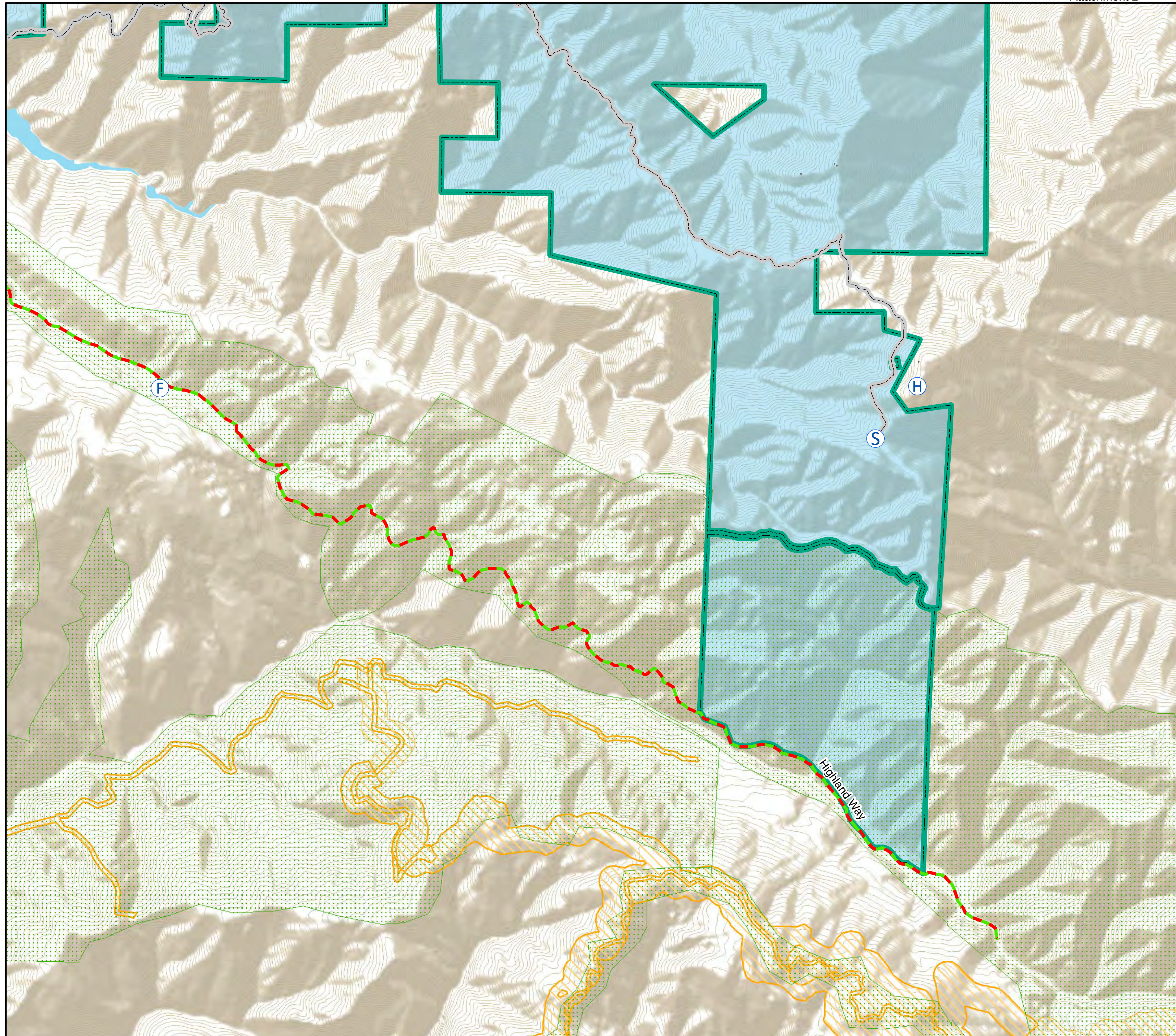
Treatment Priorities
Sierra Azul

Critical Infrastructure

- Primary Evacuation Route
- Structure Type 1 (Tender)
- Wildland Type 3

OSP & Managed Properties

- Boundary
- Sierra Azul



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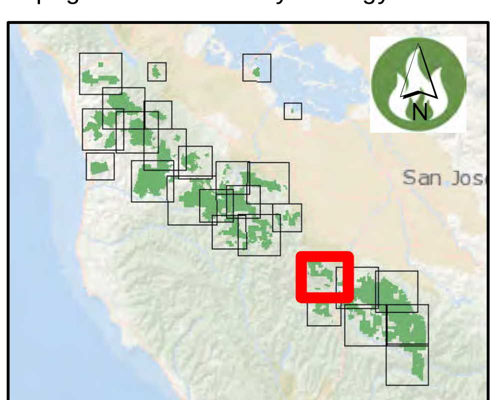

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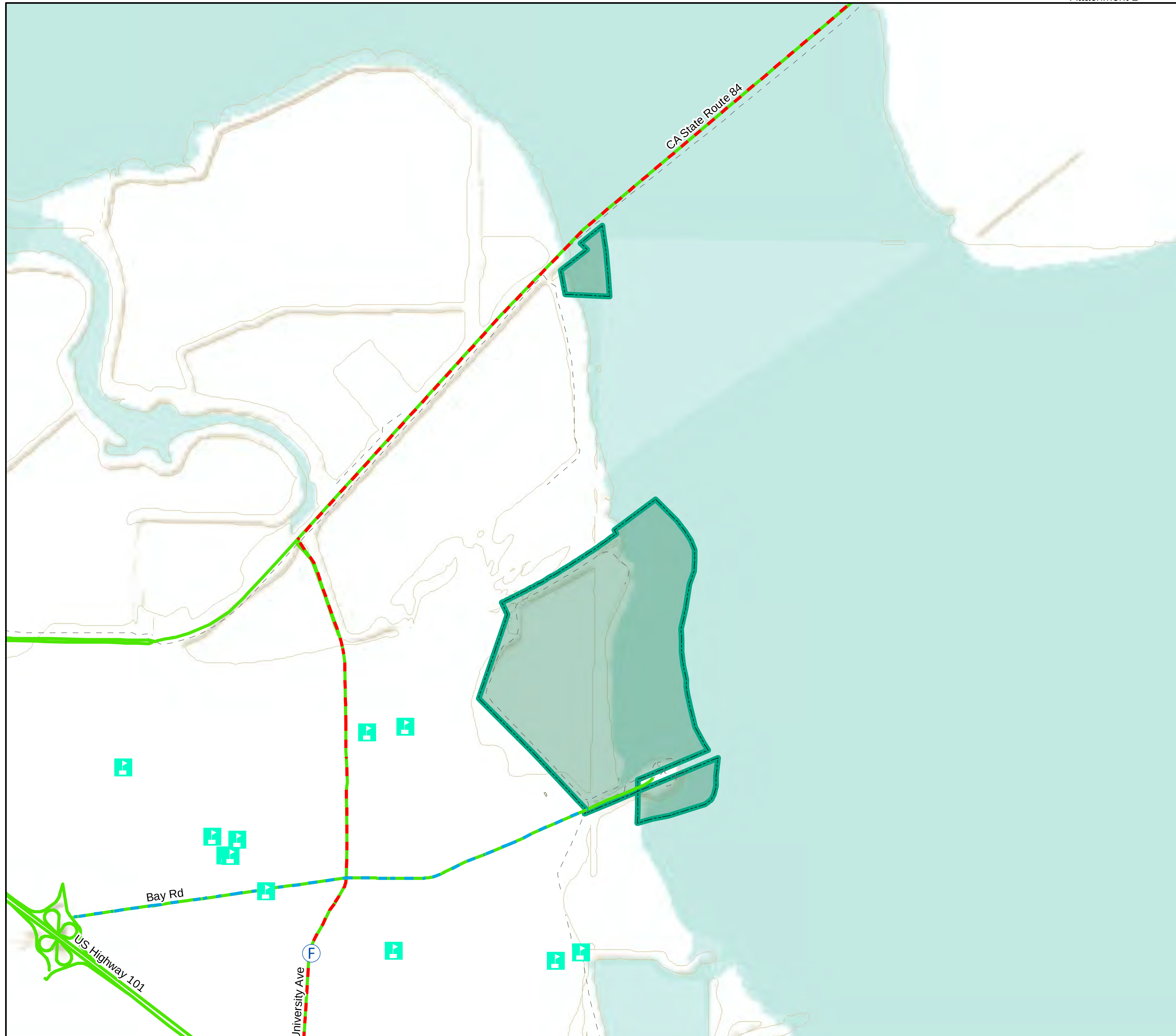
Treatment Priorities
Ravenswood

Critical Infrastructure
- Primary Evacuation Route
- Secondary Evacuation Route
- Structure Type 1 (Tender)
- Road or Trail

OSP & Managed Properties
- Boundary
- Ravenswood

Target Hazards
- School



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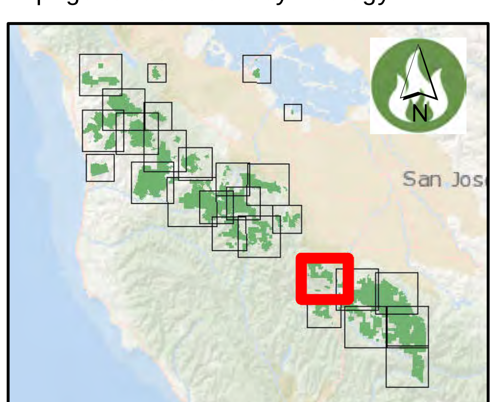

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Treatment Priorities
Stevens Creek Shoreline NSA

- - - Road or Trail

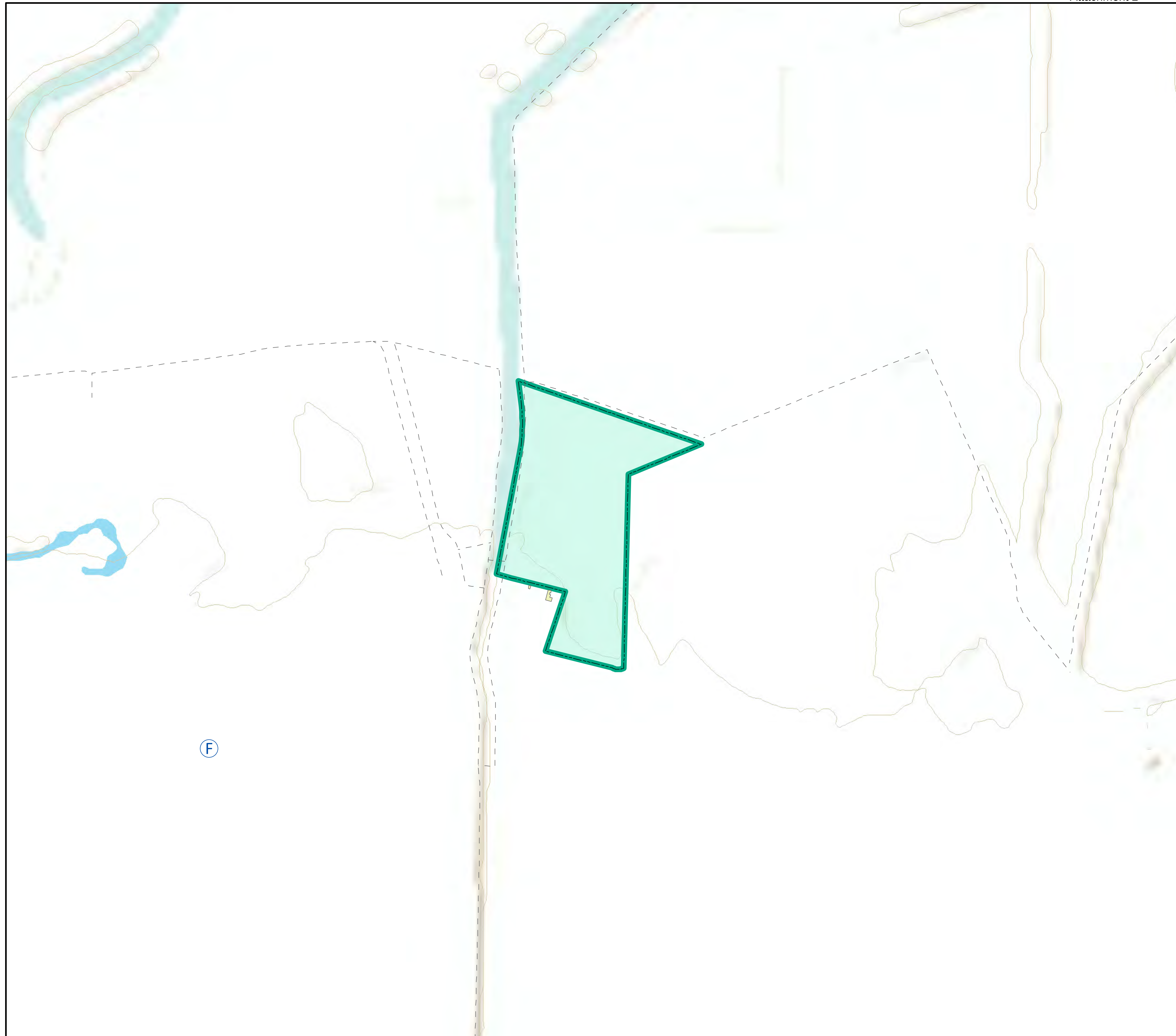
Target Hazards

Mobile Home Park

OSP & Managed Properties

Boundary

Stevens Creek Shoreline Nature Study Area



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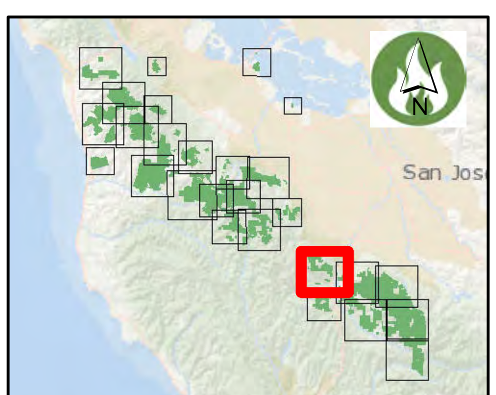

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APPENDIX C

IPMP Guidance Manual

Attachment 2

Midpeninsula Regional Open Space District

Integrated Pest Management Program
Guidance Manual

September 2014

PREPARED FOR:
Midpeninsula Regional
Open Space District
330 Distel Circle
Los Altos, CA 94022

Midpeninsula Regional Open Space District

Integrated Pest Management Program
Guidance Manual

PREPARED FOR:
Midpeninsula Regional Open Space District
330 Distel Circle
Los Altos, CA 94022

PREPARED BY:
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September 2014

Attachment 2

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ACRONYMS AND ABBREVIATIONS

BAEDN	Bay Area Early Detection Network
Cal-IPC	California Invasive Plant Council
CDFA	California Department of Food and Agriculture
CDFW	California Department of Fish and Wildlife (formerly Department of Fish and Game)
CEQA	California Environmental Quality Act
District	Midpeninsula Regional Open Space District
EDRR	Early Detection and Rapid Response
GGNRA	Golden Gate National Recreation Area
IPM	Integrated Pest Management
MSDS	Material Safety Data Sheets
OSP	Open Space Preserve
PCA	Pest Control Advisor
PCR	Pest Control Recommendation
PPE	Personal Protective Equipment
PSIS	Pesticide Safety Information Series leaflets
QAC	Qualified Applicator's Certificate
QAL	Qualified Applicator's License
SPCA	Structural Pest Control Applicator
SPCO	Structural Pest Control Operator
SOD	Sudden Oak Death
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service

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1 OVERVIEW

Integrated Pest Management (IPM) is a process of efficiently managing pests while protecting human health and environmental quality. With this Guidance Manual, the Midpeninsula Regional Open Space District (District) is adopting a comprehensive IPM approach throughout all of its preserves, other properties, and associated buildings and facilities. The District's definition of IPM and its IPM Policy are described in Chapter 2.

The IPM Policy and this Guidance Manual will be considered by the Board of Directors for adoption. Once adopted, the Guidance Manual will be updated as needed. The Guidance Manual is intended to have a ten-year planning timeframe. The Guidance Manual is split into two main sections: chapters that deal with program-wide processes (Chapters 1-5), and chapters that guide individual pest management decisions (Chapters 6-10).

The IPM Coordinator and the IPM Coordination Team will play key roles in reviewing pest management projects for consistency with the Guidance Manual and overseeing licensing, training, and safety (Chapter 3) in carrying out the IPM Program. Other processes undertaken by the IPM Coordinator or staff throughout the year include planning, notification, and monitoring of the projects(Chapters 3 and 4). The Guidance Manual primarily emphasizes the review, prioritization and approval of pest management activities through the development of an Annual IPM Work Plan (Chapter 3). Any new pest management activities not originally included in the Annual IPM Work Plan will be reviewed on an individual basis throughout the year.

An Annual IPM Report will summarize the work completed in the year (Chapter 3), evaluate the program's progress in meeting overall goals, and recommend any modifications (Chapter 4).

To adopt a comprehensive IPM program, especially one that emphasizes prevention and monitoring, there are certain tasks that are too large to implement all at once. Therefore, an IPM Implementation Plan will be developed in the first year of the program (Chapter 5).

The most important decisions regarding IPM are made when individual projects are designed. This Guidance Manual identifies specific approaches to pest management including: preventative and maintenance measures; damage assessment procedures; tolerance levels and thresholds for action; and treatment options. Within the District, situations that trigger the need for pest control fall into five distinct pest management categories. Chapters 6 through 10 guide specific pest management decisions in these five major categories of work:

- Buildings (Chapter 6),
- Recreational facilities (Chapter 7),
- Fuel managment areas (Chapter 8),
- Rangelands and agriculture properties (Chapter 9), and
- Natural areas (Chapter 10).

Human health, environmental quality, and effective and efficient management of District property is a concern across all categories. Pests and treatment options are somewhat unique in each of the five work categories because each category represents not only a different purpose under the District's mission, but also a different type of environment. In general, the first three categories represent conditions that have been altered to a greater degree for human purposes, are more frequently occupied or visited by humans, and where the District has greater concerns for human safety. The later two categories are in a more natural state, and environmental quality is of great importance.

1.1 THE IPM APPROACH

This IPM program emphasizes pest prevention as a first approach, followed by actions to discourage or reduce pest populations from reaching levels where active control may be required. Tolerance levels are described to help staff determine when pest populations have reached levels where active pest control should be considered. A wide array of physical (e.g., separation of the pest from the public), biological (e.g., bio-control agents), and cultural (e.g., education and human behavior modification) actions are provided before chemical treatments can be considered. Pest treatment options are provided, including the most effective and least environmentally harmful options by pest type. Monitoring and adaptive management principles, both on the project level and on the program level, are provided to help ensure improvements in efficiency and effectiveness of pest control over time.

Certain vegetation management projects are primarily undertaken to meet legal requirements (e.g., defensible space regarding wildfire protection) or District-adopted specifications (e.g., clearance adjacent to trails and roads for hikers, bicyclists, equestrians and vehicles), and these types of projects are undertaken on a routine basis at the same locations primarily by mechanical methods without the need to conduct detailed analysis or monitoring of the appropriate treatment method every time.

1.2 QUICK REFERENCE TO THE IPM GUIDANCE MANUAL BY PEST TYPES

The following provides a quick cross-reference by types of pests to specific sections in the Guidance Manual.

- **Rodents, insects or other animals in buildings and vehicles** –Chapter 6 Section 6.7.2, Nuisance Animals in Buildings.
- **Rattlesnakes or stinging insects outside and near people** –Chapter 7, Section 7.7.2 Nuisance Animals Near Recreational Facilities.
- **Invasive animals in natural areas or rangelands** – Chapter 10, Section 10.10.1 Invasive Animals In Natural Areas (cross –referenced in Chapter 9, Section 9.9.1- Invasive Animals in Rangelands).
- **Vegetation encroaching on trails, roads, parking lots and other outside recreational facilities** – Chapter 7, Section 7.7.3 Vegetation Management of Trails and Other Recreational Facilities (cross referenced in Chapter 8, Section 8.7.3, Maintaining Vegetation along Trails for Fire Safety).
- **Landscaping around buildings** – Chapter 7, Section 7.4.2 Retrofit.
- **Flammable vegetation in designated fuel management areas** – Chapter 8, Section 8.6 Treatment Options.
- **Weeds on rangelands or in agriculture fields** – Chapter 9, Section 9.9.5 Weeds in Agricultural Fields and 9.9.2, Invasive Plants in Rangelands (Cross Referenced to Chapter 10, Section 10.8.2 Invasive Plants)
- **Invasive plants in natural areas** – Chapter 10, Section 10.8.2 Invasive Plants.
- **Forest diseases** - Chapter 10, Section 10.8.3 Forest Diseases.

2 IPM DEFINITION AND POLICY

2.1 DEFINING IPM AND PESTS

IPM is a long-term, science-based, decision-making system that uses a specific methodology to manage damage from pests. The District defines pests in its Resource Management Policies as "Animals or plants that proliferate beyond natural control and interfere with the natural processes which would otherwise occur on open space lands," and target pests as "Plant or animal species that have a negative impact on other organisms or the surrounding environment and are targeted for treatment." This IPM Guidance Manual addresses plant, animal and disease pests that occur on District properties including preserves and buildings or on lands otherwise managed by the District.

IPM requires monitoring site conditions before, during, and after treatment to determine if objectives are being met and if methods need to be revised. IPM can be used for many types of pests and situations, including invasive species control, control of structural and agricultural pests, and control of other nuisance species (e.g., rattlesnakes and stinging insects). This methodology includes the following elements:

- Correctly identify the pest and understand its life cycle.
- Determine the extent of the problem or infestation.
- Evaluate the site conditions.
- Establish the tolerance level for control actions.
- Utilize the least harmful suite of treatment methods to control the pest at the most vulnerable stages of its life cycle.
- Monitor pest populations and effectiveness of treatment methods.

IPM requires knowledge of the biology of pests, the available techniques for controlling them, and an understanding of the secondary effects of the control techniques (e.g., soil erosion, pesticide drift, and bioaccumulation). Control of a pest is only undertaken once a "tolerance level" has been exceeded. A tolerance level, also referred to in IPM systems as a "tolerance threshold," is the level below which pests can be present without causing substantial economic damage, degradation of intended uses or human enjoyment of facilities, disturbance of natural processes, or unacceptable human health risks.

The effectiveness, safety, and efficiency of control methods are important considerations as they apply to the specific site conditions and life history of the target pest. IPM requires monitoring site conditions before, during, and after treatment to determine if objectives are being met and if methods need to be revised. IPM requires that non-chemical methods be considered in addition to chemical methods (i.e., pesticides, herbicides, insecticides).

Pesticides is a broad term defined by the Food and Agricultural Organization of the United Nations as

> "…a substance or mixture of substances intended for preventing, destroying or controlling any pest, including vectors of human or animal disease, and unwanted species of plants or animals …"

Pesticides include ***insecticides*** (substances intended to control insect pests), ***rodenticides*** (substances intended to control rodents), ***herbicides*** (substances intended to control plant pests), and ***fungicides*** *(*substances intended to control fungi). Pesticides often include ***surfactants*** or ***adjuvants*** that are substances intended to adhere and spread pesticides on a surface, typically an insect's exoskeleton, a plant's leaf, or dry soil.

If the use of chemical methods is determined to be necessary to meet a pest control objective, the potential for harm to workers and the public is carefully considered, as are effects on the environment, and then the least harmful and most effective, efficient, and target-specific method is chosen.

IPM was originally developed in the 1960s for agricultural pests and then urban landscapes. Somewhat different approaches are needed when implementing an IPM approach on natural lands. For purposes of managing pests on District land, IPM is:

- An adaptive process that takes into account new science, technology, and understanding of pests and their environment.
- A program to ensure judicious use of pesticides. It is not necessarily intended to eliminate pesticide use; however, well-developed, science-based IPM programs typically reduce pesticide use per acre over time because they employ a wider array of pest management techniques (i.e., physical, biological, and cultural pest control as well as chemical control) that are more effective at eliminating pest issues.
- A decision-making system that adapts to changing conditions. Control methods are determined based on the pest and site-specific conditions, and methods are not universally applied to all pest problems or work categories.

2.2 IPM POLICY

The District's proposed IPM Policy, once adopted, will guide staff in defining, preventing, and managing pests on District lands. The IPM goal, policies, and implementation measures were reviewed initially in 2013, and will be considered for adoption by the Board of Directors concurrently with this Guidance Manual.

2.2.1 GOAL (PROPOSED)

Goal IPM- Control pests by consistent implementation of IPM principles to protect and restore the natural environment and provide for human safety and enjoyment while visiting and working on District lands.

2.2.2 POLICIES (PROPOSED)

Policy IPM-1 Develop specific pest management strategies and priorities that address each of the five work categories.

1. Manage pests in buildings to support existing uses, while also protecting human health and surrounding natural resources.

2. Manage pests and potential human interactions in recreational facilities to minimize conflict, ensure visitor safety and enjoyment, and protect the surrounding natural resources.

3. Manage pests in fuel management areas to reduce risk to human life and property, while also protecting natural resources.

4. Manage pests in rangelands and on agricultural properties to support existing uses, while also protecting human health and surrounding natural resources.

5. Manage invasive species in natural areas and set priorities for their control based on the potential risk to sensitive native species and loss of native biodiversity.

Policy IPM-2 Take appropriate actions to prevent the introduction of new pest species to District preserves, especially new invasive plants in natural areas, rangelands, and agricultural properties.

Policy IPM-3 Manage pests using the procedures outlined in the following eight implementation measures.

1. Develop and implement tolerance levels for pests within each of the Work Categories to determine when to undertake pest control (refer to Chapters 6 through 10 in this Guidance Manual).

2. Identify the pest, determine its life cycle and disruptive potential, and identify relevant site conditions prior to implementing a pest control activity. Review pest control objectives for consistency with other site goals and with established tolerance levels that must be exceeded before pest control is undertaken (refer to Chapters 6 through 10 in this Guidance Manual).

3. Choose site-specific strategies and times of treatment that provide the best combination of protecting preserve resources, human health, and non-target organisms and that are efficient and cost effective in controlling the target pest. Wherever feasible, direct the control method narrowly at the most vulnerable point in the target organism's life cycle to avoid broad impacts (refer to Chapters 6 through 10 in this Guidance Manual).

4. Monitor results and modify control methods over time as site conditions and treatment techniques change and as needed to obtain an effective level of control (refer to Chapters 6 through 10 in this Guidance Manual).

5. Use the least harmful method(s) to control identified pests. Where the use of pesticides is necessary, apply according to the label using all safety precautions and take all measures needed to protect the environment, the health and safety of visitors, employees, neighbors, and the surrounding natural areas including water and soil resources (refer to Chapters 6 through 10 in this Guidance Manual).

6. Plan for repeat treatments as indicated by the pest's regenerative capabilities.

7. Coordinate and cooperate with adjacent landowners, neighbors, and other responsible agencies to control pests and limit secondary effects.

8. If eradication of a pest from a distinct location is not feasible, apply measures to achieve containment, sustained control, slow down a pest's rate of spread, or minimize pest damage.

Policy IPM-4 Monitor pest occurrences and results of control actions and use adaptive management to improve results.

Policy IPM-5 Develop and implement a Guidance Manual to standardize pest management and IPM procedures across all District lands.

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3 THE IPM PROGRAM

This Chapter describes the IPM Program, including roles and responsibilities, management systems, and organizational processes that will be used to implement IPM on District lands. To illustrate this, refer to Exhibit 3-1 for a diagram of the decision-making process to be used by staff when implementing IPM in various work situations.

3.1 ROLES AND RESPONSIBILITIES

This section describes roles and responsibilities for implementing the IPM program. The Board of Directors is responsible for approving the IPM Policy. The General Manager is responsible for ensuring the implementation of the IPM Policy through District managers and supervisors who train all staff on the IPM Guidance Manual and guide its implementation within the departments.

3.1.1 IPM COORDINATION TEAM

The District will establish an IPM Coordination Team. The team will be made up of District staff working with the advice of technical pest control experts. At a minimum, the team will include one staff representative from each of the field offices, the Natural Resources Department, the Real Property Department, and the Volunteer Program. As necessary, the IPM Coordination Team will consult with the Rangeland Ecologist regarding rangeland and agricultural practices and properties, and with the Planning Department regarding long-range plans and construction and maintenance of capital projects.

The IPM Coordination Team is responsible for the following:

- review and approve an Annual Work Plan that is consistent with this Guidance Manual, feasible and within the District’s projected staff and budget capabilities, and balances the District’s pest management and other responsibilities while providing consistency from year-to-year so that effective progress can be made on multi-year projects;
- provide expertise and staff assistance to complete tasks in the IPM Implementation Plan to ensure that the District’s approach to IPM principles and processes are continually improved;
- review and approve Individual Pest Management Plans throughout the year that were not included in the Annual Work Plan;
- assess the IPM program for safety and effectiveness on an annual basis or whenever urgent changes are indicated;
- develop, periodically review, and recommend changes to the District’s List of Approved Pesticides (Section 3.7 and Appendix A) for initial approval by the General Manager; additions to the District’s List of Approved Pesticides will be brought to the Planning and Natural Resources Committee before approval by the full Board of Directors.
- investigate lower risk/least hazardous alternatives to current practices described in this Guidance Manual, and make recommendations for revising or updating District procedures as described herein;
- review the Annual IPM Report to ensure that it accurately represents pest management work completed in the year and that any recommendations for change are consistent with the District’s adopted IPM Policy; and
- oversee and peer review of the IPM Coordinator position.

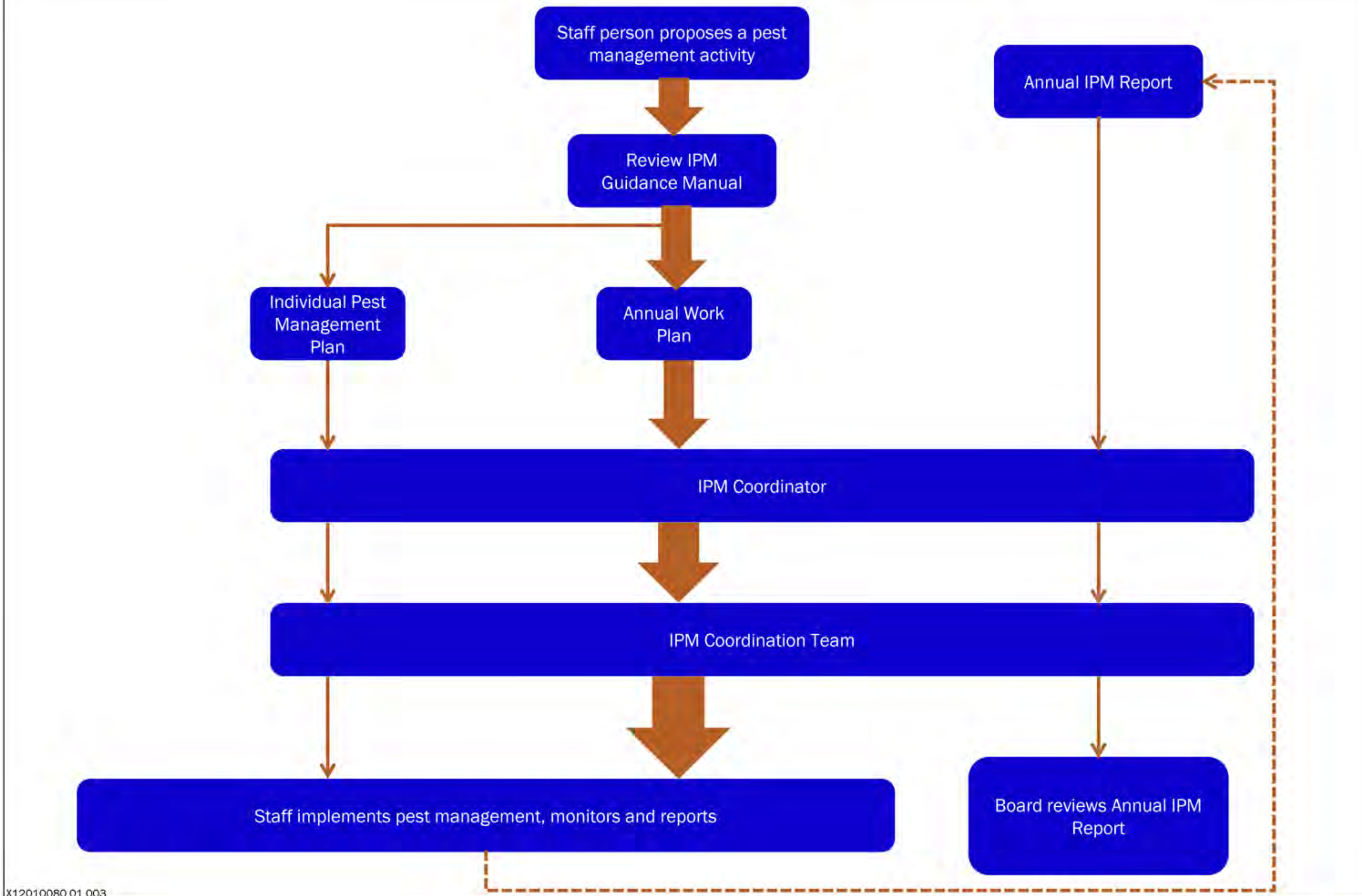

Exhibit 3-1

Flow Chart of the District's IPM Decision-Making Process

IPM COORDINATOR

The IPM Coordinator will have day-to-day oversight of the integrated pest management practices at the District, including the following:

- prepare the Annual Work Plan and Annual IPM Report for review by the IPM Coordination Team;
- coordinate the meetings and tasks of the IPM Coordination Team;
- coordinate staff, contractor, and volunteer IPM training;
- coordinate/implement the pesticide safety program;
- educate and respond to the public;
- prepare other required reports, such as pesticide use reports to the County Agricultural Commissioner; and
- undertake, tasks required by the IPM Implementation Plan with assistance from the IPM Coordination Team, other staff and contractors or consultants.

The IPM Coordinator will report directly to the Natural Resources Manager who will have the overall responsibility for ensuring that the program guidelines are followed. The District will hire an IPM Coordinator who will need to have experience with pests in natural settings such as invasive plants and animals, insects, and pathogens; and will need to have or gain experience with pest management in agricultural crops, rangelands, forests, park facilities (such as non-crop lawn and landscape areas), rights-of-way, and aquatic environments. The IPM Coordinator will have either a PCA, QAC, or QAL certification, or will obtain one or more of these certifications within 2 years of hire date.

The IPM Coordinator must keep records of all pesticide recommendations for a minimum of two years. Recommendations may be site-specific or programmatic (cover multiple sites within the same property or preserve). Each written recommendation must include the following information:

- category, active ingredient, pesticide formulation (i.e., brand name or common name) and dosage of each pesticide to be used;
- identity of each pest to be controlled by a name of common usage;
- property owner and location on the property that will be treated;
- description of commodity, crop, or site to be treated. This includes specific crops (i.e., wine grapes) or descriptions of non-crop sites such as roadsides, habitat restoration sites, forests, etc.;
- suggested schedule, time, or conditions for the pesticide application or other control method;
- any warnings of the possibility of damages by the pesticide application that reasonably should have been known by the agricultural pest control adviser to exist;
- signature and address of the person making the recommendation, the date, and the name of the business such person represents;
- total acreage or units to be treated;
- concentration and volume per acre or other units;
- worker reentry interval, if one has been established; pre-harvest or pre-slaughter interval; and label restrictions on use or disposition of the treated commodity, by-products or treated area;
- criteria used for determining the need for the recommended treatment (tolerance level or tolerance threshold); and
- certification that alternatives and mitigation measures that would substantially lessen any significant adverse impact on the environment have been considered and, if feasible, adopted.

STRUCTURAL PEST CONTROL OPERATOR

The District will designate an employee with an active California Structural Pest Control Operator (Operator) license, or will retain the services of a licensed Branch I (fumigation), II (General Pest), or III (Wood Destroying Pest and Organisms) Structural Pest Control Operator as needed. The Operator will be responsible for reviewing the Annual Work Plan, Individual Pest Management Plans, and developing guidelines for the control of pests in all buildings within the District. Operator guidelines will be forwarded to the IPM Coordinator for a consistency review with the IPM program before implementation.

In the event the District engages the services of a structural pest management company to operate in this capacity, the company will be required to comply with all applicable provisions of the state of California's Department of Consumer Affairs Structural Pest Control Act dated October 2013 (available online at http://www.pestboard.ca.gov/pestlaw/pestact.pdf). The District will require proof of company registration and proof of the companies' qualifying Operators license information before engaging in a contract. The company should be licensed in the applicable Branch of the work being performed (as specified above). The District will monitor the work being done by the company to ensure quality workmanship and compliance with the District's IPM program.

QUALIFIED APPLICATOR

Pesticides will be applied in all areas except buildings by or under the supervision of a California licensed Qualified Applicator (QAC/QAL) who will be licensed in categories relevant to the type of pest control work. The QAC/QAL will be responsible for pesticide use records, work hours, and compliance with the Annual IPM Work Plan, Individual Pest Management Plans, and pesticide labels. Qualified applicators may include District field staff, contractors, and farmer/rancher tenants. Non-QAC or QAL certified District staff can apply pesticides, but only under direct supervision of the QAC or QAL and after completing the District's annual pesticide safety training (Section 3.6).

All contract pest control applicators, the IPM Coordinator, and designated field supervisors must have a valid California QAC or QAL license in one or more of the following categories:

- Residential, industrial, institutional (A);
- Landscape maintenance (B);
- Right-of-way (C);
- Plant agriculture (D);
- Aquatic (F); and/or
- Forestry (E)

Field supervisors who hold a QAC/QAL license or another certified trainer must train all staff who apply and handle pesticides on an annual basis as described in the Training section below (see Section 3.6).

3.1.2 STRUCTURAL PEST CONTROL APPLICATOR

Household and structural pesticides will be applied under the supervision of a California licensed Branch I, II, or III Structural Pest Control Applicator (SPCA). SPCA's will be responsible for pesticide use records, work hours, and compliance with written recommendations in the approved Annual Work Plan, Individual Pest Management Plans, and compliance with pesticide labeling instructions. SPCA's may include a combination of District field staff and contractors. No unlicensed staff, contractors, volunteers, or tenants will perform structural or household pest control except for the limited use of District approved ant/roach bait stations.

Structural pesticide applications made on District property by an outside vendor will be by a registered structural pest control company in accordance with the state of California’s Structural Pest Control Act dated October 2013. Structural pesticide applications made by District staff will be carried out by trained applicators under the supervision of the IPM Coordinator or designated field supervisors. All applications on District property will be made in compliance with the Annual Work Plan, Individual Pest Management Plans, and pesticide labeling instructions. No untrained staff, volunteers, or tenants will make structural pesticide applications.

3.2 DECISION-MAKING AND RECORD-KEEPING

This section describes the procedures that the District will follow to make decisions and track pest management throughout its lands and departments. The primary process by which pest management decisions will be made and evaluated is through an Annual IPM Work Plan. Pesticide use record-keeping completed by each department will be kept by the IPM Coordinator, who will be responsible for consolidating this information into the Annual IPM Report, as described below.

3.2.1 DEVELOPMENT OF THE ANNUAL IPM WORK PLAN

The IPM Coordinator and the IPM Coordination Team will prepare an Annual IPM Work Plan each year that describes planned pest control projects in the upcoming year. Working through department supervisors, staff will provide the IPM Coordinator with a standardized spreadsheet or similar summary form describing upcoming pest control for the following basic types of activities:

- Routine minor pest control actions;
- Ongoing pest control projects; and
- New pest control projects.

Using this staff information, the Annual IPM Work Plan will be prepared by the IPM Coordinator, then reviewed and approved by the IPM Coordination Team. Information in the Annual IPM Work Plan will also be used to inform the Annual IPM Report (described below in Section 3.4.1).

The Annual IPM Work Plan will include the following basic information:

- Summary (e.g., Excel spreadsheet) of routine minor and ongoing pest control projects;
- Detailed descriptions of new pest control projects;
- Projected amounts of pest control in the next year (acres, hours, acres treated per gallon, total gallons used); and
- Any new approaches to be implemented as a result of the adaptive management review in the Annual IPM Report of the preceding year.

These types of pest control activities are described in more detail below. Refer to Appendix B for sample forms.

INDIVIDUAL PEST MANAGEMENT PLANS

If a project is proposed during the year which was not included in the Annual Work Plan, then a description of the project will be prepared for review and approval by the IPM Coordinator and the IPM Coordination Team. Examples of when individual pest management plans might be required are when new properties are acquired or new pests of high priority are discovered in the course of a year.

3.2.2 ROUTINE MINOR PEST CONTROL

Routine minor pest control activities include maintenance activities that generally utilize the same pest control methods at the same site from year to year. These are primarily non-chemical methods such as brush cutting of trails and mowing/discing for fuel management, but also include minor use of pesticides in cut-stump or spot-spraying application at recreational facilities and fuel management areas, the use of approved insecticide baits in buildings, or wasp spray for stinging insects in trails or bathrooms.

Staff will provide a brief projection of routine minor pest control activities in spreadsheet or similar format.

3.2.3 ONGOING PEST CONTROL PROJECTS

Ongoing pest control projects are existing projects that are expected to have an end date (even if it is takes ten years) such as treatment of brush on rangelands or French broom on natural lands. Because these are ongoing projects, they will have already been surveyed for site conditions, a multiple-year strategy will have been developed. Tracking and monitoring of these ongoing projects will be important to determine if treatment is effective and at what stage treatment methods should be adjusted (such as switching from herbicide to pulling when the density of invasive weeds has substantially decreased). Ongoing pest control projects will be summarized in the Annual Work Plan and tracked for staffing, costs, and adaptive management (effectiveness of selected pest control) purposes.

Staff will provide a projection of ongoing pest control projects in a spreadsheet or similar format and will specifically note any changes that are to be made to specific ongoing projects in the upcoming year (e.g. change in treatment method, change in level of effort, requirements for periodic pre-treatment surveys).

3.2.4 NEW PEST CONTROL PROJECTS

New pest control projects will receive a more detailed review and assessment by the IPM Coordinator and IPM Coordination Team. Staff will prepare a description of newly proposed projects and will specifically note how the recommended treatment is consistent with the IPM Guidance Manual, best management practices and mitigation measures.

Staff proposing new pest control actions will provide the following information:

- name and purpose of the proposed pest control activity;
- location (i.e., preserve name, building or trail name, or location including map where appropriate);
- pest identification and the population size, location, life cycle, and density;
- a brief assessment of damage caused by the pest, including the perceived threshold for action (e.g., severity of the infestation/amount and type of damage);
- site conditions including the presence of aquatic areas, rare species, steep slopes, access and other environmental conditions that are relevant to the effectiveness of pest control and avoidance of environmental impact;
- a description of prevention, options that were considered/previously implemented before the active pest control project was proposed;
- proposed pest treatment options (e.g., grazing, brushing, mowing, herbicide application) and amount of each type of treatment (e.g., acres to be treated), project duration, project timing, performance standards, and remedial actions;
- proposed labor force (staff, contractor, volunteers or special groups) projected labor hours or special materials or equipment required, and direct costs for the next year.

If new pest control projects are determined outside of the Annual IPM Work Plan, then an Individual Pest Management Plan will likewise be prepared and reviewed and approved by the IPM Coordinator.

3.3 PRIORITIZATION

One of the most difficult aspects of implementing an IPM program is to develop a consistent, transparent, and replicable decision-making and prioritization system that allows the District, or any other organization, to make informed decisions about which pest control projects out of many potential ones will be funded. The decision-making process must be flexible, so that staff can adjust workloads from year-to year while still resulting in consistent IPM decisions across departments and staff. The prioritization approaches developed by the Golden Gate National Recreation Area and Marin County Open Space District were examined for their advantages and disadvantages since these two organizations are similar in size and mission to the District, and manage diverse resources, interest groups, and stakeholder groups.

A prioritization system is most useful in determining relative importance of closely related pest management activities. For example, a prioritization system can help staff compare the benefits of treating yellow starthistle in two pastures, one of which is newly invaded with weeds, the other which is an ongoing treatment site. Another example would be comparison of treatment of a newly-discovered invasive plant population with treatment of an established population of French broom that is located in a sensitive habitat. The District will use the prioritization system for IPM on rangeland, agricultural lands, and natural lands.

The District will not use the prioritization system for pest control in buildings, recreational facilities, or fuel management because these routine activities are a relatively fixed, constant priority for the District and are primarily undertaken to meet legal requirements (e.g., defensible space for wildfire protection) or District-adopted specifications (e.g., fuel management clearance adjacent to trails and roads for hikers, bicyclists, equestrians and vehicles), or to protect human health in or the structural integrity of a building. Although there is little flexibility in whether to manage pests associated with these routine activities, there is flexibility in deciding what treatment methods to use and how to conduct them.

The prioritization system will be used mostly when the IPM Coordination Team meets to finalize the Annual IPM Work Plan. This process should be coordinated with the overall staffing, budgeting and objectives of the agency and departments for the year.

Projects will be given a score within each category depending on how well it addresses the most important criteria (at top of each list) and/or the number of criteria within that category (Table 3-1). The score within each category will be within 0 through 3 points with 3 indicating a higher score. The category scores will be totaled at the bottom of the table to provide an overall project priority score.

Table 3-1 Sample Project Ranking System

Category and Criteria	Ranking (Assign a score of 0,1,2, or 3 to each of the 5 categories using the criteria shown in each category 0 =does not apply, 1 minimally meets criteria to 3=meets all or most criteria)
1. Safe ◢ Low level of risk (exposure) to human health, the environment and non-target organisms for anticipated result. ◢ Nonchemical method provides acceptable level of pest control especially for structures frequently occupied by humans.	
2. Prevents and Controls Most Destructive Pests ◢ Prevents new populations of pest. ◢ Activity is early detection of and rapid response to small populations of a new pest species or new occurrences of known pests. ◢ Pest has been ranked as or is otherwise known to be highly invasive or destructive. ◢ Continues, or completes an ongoing District pest control project or action. ◢ Reduces, contains, or eliminates a target pest species. ◢ Enhances or encourages natural predation or natural systemic control of pests.	
3. Protects Biodiversity ◢ Results in protection or enhancement of native biodiversity especially for special-status species or sensitive plant communities such as wetlands, serpentine grasslands, and coastal prairies. ◢ Contributes to the long-term preservation of natural resources and functioning ecosystems. ◢ Reduces spread of plant pathogens that have the potential for large-scale and long-term ecological change such as with Sudden Oak Death. ◢ Reduces risk of vegetation converting to less native biological diversity ◢ Improves rangeland or natural area health or otherwise provides for ecological resiliency in light of future climate change and wildfire cycles.	
4. Provides for Public Engagement ◢ Has significant public interest and support particularly from collaborating organizations or neighbors. ◢ Provides for increased volunteer and/or stewardship opportunities/participation in IPM program. ◢ Increases public understanding and support of IPM program	
5. Feasible and Effective ◢ Can be accomplished with existing staffing and funding. ◢ Project readiness (i.e., project can be accomplished within projected timeline, including permitting and environmental compliance). ◢ High level of anticipated outcome for the staffing and funding (cost/benefit). ◢ Selected technique has been shown to be effective in controlling target pest under relevant site conditions within 5 years. ◢ Integrates with existing District programs, including grazing leases and approved agricultural land uses. ◢ Reduces overall maintenance costs.	
TOTAL PROJECT SCORE (Add scores in each of the 5 categories to get a total scope for the project. Range from 0=low priority to 15=high priority)	

3.4 REPORTING

3.4.1 ANNUAL IPM REPORT

The District will prepare an Annual IPM Report each year that describes past pest control activities (both chemical and non-chemical) on District Lands. The draft Annual IPM Report will be prepared by the IPM Coordinator and reviewed by the IPM Coordination Team. Once approved by the IPM Coordination Team, the final report will be presented to the General Manager for initial approval. The report will then be forwarded to the Board of Directors for review, and where necessary, approval (e.g., changes to the List of Approved Pesticides).

At a minimum, the Annual IPM Report will include the following basic information:

- A summary of pest problems that the District has encountered during the year, and a comparison to past years.
- A summary of District pest control treatments, presented by type of control (e.g., mowing, herbicide use). Wherever possible, a comparison of units treated (e.g., acres, square feet, linear feet or miles) in the current year and previous years will be provided for comparison purposes. A cost per acre will be provided for major pest control treatment types.
- A qualitative assessment of effectiveness of the District's pest control program, and suggestions for increasing future effectiveness (see Chapter 4 for additional details).
- A summary of pesticide use, presented by category (e.g., herbicide, insecticide), active ingredient (e.g., glyphosate, imazapyr) or pesticide formulation (e.g., Roundup ProMax™).
- A brief summary of public notifications and public inquiries about IPM on District lands;
- Assessment of compliance with the Guidance Manual including:
  - An evaluation of the effectiveness of any changes in practices that were implemented in the past 12 months.
  - A description of any experimental pest control projects (test studies) and the results, including a cost/benefits analysis.
  - Suggested changes to the IPM program or the Guidance Manual's pest control practices proposed for adoption within the next 12 months including:
    - Any substitute pesticides to replace phased out pesticides (additions to the List of Approved Pesticides).
    - Any proposed alternative pesticides (additions to the List of Approved Pesticides) or pest control methods proposed for adoption.

3.4.2 PESTICIDE REPORTING

As required by regulations of the California Department of Pesticide Regulation (California Code of Regulations, Title 3, Division 6), the IPM Coordinator will report all pesticide use on a monthly basis to the County Agriculture Departments (San Mateo, Santa Clara and Santa Cruz Counties); will prepare, or obtain Pest Control Recommendations from a licensed Pest Control Advisor on an annual basis; will renew the District's Operator Identification with the County Agriculture Departments; and will most likely require designated field supervisors to obtain either a Qualified Applicator License or a Qualified Applicator Certificate. The IPM Coordinator will also collect monthly pesticide reporting from its contractors who apply pesticides on District lands (See Section 3.4.3).

3.4.3 CONTRACTOR REPORTING

The District will ensure that all pest control contractors working on District lands comply with the Guidance Manual, including restricting use of pesticides to products on the District's List of Approved Pesticides (Appendix A). As required by regulations of the California Department of Pesticide Regulation (California Code of Regulations, Title 3, Division 6), contractors will report all pesticide use on a monthly basis to the County Agriculture Departments (San Mateo, Santa Clara and Santa Cruz Counties); will obtain Pest Control Recommendations from a licensed Pest Control Advisor (either from the District's IPM Coordinator or from an independent PCA); will renew its Operator Identification with the County Agriculture Departments; and require Contractor's field supervisors to obtain either a Qualified Applicator License or a Qualified Applicator Certificate. The Contractor will provide copies of its reports to the IPM Coordinator.

Contractors who trap certain pest animal species must also obtain and comply with predation permit requirements from CDFW to record the species, pounds captured, and final destination of the animals (to prove that the species were not transported live or re-released elsewhere in California).

3.5 TRAINING AND SAFETY

3.5.1 TRAINING

The IPM Coordinator is responsible for coordinating staff training across departments, and for overseeing safety procedures. In general, three types of trainings will be provided:

- Pest identification training (for staff involved in pest control), and
- Annual pesticide safety training (for staff that use/apply pesticides).

PEST IDENTIFICATION TRAINING

The pest identification training will be prepared by District staff, with assistance from the IPM Coordinator, then provided to staff, particularly those who work in natural areas, rangelands, and agricultural properties. This training will most likely be provided on an as needed basis (as determined by the IPM Coordinator and department supervisors).

Pest identification training will include procedures for identifying and reporting pest sightings. Color photographs of several life stages (e.g., seedling, flowering, fruiting stages or larval and adult stages), a brief description and life history of each pest, associated habitat types, map of where the pest is found on District preserves and summary of best management practices for working in and around infested areas will be covered in this training. It may take several years to comprehensively develop information and train staff on all pests in District preserves. The District's Invasive Plant Control Notebook already contains information on approximately 150 invasive plants of the region and is already used as a key training and identification tool by the staff; it will be expanded to include other types of pests.

ANNUAL PESTICIDE SAFETY TRAINING

The annual pesticide safety training is intended to help supervisors, managers, and other staff involved in pest control application become familiar with non-chemical pest control actions; limit exposure and risk associated with the use of pesticides; and understand Best Management Practices for environmental protection. The District's Annual Pesticide Safety Training will also describe regulatory requirements of the California Department of Pesticide Regulation's pesticide application requirements and CDFW's wildlife handling procedures.

The annual pesticide safety training will be performed by the IPM Coordinator (if a licensed PCA QAL and/or QAC), or a PCA-, QAL/QAC-licensed contractor who is familiar with District resources, pest management issues, and staff work procedures.

The annual Pesticide safety training must include the following:

- Pesticide product labeling format and meaning of information, such as precautionary statements about human health hazards.
- Hazards of pesticides (acute, chronic, delayed, and sensitization effects) identified in pesticide product labeling, Material Safety Data Sheets (MSDS), or Pesticide Safety Information Series (PSIS) leaflets.
- Pesticide safety requirements and procedures in regulation, PSIS leaflets, MSDS.
- Engineering controls (closed systems, enclosed cabs) for handling, transporting, storing, and disposing of pesticides.
- Environmental concerns (drift, runoff, and endangered species best management practices to reduce risks to sensitive natural resources).
- Routes by which pesticides can enter the body.
- Common signs/symptoms and emergency first aid for pesticide exposure.
- How to obtain emergency medical care.
- Routine and emergency decontamination procedures, including spill cleanup and the need to thoroughly shower with soap and warm water after the exposure period.
- Use and care of any required personal protective equipment.
- Prevention, recognition, and first aid for heat-related illness.
- Notification requirements.

Records of annual training will be retained by the IPM Coordinator or the District's Training and Safety Specialist and will be kept for two years in a location accessible to employees. Training records must indicate the topics covered during training, the materials used for training, the name and qualifications of the trainer, and the signature and date of all employees who received the training.

3.5.2 SAFETY

SAFETY PROCEDURES FOR HERBICIDE APPLICATION

Section 17.005 of the District's Operations Maintenance Manual provides guidelines to the staff for safely handling and applying pesticides. Upon adoption of the IPM Guidance Manual, those procedures will be updated to be consistent with the IPM Guidance Manual and will be subsequently included herein.

3.6 LIST OF APPROVED PESTICIDES

A List of Approved Pesticides was developed specifically for use on District lands. Refer to Table 1.1 in Appendix A for the complete list of approved pesticides, as well as detailed toxicological analysis and results presented for each pesticide. This list presents pesticides by ***category*** (e.g., herbicide, insecticide); ***active ingredient*** (e.g., glyphosate, imazapyr); and ***pesticide formulation*** (e.g., Roundup ProMax™) (sometimes referred to as brand name or common name).

This list of pesticides is intended only for use on the pests, environment, and microclimates of properties and buildings managed by the District, and would not be used on other lands without additional analysis. Each product on this list has been (and new proposed products would be):

- screened for human toxicology, ecological toxicity environmental fate and transport, and proven efficacy against target pests;
- reviewed annually by the District's IPM Coordinator and IPM Coordination Team;
- reviewed and approved by the Board of Directors;
- presented for public comments at public hearings; and
- included in the environmental documentation and public notification procedures that are being prepared for the IPM Program (i.e., the list is adopted as part of environmental review and approval process).

This list encompasses mostly products already in use by the District, as well as a few new pest control products. Products on this list were reviewed for human and environmental safety, and efficacy on the District's target pest species. Additional details about the District's screening process are provided below.

3.6.1 PESTICIDE SCREENING PROCESS

The District, using toxicologists, its IPM Coordinator and IPM Coordination Team and other licensed experts, has or will screen proposed pesticides by the following three steps:

1. Conduct a toxicological analysis of each pesticide under consideration (Appendix A).
2. Assess the risk to the human health and safety of workers and visitors on District lands, as well as the risk to the environment from proposed pesticide use.
3. Review the List of Approved Pesticides and associated background materials, then reject, modify, or adopt the list for use by District staff, contractors and tenants.

3.6.2 UPDATING THE LIST OF APPROVED PESTICIDES

The List of Approved Pesticides is intended to change over time as the science of pest control advances and more effective, safer, and less harmful pesticides are developed; as manufacturers update, discontinue, or substitute products; and as the District's target pests change over time. The process for updating the List of Approved Pesticides is as follows:

- ***Product Substitutions.*** When manufacturers substitute a product or change a product name or formulation, but when the active ingredient stays the same, the new product can be substituted for the old product on the List of Approved Pesticides. In general, this type of change to the list would not trigger a change in condition or result in the need for additional environmental documentation. Therefore, this change typically will require a simple update to the List of Approved Pesticides (Table 1.1- Appendix A). Additional environmental review would only be required if the change results in a substantive change in human health exposure, environmental fate, or toxicity.
- ***Product Eliminations.*** In instances where products on the list are no longer available from the manufacturer, are found to be ineffective against the District's target pests, or if new risks are discovered that were not previously evaluated by the District (see Appendix A), a product may be eliminated from the List of

Approved Pesticides. This type of change requires an update to the List of Approved Pesticides (Table 1.1-Appendix A), but does not require additional environmental review.

- ***Product Additions***. In instances where new products with new active ingredients are found to be safer, more effective, and/or less costly than products on the on the List of Approved Pesticides, the District may elect to add new pesticides. This type of change typically requires additional toxicological review, and depending on the results, may also require additional environmental review.

For simple substitutions and elimination of products from the List of Approved Pesticides, the IPM Coordinator will, as necessary seek the advice of technical experts and independent Pest Control Advisors; keep the IPM Coordination Team informed; and include such changes in the Annual IPM Report.

In instances where new pesticide formulations (products) are being recommended for addition to the List of Approved Pesticides, the IPM Coordinator will, with assistance from technical experts such as independent PCAs, conduct the same analysis on the proposed new pesticide formulation as was conducted on the approved pesticide formulation (Appendix A). All new pesticide formulations (products) under consideration will be evaluated using the same standards for human and environmental safety, and efficacy on the District's target pest species.

Based on the results, the IPM Coordinator will then present the findings to the IPM Coordination Team, along with a recommendation to add or eliminate the new pesticide formulation from consideration. The IPM Coordinator can also recommend a test study to provide additional information. Based on the information provided by the IPM Coordinator, the IPM Coordination Team will advance the new pesticide formulation (product) plus any required environmental review for consideration by the Board of Directors for approval, request additional information, or eliminate the new pesticide formulation from consideration. If the IPM Coordination Team recommends advancement, the IPM Coordinator will provide pertinent information about the new pesticide formulation, including a description of why the new pesticide formulation is being considered, risk, efficacy, cost, application standards and limitations for use, results of test studies (where available), and environmental review to the Board of Directors for consideration. Approval of all new pesticide formulations is the responsibility of the Board of Directors. If approved, the new pesticide formulations will be added to the List of Approved Pesticides.

In the event of an emergency situation, such as a human health disease outbreak, pesticides that are not included on the List of Approved Pesticides may be used for short periods of time. In these unusual situations the District will comply with required regulatory procedures, then will evaluate the emergency response pesticide use and determine if its IPM program needs to be modified to accommodate similar future emergencies.

3.7 NOTIFICATION

The District has developed notification procedures for use of pesticides (Section 17.006 of the District's Maintenance Operations Manual will be updated accordingly). District procedures are summarized below.

Prior, during, and after the application of a pesticide (including herbicides, insecticides, or other types of pesticides) on District preserves, employees or contractors will post signs at the treatment area notifying the public, employees and contractors of the District's use of pesticide. Posting periods designated below are the minimum requirements; signs may be posted earlier and left in place for longer periods of time if it serves a public purpose or if it provides staff flexibility in accessing remote locations.

- For pesticide application in outdoor areas of all District-owned preserves and in buildings which are not occupied or are rarely visited (e.g. pump houses), signs will be posted at the treatment areas 24 hours before the start of treatment until 72 hours after the end of treatment. Signs stating “Pesticide Use Notification” will be placed at each end of the outdoor treatment area and any intersecting trails.

- For urgent application of pesticides to control stinging insects, signs will be posted at the treatment area 72 hours after the end of treatment but no pre-treatment posting is required.
- For pesticide application in occupied buildings such as visitor centers, offices and residences, notification will be provided to building occupants (employees, visitors, residents) 24 hours before the start of treatment by email, letters or telephone calls. Additionally, for buildings which might be visited by more than just a single family, signs stating “Pesticide Use Notification” will be placed at the entrances to the building 24 hours before the start of treatment until 72 hours after the end of treatment. The use of approved insecticidal baits in tamper-proof containers will require notification 24 hours before the start of treatment by email, letters or telephone calls, but will not require posting of signs.
- The information contained in the pesticide application signs will include: product name, EPA registration number, target pest, preserve name and/or building, date and time of application, and contact person with telephone number. The contact person will usually be the IPM Coordinator.
- On lands that the District manages but does not own (e.g., Rancho San Antonio County Park), the District will provide notification of pesticide use in the same manner and applying the same actions as it does with its properties, unless the contracting agencies have adopted more restrictive management standards. In those cases, the more restrictive management standards would be implemented by the District.
- In the event of an immediate public safety concern, notification will occur at the time of treatment but pre-posting may not be possible.

All contractors and lessees need to also notify District before application on any property, and comply with requirements for notification and posting of signs described above.

At the discretion of the District staff and depending on the site conditions, neighboring land owners will be notified if the District is conducting pest management near a property line.

At the discretion of the District staff, pest management activities that do not require pesticides (e.g., mowing, discing) may or may not be posted, depending on the level of visitor use and the potential for conflicts between site uses and planned pest management actions. Additional notification may also be provided in emails, newsletters, and public meetings, depending on the level of public safety concerns, public interest, and the size and duration of the planned pest control action.

4 ASSESSING THE IPM PROGRAM AND UPDATING THE GUIDANCE MANUAL

This chapter describes procedures for assessing the effectiveness of the IPM program as a whole using adaptive management, and the process for updating the Guidance Manual.

Adaptive management is a tool that allows natural resource managers to make good decisions and effective action plans based on limited information, and provides a means of reducing uncertainty over time through assessing the results of an action and changing subsequent actions (The Nature Conservancy 2007). Adaptive management is often described as “learning by doing.” Given the types and rates of change observed on District preserves resulting from global, regional, and local factors (many of which are beyond the District’s control), adaptive management is an important tool to help the District implement IPM in the face of change and uncertainty.

Adaptive management encompasses the following steps: establishing assessment criteria, collecting information, evaluating the program, and undertaking program modifications to make the program safer, more effective, and efficient.

4.1 CRITERIA TO ASSESS THE IPM PROGRAM

These criteria are intended to quantitatively and qualitatively measure and evaluate changes in the District’s IPM program over time:

- **Compliance with the Guidance Manual and List of Approved Pesticides.** The Guidance Manual’s procedures are designed to select the least harmful pest control methods. When chemical control is selected, the Guidance Manual requires the selection of the least harmful effective pesticides (through the review and approval process).
- **Demonstrated use of lower pesticide worker health/exposure classifications in buildings and recreational structures** (as measured by totaling use of pesticides using the U.S. EPA Classifications I, II, III, and IV).
- **Reduction of pesticide use in buildings** (i.e., in areas where human use levels are high and the potential for human exposure to pesticides is greater than in other areas). The District will seek to comprehensively oversee all pesticide use in and around District buildings, including use by tenants, which is expected to result in an overall reduction of pesticide use in buildings, and in particular, eliminate use of pesticides not appropriate for use around human occupants or visitors, or which can inadvertently escape into the surrounding wildland environment. Pesticide use in buildings will be measured in units of product used per treatment area (each building), or by units of product used per total square footage for District buildings.
- **Reduction in per-acre herbicide use at individual sites in natural areas over time.** The District will seek a reduction in per-acre usage of herbicides over time at individual sites, but acknowledges that in some instances, use will initially increase, followed by a reduction in herbicide use when the pest is eliminated or reduced. As an example, as new properties are acquired or new invasive plant infestations are discovered, overall herbicide use may initially go up, however, they are anticipated to drop over time as pests are controlled or eliminated at such sites.
- **Preservation of biodiversity and natural resource values** in natural areas, rangelands, and agricultural properties. District staff will provide an annual qualitative assessment of natural resources conditions of IPM projects in natural areas, rangelands, and agricultural properties in the Annual IPM Report.
- **Provide a brief summary of public notifications and responses to inquiries from the public.** District staff will provide a summary of public notifications in the Annual IPM Report. The District will also record public

inquiries made by telephone or in person regarding the IPM program, and will briefly summarize inquiries and its responses to such inquiries on an annual basis.

- **Provide an annual summary of public participation in pest control.** The public is seen as an integral part of the success of the IPM program. In particular, volunteers who assist with invasive plant identification and control are a valuable asset to the IPM program. The District will tally volunteer hours spent on invasive plant control, and where possible will identify future activities for volunteers, and/or new ways that the public can participate in the IPM process.
- **Provide an annual summary of staff training, public outreach, and educational activities related to IPM**. The District will summarize staff trainings, public outreach efforts, and educational outreach efforts such as working with tenants to use appropriate pesticides in structures and rangeland/agricultural areas.

4.2 TRACKING THE PROGRAM

Using the criteria described above, District staff will monitor pest control projects, and tally quantitative and qualitative results on an annual basis.

- Each Department will report pesticide use (quantities of each pesticide product per toxicity classification) to the IPM Coordinator, as described in Chapter 3. The IPM Coordinator will present results in the Annual IPM Report.
- District staff will regularly update the District's pest database, including a summary of District pests of concern, pest control activities, acres treated, and geographic (mapping information) on treatment locations. The IPM Coordinator will use this information to prepare an annual assessment of units of herbicides per acres treated, as well as non-chemical treatments of pests. The IPM Coordinator will present results in the Annual IPM Report.
- The IPM Coordinator will qualitatively describe the condition of natural areas and managed landscape areas, identifying problem pests or areas requiring further investigation or treatment. The IPM Coordinator will present results in the Annual IPM Report
- The volunteer coordinators will tally volunteer hours spent on invasive plant control and provide this information to the IPM Coordinator.
- The IPM Coordinator will track and record public inquiries, questions, comments, and concerns about the IPM program.

4.3 PROGRAM EVALUATION

Using the information described above, the IPM Coordinator, with input from District staff, will evaluate the IPM Program as a whole on the basis of:

- ***Safety*** (i.e., did the IPM program reduce risks and help ensure the safety of people and the environment?);
- ***Effectiveness*** (i.e., were pests controlled or eliminated in a cost effective and safe manner?); and
- ***Purpose*** (i.e., are District buildings; recreational facilities; and agricultural lands, rangelands, and natural areas functioning as intended?).

The results of the evaluation will be presented in the Annual IPM Report. The Annual IPM Report will be presented to the IPM Coordination Team for review and approval. Using the monitoring protocol described above in Section 4.1, the IPM Coordination Team will assess the effectiveness of the IPM Program, and recommend changes to the program intended to increase effectiveness and efficiency of pest control activities.

The final Annual IPM Report, which will include the IPM Coordination Team recommendations, will then be submitted to the General Manager for initial approval and to the Board of Directors for review and acceptance, including any changes to the Approved Pesticide List.

4.4 PROGRAM MODIFICATIONS

The Annual IPM Report, as approved by the General Manager and accepted/approved by the Board of Directors will be the basis for making changes to the Guidance Manual, including modification of any IPM procedures or changes to the List of Approved Pesticides.

Each year following Board of Directors review of the Annual IPM Report, the IPM Coordinator will implement recommended changes to the Guidance Manual and IPM program.

4.5 UPDATING THE IPM GUIDANCE MANUAL

This Guidance Manual is intended to be a "living document," in which minor changes that do not trigger additional environmental effects can be made without needing to complete additional environmental analysis. The document will be updated approximately every ten years, and as necessary, supplemental CEQA and other environmental analysis will also be prepared in the interim. The IPM Coordinator and IPM Coordination Team will review proposed changes to determine if they would result in changes to adopted IPM Policy and guidance procedures (see Section 4.3 above). This review will include assessment of changes to the lists of target pest species, pest control methods, and pesticide use trends.

When changes to the Guidance Manual are required, the IPM Coordinator will initiate a review process to determine whether the proposed changes are minor (as defined under the CEQA approval process for the project as not resulting in substantial new information or new significant environmental impacts). If the changes are confirmed to be minor, these changes can be addressed through the IPM Coordination Team review and approval process (described above). Examples of minor changes that would not likely trigger a new environmental review include process updates and simple product substitutions for products on the District's List of Approved Pesticides (see Section 3.7.2).

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5 IPM PROGRAM IMPLEMENTATION

An IPM Implementation Plan will be developed in the first year of the program. The purpose of the Implementation Plan is to systematically develop larger tasks (i.e., prevention and monitoring) and integrate them into the Annual IPM Work Plan over a five-year period. Major tasks to be included the IPM Implementation Plan in the first year include:

- designate an IPM Coordinator and an IPM Coordination Team;
- develop an Annual Work Plan;
- develop a comprehensive pest database including forms to allow staff to record and report pests and pesticide use to the IPM Coordinator in a streamlined fashion;
- develop and implement training and safety programs to ensure IPM as described in the Guidance Manual is properly implemented by staff;
- assess, and as necessary modify, the Guidance Manual (adaptive management) in the Annual IPM Report to the Board of Directors.

In future years, the following additional steps would be taken to further implement the IPMP:

- test and revise a priority system to rank pest control projects on natural areas, rangelands, and agricultural lands;
- work with tenants to consistently apply IPM practices around people and in natural surroundings;
- develop an early detection rapid response program and related landscape-level monitoring program for all District lands; and
- participate in regional pest management research and monitoring efforts to keep up on the most recent innovations in pest control science, pest control methods, and pests that are detected near District preserves but may not yet be problemmatic on District lands.

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6 IPM IN BUILDINGS

6.1 DEFINITION AND PURPOSE

District properties include over 182 buildings, including an administrative office in a city, three field offices, a nature center, residences, and numerous outbuildings such as barns, sheds, and water tanks in the preserves. Certain animals and plants may be incompatible with human use of these structures or may harm the building itself. For example, rodents, ants, and similar structural pest species are typically controlled in buildings when their population numbers may result in structural damage or health risks to humans. Management of pests in buildings is estimated to occur in 103 of the total buildings and it may be conducted by District staff or by residential, commercial or agricultural/rangeland tenants at some level almost every year. For purposes of this management category, rodent infestation of vehicles that are parked for extended periods of time on District preserves (reported by staff to happen regularly in ranger and crew trucks) will be treated similarly to rodent infestations of buildings.

For the purposes of this manual, structural pests include common insects, plants and animals that routinely occupy the open interiors and immediate exteriors of buildings. Structural pests that live within the soil and wood components of these structures such as termites, wood boring beetles, and wood decaying fungi are <u>not</u> included in the IPM program and will be addressed by the District on a case-by-case basis.

The purpose of pest control in District buildings is to manage pests for human health and safety, and to preserve the intended uses of the building structure. Most structural pests only become problematic when there are extra resources readily available (food, water, shelter) in and around the structure. Many of these types of outbreaks can be managed with cultural control options such as changing human behavior (e.g., securing garbage, cleaning up food) or engineered control options within structures (e.g., sealing up entrance area, securing garbage disposal areas).

6.2 TYPES OF PESTS

This chapter is organized by pest, although many general concepts apply throughout. Organisms of all kinds, whether vertebrate or invertebrate, are living creatures with specific biological needs and behavioral preferences. They all require food, water, safety and a point of entry to become a structural pest. Cutting off access to any one of these resources can often be sufficient to prevent or reduce a structural pest problem. The prevention methods discussed below aim to reduce the conditions that support structural pests.

6.2.1 STRUCTURAL PESTS

Structural pests include insect, plant, fungi and animal pests that damage occupied buildings and other structures, or pests that are a health threat to humans working in, living in, or visiting the buildings. Nuisance insects and wildlife pests in buildings addressed within the District's IPMP include ants, cockroaches, flies, mice, rats, skunks, opossums, raccoons, and bats. These pests may be present throughout District lands, but they may only be incompatible with planned District uses when their proximity or behavior conflict with human uses in buildings. Some structural pests can only survive in a human-modified environment (e.g., German cockroaches) versus others that are only opportunistic visitors from nearby wildlands (e.g., deer mice).

The definition of a structural pest can be highly variable between individuals and groups of people based on the perception of damage versus any true damage to structures. Care must be exercised when defining tolerance levels for each pest species. One must consider the actual damage potential of the organism, the cultural acceptance of the organism to humans who may have to live and work nearby, and any broader environmental consequences to the natural environment. For example, deer mice may be tolerated if they occupy the exteriors of human-occupied buildings, but once they penetrate the structure and begin to occupy building interiors, they become unacceptable pests. The traditional approach to structural pest control is modified in the District's IPM program because District structures are located in natural areas. Native species (e.g., deer mice) that can move freely between the inside (pest) environment and outside (native/natural) environment must be treated in a manner that achieves control of the pest without compromising the natural resources around the structure. The District's structural IPM decision-making must always balance health and human safety concerns with District's goal of protection of natural resources.

Structural IPM focuses on first modifying the behavior of humans or the structure of our environment to moderate or eliminate pest problems. The District can use familiar planning and building tools to engineer pests out of conflict areas such as structures through the use of physical barriers, materials selection, and site modifications. Tolerance levels for this category of pests take into consideration the risks of economic damage along with the fact that these species will inevitably occur in the built environment.

6.3 PEST IDENTIFICATION

Structural pests are generally identified when routine building inspections are conducted by IPM professionals, but are also commonly identified by the building occupants themselves. Because buildings are much more intensively utilized than the District's surrounding natural areas, structural pests can usually be identified relatively quickly before major infestations become problematic. Visual inspections will focus on identifying conditions where excess food, shelter, and access can support pests (e.g., the break room); signs of pest damage or entry (e.g., holes in the building exterior); or on observations of the pest itself.

Some District buildings could benefit from routine inspections from IPM professionals who have specialized training to find structural pests and their associated damage. Professionals may utilize special monitoring traps for specific organisms to monitor the population thresholds of common pest species (e.g., "sticky" bait traps for ants). These types of monitoring devices are useful in scenarios where the presence of the pest is inevitable, and the pest population must be maintained at an acceptable tolerance level. Other buildings and structures that are less intensively utilized will rely on the observations of the District's employees, tenants, and visitors to identify pests.

Employees, tenants, and visitors will have clear communication pathways to the IPM Coordinator to report structural pest presence and damage in a timely manner. Structural pest problems will be reported to the IPM Coordinator at any time during the year via telephone, email or meetings, in an Individual Pest Management Plan, or as part of Annual IPM Reporting. The IPM Coordinator can help problem-solve structural pest situations by providing the following types of assistance:

- assist with determining pest control treatment threshold levels,
- provide recommendations for building or human use modifications to reduce pest problems below threshold levels,
- review Individual Pest Management Plan and facilitate their implementation by staff or tenants, and/or
- recommend professional assistance such as use of a structural pest control advisor or structural pest control operator to actively control pests.

6.4 PREVENTIVE AND GENERAL MAINTENANCE ACTIVITIES

Modern IPM programs for buildings rely on prevention (i.e., building design and human behavior modification) as the primary structural pest control treatment options to eliminate pest problems. Active pest control is used only as a last resort. Because humans occupy a highly engineered environment, use of such control options as physical barriers, materials selection, and site modifications provide the primary means to eliminate pest from buildings and other structures without the need to use pesticides or other lethal control.

If structural pest control in vacant structures is expensive, time-consuming, or otherwise damaging to the surrounding natural environment, demolition of the buildings will be considered as part of the Annual IPM Report (See Chapter 3, section 3.4 Reporting). Demolition activities will be subject to separate permitting processes through respective County planning departments. Modern IPM programs for buildings rely on prevention (i.e., building design and human behavior modification) as the primary structural pest control treatment options) to eliminate pest problems. Therefore, a discussion of preventive and general maintenance activities is summarized below.

6.4.1 PREVENTION

Preventing insects and wildlife pests in buildings include general guidelines that promote pest-resistant materials, block common access points to buildings, and promote the modifications of common structures to repel rather than attract common pests. These guidelines may include landscape design practices that can be incorporated at District facilities in natural areas. For example, defensible space around structures should not be planted with dense ground covers and/or climbing vines like ivy that could attract structural pests such as mice and skunks.

Pests need a place to live – or harborage; most prefer a hidden space where they will not be disturbed. Preventing access to hidden spaces can, therefore, assist pest management efforts: cracks, crevices, gaps, holes, loose structural elements, and dense vegetation can all act to hide small pest organisms. In some cases, the materials present in District structures can create a potential harborage, such as when rigid foam insulation - a material that is known to attract termites - is used on the outside of foundations.

Incorporating some preventive measures will be simple, while others (like discontinuing the use of rigid foam insulation) may directly conflict with building codes and other design goals for the structure. Generally, the inclusion of standard pest prevention practices during the building design and construction or retrofit phase can dramatically reduce pest problems in the future while still fulfilling all the requirements for modern building codes. For example, proper placement of exterior lighting can significantly reduce the attraction of night flying insects into the building. Eliminating ledges under roof eaves can discourage pigeons and swallows from taking up residence. Planting and maintaining landscaping so that it does not touch building walls can help reduce the transmission of pests inside the structure. All of these retrofit, design, and construction practices can help prevent the establishment of pests in District structures, thereby reducing the need for pest management.

6.4.2 RETROFIT

Architects, planners, and engineers have only recently begun to consider pest control and building maintenance in the design of new structures and within the retrofitting of existing structures. New local green building ordinances and elective building rating systems now incorporate methods for enhancing modern buildings to be more energy efficient and less toxic beyond modern building codes. Reducing the need for toxic pesticides to control structural pests is especially feasible because much of their damage can be prevented by improved design.

Designing pests out of new and existing structures may include structural materials selection and the addition of non-structural components to reduce building access or utilization by pest species. Design guidelines are now available from the International Code Council/San Francisco Department of the Environment (Geiger and Cox 2012). Much of the focus of these guidelines is on the building envelope and the building interface with soil and landscaping. This allows buildings to repel ground-dwelling insects and rodents and significantly reduce their access to the building interior. Other more general guidelines promote pest-resistant materials, block common access points to buildings, and promote the modifications of common structures to repel rather than attract common pests. These guidelines include landscape design practices that can be incorporated at District facilities in natural areas. For example, defensible space around structures should not be planted with dense ground covers and/or climbing vines like ivy that could attract structural pests such as mice and skunks. Maintenance practices that can reduce structural pest impacts are summarized in Table 6-1.

Table 6-1 Maintenance Practices to Prevent and Reduce Structural Pests
Minimize moisture. Moisture in and near structures can provide harborage for insect pests such as termites, wood-boring beetles, cockroaches, flies, carpenter ants, silverfish, and millipedes. Utilize the following procedures to minimize building moisture during construction or general maintenance and repairs: ◢ Check for proper ventilation of crawl spaces; add vapor barriers in crawl spaces. ◢ Ensure appropriate slopes and drainage next to structures. ◢ Downspouts and gutters should discharge at least one foot away from walls; splash guards, rain barrels, or gutter extensions may be added to reduce accumulation of moisture near structural walls. ◢ Ensure that landscape irrigation does not introduce moisture to foundations – use drip irrigation and position sprinklers to avoid structures.
Maintain landscaping next to structures. ◢ Prune vines, shrubs, and trees at least six feet away from roofs and exterior walls, as rodents can use these for access into buildings and shelter next to foundations. ◢ Remove and avoid planting Algerian or English ivy, star jasmine, or honeysuckle vines, which provide shelter and food sources for rats and other urban pests. Remove and avoid planting bamboo, cherry laurel, fig, pine, and roses near buildings, which encourage scale, aphid, and ant populations. ◢ Clear landscaping away from vent openings to crawlspaces to prevent moisture buildup. ◢ Remove plants and wood mulch within several inches of foundations to minimize ants and other nests. A gravel strip around foundations at least two feet wide and 0.5 feet deep of one-inch gravel or larger discourages rodent burrowing and other insect nesting. ◢ Select plants that attract beneficial insects such as parasitic wasp, native bees, and ladybugs.
Move stored materials away from structures. ◢ Store compost and trash bins away from structures, as these can attract rodents, insects, and other nuisance pests. ◢ Store woodpiles and debris away from structures to prevent rodent, beetle, and termite infestation.
Seal off openings. ◢ Inspect openings to crawlspaces and other ventilation features to ensure screens are intact. ◢ Inspect, maintain, and use elastomeric sealant, polyurethane foam, and weather-stripping to seal all small cracks in structures, around countertops and windows, pipe breaks, and areas where pipes enter walls. Use stainless steel wool and mesh and fire block foam to re-seal larger openings in buildings and below decks. ◢ Add door sweeps or high density pest brushes to seal gaps greater than ¼” below doors.
Block access for rodents to climb pipes and gutters. ◢ In areas with Norway rats or other rodent issues, various items can be installed to prevent the rodents from climbing downspouts and pipes, including flap valves or screens in downspouts, 12”-diameter downward-facing cones or 18”-diameter discs, or a 12” band of glossy paint on exterior vertical pipes.
Add bird exclusion materials to lighting and other horizontal surfaces. ◢ Bird spikes, wires, netting, or similar materials should be installed prevent birds from roosting or nesting on structures or on light poles.
Reduce or move exterior lighting. Exterior lighting may encourage insects to gather near doors and windows. ◢ Timers and motion detectors can be installed to minimize unnecessary lighting. ◢ Use reflected light instead of direct light to illuminate entryways, as insects are more attracted to direct light. ◢ Use yellow (sodium) bulbs to reduce insect attraction in exterior areas.

Table 6-1 Maintenance Practices to Prevent and Reduce Structural Pests
Exclude rodents from refuse and recycling areas. ◢ Enclose refuse and recycling areas with metal, concrete, or similar materials to prevent wildlife from climbing, burrowing, or chewing into the enclosure. Do not plant ivy around the enclosure. ◢ Use refuse containers that are heavy duty, rust resistant, rat and damage resistant, and equipped with tight-fitting lids.
Notes: Recommendations selected from Pest Prevention By Design: Authoritative guidelines for designing pests out of structures (Geiger and Cox 2012).

In the same way that buildings can be re-engineered to resist and prevent pests, so can appropriate planning. Architectural standards have long dictated how buildings should be situated in an environment for appropriate function and appeal. In the same way that a subdivision of straw houses is not appropriate for high fire risk areas, appropriate site planning and design can also reduce future pest problems. Better planning for lighting, storage, building use and landscaping around existing buildings can all contribute to fewer pest problems in and around District structures. District staff should assess how existing buildings are being used and how they are arranged together and within the landscape to maximize the reduction of future pest management.

Pest impacts to wooden structures often result from the introduction of moisture. Subterranean termites, carpenter ants, most wood boring beetles, and fungal rots only impact wood that is already impacted by moisture. Maintaining structures so they remain dry at all times, especially in the high humidity of the Santa Cruz Mountains and Central Coast, will reduce the potential for pest outbreaks in the structure. Maintenance of older structures should focus on keeping the building envelope functional to minimize leaks and moisture accumulation.

Other general maintenance practices in and near structures involve general cleanliness and vigilance in preventing access to resources that encourage pests. For example, equipment that attracts rodents or provides harborage should not be left in natural areas for long periods of time. Landscape maintenance should focus on elimination of vegetation touching the building envelope, or reduction or elimination of the types of landscaping that are known to provide harborage for structural pests.

6.4.3 SANITATION AND MAINTENANCE

Many pest species are present because of improper handling and storage of food and food waste, or improperly cleaning up food scraps and dishes. Uncovered garbage containers, both inside and adjacent to buildings can attract rats and other pests. Storing native plant seeds in paper envelopes rather than hard sealed plastic containers may encourage mice to take up residence in storage areas. All of these types of pest attractants can be eliminated with human behavioral modification as a prevention method. Optimally managing human behavior can drastically reduce or even completely eliminate the need for pesticide products in District structures and landscapes.

Recommendations for structural pest prevention measures to be implemented by District staff and volunteers in food and waste storage areas are listed below. If behaviors cannot be easily modified, hire a janitor or cleaning service for common area cleaning.

ADDITIONAL RESIDENTIAL/OFFICE UNIT PREVENTION STRATEGIES

The following additional measures may be applied in District residential and office buildings:

- train staff, including building occupants and janitorial staff on safe food and trash handling procedures;
- store all food and food wastes in sealed containers;
- in communal spaces, provide extra containers, sealed cabinets, or a refrigerator for temporary food storage;

- do not allow food waste to remain in open areas overnight;
- regularly clean dishes, floors and counter tops;
- use sealed garbage cans, or alternatively place them on a crawling insect-proof platform;
- rinse out cans and bottles before they are placed in a recycling bin; and
- do not leave pet food out overnight.

INDUSTRIAL UNIT PREVENTION STRATEGIES

The following types of additional measures may be applied in District storage buildings, livestock structures such as corrals, and for District projects utilizing contractors and outside construction materials such as fill dirt or erosion control materials:

- Train staff about proper storage of work supplies in non-occupied buildings.
  - Store all pet food, animal grains, and other consumable agricultural supplies in sealed containers (metal/plastic).
  - Store plant seeds used for habitat restoration and landscaping in sealed containers.
- Monitor landscaping and rooted plant materials for pests, and treat as necessary to prevent pest outbreaks.
- Position attractive harborage areas, such as rock piles, soil storage piles, hay and erosion control materials away from buildings.
- Control food waste in contractor work areas, outbuildings, storage areas and other non-occupied structures. Provide sealed garbage containers in or near such areas to prevent inadvertent disposal.
- Reduce, monitor, and where possible eliminate use and import of natural materials that could introduce pests onto District lands, such as reducing use of offsite fill (soil, gravel, and rock) and livestock feeds (hay) that may contain weed seeds. Where possible, include requirements to utilize onsite fill, require balanced cut and fill projects on District lands, and require use of certified weed-free erosion control materials for construction projects on District lands.

6.5 DAMAGE ASSESSMENT

Determine what, if any, damage to the structure is present. If there is no structural damage, but a pest is present that is in conflict with human use or enjoyment of the structure, determine the tolerance level for each pest species to determine if control is warranted. To the extent possible, quantify the damage (square feet affected or number of occurrences) and qualitatively describe the perceived damage in its context. As an example, a staff person could estimate the square footage of a building affected by ants and evaluate if the ants are always present at observed levels or if the incident is just a temporary outbreak.

6.6 TOLERANCE LEVELS/THRESHOLD FOR ACTION

Tolerance levels vary greatly for structural pests depending on the true or perceived impact of the pest to the structure or human experience. Some species, such as cockroaches, are unwelcome guests but present no real damage to either people or structures. Other species, such as woodrats, can seem more acceptable because they are attractive native animals but they can also carry deadly, incurable human diseases. The District's IPM approach for structural pest species begins with establishing human and structural tolerance levels that balance human safety, enjoyment, and comfort within the build environment with the ability to conserve natural resources and cost/benefit assessment.

Human safety and enjoyment is the primary metric for establishing tolerance levels in structures. Although structural pests can be both native, protected species, and non-native invasive species, staff and visitor safety is paramount in regulating treatment actions. Tolerance levels will consider conservation goals and impacts to the larger surrounding natural system in determining treatment actions.

6.6.1 MANAGEMENT THRESHOLDS FOR STRUCTURAL INSECT PESTS

Refer to Table 6-2 for establishing management thresholds and treatment options for nuisance insects in buildings.

Table 6-2 Management Thresholds and Treatment Options for Nuisance Insects in Buildings

Pest Category	Management Threshold (Population Size/Conditions)	Treatment
Ants	Colonies near structures and occasional trails indoors	Use a combination of the following: ◢ Clean up ant trails with soapy water or sticky lint rollers. ◢ Ensure all food sources are in sealed containers. ◢ Fill entry points with caulk, silicone, or expanding foam.
	Heavy invasion, more than occasional seasonal nuisance	Use a combination of the following: ◢ Inject diatomaceous earth dust into cracks before sealing if there are multiple entry points. ◢ Use Boric acid bait ◢ Use Fipronil bait as last resort (extreme infestations, fast control)
	Homopteran insect populations on plants (aphids, etc.) that support ants invading structures	Use a combination of the following: ◢ Prune vegetation that supports ants and/or Homopteran insects away from structures. ◢ Control Homopteran insects by dusting the infested vegetation with diatomaceous earth ◢ treat the infested vegetation with a soap and water solution.
Cockroaches	Occasional presence indoors in low numbers	Use a combination of the following: ◢ Fill entry points with caulk, silicone, or expanding foam. ◢ Ensure all food and water is unavailable.

	Heavy invasion, more than occasional seasonal nuisance	Use a combination of tools and alternate to avoid resistance:
		◢ Inject **diatomaceous earth** dust into cracks before sealing if there are multiple entry points.
		◢ Use **Boric acid** dust in walls, cracks, and other inaccessible areas.
		◢ Use **baits**:
		  ▰ Hydropene
		  ▰ Indoxacarb bait
		  ▰ Fipronil bait as last resort

Flies	Heavy invasion, more than occasional individual nuisance indoors or in picnic areas	Use a combination of the following: ◢ Fill entry points with caulk, silicone, or expanding foam ◢ Install Sticky fly traps indoors ◢ Install Baited electric traps outdoors ◢ Remove food and breeding sources

6.6.2 STRUCTURAL WILDLIFE PESTS

Refer to Table 6-3 for establishing management thresholds and treatment options for wildlife nuisance pests in buildings.

Table 6-3 Management Thresholds and Treatment Options for Nuisance Wildlife in Buildings

Pest Category	Management Threshold (population size/conditions)	Treatment
Mice & rats	Occasional presence indoors in low numbers (< 10 individuals)	Use a combination of the following tools and alternate to avoid resistance: ◢ Snap traps 6 feet apart for initial population control and maintenance. Prebait up to several weeks for rats. ◢ Box traps for mice – inspect daily. ◢ Glue boards – supplemental control.
	Moderate to Heavy infestation (> 10 individuals of house mice, Norway or roof rats ONLY) AND infestations posing risk to human health that do not respond to preventative and non-chemical methods	Use a combination of the tools and alternate to avoid resistance: ◢ Tools listed above for occasional presence ◢ Cholecalciferol – During instances when human health and safety are in jeopardy
	Moderate to Heavy infestation ((> 10 individuals) of Dusky-footed woodrats	Use exclusion methods to prevent entry of native rats into structures.
Skunks, opossums & raccoons	Individual animals invading structures	Implement trapping. Animals must be released or euthanized immediately. Relocation requires a permit from CDFW.
Feral Pets	Aggressive animals or resident populations that cause nuisance or impede resource protection goals	Implement live trapping with city or county animal control departments or animal shelters.
Bats	Roosting in structures that allows access to human-occupied rooms	Use a combination of the following: ◢ Implement strategic exclusion. ◢ Block entry to spaces where roosting causes conflict with human health and safety.

6.7 ACTIVE PEST CONTROL TREATMENT OPTIONS

When thorough prevention measures have been undertaken and human health and safety dictates, District staff may determine active pest control is required in buildings. The basic steps for planning active pest control in buildings include:

- Identification of a potential pest problem by trained professionals, staff, or tenants;
- Inspections to establish pest activity and treatment options;
- Identifying a preferred pest control approach;

- Implementing the selected pest control;
- Monitoring the results of pest control; and
- Reviewing results to inform and improve future pest control actions (adaptive management).

Some pest management options include:

- Indoor monitoring/trapping stations (non-chemical options such as snap traps and glue traps are preferred over other chemical control options);
- Natural pest controls (e.g., diatomaceous earth);
- Other active IPM controls (as described above in Tables 6.6.1 and 6.6.2).

Where pesticide use is determined to be the only viable treatment option to address the specific infestation of concern, selection of least harmful products is required. Only pesticides on the District's List of Approved Pesticides (Table 1.1, Appendix A) may be utilized. As an example, structural pest infestation that poses an immediate threat to human health or public safety would exceed District tolerance levels and warrant use of pesticides if non-chemical control could not protect the public. The chemical control options presented in this Chapter represent the least harmful, most efficient treatment methods for controlling structural pests. For example, a wasp nest in a public restroom may require use of a pyrethroid wasp spray to immediately eliminate the hazard of wasp injury to visitors. The inclusion of a variety of pest treatment method options in the IPM program allows the District to respond with the necessary tools based on actual risk to the District, its visitors, workers, structures, and lands.

6.7.1 INSECTS

Structural insects found on District lands include ants, cockroaches, flies, and wasps. As described above, these species can be deterred from establishing in District structures through design, maintenance, and behavioral modifications. However, some structural and nuisance pests may exceed tolerance levels for their presence in buildings. The following section discusses treatment methods for populations that exceed tolerance levels.

The presence of insects in buildings is very unappealing to most facility users. Their occurrence tends to suggest unsanitary conditions or deferred maintenance. Though these insect species usually do not pose a threat of direct harm to humans, their presence is almost always deemed to be unacceptable in our homes and landscapes. In the absence of immediate public health and safety risks, prevention and physical controls are the first treatment methods implemented in an IPM program, and these methods typically provide the most long-term effective control. Sanitation and cleanliness are the most effective methods for preventing and managing these insect pests. Chemical treatment methods are generally only used if the other methods prove inadequate to bring the insect pest population to within tolerance levels.

IPM strategies for common insect pests must utilize a spectrum of different control techniques to avoid problems with pesticide resistance. For example, both Argentine ants and German cockroaches have developed resistance to a number of common pesticides. For this reason, no single treatment or product can be recommended for complete control. All products that have chemical modes of action – both natural and synthetic – can promote resistance if used indiscriminately. All chemical products must only be used in the most appropriate and effective manner and in parallel for consistent results.

ANTS

The most common nuisance ant species in District structures is the Argentine ant (*Iridomyrmex humilis*). The Argentine ant is a non-native species from South America that likely arrived in California in the early 1900s and quickly spread throughout the state's citrus growing regions. Argentine ants have largely replaced native ant species in the urban environments that they have invaded (Holway 1998). Although the species is usually considered a nuisance pest in structures, the Argentine ant has eliminated nearly all native ant species in natural areas as well. Other native insects and some populations of native birds, lizards, and salamanders may have been similarly affected by the Argentine ant (Randall 2011). Many native plants rely on insect pollination and insect-related seed dispersal; the loss of native insects resulting from the invasion of the Argentine ant has most likely also reduced native plant seed production, dispersal and other mutualistic relationships between insects and their host plants (Gomez 2003, Nygard 2008).

Argentine ants have four life stages: egg, larva, pupa (cocoon), and adult. They are social insects that live in organized colonies where different adults have specialized duties and where numerous queens and workers mix freely among spatially separated nests. Unlike native ants, Argentine ants mix freely between colonies without any intraspecific competition and thus are capable of reaching unnaturally high population densities compared to native ant species (Silverman 2008). For this reason, eradication of Argentine ant populations is impossible; if a sub-colony collapses, other nearby queens will shift to fill the void. Argentine ants are omnivorous, preferring high protein sources until those resources are exhausted and then shifting to plant and nectar based resources. They are especially fond of honeydew produced by Homopteren insects (e.g., aphids, scale) and the pest problems of each of these species in gardens and structures are often linked.

PEST MANAGEMENT STRATEGIES FOR ANTS

Prevention

- Clean all kitchen and food storage surfaces regularly; sweep and vacuum kitchen floors daily. Shared-use appliances such as sinks, microwaves, and vending machines should be cleaned regularly to eliminate spills.

- Store all food properly. Argentine ants are especially small creatures that can easily crawl along the threads of a screw-top jar and enter the container if there is no silicone or rubber seal on the lid. Store all food in containers with tight fitting lids, or in the refrigerator or freezer.

- Rinse recycling waste if it is temporarily stored in open bins. Alternatively, store all waste in containers with tight fitting lids/seals or place open bins on insect-proof bases (e.g., AntserTM) and always line trash bins with plastic bags. Regularly take out the garbage to an outside storage area/dumpster.

- Do not leave pet food in open bowls overnight. Wash pet food bowls after the pet is done eating.

- Inspect potted plants for ant nests regularly. If ant nests are found, remove the potted plant. If potted plants become a frequent harborage for ant nests, use ant-proof platforms (e.g., AntserTM) or use a double saucer system (inside saucer – water – outside saucer – soapy water) for all inside/outside potted plants. Flooding the pot for several days can treat ant-infested potted plants.

- Inspect landscaping for aphids, scale, and other honeydew producing insects. If found, treat plants for insect pests, and manage ants in a coordinated effort to eliminate both problems.

Physical Control

- Clean up ant trails when they are found with soapy water or sticky lint rollers. Note the location the ants were headed and the location where they were coming from. Clean-up whatever was attracting the ants, if possible.
- Use caulking, silicone, or expanding foam to fill cracks, holes, or other entry points where ant trails originate. If multiple entry points are suspected, inject diatomaceous earth dust into cracks before sealing.
- Prune outside vegetation that is touching the structure if it supports ants, aphids, or scale. Some species, such as Citrus, are especially susceptible to sucking Homopteran insects that in turn attract ants. Consider replacing these species of plants with others that do not attract Homopteran pests. Treat infested

vegetation by spraying with soapy water or insecticidal soap sprays, dusting with diatomaceous earth, or physically removing insects.

Chemical Control

Chemical control of ants includes two options: 1) direct control using sprays for instant, but temporary knockdown of individual ants and the treatment of Homopteran pests that attract ants, and 2) baits for colony control. Sweet liquid baits are useful throughout the year because adult Argentine ants only feed on sugary liquids. High protein baits are generally only useful to treat colonies during the periods of the year when they are actively expanding because such solid food is typically used by the ants to feed larvae. Baiting is generally a slower process than direct control but it has a much greater long term impact on controlling the entire local colony. Baits are taken back to feed larvae and shared with other adults and queens so they potentially can eliminate the entire colony rather than just a few individuals. Modern baits are designed to be extremely host-specific compared to generalist insect sprays. Baits target the pest directly, rather than being applied to the environment. Never use direct control (spray) around a bait station, as the spray will impede the bait's ability to attract the insects. Baits will only be used indoors in tamper-proof stations.

For the control of insects, multiple baits with different modes of action are recommended to prevent local populations from developing resistance to the pesticides. Every structural insect management program should include a few products to use in rotation to prevent resistance.

- **Insecticidal Soap Spray.** Insecticidal soaps are specially designed mixes of fatty acids that are made to penetrate an insect's covering and dissolve its cell membranes causing dehydration and mortality. Generally, the soaps are formulated to not dissolve plant cell membranes so are safe to apply directly to plants. Insecticidal soaps are not effective on all insects, but soft bodied insects, such as Homopterans, are highly susceptible. When used for ant control, soaps are most effective in controlling the Homopteran insects on plants that attract and sustain ant colonies.
- **Boric Acid Bait.** Boric acid is a naturally occurring compound found in many fruits and vegetables, but at concentrated doses it can be an effective stomach poison for insects. Baits use low concentrations of boric acid – sodium tetraborate decahydrate – in the range of 0.5 – 5% to allow for ants to ingest the bait and take it back to the colony to share with other workers before there is a lethal effect. Higher concentrations risk killing the individual before it has time to take the bait back to the colony. Studies show that the lowest concentrations (<1%) are optimum for Argentine ant preference (Klotz 2000).
- **Fipronil.** Fipronil is a broad-spectrum insecticide common in household cockroach/ant baits and flea sprays for pets. When used as an ant bait, it is toxic to insects through ingestion where it blocks chloride channels in the central nervous system; resulting in excess neuronal stimulation and death of the target insect pest. It has higher binding affinity in insect receptor sites versus mammalian receptors so it is considered highly selective for insects and safe to use in human environments (Jackson et al. 2009). It is considered one of the most effective baits for colony control of Argentine ants in situations when boric acid-based baits are less effective (Hooper-Bui and Rust 2000; Mathieson et al. 2012). Fipronil is relatively quick-acting compared to other natural pesticides. It should be used as a last-resort option when extremely high populations of ants must be controlled quickly. Only small amounts of bait are necessary to control ants compared to knockdown sprays, which must be applied more widely in the environment to be effective. Small amounts of fipronil will be used as a last-resort option when extremely high populations of ants must be controlled quickly.
- **Diatomaceous Earth.** Diatomaceous earth (DE) is a silica-based, naturally occurring mineral product that works as a generalist insect pesticide. It is composed of the fossilized silica cases of marine diatoms that have been mined from ancient marine sediments. The dusts are considered non-toxic although care should be taken to not inhale large amounts of dust during application as all mineral and wood dusts are considered hazardous in extremely large amounts. Food-grade DE is available to mix directly in human and pet foods to manage pests that occur in bulk food storage. DE works by mechanically abrading an insect's

exoskeleton that leads to dehydration and eventual death of the insect. DE is non-selective so it must be used only in specific areas where the target pests travel. The dusts are not eaten – so must be applied in areas where they will make contact with the bodies of insect pests. For ant control, it is often applied to cracks and crevices and may also be used in conjunction with caulks and foams to fill problem areas.

COCKROACHES

One of the most common structural nuisance insect pests in North America is the cockroach (Olkowski et al. 1991). Though rarely carrying disease or causing major economic damage to our structures, it is typically considered unacceptable in our homes and workplaces; triggering psychological distress, embarrassment, and general feelings of disgust. Cockroaches do consume human foodstuffs and wastes, and can contaminate them with saliva and excrement. In some cases, they carry disease and may be linked to increased asthma rates (CDC 2013a).

Cockroaches are scavengers of plant materials; as a result, they prefer carbohydrates over fats and proteins. They consume any human food or food waste that contains significant carbohydrates in addition to materials such as pastes, glues, and soaps. Most common cockroach species can only exist in high humidity and high temperature environments such as those present in human structures.

Several different species of cockroaches occur as pests in Northern California and each has separate behaviors and habitat preferences that dictate different types of pest management. The non-native German cockroach is the most common pest species in the counties in which the District is located. The German cockroach (*Blatella germanica*) is the smallest and most widely spread pest cockroach in North America. It has three life stages: egg, nymph, and adult. German cockroaches prefer dark, warm, and humid hiding places and they are common in basements, kitchens, and bathrooms. They are thigmotactic, meaning they prefer to rest in small cracks where their stomach and back touches surfaces during most of the day, so regular inspection of crack areas can sometimes aid in cockroach detection in buildings. Unlike ants, they are solitary insects but since preferred habitats are rare in buildings, it is common to find large numbers of cockroaches hiding in the same general areas.

German cockroaches are ubiquitous in human environments that occur in temperate climates so complete pest eradication is almost never achievable. Cockroaches regularly disperse in cartons, boxes and other containers coming to and from grocery stores, warehouses, flower shops, and other shipments, and are thus are likely to always be present in human environments. Strategies such as sealing exterior cracks/holes in buildings and strict sanitation measures both inside and out of buildings will help maintain their populations at nearly indiscernible levels which should be sufficient for most District properties.

PEST MANAGEMENT STRATEGIES FOR COCKROACHES

Prevention

- Clean all kitchen and food storage surfaces regularly; sweep and vacuum kitchen floors daily. Shared-use appliances such as sinks, microwaves, and vending machines should be cleaned regularly to eliminate spills.
- Store all food properly. Store all food in containers with tight-fitting lids, or in the refrigerator or freezer.
- Rinse recycling waste if it is temporarily stored in open bins. Alternatively, store all waste in containers with tight fitting lids/seals or place open bins on insect-proof bases (AntserTM bases) and always line trash bins with plastic bags. Regularly take out the garbage to an outside storage area/dumpster.
- Do not leave pet food in open bowls overnight. Wash pet food bowls after the pet is done eating.
- Ensure all exterior windows that open have insect screens to prevent roaches from gaining entry into structures.

Physical Control

- Use caulking, silicone, or expanding foam to fill cracks, holes, or other entry points where cockroaches are known to hide or enter structures. If multiple entry points are suspected, inject diatomaceous earth dust into cracks before sealing.
- If hiding places are unknown, use a sticky-trap monitoring program to determine where in the building roaches are hiding.

Chemical Control

Only baits in tamper-proof stations will be used indoors.

- **Diatomaceous Earth.** Diatomaceous earth (DE) is a silica-based, naturally occurring mineral product that works as a generalist insect pesticide. It is composed of the fossilized silica cases of marine diatoms that have been mined from ancient marine sediments. The dusts are considered non-toxic although care should be taken to not inhale large amounts of dust during application as all mineral and wood dusts are considered hazardous in extremely large amounts. Food-grade DE is available to mix directly in human and pet foods to manage pests that occur in bulk food storage. DE works by mechanically abrading an insect's exoskeleton that leads to dehydration and eventual death of the insect. DE is non-selective so it must be used only in specific areas where the target pests travel. The dusts are not eaten – so must be applied in areas where they will make contact with the bodies of insect pests. For cockroach control, they are often applied to cracks and crevices and may also be used in conjunction with caulks and foams to fill problem areas.
- **Boric Acid Dusts.** Boric acid is a naturally occurring compound found in many fruits and vegetables, but in concentrated doses, can be an effective stomach poison for insects. Boric acid dusts are highly effective for cockroach control when applied to cracks and crevices where cockroaches are known to occur. The dusts (when kept dry) have a long service life and provide control for many years after application. They are practically non-detectible to cockroaches, so unlike many other chemical products that cockroaches can detect and avoid, they offer one of the more effective methods for cockroach control (Gore and Schel, 2004). Since they have such a long service life, they are effectively applied inside building walls, plenum (false) ceilings, crawlspaces and other relatively inaccessible areas where cockroaches can occur. Boric acid dusts are relatively slow acting compounds that take up to 10 to 15 days to achieve effective elimination of problem insects so they should generally be used in compliment with a baiting program to achieve full control of cockroach outbreaks.
- **Hydroprene.** Hydroprene is a synthetic insect growth regulator (IGR) that mimics juvenile insect hormones to regulate insect pest populations. Although they do not poison an insect directly to cause a lethal effect, they do interrupt the development cycle of juvenile cockroaches so they do not ever reach a reproductive stage. This mode of action can be important to reducing adult populations by preventing young insects from reaching adulthood and breeding in a long term control strategy. For this same reason, hydroprene is considered highly specific to insect pests and has low toxicity for birds and mammals, species that do not possess these same types of growth hormones. IGRs are not an ideal stand-alone control, but they are effective when used in combination with other methods to reduce populations of troublesome insects.
- **Fipronil insecticidal baits.** Fipronil is a relatively recently developed, broad-spectrum insecticide common in household cockroach/ant baits and flea sprays for pets. When used as cockroach bait, it is toxic to insects through ingestion where it blocks chloride channels in the central nervous system. This results in excess neuronal stimulation and death of the target insect pest. It has higher binding affinity in insect receptor sites versus mammalian receptors so it is considered highly selective for insects and safe to use in human environments (Jackson et al. 2009). Fipronil is relatively quick acting compared to other natural pesticides. It should be used as a last-resort option when extremely high populations of cockroaches must be controlled quickly. As it is insecticidal bait, only small amounts of bait are necessary to control cockroaches effectively compared to knockdown sprays that must be applied much more widely in the environment.

- **Indoxacarb insecticidal baits.** Indoxacarb is a synthetic, non-systemic insecticide effective on chewing and sucking insects. When used as cockroach bait, it is toxic to insects through ingestion where it blocks sodium channels in the central nervous system resulting in paralysis and elimination of the target insect pest. Iit replaces more hazardous organophosphate insecticides while still providing a fast acting, quick knockdown pest control option. Indoxacarb is a quick acting insecticide and offers exceptional German cockroach control potential. In laboratory conditions, small amounts of gel baits can provide several generations of control when the product is re-consumed through feces, regurgitates, and through bodily contact from the primary exposed individual cockroach (Buczkowski et.al, 2008). This product is recommended for last-resort options in challenging cockroach pest control scenarios.

FLIES

Flying insect pests such as flies can be problematic inside buildings. In our region, the most common pest fly species, also referred to as filth flies, are common house, stable, and greenbottle flies (Calliphoridae and Muscidae families). Common houseflies and greenbottle flies tend to be the most problematic groups of filth flies that cause pest problems in buildings and other public spaces. The presence of filth flies is generally indicative of unsanitary conditions, which makes them undesirable. They can also carry disease pathogens to humans through feces and regurgitation.

Pest flies breed in animal wastes and decaying organic material from which they can pick up bacteria and viruses that may cause human diseases. In addition, adult stable flies feed on mammalian (livestock) blood and can offer a painful bite. All flies undergo complete metamorphosis with egg, larva, pupa, and adult stages in their development. The female fly deposits her eggs in animal waste or moist organic material where the larvae, or “maggots,” complete their development, feeding on wastes until they pupate in a dry location.

PEST MANAGEMENT STRATEGIES FOR FILTH FLIES

Prevention

- Clean all kitchen and food storage surfaces regularly; sweep and vacuum kitchen floors daily. Shared use items such as sinks, microwaves, and vending machines should be cleaned regularly to eliminate spills.
- Store all food properly. Store all food in containers with tight fitting lids, or in the refrigerator or freezer.
- Rinse recycling waste if it is temporarily stored in open bins. Alternatively, store all waste in containers with tight fitting lids/seals or place open bins on insect-proof bases (AntserTM bases) and always line trash bins with plastic bags. Regularly take out the garbage to an outside storage area/dumpster.
- Ensure outside garbage cans and dumpsters have tight-fitting lids to prevent flies from completing their life-cycles in waste cans.
- If garbage cans do not have tight fitting lids, use cedar sawdust to layer over wet/organic waste in the trash bins to prevent flies from accessing food waste.
- Clean trash bins regularly with pressure washer or soap/water to ensure no thick layers of organic wastes build up in the bottom of cans.
- Ensure all exterior windows that open have tight-fitting insect screens to prevent flies from gaining entry from outside.
- For stables and other livestock areas, remove animal wastes on a regular basis and dispose in sealed containers or in managed compost piles.

Physical Control

- Use caulking, silicone, or expanding foam to fill cracks, holes, or other entry points in building exteriors where flies can gain entry.

- In problem areas, use sticky fly traps (ribbons) to capture excess adult flies and remove them from building interiors.
- Use baited electric traps for problem outside areas such as picnic grounds, barns, or livestock areas.

Chemical Control

In most residential and commercial situations, pesticides are not needed or recommended for control of flies, as they are not effective. Sanitation methods along with screens to keep flies out of buildings should be sufficient for nuisance fly control outside of agricultural facilities with livestock. Fly traps and strips used in problem trash areas may be effective in reducing the number of adult flies if proper sanitation practices are followed.

6.7.2 STRUCTURAL WILDLIFE

Structural wildlife is a diverse group of native and non-native mammals and reptiles that are especially tolerant, and even attracted to human behaviors and structures. This group includes common urban pests such as house mice and roof rats as well as native forest dwellers such as woodrats, deer mice, skunks, raccoons, bats, and rattlesnakes. House mice, roof, and Norway rats typically invade urban structures. More rural, natural areas may be invaded by deer mice and woodrats. Some species (house mice, woodrats) can be controlled relatively easily in single structures as they typically set-up single, temporary colonies in human structures. Others (roof and Norway rats) can be especially challenging since they have much larger, regional populations that interconnect. In all cases, the presence of increased shelter or food availability derived from the human world attracts these animals to buildings, including residential buildings, offices and landscaped area where they can be problematic.

District structures have the potential to be invaded by numerous species of rodents – some of which are native species that are naturally occurring in the natural areas surrounding District structures, while others are typical urban pests. Because many of the District properties occur in natural areas, the natural populations of these pest species can reinvade and repopulate the treated areas. Most native wildlife species that are common structural pests are classified as non-game animals in California’s Fish & Game Code and can be controlled with any method at any time they are found to be injuring human property. Some wildlife species have special protections and additional regulations covering their management such as game species (e.g., grey squirrels, deer), furbearers (e.g., skunks, raccoons) and threatened and endangered species (e.g., California red-legged frogs).

The following sections present pest management information by species.

HOUSE AND DEER MICE

The house mouse (*Mus musculus*) and deer mouse (*Peromyscus* sp.) are both small rodents that readily invade human structures in search of shelter and food. The house mouse is a widespread species that has been linked to human culture for over 1,000 years (Timm 1994). It is now found on every continent except Antarctica. Deer mice are native to California and most other parts of North America. They are common in nearly every habitat in their range – from deserts to forests and also in urban and suburban areas that interface with natural areas.

Both types of mice are omnivorous but generally prefer grain, seeds, and nuts. Both are nocturnal, have similar reproductive traits and reside in nests composed of fibrous materials. All mice species that are considered pests are capable of extremely high reproductive rates anytime during the year, making control difficult. House mice are rather plain looking versus deer mice that have light/dark fur color schemes, white feet, large eyes, and large ears.

Mouse damage includes the consumption of human foods, building nests in human structures, defecation, physical gnawing, damage to paper, clothing and other textiles and the vectoring of disease. House mice are known to carry salmonellosis, leptospirosis, and a variety of other diseases but transmission to humans is rare.

Deer mice, on the other hand, frequently carry Hantavirus – which has been linked to several human deaths in California in the last decade.

PEST MANAGEMENT STRATEGIES FOR MICE

Prevention

- Ensure outside garbage cans and dumpsters have tight-fitting lids to prevent mice from foraging on human food waste. This is especially important in public gathering areas in parks and open spaces. Cans with domed lids and self-closing, hinged lids are preferred in these outside areas.
- Clean all kitchen and food storage surfaces regularly; sweep and vacuum kitchen floors daily. Shared use items such as sinks, microwaves, and vending machines should be cleaned regularly to eliminate spills.
- Store all food properly, in containers with tight fitting lids, or in the refrigerator or freezer.
- Store native seeds, hay, and other vegetation-based materials that can attract mice properly in sealed containers or designated sealed storage facilities.
- Do not leave pet food in open bowls overnight. Wash pet food bowls immediately after feeding.

Habitat Modification

- Use silicone caulking and stainless steel/bronze mesh to plug/fill cracks and holes greater than ¼” in the exterior of building where mice could gain entry. Focus especially on utility penetrations, as mice are known to travel along pipes/wires. Avoid using carbon steel wools and expandable foams that degrade quickly and require repeat maintenance.
- Ensure all exterior windows that open have tight-fitting insect screens to prevent mice from gaining entry from the outside when windows are opened.
- Use galvanized sheet metal to create climbing barriers and exclude mice from travelling up vertical posts where necessary (pet cages/food storage tables/etc.).
- Mouse-proof storage facilities and seasonal buildings after visitor season ends to reduce possible nesting areas.

Physical Control

- **Snap Traps.** Basic hardware store mouse traps offer one of the most effective means for mouse population control when executed with enough preparation, time, and effort. When uncontrolled mouse populations are present, snap traps can be used to “knockdown” large populations and then maintained to keep the population under control. Mice generally travel very short distances throughout their life – space traps approximately every six feet where mice are active. Time must be invested in determining where mice are active and then setting traps in appropriate locations. Pre-baiting will help prevent trap shyness and allow for the operator to test appropriate baits. Only highly desired baits should be used in the actual trapping program. Most mice species are not as trap shy as roof and Norway rats.
- **Box Traps.** Several types of box traps are available that are capable of trapping multiple individual mice per trapping event. These traps operate on the principal that mice are attracted to small openings and are naturally inquisitive. These traps are most successful for house mouse control. Traps should be inspected on a daily basis so live trapped mice can be humanely dispatched.
- **Glue Boards.** Glue or sticky boards are effective for supplementing other trapping methods in challenging areas. Glue boards work especially well in established runways where other traps cannot be easily placed. If a trapping program fails to trap all individuals that then become trap shy, glue boards are an alternative method that can capture the remaining rogue individuals. Traps should be inspected on a daily basis so live trapped mice can be humanely dispatched. Glue boards will be used indoors only to prevent incidental catch of other wildlife.

Chemical Control

Chemical control of mice should not be considered except under very unusual (human health and safety considerations). In the unlikely event that chemical control of mice is deemed necessary, Refer to the Chemical Control section for rats, below.

ROOF, NORWAY, AND WOOD RATS

Roof rat (*Rattus rattus*), Norway rat (*Rattus norvegicus*), and Dusky-footed woodrat (*Neotoma fuscipes*) are medium sized rodents that readily invade human structures in search of shelter and food. With the exception of the native woodrat, rats represent some of the most challenging pest rodents to control in urban environments (Marsh 1994). Roof and Norway rats can be present in very large numbers in urban areas. Their home ranges are much larger than those of mice so effective treatment is challenging and may require treatment of more than a single structure. Both the roof and Norway rat are a widespread pest species that have co-evolved with humans for thousands of years.

Dusky-footed woodrats are native California mammals that are occasionally considered pests when they invade structures from nearby wildlands. All woodrats found on District lands are the San Francisco Dusky-footed woodrat (*Neotoma fuscipes annectens*) which is a CDFW Species of Special Concern. Control of woodrats, as with all native species, should first focus on prevention instead of physical or chemical control.

Like cockroaches, rats trigger general feelings of disgust in humans as they are thought to be representative of dirty living conditions and squalor. They do bite, and many people in the U.S. suffer from rat bites each year. Rats are known to carry diseases that can be transmitted to humans. The majority of actual rat damage in the United States is due to structural damages caused by burrowing (Norway rats), defecation and contamination of food products, textiles and living spaces (Norway/roof/wood rats), and damage to agricultural crops and landscaping (roof rats). Woodrats typically build elaborate nests in wildland areas, but can also be nuisance pests in structures where they make nests and cache food. Woodrats also are the only species of rat known to carry Hantavirus and Arena virus in North America, both of which can be deadly to humans (Salmon and Gorenzal, 1994).

PEST MANAGEMENT STRATEGIES FOR RATS

Prevention

- Ensure outside garbage cans and dumpsters have tight-fitting lids to prevent rats from foraging on human food waste. This is especially important in public gathering areas in parks and open spaces. Cans with domed lids and self-closing, hinged lids are preferred in these outside areas.
- Clean all kitchen and food storage surfaces regularly; sweep and vacuum kitchen floors daily. Shared use items such as sinks, microwaves, and vending machines should be cleaned regularly to eliminate spills.
- Store all food properly, in containers with tight fitting lids, or in the refrigerator or freezer.
- Do not leave pet food in open bowls overnight. Wash pet food bowls immediately after feeding.

Habitat Modification

- Inspect building exterior for possible rodent entryways. Especially inspect attics for signs of rat occupation and openings or gaps between the structure and roofs or foundations. Use silicone caulking and stainless steel/bronze mesh to plug/fill cracks and holes greater than ½” in the exterior of building where rats could gain entry. Focus especially on areas where utilities enter the buildings, as rats are known to travel along pipes/wires. Avoid using carbon steel wools and expandable foams that degrade quickly and require repeated maintenance.
- Ensure all exterior windows that open have tight-fitting insect screens to prevent rats from gaining entry from the outside when windows are opened.

- Use galvanized sheet metal to create climbing barriers and exclude rats from travelling up vertical posts where necessary (e.g., utility poles, pet cages, food storage areas, tables).
- Rodent-proof storage facilities and seasonal buildings after visitor use season ends to reduce possible nesting areas.
- If they appear to be a constant source of infestation, woodrat nests within 100 feet of buildings will be moved after consultation with the California Department of Fish and Wildlife.

Physical Control

- **Snap Traps.** Basic hardware store rat traps offer one of the most effective means for rat population control in small structures with small rodent populations. Where large rat populations are present, snap traps can be used to “knock down” the population size in conjunction with other management techniques (prevention, habitat modification) to keep the population under control. Time must be invested in determining where rats are active and then setting traps in appropriate locations. Roof and Norway rats are inherently wary of new objects in their environment, including rat traps. Pre-baiting is essential to allow rats to associate rat traps with feeding stations, a process that may take several weeks. Only after rats have become used to traps should the trapping portion of the control effort move forward.
- **Glue Boards.** Glue or sticky boards are effective for supplementing other trapping methods in challenging areas. Glue boards work especially well in established rat pathways of travel where other traps cannot be easily placed. If a trapping program fails to trap all individuals that then become trap shy, glue boards are an alternative method that can capture the remaining rogue individuals. Glue boards will only be used indoors and will be checked daily.

Chemical Control

The District is aware of the potential for secondary effects of rodenticide use in and near natural lands on native wildlife species, and is committed to strictly regulating rodenticide uses on its lands to the full extent possible. The District intends to use all non-chemical control options before selecting rodenticides as a treatment option, except in instances where rodent infestations are determined to present a public health issue. The District goal is to reduce all rodenticide use on its lands over time to the full extent possible, while still protecting human health. The following section carefully lays out the effects and limitations of each type of rodenticide product, and provides guidance for District staff selection of the least toxic effective treatment option in the event that chemical control of rodents must be utilized.

Primary versus Secondary Poisoning. Non-target poisoning is divided into two scenarios: 1) a non-target animal intercepts the bait – referred to as “primary exposure”; and 2) a non-target animal ingests a prey species that has been exposed to the toxicant – referred to as “secondary exposure.” Rodenticides typically have high degrees of mammalian toxicity compared to other types of pesticides so it is important to control how these compounds are presented to target rodent pests. Acute toxicant baits can attract non-target mammals and birds so these baits must be presented in environments where only rodents have a chance of encountering them. Sealed box bait stations are now common for nearly all rodent baits used in structures to prevent pets and people from encountering the baits. Bait stations are usually designed for urban environments and they offer little protection to stronger wildlife species such as raccoons, badgers and bears that can easily open them (Erickson 2004). To better protect non-target wildlife species in the urban-wildlife interface, custom protective devices can be installed to shield bait stations from non-target wildlife species. Because predators generally prefer to catch and eat live prey, acute toxicants (the products that work quickly on the target animal resulting in a quick mortality) rarely cause secondary exposures to predators and scavengers.

Acute Rodenticide – Cholecalciferol (Vitamin D3). Cholecalciferol is a natural form of Vitamin D that is industrially synthesized from lanolin (sheep’s wool) to produce human dietary supplements and rodent poison. In very high doses, it causes mobilization of calcium from the bone matrix to blood plasma, causing hypercalcemia and death. It is especially toxic to rodents and a single dose of toxicant acts as an acute poison. It is the only current rodenticide in California labeled for organic food production (OMRI 2013). Cholecalciferol is considered a novel mode of action for rodenticides and can be used in urban areas where rodents have developed resistance to other anticoagulants (Marshall 1984). It is considered a low risk for secondary poisoning in wildlife but can be a hazard to non-target pets that directly consume the bait. Rodenticides will only be used inside in tamper-proof anchored containers.

SKUNKS, OPOSSUMS, AND RACCOONS

Skunks, opossums, and raccoons are native mammals that have the potential to take residence in District structures as unwelcome guests. All these species are exceptionally common on District lands and generally will not bother humans. On rare occasions, they may invade trash cans, open kitchens, or den under and within structures. CDFW regulates these species as nongame or furbearer animals so they all may be controlled without permits if found causing agricultural damage or nuisance problems.

PEST MANAGEMENT STRATEGIES FOR SKUNKS, OPOSSUMS AND RACCOONS

Prevention

- Ensure outside garbage cans and dumpsters have tight-fitting lids to prevent foraging on human wastes. This is especially important in public gathering areas in parks and open spaces. Cans with domed lids and self-closing, hinged lids are preferred in these outside areas.
- Clean all kitchen and food storage surfaces regularly; sweep and vacuum kitchen floors daily. Shared use items such as sinks, microwaves, and vending machines should be cleaned regularly to eliminate spills.
- Do not leave pet food in open bowls overnight. Wash pet food bowls immediately after feeding.

Habitat Modification

- Use stainless steel/bronze mesh or welded wire to plug/fill cracks and holes in the exterior of building where large animals could gain entry.
- For larger openings, such as under decks and porches, fully enclose with plywood, concrete or wire mesh to prevent animals from making dens under structures. If animals are already denning in the areas, use one-way, hinged doors to allow them out but preventing them from returning. Confirm there are no juvenile animals in the den before using one-way doors.
- For raccoons in challenging areas, a single electrified strand of wire elevated eight inches from the ground can be used to deter them entering the area.

Physical Control

- **Box and Cage Traps.** All skunks, opossum, and raccoons are easily trapped with live box or cage traps. Trap design varies but solid wall traps are preferred for skunks to shield the trapper from skunk spray during the control operation. The use of live trapping methods ensures that non-target animals can be released unharmed. Current CDFW trapping regulations requires that trapped animals are either released immediately or euthanized, live animals may not be relocated without a permit from CDFW.

Chemical Control

Currently there are no toxicants or fertility control agents available in California for these species.

BATS

Bats are California's only flying mammal. There are a wide variety of bats (more than 16 species in all) that inhabit all habitats in the Bay Area; some are solitary and others colonial. All California bat species are insectivorous and they provide an ecologically valuable service of consuming vast quantities of insect pests such as mosquitos (Gannon 2003). Though they generally benefit humans greatly, bats secretive nature, nocturnal habits, coarse appearance, ability to fly, and habitation near humans have contributed to folklore, superstition, fear and ultimately persecution.

Some species of colonial bats can become structural pests when they establish colonies in homes or other human structures. Some species prefer dark open spaces, such as attics and basements and others prefer small cracks/crevices, such as between roof tiles/shingles or behind shutters (Greenhall and Frantz, 1994). One human structure can actually support a wide diversity of bat species. Though many bat species are tolerant of humans, many humans are not tolerant of bats.

Common damages caused by bats are noise coming from bat roosts, smells coming from their urine and guano, potential disease such as rabies and histoplasmosis, and discomfort anytime their presence is too close to humans in structures (CDFW 2008). Most bat damage can be mitigated with prevention and habitat modification techniques to make human structures less inviting or completely exclude bat roosting.

PREVENTION AND HABITAT MODIFICATION

- Carefully assess where bats are entering structures and modify the building to exclude future entry. Since bats are extremely small, fly and can squeeze into very small spaces, assessing bat entry points can be a tedious and challenging exercise. Evaluate spaces during day/nighttime hours; use smoke pens, and infrared cameras to assist in detecting breeches to the building envelope. Consult bat exclusion specialists for challenging structural projects.
- Install flashing, screening or netting in obvious roof/gable areas where bats can roost.
- Caulk cracks in masonry, especially chimneys.
- Use one-way trap doors to allow bats to escape roost areas after exclusionary methods are completed.

TRAPPING

- Trapping is not recommended as its more time consuming and less effective than strategic exclusion as discussed above.

CHEMICAL CONTROL

- Currently there are no toxicants or fertility control agents available in California for these species.

6.7.3 FERAL DOMESTIC PETS

Domestic pets such as feral cats and stray dogs can sometimes become structural pests. Uncontrolled feral domestic pets, unlike most wildlife, are often highly habituated to humans and therefore much more likely to come in very close contact with District staff, tenants, visitors and livestock (Information Services 2012). These close encounters can lead to increased chances of physical injury, disease transmission, contamination of District facilities and injury to tenant livestock.

Cats and dogs are generally considered private personal property when ownership can be established through collars, registration tags, microchips, tattoos, brands or other proof of ownership. Pets without identification can be considered free roaming, uncontrolled private property or feral (wild) animals. In California, both state and local laws govern domestic animal damage control under Fish & Game, agriculture codes and local ordinances. District staff consult local city and county ordinances and animal control departments when conducting any domestic animal control actions.

PREVENTION AND HABITAT MODIFICATION

- Feral domestic pets are often relics of old structures/settlements. If the District inherits older buildings/infrastructure, consider demolition or wildlife exclusion retrofitting so the structures can no longer support animals.
- Control of excessive rodent populations in structures can also help control feral cat populations.
- Ensure outside garbage cans and dumpsters have tight-fitting lids to prevent foraging on human food waste. This is especially important in public gathering areas in parks and open spaces. Cans with domed lids and self-closing, hinged lids are preferred in these outside areas.
- Ensure District staff and tenants have properly placed any bird feeders or bird nest boxes such that they do not also serve as cat feeding stations.
- Prohibit staff and tenants from feeding feral domestic pets on District property. Develop education programs to encourage the public not to feed wildlife or feral animals on District property.

TRAPPING

- Live trapping is effective to capture problem cats but generally ineffective for dogs in California (Fitzwater 1994, Green 2012). Because feral domestic pets may be private property, District staff conducts all trapping in conjunction with local animal control departments and/or animal shelters.

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7 IPM FOR RECREATIONAL FACILITIES

7.1 DEFINITION AND PURPOSE

Human use is typically concentrated on preserves at the recreational facilities provided by the District. Recreational facilities within District preserves currently include approximately 479 miles of access road and trails as well as associated infrastructure (i.e., bridges, culverts, drainage ditches, parking lots, gates, stiles, bathrooms), picnic areas, one campground, off-leash dog zones, managed turf and landscaped recreation areas, pond viewing and dam areas, and Deer Hollow Farm).

Nuisance pests in and around recreational facilities include plants, insects and wildlife that can temporarily affect the District's visitor experience in a negative manner. Sometimes nuisance pests at recreational facilities become problematic when there are extra resources readily available (e.g., food, water, shelter) and therefore can be managed with physical control options (e.g., controlling food-trash in picnic and camping areas).

The purpose of pest control in and around recreational facilities is to manage pests for human enjoyment of the the natural and scenic qualities of the preserves while also minimizing human exposure to pests. The maintenance of vegetation alongside roads and trails and the control of stinging or biting insects or reptiles at recreational facilities must incorporate protection of the surrounding natural resources as a primary consideration. Unlike buildings, recreational facilities are almost always located in natural (undeveloped) areas, therefore, pest control solutions must also consider protection of the surrounding natural resources as a primary consideration.

7.2 TYPE OF PESTS

7.2.1 NUISANCE PESTS IN RECREATIONAL FACILITIES

Nuisance pests include native and naturalized plants, insects and wildlife that are present throughout the region and are generally compatible with the District's mission and goals. Conflict only occurs when these species become overabundant or exceptionally close to staff and visitors. For example, native social wasps in outside areas would normally be tolerated, but a wasp nest in a public bathroom would be considered an unacceptable risk to visitor health and enjoyment of District lands.

The determination of a nuisance pest can be quite variable depending on the tolerance of staff or the visitor to any real or perceived harm. Care must be exercised when defining tolerance levels for each pest species. One must consider the actual damage potential of the organism versus the cultural acceptance to the risk that the organism poses. For example, poison oak is an important native plant that occurs throughout District lands and is quite common along trails. Educating the public about the effects of poison oak exposure to humans (dermatitis) is the first option to reducing perceived risk of exposure to this pest. When visitors complain about incidences of poison oak exposure, District staff must consider the context of the poison oak exposure risk. At trailheads, campgrounds, and other areas where potential for frequent visitor interactions is high, staff may elect to routinely control poison oak. In contrast, infrequent brushing and/or installation of educational signs may be appropriate for poison oak at remote, backcountry trails that are rarely visited. The District's recreational facility IPM decision-making must always balance health and human safety concerns with the District's goals to protect natural resources.

7.3 PEST IDENTIFICATION

Nuisance pests are generally identified by chance encounters by District staff, tenants and visitors. Because recreational facilities have more intensive utilization than the District's surrounding natural areas, nuisance pests can usually be identified relatively quickly before the problem reaches levels where active pest management is required. Routine inspections of recreational facilities should focus on identifying conditions where visitor use levels are high, and where conditions can result in excess food, shelter, and access that support pest problems.

Many nuisance pests can be anticipated and their management scheduled based on an understanding of their biology and behavior. For example, some types of native vegetation growth outwards onto roads and trails in search of light and space can be anticipated and preventative treatment (brushing) can be scheduled on an annual or periodic basis. District staff can identify problem areas with excess vegetation along trails each year, and schedule abatement accordingly. Other pests may present themselves randomly and/or rarely. For example, a rattlesnake denning along a trailside is a relatively infrequent occurrence. These infrequent pest problems are usually best reported when the staff and/or visitors encounter them.

7.4 PREVENTION AND RETROFIT

Nuisance pest control in recreational facilities focuses on first modifying the behavior of humans or the structure of our environment to reduce or eliminate the problem. The District's IPM program relies on cultural pest control practices, such as product design or retrofit and behavior modification as the primary pest control treatments, with active chemical or lethal controls used only as a last resort.

This section describes general operational procedures intended to prevent or minimize the need for pest control in recreational facilities. The District will undertake some or all of the following to help prevent pest infestation from reaching action thresholds:

- staff training,
- public education regarding identification and avoidance of naturally-occurring nuisance pests,
- structural changes intended to pest-proof recreational facilities,
- general sanitation and maintenance actions,
- landscape maintenance, and
- waste management procedures.

District procedures for these preventative actions are described in more detail below.

7.4.1 PREVENTION

Many pest outbreaks can be managed with cultural control options such as changing human behavior (e.g., promoting removal of food-related trash, installing educational signs promoting human avoidance of naturally occurring pests, temporary closures of facilities during periods pests are most likely to be present to physically separate visitors and pests) and engineered control options within our recreational facilities (e.g., securing garbage cans, managing vegetation around heavily used recreational facilities, sealing off buildings and structures). Many open space and park districts throughout the nation have dramatically reduced human-wildlife encounters by simply making food and garbage unavailable with wildlife-proof garbage cans (Decker et al. 2008, Herrero et al. 2005). This simple, single engineering solution reduces wildlife habituation to humans, ultimately reducing human conflicts with stinging insects, raccoons, skunks, coyotes and other naturally-occurring nuisance pest species.

Feeding wildlife can significantly increase nuisance wildlife problems in the District. Using postings and other educational materials in District picnic areas, parking lots and trailheads can help inform the public that feeding wildlife ultimately causes them great harm. Postings should emphasize that passive feeding (i.e., poor sanitation) is as detrimental to wildlife as active feeding, and that visitors should remove their food-related trash at the end of their visit. Educational postings for conservation related topics are best supported by both active and passive enforcement, or otherwise tend to be ineffective (Baruch-Mordo et al. 2011).

Recreational facilities pest problems are often temporary in nature. Rattlesnakes and skunks may temporarily occupy a facility, but otherwise remain unseen by visitors. Instead of actively managing the pest itself, the District can install educational signs promoting human avoidance of naturally occurring pests, or the facility can be temporarily closed (for buildings and other facilities) or rerouted (for trails) so District staff or visitors remain safe during time periods when pests are most likely to occur.

7.4.2 RETROFIT

The District will train staff to regularly assess and manage the areas within recreational facilities that are known to attract pests. Some examples of such areas include:

- storage areas for tools, seeds and plant materials, food, research supplies,
- waste management areas: trash cans, trash compactors, dumpsters, etc.,
- drainage areas,
- plumbing (faulty plumbing such as leaky pipes can support pests),
- entryways and windows (ensure tight seals to prevent pest entry),
- landscaped areas, especially immediately adjacent to buildings,
- storage areas (such as woodpiles) located next to buildings.

District supervisors should regularly inspect such areas and provide additional training or educational materials to encourage staff to keep such areas clean and pest free. In addition, for buildings used for storage of equipment and vegetation materials such as seed, hay or livestock feeds, and all other materials that could attract rodents will be sealed in plastic or metal containers with tight fitting lids. Actions to prevent or reduce nuisance pests in recreational facilities include:

- Train staff about proper storage of work supplies in non-occupied buildings.
  - Store all pet food, animal grains, hay, and other consumable agricultural supplies in sealed containers metal/plastic containers.
  - Store plant seeds used for habitat restoration and landscaping in sealed containers.
- Position attractive harborage areas, such as rock piles, soil storage piles, hay and erosion control materials away from recreational facilities.
- Control food waste in contractor work areas, outbuildings, storage areas and other non-occupied recreational facilities. Provide sealed garbage containers in or near such areas to prevent inadvertent disposal.
- Reduce, monitor, and where possible eliminate use and import of natural materials that could introduce pests onto District lands, such as reducing use of offsite fill (soil, gravel, and rock) and livestock feeds (hay) that may contain weed seeds. Where possible, include requirements to utilize onsite fill, require balanced cut and fill projects on District lands, and require use of certified weed-free erosion control materials for construction projects on District lands.

In addition, landscaping around recreational facilities can harbor pests. Maintenance staff should prune back or remove dense vegetation such as ivy and any landscape vegetation that touches buildings, providing a physical pathway for pests such as ants to access the building. In addition, maintenance of healthy landscapes through proper fertilization, watering, pruning and aeration is also thought to reduce potential for pests to reach problematic levels.

Landscape design and good landscape maintenance practices can discourage pests and encourage healthy plantings that may resist pest establishment. Some options for pest prevention and reduction in landscaped areas include:

- appropriate cleaning and maintenance of tools and equipment;
- selection of new landscape design intended to discourage landscape pest species;
- replacement of older landscaping design when it is found to harbor pests (e.g., dense vegetation such as ivy near buildings);
- monitoring of landscaping plants for secondary pests (such as aphids or scale), and treatment as necessary to prevent nuisance pest outbreaks (such as ants).
- ensuring new planting materials are clean of pests and disease;
- selection of pest-resistant plants for landscape maintenance projects;
- positioning planting sites away from buildings;
- proper irrigation design, proper watering practices.

In the event of a pest outbreak in landscaped areas, choose least environmentally disruptive and harmful, effective treatments for landscape pest species.

7.4.1 TIMED MAINTENANCE

Many nuisance pests can be managed through preventative treatments based on an understanding of their biology and behavior. This is especially true for the District's routine maintenance needs for horticultural landscaping and native vegetation along gates, stiles, trails and access roads. Native vegetation grows vigorously after being cut because of plant hormone responses and changes in the availability of soil nutrients (Par and Way, 1988). Vegetation types that are regularly mowed with mechanical equipment have predictable regrowth times that can be measured and incorporated into routine District maintenance schedules. To prevent road and trailside vegetation from becoming a nuisance pest, mechanical brushing can be scheduled for specific times of year to abate the hazard before it becomes a problem. Roadside brushing also serves as secondary control for other nuisance insect and wildlife species. The reduction of cover near trails reduces the chances that visitors and staff will encounter ticks and rattlesnakes.

Some native perennial vegetation (e.g., poison oak or stinging nettles) is less tolerated by humans than other types of native vegetation. The presence of such vegetation may not be appropriate for some trailside locations that have high visitation rates. These special circumstances require the use of more complex management tools for perennial plants such as chemical control. Refer to vegetation management options presented for perennial plants, as detailed in Chapter 10, Section 10.8 for such special circumstances.

7.4.2 PLANT HEALTH CARE

Many nuisance pests in horticultural landscaping and turf (e.g., as mildews, rusts, aphids, whiteflies) can be controlled with routine and proper horticultural practices. Proper watering, fertilization, and cutting/pruning can insure horticultural plants have sufficient resources to grow well without providing support to fungal, insect and mammalian pests. Horticultural plants that are especially susceptible to nuisance landscaping pests should be considered for replacement with more suitable varieties. Often pests can be 'designed' out of the landscape by choosing more appropriate species or varieties for a specific location.

7.5 DAMAGE ASSESSMENT

Determine what, if any, damage to recreational facilities or the visitors using them is present. If there is no damage to a recreational facility, but a nuisance pest is present that is in conflict with human use or enjoyment of the structure, determine the tolerance level for each nuisance pest species to determine if control is warranted. To the extent possible, quantify the damage (square feet or number of occurrences affected) and qualitatively describe the perceived damage in its context.

7.6 TOLERANCE LEVELS/THRESHOLD FOR ACTION

Recreational facility IPM focuses on modifying the structure of the environment to balance nuisance pest conflicts with visitor needs. In recreational facility pest management, often small retrofits or facility modification can reduce risk of exposure, or manage the pest population down to acceptable tolerance levels.

Tolerance levels vary greatly for nuisance pests in recreational facilities. Most nuisance pest species are native species that are compatible with the District's goals for conservation. The District's IPM approach for nuisance pest species begins with establishing tolerance levels that balance human safety, enjoyment, and comfort within visitor facilities with the ability to conserve natural resources, meet regulatory requirements and cost/benefit assessment. Human safety and enjoyment is the primary metric for establishing tolerance levels in visitor facilities. Staff and visitor safety is paramount in regulating treatment actions for nuisance pests. Tolerance levels will consider conservation goals and impacts to the larger surrounding natural system in determining treatment actions.

Refer to Table 7-1 below for management thresholds, and possible treatment options for nuisance pests in and near recreational facilities, presented by pest category.

Table 7-1 Management Thresholds and Treatment Options for Nuisance Insect, Animal, and Plant Pests in Recreational Facilities

Pest Category	Management Threshold (Population Size/Conditions)	Treatment
Mosquitoes	Detection of pest at levels at levels that could cause human health problems, populations causing visitor discomfort or as required by local regulatory agencies.	Use a combination of the following: ◢ Inspect areas in vicinity of problem area for standing water and other potential mosquito breeding sites. Where possible, repair or drain /eliminate potential breeding habitats ◢ Educate visitors about mosquitos and human health risks by posting temporary signs in problem areas ◢ Protect workers by requiring use of protective clothing when working in affected areas ◢ Use BTI discs in water troughs ◢ For ongoing pest issues, contact a local county Mosquito and Vector Control District to schedule treatment (District to comply with legal requirements to control mosquitos for human health and safety).

Table 7-1 Management Thresholds and Treatment Options for Nuisance Insect, Animal, and Plant Pests in Recreational Facilities

Pest Category	Management Threshold (Population Size/Conditions)	Treatment
Social Wasps	Populations causing conflict with humans near structures or other high use visitor areas	Use a combination of the following: ◢ Remove or enclose attractants in well-sealed containers (trash cans, etc.) ◢ Use baited non-toxic water traps (late winter and early spring) ◢ Use non-toxic lure traps set approximately 200 feet apart.
	Nests determined to pose immediate threat to human safety	Use a combination of the following: ◢ Physically remove problem nests with water jets or by digging ◢ Use Pyrethrin aerosol spray to target individual nests.
Ticks	Detection of multiple individual in work areas or offices, tick populations causing visitor discomfort.	Use a combination of the following: ◢ Remove and destroy individual ticks. ◢ (See also preventative trail maintenance for native vegetation below.)
Rattlesnakes	Individuals within structures or recreational facilities where contact with humans is likely	Use a combination of the following: ◢ Trap and relocate (obtain appropriate permits from CDFW). ◢ Block access to structures and remove hiding places adjacent to structures and high public use areas.
Native vegetation along trails and roads (poison oak, stinging or scratching plants, brush)	Conditions could cause severe discomfort or health hazards to visitors, volunteers, and staff, or vegetation that is blocking emergency access.	Follow District guidelines for trail clearing in various habitats and slopes. ◢ Mow and prune buffers along trails and roads to reduce direct contact by visitors. ◢ Herbicide use on perennial species only if permanent control is needed.

7.7 TREATMENT OPTIONS

In recreational facilities, pest tolerance levels are based on ensuring the health and enjoyment of visitors, in addition to human health and safety requirements, by following the District adopted details and specifications for trail and other recreational facilities.

When the presence of pests in recreational facilities is determined to require action, pest prevention actions the District may consider in recreational facilities include:

- Reducing the attractiveness of the recreational facilities areas to pests. For example, remove rock and brush piles that are attractive to snakes; seal small burrows and holes that attract ground-dwelling pests; regularly remove food debris that can attract wildlife (e.g., skunks, ravens).
- Educating the public about interactions with wild creatures such as snakes and ticks, and providing suggestions for avoiding unpleasant or dangerous interactions. Support this action with proactive enforcement.
- Sealing up entrances in and near recreational facilities to discourage pest occupation (e.g., screening air vents to bathrooms, screening in overhangs to prevent pests from entering the facility).
- Cutting back unwanted brush such as poison oak along trailheads and high use trails to reduce potential for visitor interaction.
- Mowing high grasses along heavily used trails where ticks tend to congregate.

Pest management options for nuisance pests in and around recreational facilities are the same for insect and wildlife pests in buildings that is described above in Chapter 6. The following section describes additional nuisance pests that are not covered in Chapter 6.

Where pesticide use is determined to be the only viable treatment option to address the specific infestation of concern in and around recreational facilities, selection of least harmful products is required. In these limited instances, only pesticides on the District's List of Approved Pesticides (Table 1.1, Appendix A) may be utilized.

The chemical control options presented in this Chapter represent the least harmful, most efficient treatment methods for controlling structural pests. For example, a wasp nest in a public restroom may require use of a pyrethroid wasp spray to immediately eliminate the hazard of wasp injury to visitors. The inclusion of a variety of pest treatment method options in the IPM program allows the District to respond with the necessary tools based on actual risk to the District, its visitors, workers, structures, and lands.

7.7.1 STINGING INSECTS

MOSQUITOES

Mosquitoes are a family of small, midge-like flies in the *Culicidae* family. Most mosquitoes are considered a pest species because they consume blood from vertebrates, including humans and can transmit diseases and cause uncomfortable dermatitis. Mosquitoes go through four life stages: egg, larva, pupa, and adult. The first three life stages are largely aquatic and last approximately 14 days. Control of wet areas, including stagnant standing rain water, stock ponds, and even ponded water from leaky pipes is therefore an effective control strategy for controlling this pest species. The females of many, but not all species of mosquitoes consume blood during a portion of their life cycle. In feeding on blood, some species of mosquitos can transmit extremely harmful human and livestock diseases, such as West Nile virus and Malaria. Therefore, pest control focuses on elimination of stagnant water and wet area habitats, and on control of adults' population numbers where a health concern is detected.

Although mosquitos are members of the ecosystems of natural areas, the threat of mosquito bites makes them unwelcome in and near buildings and recreational facilities. Mosquitos are generally only considered pests when their population numbers are incompatible with human health and safety, at which point the District will contact the appropriate county Mosquito and Vector Control District. The county Mosquito and Vector Control District is the agency responsible for monitoring disease outbreaks, and implementing necessary pest control for human health and safety.

PEST MANAGEMENT STRATEGIES FOR MOSQUITOES

Prevention

In addition to actions taken by local county Mosquito and Vector Control District to detect and control mosquito populations in natural areas, the District can also implement many non-chemical, cultural control methods to prevent infestation or reduce the number of adult mosquitoes that come into contact with workers and visitors. Depending on the situation, the most important usually include:

- source reduction (e.g., removing stagnant water around), and
- education (e.g., posting public information signs to inform visitors about mosquitos and human health risks).

Physical Control

- Install and maintain window screening in recreational buildings.

- Train staff to protect themselves from exposure by wearing long-sleeved clothing, tucking pant legs into socks and/or taping pant cuffs close to the body.

Chemical Control

The District places *Bti* disks (*Bacillus thuringiensis israelensis*) in watering troughs throughout the preserves to control mosquitoes. *Bti* is a specific type of bacteria that prevent mosquito larvae from developing.

Where other forms of chemical control are determined to be the only viable treatment option to address the specific infestation of concern in and around recreational facilities, the District will contact the appropriate county Mosquito and Vector Control District for assistance and will comply with legal requirements to control mosquitos for human health and safety).

SOCIAL WASPS

Social wasps are a large group of native stinging insects that include yellow jackets, hornets, and mud daubers. Wasps' yellow and black color schemes and social behavior are shared with distantly related bees. Like bees, wasps are an important group of native insects that perform valuable ecological functions in our natural world (Hinkle et al. 2002). Most of the species in this group are generalist insect predators that are essential in their natural environments to aid in decomposition, control populations of other insects, and some even pollinate flowers like bees. Although wasps are important members of the ecosystems of natural areas, the threat of wasp stings makes them unwelcome intruders in and near buildings and recreational facilities. Social wasps are generally only considered pests when their nests are located in areas where they are incompatible with human use. For example, when social wasps nest under the eaves of buildings or alongside trails, they can sometimes exhibit aggressive protective behaviors that can threaten humans with painful and sometimes dangerous stings. Where multiple stinging incidents occur, District staff will consider control of wasp nests.

Wasps belong to a large group of insects in the family *Hymenoptera* that includes ants, bees, and wasps. Many genera and species within *Hymenoptera* are difficult to tell apart as they share similar body shapes and color schemes. Because many of these *Hymenopteran* insects have protective stings and bites, even some other species outside the family like flies have adapted their body styles to mimic wasps. For this reason, staff must be careful to properly identify the pest to species to ensure that it is an actual nuisance pest species that can sting, rather than a similarly shaped or colored harmless species.

Like bees, wasps are social organisms that live together in colonies where individuals have specialized roles. Queens emerge from hibernation each spring to build nests and start larger colonies composed of workers. Pupae are raised in cell-like structures within paper or mud nests that are tended by workers and queens. Different species build different types of nests – from small mud structures that are attached to ledges to aerial and underground paper-type nests. Different species also have different foraging habits. Some prefer hunting for carrion and sweet liquids while others prefer hunting live prey. The species that forage for carrion and sweet liquids are often the most problematic individuals that disturb picnickers.

PEST MANAGEMENT STRATEGIES FOR SOCIAL WASPS

Prevention

- Ensure outside garbage cans and dumpsters have tight-fitting lids to prevent wasps from foraging on human food wastes. This is especially important in public picnic and gathering areas in parks and open spaces. Cans with domed lids and self-closing, hinged lids are preferred in these outside areas.
- Periodically clean the hinged-lids of garbage and recycling bins so spilled sweet liquids do not attract wasps to picnic areas.

- Ensure all exterior windows that open have tight-fitting insect screens to prevent wasps from gaining entry from the outside when windows are opened.
- If concessionaires sell soft drinks and other sweet liquids on District properties, require drinks to be sold with straws and tight fitting lids to prevent wasps from entering drinking containers while in use.

Physical Control

- Install baited non-toxic water traps in late winter and early spring to reduce queens in problem areas where wasps are known to be regularly problematic.
- Install pesticide-free lure traps set approximately 200 feet apart in outside problem areas where human/wasp conflicts are known to occur (e.g., picnic areas, outside amphitheaters). Place traps between the center of human activity and natural areas in an attempt to attract wasps away from humans instead of attracting more wasps to human areas.
- Physically remove problem wasp nests with water jets or by digging them out of underground locations. Ensure pest control workers wear protective beekeeper suits to reduce the potential for dangerous stings.

Chemical Control

- **Pyrethrin Aerosol Sprays.** Pyrethrin-type aerosol sprays containing d-trans allethrin and phenothrin are only recommended where immediate threats exist to human health and safety. These aerosol sprays are extremely effective at immediately eliminating single, problem wasp nests that threaten District staff or visitors. The pyrethrin-type sprays work as a contact neuro-poison that results in near immediate mortality of any insect (Jackson 2011). The sprays offer a relatively safe and effective means for park ranger and maintenance workers responding to immediate threats of wasp nests. Contact pyrethrins are completely non-selective, so care must be taken to target only the pest wasp and not to impact other beneficial insects. Contact sprays do not offer population-level control for wasps; diligent sanitation and early seasonal queen trapping are the only known methods to effectively reduce populations of stinging wasps in open landscapes.

7.7.2 TICKS

The western black-legged tick (*Ixodes pacificus*) is a native arachnid (i.e., spider relative) that is very common in grasslands, scrub, and woodlands throughout District lands. Black-legged ticks are common parasites of native mammals such as deer, but they can also be problematic parasites of District visitors and staff. To complete their life cycles, ticks must feed on blood and for this reason can also be dangerous vectors that can transmit blood-borne diseases such as Rocky Mountain spotted fever, Lyme disease, and tularemia (CDC 2013b). Ticks are an important part of the natural environment and are present on District lands in abundance. Due to their prevalence in naturally occurring deer populations that move through District lands, eradication of ticks in natural areas is impossible; however, some level of preventative control may be warranted in high visitor use areas in and around recreational facilities and buildings. Ticks can be especially problematic indoors where field staff work and store clothing; staff returning from field work can unknowingly introduce ticks into buildings where they can be transmitted to unsuspecting office workers.

PEST MANAGEMENT STRATEGIES FOR TICKS

Prevention

- In high visitor use areas, regularly cut or mow alongside trails and picnic areas to reduce the chance of visitors and staff picking up ticks. Ticks often summit tall grass blades and shrub branches to “catch” or brush against a passing animal. Keeping vegetation cut low and pruned reduces the opportunities for ticks to utilize this strategy in areas with high pedestrian use.
- Post tick educational materials in District offices and at major trailheads and parking areas.

- Regularly vacuum carpeted areas where District employees work.
- Ensure all exterior windows that open have tight-fitting insect screens to prevent ticks from gaining entry from outside when windows are opened.

Physical Control

- Install carbon dioxide traps daily to collect ticks in field offices where field staff regularly begin and end field days. This may be especially effective in staff changing rooms where field clothes are shed, changed, and stored.
- Train staff to protect themselves from exposure by wearing light colored long-sleeved clothing, tucking pant legs into socks and/or taping pant cuffs close to the body; performing regular inspections of clothing and exposed areas such as the head and neck; and showering or bathing and inspecting their bodies as soon as possible upon completion of work.
- Post educational signs with the information above to help inform visitors of tick prevention and detection strategies they can employ before and after using recreational facilities.
- As ticks are found, remove and destroy individuals.

Chemical Control

No chemical control strategies are recommended for ticks.

7.7.3 NUISANCE ANIMALS

RATTLESNAKES

Rattlesnakes are the only type of venomous snake found in California. They are native to California and are considered to be important predators that help keep rodent populations under control. Rattlesnakes are generally extremely wary of humans and tend to shy away from human activities. They are not aggressive towards humans unless cornered, surprised, or stepped-on. Occasionally, they can be considered nuisance pests when they find themselves too close to recreational facilities, occupied buildings, or other areas where human encounters are likely. Though important to the natural world, the threat of rattlesnake bites makes them unwelcome pests in certain portions of District lands.

PEST MANAGEMENT STRATEGIES FOR RATTLESNAKES

Prevention

- District field staff can protect themselves from rattlesnake bites during workdays by wearing high-top leather boots and snake-resistant chaps or gaiters. Snake gaiters are also useful in preventing the dispersal of non-native weed seeds, since weed seeds usually do not penetrate the gaiters.
- Educational materials can warn visitors about rattlesnake hazards and suggest preventative actions such as wearing protective clothing, as described above for District field staff.

Habitat Modification

- Eliminate hiding places for snakes by trailheads and parking areas with brushing, removing rock and brush piles near busy human use areas especially those with children, and filling cracks and holes in publicly accessible buildings. Use stainless steel/bronze mesh or welded wire to plug/fill cracks and holes in the exterior of buildings where snakes could gain entry.

- Where rattlesnake sightings are common, manage recreational facilities during the spring and summer months to reduce suitable habitat, and especially eliminate hiding places for snakes (e.g., brushing trailheads and parking areas, removing rock and brush piles, managing localized prey populations near known snake problem area, filling cracks and holes in public accessible buildings).

Physical Control

- **Tongs and Funnel Traps.** In certain areas (especially in structures and recreational facilities where humans gather and there is potential for snakebites), the District may elect to capture and relocate, or eliminate single problem snakes.

  - Using snake tongs, snake hooks or shovels, capture and relocate or eliminate problem rattlesnakes. Captured rattlesnakes can be placed in a secure container for relocation in the preserve to suitable habitat away from people. Occasionally, because of site conditions or the urgency of the situation, a staff member or tenant may need to kill a rattlesnake with a shovel.
  - Funnel traps can be used to collect problem snakes. Traps must be checked daily to ensure that non-target wildlife is not trapped accidentally.

Chemical Control

Currently there are no toxicants or fertility control agents available in California for rattlesnakes.

OTHER NATIVE AND DOMESTIC MAMMALS

See discussion of skunks, raccoons, opossum, and feral cats/dogs in Chapter 6 above.

7.7.4 VEGETATION MANAGEMENT OF TRAILS AND OTHER RECREATIONAL FACILITIES

The majority of IPM activity associated with recreational facilities is annual brushing (i.e., pruning of vegetation along roads and trails) which keeps them open for vehicular, horse, bicycle and human foot traffic, and furthermore provides a buffer area to separate humans from pests like ticks, rattlesnakes and poison oak. The District maintains guidelines for road and trail brushing that prescribe different treatments for different vegetation types and slope conditions (District 2013). Mowers and saws may be used by District staff to maintain grass and shrubs near roads and trails in short stature, limb up overhanging tree branches, and remove dead or decadent vegetation. Wider strips of brushing occur along certain roads to provide access for emergency vehicles.

The following section outlines typical vegetation management actions conducted in right of way areas on District lands.

PEST MANAGEMENT STRATEGIES FOR VEGETATION RIGHTS-OF-WAY

Prevention

- Prepare an annual treatment schedule for maintaining designated trail and roadside rights-of way based on use and vegetation types. Mechanically mow and brush annually to prevent nuisance vegetation from impeding roads and trails.

Habitat Modification

- Where possible, pave trailheads, parking lots or other heavily used right-of-ways to reduce annual maintenance needs.
- Eliminate roads, trails, or other rights-of-ways that are determined to be redundant or not necessary.

Physical Control

Manual/mechanical control treatment options include maintenance of existing recreational facilities within District preserves via brushing and/or mowing:

- *Road and trail brushing*. Mechanical mowing is used to prevent nuisance vegetation from impeding roads and trails. Vegetation along approximately 600 miles of trails and roads is cut back to maintain an open corridor for trail and road use. This work is primarily mechanical work done with brushcutters (a.k.a. weed-whips), hedgers, chainsaws, poles saws, chippers, and tractor-operated mowers (mowing decks either pulled by a tractor or attached to the tractor as part of an articulated arm). All roads are mowed one to four times per year depending on the rainfall/vegetation growth in any one year. Most trails are mowed or brushcut on an annual basis; some trails may need to be brushed up to four times a year if there is a lot of rain and it is a trail heavily used by the public. Some more remote trails may not be brushed every year.

- *Parking lots, gates, and stiles*. On an annual basis, a strip of land around 13 parking lots and 213 gates and stiles in the preserves are sprayed to maintain an open area for parking and visibility. A few of the locations are brushcut or mowed instead if they are large grassy areas or if there is water too close to allow spraying. Islands in the middle of parking lots or parking lots with narrow grassy edges are mowed.

- *Miscellaneous recreational areas.* A few miscellaneous recreational areas are mowed one to five times a year with a tractor pulling a mowing deck. This includes a model airplane field and three meadow areas along Rogue Valley Trail maintained at Rancho San Antonio Open Space Preserve (OSP), the picnic table area at the top of Anniversary Trail on Windy Hill OSP, and the hang gliding take off and landing areas at the top and bottom of Spring Ridge Trail of Windy Hill OSP. In addition, special events occur in the preserves each year (i.e.,Volunteer Recognition Event, summer camps, and other public gatherings) that require mowing of grassy areas. At Deer Hollow Farm in Rancho San Antonio OSP, pastures, animal pens and the Ohlone village are mowed four to five times per year with a tractor mower or brushcutters.

- *Campsite*. The Black Mountain campsite is mowed once a year to provide a comfortable camping experience and to reduce the risk of wildfire encroaching either into or out of the campground.

- *Pond Viewing Areas and Dams*. At some ponds, aquatic and terrestrial vegetation is managed at viewing areas and on dams. Windows of cattails and other tall wetland vegetation are removed in small select areas to allow public viewing of these water bodies. The California Division of Dam Safety requires all woody material be removed and tall herbaceous vegetation be cut on both faces of certain pond dams to improve visibility to see possible failure hazards. Vegetation on the water side of the dam is clipped with mowers and brush cutters; vegetation on the dry side of the dam is controlled with mowers and selective use of herbicides to maintain a light grassy vegetation cover. Woody vegetation is cut in pond spillway to prevent blockage of water flow. Duckweed or azola (aquatic fern) skimming has been done, with limited success, to control these plants from covering the entire surface of some ponds. Downed trees that have fallen in a pond can require removal for aesthetic or other management reasons.

- *Streambed Alteration*. The District follows conditions of an annual routine maintenance Streambed Alteration Agreement from CDFW for manual/mechanical vegetation management activities located within CDFW’s jurisdiction.

- *Hazard and downed trees*. An estimated 50 to 150 hazard and downed trees are limbed or removed every year with chainsaws, pole saws and chippers because they are blocking roads, trails and parking lots or are otherwise hazardous to visitors, staff, tenants or contractors They may be alive or dead. Stumps of live trees may be treated with herbicide to prevent re-growth.

Chemical Control

Chemical control is typically not used for right-of-way clearing unless perennial plants require permanent treatment. For example, some problem vegetation, such as poison oak, can be eliminated from specific locations with spot application of herbicides.

- **Glyphosate,** the active ingredient in Roundup Custom™ (previously sold as Aquamaster™), is a broad-spectrum non-selective systemic herbicide used to control a wide variety of plants, including annual broadleaf weeds, grasses, perennials, and woody plants. It is absorbed through foliage and translocated to growing points. Glyphosate's mode of action is to inhibit an enzyme involved in the synthesis of aromatic amino acids, making it effective on all herbaceous and woody growing plants. It is a rather slow-acting herbicide with symptoms typically appearing with a week, including yellowing and stunting a young leaves and growing points, however it may take up to several weeks for a plant to die.
- **Imazpyr,** the active ingredient in Polaris™ (previously sold as Habitat™), is a non-selective herbicide used to control a broad range of weeds including grasses, broadleaf herbs, woody plants, riparian plants, and emergent aquatic species. Imazapyr has a similar mode of action as glyphosate but acts on a different suite of essential amino acids. Imazapyr is absorbed by leaves and roots, and moves to growing points; it disrupts protein synthesis and interferes with cell growth and DNA synthesis, plants die as a result of AHS inhibition. To be effective on aquatic plants, the majority of plant parts must be accessible above the waterline. Imazapyr can be useful for difficult-to-control species when glyphosate is less effective, and with much lower application rates.

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8 IPM FOR FUEL MANAGEMENT

8.1 DEFINITION AND PURPOSE

This management category addresses IPM as it affects staff selection of options for required and ongoing maintenance of fuel management activities. Fuel management is the practice of removing or modifying vegetation to reduce the risk of wildfire ignitions, rates of wildfire spread, and fire intensity.

The District aims to manage fuels in a context that supports the maximum safety to adjacent human communities while also allowing fire as a natural process to maintain native species diversity on its preserves. The wildland urban interface (WUI) is the meeting point between wildland vegetation (i.e., fuels) and structures. The WUI warrants fuel management consideration because it is the area where there is the most threat of damage to human life and property. Other important areas to control flammable vegetation on District lands include access roads on and adjacent to District lands that are necessary for emergency access.

Fuel management is the practice of removing or modifying vegetation to reduce wildfire ignitions, rate of fire spread, and fire intensity. Changing the continuity of the vegetation, and reducing its volume are the two primary actions in fuel management. Preventative treatment actions may include temporary trail or equipment closures during fire season.

This chapter is not intended to replace a Fuel Management Plan, nor does it present the full range of fire risk management options available on District preserves.

No new major fuel breaks or fuel management activities on District lands would be implemented as part of the IPMP. The use of prescribed burns to restore natural conditions in preserves would also not be permitted as an option under the proposed IPMP. The IPMP would provide guidance to District staff in selecting the safest, least toxic, and most effective options to maintain existing fuel management activities. Consistent with current activities on District lands, the District’s fuel management activities would first consider health, human safety, and regulatory requirements for local and state fire codes, and then balance these requirements with the District’s goals to protect natural resources. For example, defensible space around structures is required and regulated under the Uniform Building Code, Uniform Fire Code, Public Resources Code Section 4291/4119, and County and City municipal codes and ordinances).

8.2 TYPE OF PESTS

In the context of IPM, vegetation at the WUI and vegetation around structures that could contribute to large, uncontrolled wildfires is considered a potential “pest” that may warrant control, depending on site-specific circumstances.

8.3 PEST IDENTIFICATION

Vegetation may be considered a pest where it becomes overabundant, decadent or exceptionally close to facilities, structures, and communities that people inhabit and use. At the same time, fire is a natural component of many common plant communities in the District and helps to maintain species diversity of native grasslands, shrublands, and forests.

8.4 MANAGING PLANT COMMUNITIES FOR FIRE SAFETY

The District is faced with the difficult task of protecting the natural values in their OSPs while also protecting the adjacent metropolitan and rural communities of San Mateo, Santa Clara, and Santa Cruz counties from catastrophic wildfires. These goals are sometimes mutually beneficial and they are sometimes mutually exclusive. Frequent, intense wildfires can be destructive to native plants, wildlife, and people. Conversely, our attempts to reduce or eliminate wildfire can also be destructive and this may have significant impacts on biodiversity (Keeley 2006). Use of fuel breaks and other fuel management techniques that disturb large areas can significantly change the composition of native vegetation or eliminate species altogether and help to spread and establish invasive weeds throughout natural areas.

In a natural burn cycle in shrublands and forests, recovering vegetation is less susceptible to repeat fires for several years after the initial burn (Minnich 2001, Pyne et.al, 1996). The lush new growth of resprouting species is supported by existing deep root systems that help reduce the plants' flammability by maintaining high moisture content in the above-ground growth. Shrub and tree species are also generally separated by bare ground or short statured annual forbs that will not carry a fire over the larger landscape. Once invasive annuals are introduced into this natural scenario, the dynamics change dramatically. The increased abundance of these annual grasses and forbs in turn support increased ignition potential almost immediately following the initial burn (Whisenant 1990). This in turn drives an even more increased fire frequency until shrubs and trees are completely eliminated from the system altogether, leaving only weedy annual grasslands in their wake. This has been described as a "grass-fire cycle" (D'Antonio and Vitousek 1992).

Fuel management is a complex process that must balance the needs of human communities with natural resource goals. It is unrealistic to think that natural vegetation communities can be managed to create fire-safe, wildfire resilient vegetation that also supports high natural biodiversity (Zedler 1995). Given that the District's lands are all fire prone, the best option for managing fire risk is to focus active management in the wildland-urban interface where fire safety is needed most – adjacent to human communities. Because early successional landscapes contain less biomass and are more resistant to fire, targeted management of plant succession in early-successional brushlands and woodlands can be an effective fire management strategy.

8.5 PREVENTION

Preventive treatment actions include temporary trail closures or adjustment in equipment use during some high fire hazard conditions. In addition, the following actions may also be considered to prevent vegetation from becoming a fire risk:

- Focus fuel management activities in WUI areas adjacent to neighborhood communities, structures, and other at-risk assets.
- Work with local fire organizations to amplify results by encouraging neighbors to also manage adjoining properties for fire (reduce fuel loads) within the WUI.
- Conduct visitor and neighbor outreach and education about wildfire dangers on and near District preserves.
- Eliminate any redundant, unnecessary, or high maintenance roads and trails that are determined to be not necessary on individual District preserves.
- Continue to control flammable invasive plants such as French broom in established fuel management areas. Encourage the establishment of native plant communities (which are more resistant to wildfires than invasive plants such as French broom).

The following management approach is recommended to help promote high diversity natural vegetation communities that are relatively fire safe.

- Focus vegetation biomass reduction on non-native vegetation and avoid damaging native grasses, and mature shrublands and forests wherever possible. Where active treatment is needed, seek to break the vertical fuel ladder connection between the ground and the canopy layer, and create some horizontal physical separation between plants where possible. Prioritize projects where invasive plant removal alone can result in fire-safe landscapes.
- Implement fuel management projects with low impact tools and methods such as hand cutting and pruning rather than vegetation removal or soil disturbance with hand methods or machines. Although managing woody plant communities can reduce fuel volume, increased disturbance resulting from the active management can counteract the process by promoting the establishment of invasive plants and reducing native plant diversity (Lavin et al. 2013, Keeley 2002). Hand cutting and pruning is not feasible on a large scale because it takes too long across large areas and can result in injuries to staff doing this kind of work over extended periods of time.
- Prioritize leaving forest duff and organic soil layers undisturbed in all fuel management actions.
- Avoid removing/thinning the canopy layer in mature, established forests and woodlands to maximize shading (thereby promoting shade and related increased moisture under the canopy level) and increase resistance to non-native plant invasion.

8.6 TOLERANCE LEVELS

Consistent with current activities on District lands, the District's tolerance for vegetation that poses a fire risk would first consider health, human safety, and regulatory requirements for local and state fire codes, and then balance these requirements with the District's goals to protect natural resources. For example, defensible space around structures is required and regulated under the Uniform Building Code, Uniform Fire Code, Public Resources Code Section 4291/4119, and County and City municipal codes and ordinances).

Refer to Table 8-1 for management thresholds, and potential treatment options for fuel management presented by type of vegetation.

Table 8-1 Management Thresholds and Treatment Options for Wildfire Management Pests

Pest Category	Management Threshold (Population Size/Conditions)	Treatment
Grasslands	Site-specific management needs are determined based on proximity to developed areas that could be damaged by fire, proximity of ignition sources, current fuel loads within the site, and weather conditions.	Annual mowing in summer to reduce fuel loads, especially near likely ignition sources (trails, roads, recreational facilities, and parking lots).
Shrublands (coastal scrub, chaparral)		Thin brush and mow tall grasses to reduce fuel loads and break fuel ladders. In shrublands, increase spacing between shrub clusters.
Forests		Limb up trees to a height of 8 to10 feet, thin brush, and mow tall grasses to reduce fuel loads and break fuel ladders.
Agricultural Landscapes		Mowing and brush thinning along roads that could provide ignition sources for adjacent natural areas. Discing along borders of agricultural and rangeland properties to ensure fires do not spread beyond different management units. Conservation grazing reduces fuel loads.

8.7 TREATMENT OPTIONS

8.7.1 PHYSICAL CONTROL

- Use tractor, truck, and hand mowers to cut or disc vegetation along roads, trails and borders.
- Limb up trees to a height of 8 to 10 feet, thin brush, and mow tall grasses to reduce fuel loads and break fuel ladders in high risk fire areas.
- Target control of invasive species such as French broom that are known to form dense, highly flammable brush stands.
- If they appear to be a wildland fire hazard, woodrat nests within 100 feet of buildings will be moved after consultation with the California Department of Fish and Wildlife. Refer to treatment options under the Buildings section.

Additional details on physical control options are provided below, presented by the type of work that staff routinely conduct on District preserves.

DISC LINES

Disc lines are a type of mechanical fuel treatment that utilize an agricultural cultivator attachment for a tractor to cut and overturn many parallel small trenches in the soil 6 to 12 inches deep. A disc line is typically placed along the perimeter of undeveloped land, ranches, and roadways. The District would continue to maintain 31 miles of disc lines on its land annually as required by local fire agencies. Occasional trimming of overhanging branches with a chainsaw or pole pruner would also be undertaken along disc lines where needed to allow passage of the tractor. Brush encroaching into disc lines is removed with chainsaws, boom flails, and mowing or masticator equipment. Discing is only practical in grassland vegetation types that do not contain many woody shrub or tree species. The intent of discing is to create small swaths of barren soil that do not support fuel or conduct fire. This technique has limited applications in reducing fire risk in natural areas because the soil disturbance associated with this technique is known to encourage establishment of invasive plants such as invasive annual plants, often exacerbating the fuel load problem. Disc lines are more temporary than shaded fuel breaks (described below), but offer the advantage of being a rougher surface that is less prone to soil erosion (Amphion Environmental 1995). Discing requires annual maintenance to be effective, and once cultivation modifies native soil, must be done in perpetuity to manage invasive weeds thereafter.

SHADED FUEL BREAKS

Shaded fuel breaks is a forest management strategy that requires selective thinning and removal of the more flammable understory vegetation while leaving the majority of larger, more fire tolerant tree species in place. On District lands, a shaded fuel break is maintained along Monte Bello Road in Monte Bello OSP. Maintenance of the fuel break along the road includes annual mowing in grasslands adjacent to the road, clearance of brush and all dead vegetation, and removal of ladder fuels to the canopy in forested areas. Manual and mechanical tools used for these activities include tractors, brushcutters, chainsaws, chippers, masticators, and/or a JAWZ implement.

CLEARING AROUND BUILDINGS

Manual and mechanical clearing of flammable vegetation to provide defensible space occurs on an annual basis around an estimated 117 structures by District staff or by residential, commercial or agricultural/rangeland tenants. This work consists of manual and/or tractor mowing, brushcutting, chainsaw work, pole pruning, chipping, masticator and spraying depending on the site conditions and generally occurs within 100 feet of the structures although some jurisdictions require clearing within 30 feet of a property boundary or other additional precautions. The District developed Defensible Space Clearing Guidelines that it adheres by (refer to Appendix C of this EIR). The required amount of clearance for defensible space can vary depending on the Fire District jurisdiction that a parcel falls within. Implementation of the proposed IPMP would not result in any changes to the District's Wildfire Management Policy (District 2012, 76-84) or defensible space requirements (District, local, or state) on or adjacent to District lands. As needed to control fire risk, staff should consult local authorities to update and improve preserve-specific guidelines for clearing around buildings.

EMERGENCY HELICOPTER LANDING ZONES

Emergency helicopter zones are maintained annually or bi-annually via mowing with a tractor or brushcutter at 39 locations on District lands. As needed, encroaching brush is mechanically removed using a chainsaw or JAWZ implement.

TRAIL AND ROAD BRUSHING

Trail and road brushing is an activity undertaken to facilitate visitor recreation and safety. Refer to discussion above, IPM For Recreational Facilities, for a more detailed discussion of mechanical and manual treatments used to maintain trails and roads.

DRIVEWAYS

- Driveways to residences and other key structures receive additional treatment for ingress and egress in a fire emergency. Vegetation would be maintained to minimize flame length:
  - Within 10 feet of the road edge where flames are predicted to be 0-8 feet in length (generally grassy locations and in oak woodlands)
  - Within 30 feet of the road edge where flames are predicted to be over 8 feet in length (generally brushy locations and where understory shrubs are developed in woodlands)

Occasionally, controlling invasive plants as described in the Natural Areas section below also provide fire management benefits by removing dense, highly flammable brush stands such as French broom.

8.7.2 CHEMICAL CONTROL

Chemical control is used for fuel management directly adjacent to structures as required and in some high risk fire areas where perennial plants are not responding to manual or mechanical treatments and require permanent treatment. Chemical control treatment options for fuel management include:

- **Glyphosate,** the active ingredient in Roundup CustomTM (previously sold as AquamasterTM), is a broad-spectrum non-selective systemic herbicide used to control a wide variety of plants, including annual broadleaf weeds, grasses, perennials, and woody plants. It is absorbed through foliage and translocated to growing points. Glyphosate's mode of action is to inhibit an enzyme involved in the synthesis of aromatic amino acids, making it effective on all herbaceous and woody growing plants. It is a rather slow-acting herbicide with symptoms appearing with a week, including yellowing and stunting a young leaves and growing points, however it may take up to several weeks for a plant to die.
- **Imazapyr,** the active ingredient in Polaris™ (previously sold as Habitat™), is a non-selective herbicide used to control a broad range of weeds including grasses, broadleaf herbs, woody plants, riparian plants, and emergent aquatic species. Imazapyr has a similar mode of action as glyphosate but acts on a different suite of essential amino acids. Imazapyr is absorbed by leaves and roots, and moves to growing points; it disrupts protein synthesis and interferes with cell growth and DNA synthesis, plants die as a result of AHS inhibition. To be effective on aquatic plants, the majority of plant parts must be accessible above the waterline.

Imazapyr can be useful for difficult-to-control species when glyphosate is less effective, and with much lower application rates.

Chemical options should be applied in the following situations:

- *WUI Areas and Defensible Space.* To meet legal requirements (District, local, and/or state) for defensible space, flammable vegetation may be spot sprayed annually within the inner 30 feet of land surrounding a structure with glyphosphate in addition to mowing within this area. Trees or large shrubs that require removal within the inner 30 feet of defensible space are typically treated by cut-stump method with glyphosphate to permanently remove them from this high hazard zone. For example, some native resprouting brush species that are also known to be flammable, such as coyote brush and chamise, can be eliminated from proximity to buildings with cut-stump or spot spraying. Spraying around buildings further avoids having to run a brushcutter blade against or around buildings, fences, pipes, rocks, and other obstacles that can be a fire hazard by causing sparks.

- *Disc lines*. Although brush encroaching into disc lines is primarily removed with chainsaws (as discussed above), more stubborn woody plants may require treatment with herbicides by cut-stump method with glyphosphate or imazapyr).

- *Shaded fuel breaks*. Use of glyphosphate in a cut-stump method is used to maintain fuel breaks that contain decadent woody vegetation.

9 IPM FOR RANGELANDS AND AGRICULTURAL PROPERTIES

9.1 DEFINITION AND PURPOSE

Some District lands encompass rangelands, crop fields, and orchards that are actively managed as grazing or agricultural operations. Rangeland and agriculture activities on District preserves are primarily managed by lessees who typically operate under a Rangeland Management Plan or Agricultural Management Plan that is attached to their lease. These site-specific management plans guide the rangeland and agricultural activities to ensure compatibility with natural resource protection and low-intensity public recreation.

This IPMP does not replace the requirements of the individual range or agricultural management plans, nor does it present the full range of agricultural or range management options. Rather, it seeks to provide staff with tools that are consistent with IPM principles to select the safest, least harmful, and most effective treatment options for rangeland and agricultural pests.

9.2 RANGELANDS

IPM in rangelands focuses on maintaining land uses (e.g., grazing) while also managing for the long-term functioning and stability of high value natural resources (e.g., grasslands, creeks) that surround the rangelands and agriculture. This requires landscape level monitoring to determine when pests such as agricultural pests and invasive plants are present in sufficient numbers to reduce the intended land uses or quality of the managed habitats.

The District established a Conservation Grazing Program in February 2007 with the goal of managing District land with livestock grazing that is protective of natural resources, compatible with public access, maintaining or enhancing the diversity of native plant and animal communities, managing vegetation fuel for fire protection, helping to sustain the local agricultural economy, and preserve or foster appreciation for the region’s rural agricultural heritage.

By 2015, a total of 10 properties, totaling over 10,800 acres, is projected to be managed with livestock grazing. Stocking rates and either year-round or seasonal grazing are prescribed for each property based on site-specific factors such as soil fertility, terrain, plant composition, water availability, and available infrastructure. Typical vegetation pests on rangelands include thistles, Harding and velvet grass, poison hemlock and encroaching brush.

The IPM Coordinator is responsible for reviewing Rangeland Management Plans and periodically reviewing existing rangeland practices to make sure they are implemented using current IPM practices outlined herein, and, if pesticides are used, follow the District’s list of approved pesticides.

9.2.1 TYPES OF RANGELAND PESTS

Typical pests on rangelands include weeds poisonous to livestock or otherwise detrimental to productive pastures, primarily invasive thistles, Harding and velvet grass, poison hemlock and encroaching brush.

9.2.2 PEST IDENTIFICATION IN RANGELANDS

Because the extent of grassland communities on District lands are so large and interconnected with leased rangeland properties, rangeland pests are inherently difficult to detect. The District will assess a subset of grasslands in and adjacent to leased rangelands on a routine basis to detect problem pests (most commonly to be conducted during a lease renewal or establishment of a new lease). Monitoring rangelands should focus on:

- Sites most likely for pests to invade (e.g., corrals and areas around water troughs and feed stations);
- High value areas (e.g., grassland areas that support special-status species).
- Map pests of concern, record in the District's Pest Database, and evaluate.

9.2.3 TOLERANCE LEVELS IN RANGELANDS

Determining tolerance levels for pests in grazing lands is largely done by the grazing lessee, in consultation with District staff and rangeland experts. Active pest management would only occur where the lessee determines that tolerance level for a pest is exceeded- for example, where livestock forage quality is severely reduced, resulting in a loss of livestock production value. In some limited instances, the District may assess leased grazing land pests and determine a tolerance level, for example, when the presence of the pest is a target invasive species or particularly if it threatens the persistence of a special-status species or other high value area. Refer to Table 9-1 for an overview of management thresholds and treatment options available for use on District rangelands.

Table 9-1 Management Thresholds and Treatment Options for Rangeland Pests

Pest Category	Management Threshold (Population Size/Conditions)	Treatment
Grasslands	Site-specific management needs are determined by lessee and District in Rangeland Management Plans based on assessment of rangeland condition, type of livestock to be used, and stocking rates/seasons of use. District to work with individual rangeland lessees when rangeland forage values decrease such that stocking rates decline, and or when lessees identify pests that warrant control.	Lessee to monitor forage values in grasslands. In coordination with District, lessee responsible for detection, District notification, and control of rangeland pests such as French broom and invasive thistles that lower value of forage and grassland habitat.
Shrublands (coastal scrub, chaparral)		Lessee to monitor brush encroachment in grasslands. Lessee to work with District to thin brush in grasslands when brush encroachment significantly reduces value of forage and grassland habitat. In shrublands, increase spacing between shrub clusters.

9.3 AGRICULTURAL FARMS AND FIELDS

The purpose of IPM in on agricultural properties is to manage pests to maintain the specific land uses (e.g., crop production), while also providing natural resource protection and visitor access. Agricultural pests that may be encountered include weeds, pathogens and insects in croplands; and rodents in farm fields and buildings.

Two District properties contain agriculture fields. The Lobitos Ridge property consists of two crop fields containing flowers and vegetables on seven acres of Purisima Creek Redwoods OSP and the Madonna Creek Ranch property consists of 27 acres on Miramontes OSP on which a tenant cultivates dry farmed hay as well as smaller irrigated areas for pumpkins and other truck crops.

A draft Agriculture Production Plan has been prepared for the Lobitos property and includes the IPM approach on District agriculture properties. It requires that best management practices (BMPs) as defined by the University of California Cooperative Extension Service and the USDA Natural Resources Conservation Service for farm production be followed, and specifically, that IPM techniques, as defined by the crop specific University of California Cooperative Extension Service are employed along with BMPs. Methods for control of weeds on the site can be by mowing, grazing, flaming or the use of an approved herbicide.

Lessees operate a Christmas tree farm and chestnut orchard at Skyline Ridge OSP and a vineyard at Picchetti OSP. A historic fruit orchard is maintained by District staff and volunteers on the Stevens Canyon property. The City of Mountain View operates an educational farm located in the Rancho San Antonio OSP that offers classes and camps for thousands of schoolchildren in farm, garden, native peoples and history.

The IPM Coordinator is responsible for reviewing existing Agricultural Production Plans and periodically reviewing existing agricultural practices to make they are implemented using current IPM practices outlined herein and, if pesticides are used, follow the District's list of approved pesticides. As new agricultural lands are acquired, District staff will help draft new Agricultural Production Plans that follow the procedures outlined in this Guidance Manual.

9.3.1 TYPES OF AGRICULTURAL PESTS

Insect management in field crops is very specific to the type of crop grown. Because the District has few properties that currently support row crops, agriculture insect pest management for agricultural fields is not covered under the IPMP but would be covered in future Agriculture Management Plans and incorporated into the IPMP.

9.3.2 REGULATED AGRICULTURAL PESTS

Though the definition of a 'pest' can depend on perspective and location, some species are regulated as various types of pests by state and federal laws. Plants classified as 'Noxious' are regulated by the California Department of Food and Agriculture (CDFA) and the United States Department of Agriculture (USDA). Wildlife species classified as 'Injurious' are regulated by the CDFW and United States Fish and Wildlife Service (USFWS). Other species that transmit diseases may be regulated by local, state, or federal health departments. Regulated pests pose a risk to the environment, public health, or economic resources. Many times the acceptable IPM tolerance level of regulated pests is zero, so that any detected individual initiates a management action. These are species that the District has a legal responsibility to control per state and federal laws and regulations though control is often conducted by other agencies.

9.3.3 PEST IDENTIFICATION IN AGRICULTURAL FARMS AND FIELDS

Due to the limited number of agricultural lands on District property, pest identification is the responsibility of the lessee, who is to report significant pest infestations to the District. Once pests are reported, they should be mapped and recorded in the District's Pest Database, and evaluated for their impacts to the surrounding natural areas.

9.3.4 TOLERANCE LEVELS IN AGRICULTURAL FARMS AND FIELDS

Active pest management would only occur where tolerance levels are exceeded- for example, where agricultural crop production is greatly reduced, or where the presence of the pest threatens the persistence of a special-status species occurring in adjacent areas. Refer to Table 9-2 for an overview of management thresholds and treatment options available for use on District rangelands.

<table>
<tr><th colspan="3">Table 9-2 Management Thresholds and Treatment Options for Agricultural Pests</th></tr>
<tr><th>Pest Category</th><th>Management Threshold
(Population Size/Conditions)</th><th>Treatment</th></tr>
<tr><td>Agricultural Insect Pests</td><td rowspan="3">Site-specific management needs to be determined by lessee and District in individual Agricultural Management Plans based on assessment of farm and field conditions, type of crops, and anticipated crop yields. District to work with individual rangeland lessees when crop yields decrease such that economic damage or environmental damage warrant control.</td><td>Lessee to monitor insect damage of crops. Agriculture insect pest management to be addressed in future Agriculture Management Plans. Staff and tenants to consult crop-specific IPM guidebooks published by University of California Davis - http://www.ipm.ucdavis.edu for both organic and conventional crop production and include pest management actions in the Agricultural Management Plan for individual parcels.</td></tr>
<tr><td>Rodents and Other Nuisance Pests in Agricultural Areas</td><td>Lessee to monitor rodent damage. In coordination with District, lessee responsible for detection, District notification, and control of problem rodents in farm buildings or crop fields using procedures in the Buildings section above (Chapter 6).</td></tr>
<tr><td>Invasive Plants in Agricultural farms and fields</td><td>Cultural Control Options:
◢ Crop Rotation
◢ Cover Crops and Smother Crops
◢ Late-Season Planting
◢ Planting Rates and Crop Density
◢ Water and Nutrient Management
◢ Crop Variety Selection
◢ Covering/soil Sterilization
◢ Mulching
◢ Soil Sterilization
Physical Control Options:
◢ Mowing
◢ Pulling
◢ Green Flaming,
◢ Mulching
◢ Use Of Weedmats
◢ Hoeing
◢ Discing
◢ Cultivating with tractor implements
Chemical Control Options:
◢ To be determined by lessee and District in Agricultural Management Plans. Staff and tenants to consult crop-specific IPM guidebooks published by University of California Davis - http://www.ipm.ucdavis.edu for both organic and conventional crop production and include pest management actions in the Agricultural Management Plan for individual parcels.</td></tr>
</table>

9.4 PREVENTION

Using existing Rangeland Management Plans and Agricultural Management Plans, the District will work with lessees to encourage management practices that prevent the establishment of pest species. Prevention strategies for District lands in agricultural production may include:

- During development of new Agricultural Management Plans, encourage lessees to keep lands healthy through soil management, proper irrigation, and by providing sufficient habitat (refugia) for natural insect pest predators (natural enemies) in and near crop production areas.
- During development of new Agricultural Management Plans, and as practical, incorporate good stewardship practices such as rotational cropping, integrating annuals into perennial crops (such as Christmas tree farms), implementing no-till cropping, and, where possible, promoting organic farming practices to reduce annual disturbance and increase farm biodiversity (Coll 2004).
- During acquisition planning for new preserve lands, encourage landscape mosaics (i.e., plan for a mixture of natural and agricultural or grazing lands) to help maintain natural pest predator populations.
- During lease renewal periods, monitor pest invasions at the edges of agricultural and grazing lands, especially in and near roads, trails, and fuel breaks. Determine if tolerance thresholds are exceeded (both in and adjacent to leased lands), and develop pest control requirements accordingly in the new lease requirements.
- During preparation of new Rangeland Management Plans and lease renewals, monitor livestock feeding locations, corrals, watering troughs and livestock feeding for pests. Consider rotational grazing, changing livestock stocking rates and/or requiring different types of grazing animals to prevent spread of pests and to promote healthy, diverse grassland areas.

9.5 TREATMENT OPTIONS

Working with lessees, the District will determine a site-specific solution that meets the needs of the lessee, maintains natural resource values and District lands, and addresses the identified pest issue. The general steps involved in implementing IPM in rangelands and agricultural properties are similar, but not identical to those described for buildings and natural areas, and generally include the actions described below.

9.5.1 STRUCTURAL PEST CONTROL

MECHNICAL CONTROL OPTIONS

Mechanical control treatment options for rangeland and agricultural properties on District lands include:

- *Rodents*. For rodents in farm buildings or crop fields, refer to the procedures for controlling rodents under the Buildings section above (Chapter 6).

CHEMICAL CONTROL OPTIONS

Chemical control treatment options for rangeland and agricultural properties on District lands include:

- *Rodents*. For rodents in farm buildings or crop fields, refer to the procedures for controlling rodents under the Buildings (Chapter 6) and Natural Areas sections (Chapter 10), respectively.

9.5.2 INVASIVE INSECTS

Because the District has few properties that currently support row crops, agriculture insect pest management for agricultural fields is not covered under the IPMP. If new pesticides are proposed for agricultural insects, they will be evaluated, included in future Agriculture Management Plans, an environmental review will be conducted, and the IPMP will be revised to include the new pesticide, new treatment method and any required precautions. Staff and tenants should consult crop-specific IPM guidebooks published by University of California Davis - http://www.ipm.ucdavis.edu for both organic and conventional crop production and include pest management actions in the Agricultural Management Plan for individual parcels.

9.5.3 INVASIVE PLANTS

RANGELAND CONTROL OPTIONS

Consistent with existent management plans, grazing and agricultural lessees are allowed to control pests through grazing, mowing, pulling and careful application of District-approved herbicides. Brush, commonly the native coyote brush, limits the available forage for livestock, reduces grassland habitat areas and creates an increased wildfire fuel load. Grazing tenants typically treat brush encroachment with herbicide and then use a tractor and drag bar to break up dead vegetation for the following season.

Manual/mechanical control treatment options for invasive plants on rangelands include:

- ***Mow/Cut.*** A brushcutter, disc, brushrake or other motorized cutting machine would be selected for mowing of weeds and cutting of brush based on the size of the infestation. Most species would require repeated cutting throughout the growing season (generally late spring through mid-summer) or they could re-sprout from their base and continue to grow, flower, and produce seed. Mowing would be carefully timed according to the phenology of each plant species to minimize the amount of re-sprouting and to avoid spreading ripe seed. Mowing is a temporary measure that controls reproductive spread and can eventually reduce populations of annual plants, but other subsequent treatments (e.g., pulling, herbicide) would be necessary to eradicate perennial plants. Mowing cannot be used on steep slopes or in locations with desirable native plants unless the timing of the mowing can be selected to affect only target plants.

- **Grazing Regime Modifications.** Invasive plants can also be partially or fully controlled using carefully timed grazing rotation, and or/ manipulating the types and seasons of grazing livestock (for example, using goats instead of cattle to forage on invasive thistle species in spring before seed set). As described in Chapter 8, Possible actions to be considered include:
  - changing types of livestock to include browsing livestock that eat shrubs (e.g., goats);
  - installing physical barriers (cross fencing);
  - controlling brush through hand or mechanical treatments;
  - applying pesticides in a specific location (e.g., directly onto individual plants or small patches of brush); or
  - implementing a combination of mowing, foliar spraying, and hand removal (for very large brush encroachments).

- **Chemical Control Treatment Options.** Any of the herbicides approved under the IPM Program may be used to treat weeds on rangelands or agricultural fields if cultural or mechanical methods are not effective. Glyphosate will likely be the primary herbicide used on thistles and brush on rangelands, and for weeds in agriculture fields and orchards.

AGRICULTURAL FARM AND FIELD CONTROL OPTIONS

Cultural weed control includes crop rotations, water and nutrient management, late-season planting, and cover/smothering crops (Smith 2000, Gunsolus et al. 2010). Cultural methods are the first line of defense in weed management and primary tools for organic crop production. Manual/mechanical control treatment options for invasive plants on agricultural lands include the following cultural, mechanical, and manual weed control options:

- **Crop Rotation.** Diversifying a rotation is one of the most effective tools against weeds. Over time, routine planting and cultivation dates will select for weeds that are adapted to these strategies. Varying crops by different planting date or growing perennial crops in rotation with row crops can prevent weeds from adapting to the planting regimen.

- **Cover Crops and Smother Crops.** Offseason cover crops and smother crops are effective strategies to outcompete weeds. Cover crops occupy vacant space in an ordinarily fallow field and displace weeds that would otherwise occupy the space. Some species also have allelopathic effects on weeds.

  Smother crops are vigorously-growing crops that growers use to suppress weeds. Generally, a smother crop is not harvested, but plowed down instead. The primary risk in using smother crops is that their effectiveness in weed control may be inconsistent and unpredictable or they may become weeds themselves.

  Late-Season Planting. Delayed planting past the traditional planting times is an option in weed management, but depending on growing season and crop, may also reduce crop yields. Later season planting allows crop seedlings to bypass the competitive flush of weed seedlings and also allows for additional time for mechanical weed control operations.

- **Planting Rates and Crop Density.** Increasing the planting rate is another common strategy for weed management. Higher crop densities can lead to greater competitiveness against weeds. In addition, higher planting rates can compensate for crop losses that occur during mechanical weed control operations.

- **Water and Nutrient Management.** Effective water and nutrient management can ensure crops benefit from farming practices rather than weeds. Switching to drip irrigation from flood or broadcast styles, monitoring nutrient requirements instead of blanket fertilization, timing compost applications, and burying irrigation pipe may all help to reduce weed problems.

- **Crop Variety Selection**. Selecting the proper variety of a specific crop that is best adapted for local conditions can reduce the resources necessary for production and consequently reduce weed management problems. If the crop is better adapted to local conditions than the weed, the site will favor the crop over the weed.

- **Mechanical weed control.** Mechanical weed control is the most widely used weed control method for agriculture fields and can occur before, during, and after the crop is planted. This method includes primary tillage, row crop cultivating tillage, use of mulches (i.e., plastic sheeting, straw, wood chips, and sawdust), and/or soil sterilization techniques that use heat to kill weeds and weed seeds in soil. Passive sterilization uses clear plastic tarps to foster the germination of weeds under the tarp and then exposes the seedlings to hostile growing conditions and they perish and active sterilization uses extremely high temperature steam to eliminate weed seeds and bulbs with direct contact. Both processes are expensive and require specialized equipment and/or high labor output.

- **Primary Tillage.** Primary tillage is the initial step in seedbed preparation. It incorporates residues from the previous crop and can incorporate compost, manures, and other nutrients. It buries some weed seeds so deeply they cannot germinate, but it also brings other seeds to the surface allowing them greater opportunity for germination. Tillage is best combined with a forced germination program, where multiple tillage and watering events are coupled to force the germination of weeds and then eliminate them. The timing of primary tillage will encourage different weed species to predominate so the farmer must time the actions to correspond with the primary weed targets.

  A fundamental aspect to consider in seed bed preparation is the concept of providing the crop with an "even start." An even start means controlling weeds that germinate before the crop germinates. Once seed bed preparation is complete, the crop must be planted as soon as possible because if crop planting is delayed, weeds can germinate and get a head start on the crop.

- **Cultivation.** Row crop cultivating tillage is performed after the crop is planted. Cultivation kills weeds by digging them out, burying them, breaking them apart, or drying them out. In addition to controlling weeds, cultivation can break up soil crusting and thus can increase crop emergence, water infiltration, mineralization of nutrients, and soil aeration during the growing cycle.

  A short window of time usually exists for timely use of cultivation. Weeds that emerge before or with the crop are the most critical to eliminate. Weeds that emerge after crop emergence will have less negative impact on yield, but may still contribute to the weed seed bank for problems in future years. When it comes to weeds that emerge with the crop, it is best to be proactive, rather than reactive. Waiting until weeds are noticeable will limit the control options.

- **Mulches**. Mulch is any artificial or natural soil cover. Plastic sheeting, straw, wood chips, and sawdust are all common types of mulches for crop production. Mulches work by eliminating light availability to small weeds. The larger the weed, the deeper the mulch needs to be for effective control. Mulches have the added benefit of also conserving soil moisture and reducing soil erosion. Many organic types of mulch ultimately decompose into necessary plant nutrients for the following growing season.

- **Sterilization**. Soil sterilization uses heat to kill weeds and weed seeds in soil. Two types are common in agriculture, 1) passive soil sterilization with clear plastic tarps and 2) active soil sterilization with injected steam. Passive sterilization uses clear plastic tarps to foster the germination of weeds under the tarp and then exposes the seedlings to hostile growing conditions and they perish. Active sterilization uses extremely high temperature steam to eliminate weed seeds and bulbs with direct contact. Both processes are expensive and require specialized equipment and/or high labor output.

- **Manual weed treatment.** Specific manual weed treatment methods allowed under the Lobitos Agricultural Management plan are mowing, pulling, flaming, mowing, mulching, weedmats, and hoeing.

10 IPM IN NATURAL LANDS

10.1 DEFINITION AND PURPOSE

Natural areas make up the majority of District lands, and typically experience minimal levels of human use. The purpose of IPM in natural areas is to preserve and restore natural resources while also maintaining safe and enjoyable human access for visitors and staff.

IPM in the District's natural areas focuses primarily on the control of pests that threaten the long-term viability of natural resources on District preserves. Pests that are commonly encountered on natural areas include invasive plants and invasive animals, including regulated species (i.e., plants and wildlife that are regulated under state and federal law or CDFW Code, and feral pets. The District spends the majority of its IPM management efforts in natural areas on control of invasive plants.

- **Invasive plants** are implicated in many natural resource and conservation problems and are considered by most land managers to be a threat to their resource management goals. When transplanted to a foreign landscape, invasive plants leave behind their associated predators, prey, and diseases that previously helped to balanced their growth and abundance. In addition, many invasive plants have inherent biological traits that allow them to rapidly reproduce and colonize new areas faster than the native plants of the invaded habitat. Some of these invasive plants become problematic because of abundance – they displace native species by outcompeting them for space and resources (CA Coastal Conservancy 2003, San Mateo County 1983, State of Washington 2003). Some invasive plants can alter ecosystem processes, such as reducing or changing seasonal food sources for wildlife, hydrological patterns, fire regimes, or soil chemistry (Keeley 2006, D'Antonio 1992, Vitousek and Walker 1989).

  The California Department of Food and Agriculture designates a plant species as a noxious weed if they find it to be "troublesome, aggressive, intrusive, detrimental, or destructive to agriculture, silviculture, or important native species, and difficult to control or eradicate" (CDFA 2014). The Department designates a rating for each noxious weed species based on the present distribution of the pest within the state and the likelihood that eradication or control efforts will be successful. The ratings are not laws, but are policy guidelines that indicate the appropriate actions to take against pests. The District works closely with the Agricultural Commissioners for San Mateo and Santa Clara Counties to address state-designated noxious weeds on preserves. The California Invasive Plant Council maintains an Invasive Plant Inventory that rates the threat of non-native plant species by evaluating their ecological impacts, invasive potential and ecological distribution (Cal-IPC 2014). The Bay Area Early Detection Network along with the San Mateo County Weed Management Area and the Santa Clara County Weed Management Area set regional priorities for eradication of invasive plants in the San Francisco Bay Area, particularly those for which early action could substantially reduce future risk (Cal-IPC 2009). District staff members are active with these organizations and further apply local knowledge to evaluate the invasive risk of existing and new non-native plants found on District preserves and to determine the best responses.

- **Invasive animals** pose another threat to natural areas. Escaped/released domestic animals and other non-native wildlife species can thrive in the favorable climate of the San Francisco peninsula. Once established in a preserve, they compete for valuable resources and disturb the sensitive balance of natural food webs. Bullfrogs and wild pigs are examples of invasive introduced animals found in District preserves that physically displace or consume the native plants and wildlife that normally inhabit natural areas, or otherwise alter natural processes.

Wild (feral) pigs are an example of an invasive wildlife species with obvious impact on District lands. They have been widespread in the central coast of California since about 1970, reproduce rapidly, dig up meadows and wetlands, and carry diseases that can affect people and livestock. They eat acorns, bulbs, and roots in soil, and are difficult to control. Feral pigs were abundant in the South Skyline region in the 1990s. The District has been trapping feral pigs since 2000 and has substantially reduced their population and damage from their rooting.

The management of invasive species may sometimes involve eradication (i.e., the removal of all of the pest species, typically only achievable for new invasive species and small populations of pests), but more common natural area management methods involve incremental reduction of pest numbers (control), removal of individuals that have the greatest impact on critical resources, or the exclusion of a pest species from a defined sensitive area (containment). Programs to control invasive plant and animal species often require a long-term commitment. With many invasive species, short-term lapses in active management can negate years of expensive control programs.

First steps in all invasive species management focus on preventing the establishment of any new pest populations. Prevention or detection actions can minimize many invasive species problems in the future, reducing the need for more active management and costly treatment methods. In the future, the pest prevention tactics identified below will be based on minimizing dispersal or reacting quickly to new invasions through anticipation and surveillance.

10.2 REGULATORY BACKGROUND

Invasive species are regulated to some extent by state and federal laws. The USDA, CDFA, USFWS, and CDFW all regulate the importation, sale, transportation, and control of designated invasive species.

10.2.1 REGULATED WILDLIFE

Under the Lacey Act, the Secretary of the Interior is authorized to regulate the importation and transport of species, including offspring and eggs, determined to be injurious to the health and welfare of humans, the interests of agriculture, horticulture or forestry, and the welfare and survival of wildlife resources. Wild mammals, birds, fish, mollusks, crustaceans, amphibians, and reptiles are the only organisms that can be added to the injurious wildlife list. The current 2013 list includes 236 species, many of which are kept as pets around the world (USFWS 2013). All species listed as injurious may not be imported or transported between states or any United States territory without a permit issued by the USFWS. No injurious species of wildlife are currently known to occur on District lands. The importation of any live amphibians from outside the United States (such as bullfrogs imported from China) has been petitioned by environmental groups for inclusion on the list to prevent the importation of the chytrid fungal pathogen. The USFWS is still reviewing the petition to list exotic amphibians as injurious wildlife.

10.2.2 REGULATED PLANTS

Some species of invasive plants are regulated as noxious weeds by the CDFA and USDA. Because the two agencies work cooperatively, California’s classification scheme is representative of both federal and state regulations. CDFA currently lists 251 invasive plant species as noxious weeds (CDFA 2013a). Control actions are determined by a ranking system based on a species’ threat to economic or environmental resources. The following is California’s ranking system for invasive pest plant species:

- **Class A Noxious Weed** – A pest of known economic or environmental detriment which is either not known to be established in California or has limited distribution that allows for the possibility of eradication or successful containment. A-rated pests are prohibited from entering the state because, by virtue of their rating, they have been placed on the Plant Health and Pest Prevention Services Director's list of organisms "detrimental to agriculture" in accordance with the FAC Sections 5261 and 6461. The only exception is for organisms accompanied by a CDFA or USDA live organism permit for contained exhibit or research purposes. If found entering or established in the state, A-rated pests are subject to state (or commissioner when acting as a state agent) enforced action involving eradication, quarantine regulation, containment, rejection, or other holding action.

- **Class B Noxious Weed** – A pest of known economic or environmental detriment that, if present in California, has a limited distribution. B-rated pests are eligible to enter the state if the receiving county has agreed to accept them. If found in the state, they are subject to state endorsed holding action and eradication only to provide for containment, as when found in a nursery. At the discretion of the individual county agricultural commissioner they are subject to eradication, containment, suppression, control, or other holding action.
- **Class C Noxious Weed** – A pest of known economic or environmental detriment that, if present in California, is usually widespread. C-rated organisms are eligible to enter the state as long as the commodities with which they are associated conform to pest cleanliness standards when found in nursery stock shipments. If found in the state, they are subject to regulations designed to retard spread or to suppress at the discretion of the individual county agricultural commissioner. There is no state enforced action other than providing for pest cleanliness.
- **Class Q Noxious Weed** – An organism or disorder suspected to be of economic or environmental detriment, but whose status is uncertain because of incomplete identification or inadequate information.

10.3 TYPE OF PESTS

Pests in natural areas include invasive plants and invasive animals. This section presents an overview of IPM practices presented by for each type of pest.

Traditional IPM concepts can be difficult to apply to invasive species. The ecosystems invaded by these species normally do not support the same predators and parasites that may regulate the species populations in its native range, so simply facilitating increased natural controls may not be effective. Modern IPM strategies for invasive species emphasize use of standardized decision-making processes supported by science-based understanding of invasive species biology and ecological interactions with their host environment. Tolerance levels may vary greatly for invasive species; invasive species impacts range in severity and extent, and some species may be so widespread or complexly woven into their host environment that control is not technically or economically feasible. Monitoring is a critical part of the District's IPM program; prevention and early detection/eradication strategies can be implemented to prevent new invasive species pest problems before they become unmanageable.

Programs to control invasive plant and animal species require long-term commitment. With many invasive species, short-term lapses in management activity may negate years of expensive control programs. IPM is considered an integral part of a strategy to efficiently and effectively control invasive species on District lands.

10.3.1 INVASIVE ANIMALS IN NATURAL LANDS

Invasive animal management in natural areas focuses on first modifying the behavior of humans or the habitat of natural areas to moderate or eliminate invasive animal pest problems. After these prevention actions are exhausted, invasive animal populations will be managed to a defined tolerance level. Tolerance levels focus reducing the pest population down to a level that does not cause substantial harm to the natural resource; does not cause severe economic harm; and/or does not cause disruption of natural processes or severe displacement of native species. The District's goal is to maintain the long-term stability and resiliency of its natural areas.

State regulations concerning invasive animals are complex. Some invasive animals in California are regulated for sport and commercial purposes (e.g., feral pigs and bull frogs), others expressly prohibited (e.g., northern pike fish) and others are currently unregulated (e.g., snapping turtles and parrots). Some invasive wildlife species can be difficult to manage where adjacent landowners manage the same species for sport or profit. The District prioritizes specific invasive animals for management that have the greatest potential to impact natural areas. Some regulated game species (e.g., feral pigs) must be controlled under special permits obtained from the CDFW.

10.3.2 INVASIVE PLANTS IN NATURAL LANDS

The District has identified numerous species of invasive plant species present on District lands; 75 invasive plants were observed in a study conducted in 2004 (see Table 10-1 below). The following section presents IPM strategies for these target invasive plant species, organized by general life history (i.e., annual and biennial, perennial, aquatic plants). Because there is a great diversity of invasive plant species managed on District lands, specific treatments and management strategies must also take into account the life history traits of each species in the context of its specific environment – the details of which cannot be outlined in a single document. Ultimately, land managers, biologists, and pest control professionals must develop site-specific management for individual projects and species, using the information provided in this manual and the District Invasive Plant Control Handbook as guides. The District's goal is to maintain the long-term stability and resiliency of its natural areas.

10.4 PEST IDENTIFICATION

Pest identification for invasive plants and wildlife can be readily undertaken using existing District resources such as invasive plant identification materials, and field guides. Staff should identify the pest to species, and then investigate its life history and life cycle, and document the distribution, density, population size and population structure (i.e., percentage of each population in immature, adult, and reproductive stages) within the natural areas. Use the target pest list presented in Table 10-1 above as a starting point of identifying pests that currently occur on District lands. New pest species may invade District lands over time: if the pest is not listed in Table 10-1, staff should then do basic web searches to determine if the pest is regulated by statute, by which agency it is regulated, or determine if it is an unregulated pest on District lands.

Table 10-1 Invasive Plant Species Documented as Present on the District Lands

Scientific Name	Common Name	Life Form	Cal-IPC Invasive Status (2014)	CDFA Rating (2014)
Acacia baileyana	cootamundra wattle	Tree	Watchlist	
Acacia dealbata	silver wattle	Tree or shrub	Moderate	
Acacia melanoxylon	blackwood acacia	Tree	Limited	
Aegilops cylindrica	jointed goatgrass	Annual herb	Watchlist	B
Aegilops triuncialis	barbed goatgrass	Annual herb	High	B
Ailanthus altissima	tree of heaven	Tree	Moderate	C
Arundo donax	giant reed	Perennial herb	High	B
Asphodelus fistulosus	asphodel, onion weed	Perennial herb	Moderate–ALERT	B
Brachypodium sylvaticum	slender false brome	Perennial herb	Moderate–ALERT	A
Brassica (nigra?)	mustard	Annual herb	Moderate	
Carduus pycnocephalus	Italian thistle	Annual herb	Moderate	C
Carthamus lanatus	woolly distaff thistle	Annual herb	Moderate	B
Centaurea calcitrapa	purple star-thistle	Annual or Perennial herb	Moderate	B

Table 10-1 Invasive Plant Species Documented as Present on the District Lands				
Scientific Name	**Common Name**	**Life Form**	**Cal-IPC Invasive Status (2014)**	**CDFA Rating (2014)**
Centaurea melitensis	tocolate, Malta star-thistle	Annual herb	Moderate	C
Centaurea solstitialis	yellow star-thistle	Annual herb	High	C
Centaurea stoebe ssp. *micranthus*	spotted knapweed	Perennial herb	High	A
Cirsium vulgare	bull thistle	Biennial herb	Moderate	C
Conium maculatum	poison hemlock	Biennial herb	Moderate	
Cortaderia jubata	Jubata grass	Perennial herb	High	B
Cortaderia selloana	pampas grass	Perennial herb	High	
Cotoneaster spp.	cotoneaster	Shrub	Moderate (several species)	
Cynara cardunculus	artichoke thistle	Perennial herb	Moderate	B
Cytisus scoparius	Scotch broom	Shrub	High	C
Dactylis glomerata	orchard grass	Perennial herb	Limited	
Delairea odorata	Cape ivy	Perennial herb	High	B
Dipsacus sativus	teasel	Biennial herb	Moderate	
Dittrichia graveolens	stinkweed	Annual herb	Moderate	
Elymus caput-medusae	Medusa head grass	Annual herb	High	C
Ehrharta calycina	Perennial velt grass	Perennial herb	High	
Ehrharta erecta	Erect velt grass	Perennial herb	Moderate	
Eucalyptus camaldulensis	red river gum	Tree	Limited	
Eucalyptus globulus	blue gum	Tree	Moderate	
Euphorbia oblongata	Oblong spurge	Perennial herb	Limited	
Foeniculum vulgare	fennel	Perennial herb	High	
Genista monspessulana	French broom	Shrub	High	C
Hedera helix	English ivy	Woody vine	High	
Helminthotheca (Picris) echioides	bristly ox-tongue	Annual or biennial herb	Limited	
Hesperocyperis (Cupressus) macrocarpa	Monterey cypress	Tree	Moderate (when outside native range)	
Hypericum perforatum	Klamath weed	Perennial herb	Moderate	C
Lathyrus latifolius	sweet pea	Perennial herb	Watchlist	
Ligustrum lucidum	glossy privet	Tree or shrub	Watchlist	
Lythrum salicaria	purple loosestrife	Perennial herb	High	B
Marrubium vulgare	horehound	Perennial herb	Limited	
Mentha pulegium	pennyroyal	Perennial herb	Moderate	
Mesembryanthemum crystallinum	crystalline iceplant	Annual herb	Moderate–ALERT	
Myosotis (latifolia?)	forget-me-not	Perennial herb	Limited	
Nerium oleander	oleander	Tree	Watchlist	
Olea europaea	olive	Tree or shrub	Limited	
Oxalis pes-caprae	Bermuda buttercup	Perennial herb	Moderate	
Phalaris aquatica	Harding grass	Perennial herb	Moderate	
Pinus radiata	Monterey pine	Tree	Limited (when outside native range)	
Robinia pseudoacacia	black locust	Tree	Limited	
Rubus armeniacus (discolor)	Himalayan blackberry	Shrub	High	
Senecio minimus (Erechtites minima)	coastal burnweed	Annual or perennial herb	Moderate	
Silybum marianum	milk thistle	Annual or biennial herb	Limited	

Table 10-1 Invasive Plant Species Documented as Present on the District Lands

Scientific Name	Common Name	Life Form	Cal-IPC Invasive Status (2014)	CDFA Rating (2014)
Spartium junceum	Spanish broom	Shrub	High	C
Stipa mileacea var. *mileacea (Piptatherum miliaceum)*	Smilo grass	Perennial herb	Limited	
Ulex europaeus	gorse	Shrub	High	B
Verbascum (thapsus?)	mullein	Biennial herb	Limited	
Vinca major	periwinkle	Perennial herb	Moderate	
Zantedeschia aethiopica	calla lily	Perennial herb	Limited	

Notes: Species documented during 2004 study (District/Shelterbelt Builders Inc. 2004).
CalIPC Invasive Status Definitions:

- High- Species with severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.
- Moderate- ALERT – Species on an active Cal-IPC watch list as a species suspected to causing severe impacts (may be moved to High status). These species have substantial and apparent-but generally not severe-ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.
- Moderate – See above---same as above but not on active Cal-IPC Watch list
- Limited –Species that are invasive, but that ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.
- Watch List - - On a list of species that require further evaluation and monitoring to determine impact.

CDFA Rating Definitions:

- A = A pest of known economic or environmental detriment and is either not known to be established in California or it is present in a limited distribution that allows for the possibility of eradication or successful containment. A-rated pests are prohibited from entering the state because, by virtue of their rating, they have been placed on the of Plant Health and Pest Prevention Services Director's list of organisms "detrimental to agriculture" in accordance with the FAC Sections 5261 and 6461. The only exception is for organisms accompanied by an approved CDFA or USDA live organism permit for contained exhibit or research purposes. If found entering or established in the state, A-rated pests are subject to state (or commissioner when acting as a state agent) enforced action involving eradication, quarantine regulation, containment, rejection, or other holding action.
- B – A pest of known economic or environmental detriment and, if present in California, it is of limited distribution. B-rated pests are eligible to enter the state if the receiving county has agreed to accept them. If found in the state, they are subject to state endorsed holding action and eradication only to provide for containment, as when found in a nursery. At the discretion of the individual county agricultural commissioner they are subject to eradication, containment, suppression, control, or other holding action.
- C - A pest of known economic or environmental detriment and, if present in California, it is usually widespread. C-rated organisms are eligible to enter the state as long as the commodities with which they are associated conform to pest cleanliness standards when found in nursery stock shipments. If found in the state, they are subject to regulations designed to retard spread or to suppress at the discretion of the individual county agricultural commissioner. There is no state enforced action other than providing for pest cleanliness.

10.5 PREVENTION

IPM in natural areas focuses first on preventative actions. Preventative actions include modifying human behavior and land use practices to minimize conditions that favor invasive plant infestation and establishment. When combined with landscape-level invasive plant monitoring and early detection/rapid response methods, this approach ensures that invasive plants can be managed when they are small, rather than large populations.

Many invasive plants establish themselves in ruderal or disturbed areas, for example, freshly graded, flooded, or mechanically cleared land, while others exploit more subtle disturbance areas, such as edges of trails and roads or overgrazed rangelands. Management of these species can often be accomplished by implementing better land use practices. Landscape management changes such as restoring natural processes (e.g., fire and flooding), reducing stocking rates/utilize rotational grazing on rangelands, increasing biodiversity in croplands or altering forestry practices on timber tracts, can reduce invasive species populations to a level where active management is not required (Jackson et al. 2007). Other invasive species can invade stable, intact landscapes. These competitive species usually require active management to achieve effective control.

Seeds, insects, pets, and pathogens from anywhere in the world can easily arrive on District lands via numerous sources. The District's mission includes providing recreational access to 60,000 acres of public open space, so visitors are one of many sources of potential new pest infestations. For example, a nature-loving tourist may take a plane from another region of the world with a climate similar to California's, and visit one of the District's properties for a hike, inadvertently introducing seeds from invasive species on their hiking boots.

Agricultural pest prevention programs have been implemented by governments throughout the world, with point-of-entry and trade distribution inspections, insect trap monitoring, and nursery certification. In California, more than 30 million vehicles are monitored annually at California agricultural inspection stations when entering the state (CDFA 2013b). From these inspection stations, tens of thousands of prohibited materials are intercepted and seized annually which include a wide variety of agricultural pest species. Similar inspection systems are in place in many international ports of entry throughout the state, including airports, ports, and border crossings. Only more recently have regional entities and local governments begun to develop similar programs for species of local interest. These programs face many challenges in locations where defined borders where effective monitoring can occur do not exist. There is no clear regulatory oversight for local programs, and there is little funding and staffing available. The most successful examples of local control programs have so far been limited to the management of aquatic pest species of restricted distribution (e.g., California's quagga/zebra mussel quarantines using boating restrictions in recreational waterways) (California State Parks 2013).

Although the District may have limited opportunities to restrict the flow of invasive species into its preserves from world trade and tourism, prevention is possible at smaller scales. Project-specific best management practices and improved planning can help prevent inadvertent species introductions by requiring staff training on new invasive species that could invade District lands; inspection of outside materials, equipment and vehicles; and requiring staff ad contractors to only use clean materials equipment and vehicles on District lands. These best management practices intended to prevent introduction or establishment of new invasive species should be incorporated into the construction and maintenance of facilities, road maintenance, fire prevention, firefighting, and routine tool maintenance. Table 10-2 identifies specific preventative actions to reduce the potential to introduce and spread invasive species to District lands. Likewise, District visitors can be trained to identify, look for and report new invasive species that can invade District lands. Educational materials and boot cleaning stations at key entrance points can help prevent inadvertent introductions, or catch them early. And finally, managing lands in a manner that monitors and reduces areas of soil disturbance, reduces unnecessary and redundant trails and roads, and helps promote larger, intact areas of undeveloped natural areas can also make District lands more resilient to new invasive species invasions.

Table 10-2 Best Management Practices to Prevent Invasive Species Introductions (Recommendations selected from Cal-IPC)
Sanitation and Prevention of Contamination - All personnel working in infested areas will take appropriate precautions to not carry or spread weed seed or SOD-associated spores outside of the infested area. Such precautions will consist of, as necessary based on site conditions, cleaning of soil and plant materials from tools, equipment, shoes, clothing, or vehicles before entering or leaving the site.
All staff, contractors, and volunteer crew leaders will be properly trained to prevent spreading weeds and pests to other sites.
District staff will appropriately maintain facilities where tools, equipment, and vehicles are stored free from invasive plants.
District staff will inspect rental equipment and project materials (especially soil, rock, erosion control material, and seed) to confirm as much possible that they are free of invasive plant material before their use at a worksite.
Suitable onsite disposal areas will be identified to prevent the spread of weed seeds.

Table 10-2 Best Management Practices to Prevent Invasive Species Introductions (Recommendations selected from Cal-IPC)
Invasive plant material will be rendered nonviable when being retained onsite. Staff will desiccate or decompose plant material until it is nonviable (partially decomposed, very slimy, or brittle). Depending on the type of plant, disposed plant material can be left out in the open as long as roots are not in contact with moist soil, or can be covered with a tarp to prevent material from blowing or washing away.
Monitor all sites where invasive plant material is disposed onsite and treat any newly emerged invasive plants.
When transporting invasive plant material offsite for disposal, the plant material will be contained in enclosed bins, heavy-duty bags, or a securely covered truck bed. All vehicles used to transport invasive plant material will be cleaned after each use.

10.5.1 EARLY DETECTION/RAPID RESPONSE

Preventing the introduction of invasive species is the first line of defense against invasions. However, even the best prevention practices will not stop all invasive species introductions. Early Detection and Rapid Response (EDRR) programs increase the likelihood that invasions will be addressed successfully while the population size and extent are not beyond that which can be contained and eradicated on both practical and economic scales. According to the 2005 California State Noxious Weed Plan, “early detection is the single most important element in successful and economical eradication of new weeds before they become permanently established in new localities” (CDFA 2005).

An EDRR Program is a formalized monitoring program that utilizes active and passive land surveillance as a method to discover and identify new invasive species or their symptoms before they become widely established. This can be accomplished with 1) active detection, 2) passive detection, and 3) syndromic surveillance as defined by the National Invasive Species Working Group (National Invasive Species Counsel 2003, 2008).

- **Active Detection.** Active detection programs have structure, staffing, and dedicated funding to accomplish land surveillance (landscape-level invasive plant monitoring). Dedicated staff, volunteers, or contractors under a specific set of goals may run these programs. Active detection programs for invasive species often have limited resources so it is important to be focused on high-priority targets, such as high-risk locations, high-value resources, important pathways, and populations and species of concern.
- **Passive Detection.** Passive detection programs have more limited goals and structure that are embedded into existing programs and activities. These programs fortuitously detect invasive species as staff, volunteers, or contractors conduct other activities and may or may not have specific training or funding for the detection of invasive species.

Syndromic Surveillance. Syndromic surveillance uses the analysis of other resource management problems to detect invasive species indirectly through their direct damage or other ecosystem disruption. Detecting the damage associated with invasive species may be the first indication of a new invasion. This is often the case with invasive pathogens and parasites that are difficult to detect. Regardless of which detection system is selected for use by the District, EDRR efforts should include the following objectives:

- identify potential threats in time to allow control or mitigation measures to be taken;
- detect new invasive species in time to allow efficient and safe eradication or control decisions to be made;
- respond to invasions effectively to prevent the spread and permanent establishment of invasive species;
- provide adequate and timely information to decision-makers, the public, and to partner agencies concerned about the status of invasive species within an area; andadaptively implement detection and early response strategies over time.

The District currently does not have a well-developed EDRR program, or dedicated staff or contractors to implement such a program on a comprehensive basis. Some aspects of an EDRR program are implemented as District staff work on other projects.

DETECTION STRATEGIES

New invasive species may arrive in the District through sudden, unpredictable pathways (e.g., boots on a traveler) and more constant, predictable pathways (e.g., roads, trails, and/or horticultural escapees from neighboring properties). District lands are scattered throughout the San Francisco Peninsula, adjacent to urban development, rural private residences and hobby farms, and production agricultural landscapes including rangelands, dairies, commercial nurseries, and row and cereal crops. Each of these lands uses account for some possible introductions of invasive species along preserve borders, roads, trails, and easements.

The most efficient way to prevent routine introductions of invasive species into District lands is to use vigilant patrol and monitoring protocols along District boundaries that interface with urban and agricultural landscapes. Trails, roads, and waterways intersecting District lands are the most likely routes of invasion for new species. Many of these common pathways have been confirmed by previous District mapping and planning work (District 2004). Refer to Chapter 5, IPM Program Implementation, for more information on how the District intends to implement this action during IPM Program implementation.

MODELING INVASION PATHWAYS

The District maintains approximately 142 miles of single-track trail, 444 miles of road, and has a geographic border (not including adjacent District parcels) totaling 397 miles. Not all of these trails, roads, and edges have the same potential to introduce new invasive species into District properties. Locations within the District that receive the most intense impacts from disturbance, visitation, utility maintenance, and neighboring land use are the most likely sources for new species introductions. Simple models can be used on a local preserve level to analyze probable pathways for key invasive species the District may expect to encounter. The District can identify routine and sporadic activities that have a high probability of introducing invasive species and also the types of species anticipated.

Refer to Chapter 5, IPM Program Implementation, for more information on how the District intends to address EDRR during the IPM Program implementation. Table 10-3 defines a ranking system for the District to identify activities on preserves that are most likely to promote invasive species introductions. Table 10-4 provides a summary of known occurrences of novel invasive species (i.e., current targets of early detection programs that are considered likely to invade and impact California ecosystems if allowed to establish), and is intended to be a “Watch List” for use by the District in raising awareness of new invasive plants that may be found in the future on District lands. By understanding both the activities that promote invasions and the candidate species for likely invasion, the District can more successfully plan for prevention, detection, and control activities.

Table 10-3 Ranking of Most Likely Pathways of Invasive Species Introductions (Identification of Areas and Activities to Prioritize for Early Detection Monitoring)

Ranking of vectors’ Probability to Import/Distribute Invasive Plants	
1	Heavy equipment from outside District
2	Top soil importation for construction
3	Sand or gravel for road construction
4	Work activities along rights-of-way external to District (e.g., PG&E, CalWater)
5	Work activities of District employees or contractors

Table 10-3	Ranking of Most Likely Pathways of Invasive Species Introductions (Identification of Areas and Activities to Prioritize for Early Detection Monitoring)
6	Grazing lessees/livestock grazing
7	Visitor vehicle traffic
8	Wind
9	Visitors hiking
10	Wildlife
11	Water
Prioritization of Specific Areas for Monitoring Based on Suitability for Invasion and Volume of New Plant Material (Seeds, etc.) likely to be Introduced	
Very high priority	
1	Construction/maintenance areas
2	Buildings, houses at the urban interface
3	Paved areas (e.g., roads/parking lots/trailheads)
4	Landscaped areas
5	Disturbance from human intervention (e.g., emergency fuel breaks during fire fires)
6	Trails
7	Areas of high visitor use
8	Utilities (e.g., cell towers, powerline corridors)
9	Pastures/agricultural areas
Medium priority	
10	District offices, structures
11	Riparian areas
12	Natural disturbances with no human intervention (e.g., fire, rockfall)
Low priority	
16	Off-trail wilderness areas
Source: adapted from Gerlach et al. 2001	

Table 10-4 Invasive Plant Watch List: Invasive Plants that are Known to be Problematic near District Lands (for use in Early Detection and Rapid Response Efforts)

Scientific Name	Common Name	Species Reported (X) to Occur in: District	San Mateo County	Santa Clara County	Santa Cruz County
Plants					
Acacia paradoxa	Kangaroo thorn		X	X	X
Acaena novae-zelandiae	Biddy biddy				X
Achnatherum brachychaetum	Puna needle grass				
Acroptilon repens	Russian knapweed			X	X
Aegilops cylindrica	Jointed goatgrass	X	X	X	
Aegilops triuncialis	Barbed Goatgrass	X	X	X	X
Ambrosia trifida	Giant ragweed				

Table 10-4 Invasive Plant Watch List: Invasive Plants that are Known to be Problematic near District Lands (for use in Early Detection and Rapid Response Efforts)

Scientific Name	Common Name	Species Reported (X) to Occur in:			
		District	San Mateo County	Santa Clara County	Santa Cruz County
Araujia sericifera	Bladderflower		X	X	X
Arctotheca calendula	Cape weed		X		X
Arrhenatherum elatius	Tall oatgrass		X	X	X
Asparagus asparagoides	African asparagus fern			X	X
Asphodelus fistulosus	Onionweed				
Brachypodium sylvaticum	Slender false brome	X	X	X	
Buddleja davidii	Butterfly bush		X	X	
Carduus acanthoides	Spiny plumeless thistle				
Carex pendula	Hanging sedge	X	X		
Carthamus leucocaulos	White stemmed distaff thistle				
Centaurea diffusa	Diffuse knapweed			X	
Centaurea iberica	Iberian knapweed			X	
Centaurea stoebe ssp. micranthos	Spotted knapweed	X		X	
Centaurea sulphurea	Sicilian starthistle			X	X
Cestrum parqui	Chilean Jessamine				
Chondrilla juncea	Skeleton weed		X	X	
Cirsium undulatum	Wavy leaved thistle				
Coprosma repens	Creeping mirrorplant		X		X
Crupina vulgaris	Bearded creeper				
Cuscuta japonica	Japanese dodder				
Cytisus striatus	Portuguese broom		X		X
Dittrichia graveolens	Stinkweed	X	X	X	X
Echium plantagineum	Salvation echium				
Elymus caput-medusae	Medusa head grass	X	X	X	X
Ehrharta calycina	Perennial velt grass				X
Ehrharta erecta	Erect velt grass	X	X		X
Euphorbia esula	Leafy spurge				
Euphorbia oblongata	Oblong spurge	X	X	X	X
Euphorbia terracina	Geraldton carnation weed				
Fallopia japonica	Japanese knotweed			X	X
Festuca pratensis	Meadow fescue			X	X
Gazania linearis	Gazania	X	X	X	
Gunnera tinctoria	Chilean gunnera				
Halimodendron halodendron	Russian salt tree				
Helichrysum petiolare	Licorice plant				
Hypericum canariense	Canary Island St John's Wort		X		X
Isatis tinctoria	Dyers woad				
Lepidium appelianum	Hairy whitetop	X	X	X	
Lepidium campestre	Field pepper grass		X		

Table 10-4 Invasive Plant Watch List: Invasive Plants that are Known to be Problematic near District Lands (for use in Early Detection and Rapid Response Efforts)					
Scientific Name	**Common Name**	**Species Reported (X) to Occur in:**			
		District	**San Mateo County**	**Santa Clara County**	**Santa Cruz County**
Ligustrum lucidum	Glossy privet				
Ligustrum ovalifolium	California privet		X		
Limonium ramosissimum	Algerian sealavender		X	X	
Linaria genistifolia ssp. dalmatica	Dalmatian toadflax		X		X
Linaria vulgaris	Butter and eggs			X	
Lonicera japonica	Japanese honeysuckle		X		X
Lythrum salicaria	Purple loosestrife		X		X
Nassella formicarum	Andean tussockgrass				
Nassella tenuissima	Finestem needlegrass		X	X	X
Oenothera sinuosa	Wavy-leaved gaura		X	X	X
Oenothera xenogaura	Drummond’s gaura		X		X
Onopordum acanthium	Scotch cottonthistle				
Onopordum Illyricum	Illyrian thistle			X	
Paspalum urvillei	Vasey’s grass	X		X	
Persicaria wallichii	Himalayan knotweed				X
Polygonum aubertii	Bukhara fleeceflower				
Pyracantha coccinea	Scarlet firethorn				
Pyracantha crenulata	Nepalese firethorn				
Ricinus communis	Castor bean		X	X	X
Rubus laciniatus	Cut leaved blackberry				
Rumex dentatus	Toothed dock				
Rytidosperma penicillatum	Purple awned Wallaby Grass		X	X	X
Saccharum ravennae	Ravennagrass				
Sapium sebiferum	Chinese tallowtree				
Scolymus hispanicus	Golden thistle		X	X	
Senecio jacobaea	Tansy ragwort				X
Senna multiglandulosa	Glandular cassia			X	
Sesbania punicea	Rattlebox			X	
Solanum carolinense	Carolina horse nettle				
Solanum rostratum	Buffalo berry				X
Spartina alterniflora	Salt water cord grass				
Spartina densiflora	Dense flowered cord grass		X		
Spartina patens	Salt meadow cord grass				

Notes: Species list and occurrences compiled from the Bay Area Early Detection Network (BAEDN) Priority Weeds and CalFlora (2013), District Weed List. Records of occurrence shown below may be extirpated, but indicate some likelihood of current or future occurrence on District properties.

STAFF TRAINING

Early detection monitoring can be accomplished by staff, volunteers, park patrons, or contractors. The utilization of existing natural resource management and maintenance staff and volunteers provides the best value for the District. With limited training, existing staff resources can be utilized and repurposed for early detection monitoring at minimal additional cost although it will not be a comprehensive effort. Refer to Chapter 3, Section 3.6 for a more detailed description of planned IPM trainings.

In a world with millions of species, detecting a new arrival can sometimes be a challenge since very few people have adequate training to identify foreign and unfamiliar species. However, there is potential to train staff and volunteers familiar with District habitats to notice and report when species are found that appear unusual or out-of-place. In addition to new invasive species, other resource management targets such as rare plants and animals may also be discovered through this type of observation.

The following techniques should be implemented to support an effective early detection program:

- Develop a simple invasive species identification guide for use by laypeople. Include invasive species currently known to occur in District preserves (Table 10-2), as well as “Watch List” species known to occur in the regions (Table 10-4). The identification guide should include photographs (several life stages), life cycle, and associated habitats. As funding and staffing allow, update this identification guide over time to ensure its usefulness in EDRR efforts. The IPM Coordinator will coordinate regularly with local agencies who track and monitor invasive plants in the region, such as California State Parks, San Mateo/Santa Clara Weed Management Areas, and BAEDN.
- Train permanent and seasonal Rangers, Open Space Technicians, volunteers, and contractors in using electronic and/or paper weed mapping methods. Practice data collection with staff and volunteers so data recording and processing is consistent. Start with basic paper mapping methods, which can be suitably accurate, easier, and cheaper to manage than digital systems. Enter this information into the District’ Pest Database.
- Develop simple workflows that incorporate all District departments/staff that perform pest control. Develop a methodology to receive and organize weed mapping information so none is lost or forgotten. Consider ways to incorporate this information into existing forms or maps to keep things simple and reduce paperwork.
- Produce and post baseline weed maps for each preserve at field offices so staff can stay informed about current populations and make updates in real-time directly on maps.
- Ensure that data collection methods are relevant to partner organizations such as California State Parks, San Mateo/Santa Clara Weed Management Areas, and BAEDN so the information can be shared with other cooperating agencies.
- If using volunteers, support a specialized group of committed individuals that receive training for invasive species identification and mapping activities. Ensure the goals for use of volunteers in this capacity are clear and that the resulting data generated by the volunteers is useful to District staff.

RAPID RESPONSE STRATEGIES

Small infestations of invasive species generally offer the greatest number of treatment method options for successful eradication. Many times, hand removal of individuals is the control method with the greatest selectivity and cost effectiveness with the least amount of indirect impacts. Individual specimens or small patches identified incidentally or during regular monitoring can often be immediately removed. For vegetation removal, hand digging, cutting, or pulling are all examples of selective hand removal. For vertebrate species, hand removal usually means trapping or shooting. Small-scale removal is most effective on newly-established and small populations with limited distributions.

Pesticides may also be an efficient treatment method for rapid response actions. In some cases, a specific pesticide may be identified to abate an immediate invasive species hazard when it is found. Pesticides may be especially effective for species where hand removal actions are impractical (e.g., steep cliffs) or where hand or mechanical removal methods would risk spread of the species (e.g., where plants that can spread from broken root fragments). It is critical that herbicides be on the List of Approved Pesticides (Appendix A) so there is no delay because of the approval process for implementing a rapid response.

In all cases, the District will map the occurrence before control, and then revisit the control site several times to ensure full control was achieved. Eradication may require multiple visits in a year, or possibly multiple years of monitoring and treatment.

10.6 DAMAGE ASSESSMENT

Staff will determine what, if any damage to the natural area and its natural resource values has resulted from the presence of the pest species. To the extent possible, quantify the damage (in acres, square feet or numbers of occurrences affected) and qualitatively describe the perceived damage in its context. As an example, a staff person could determine that a certain percentage of the District's native perennial grassland acres are infested with yellow star-thistle, a target pest species, resulting in displacement native species and degradation of a large percentage of the natural resources on District lands. Ultimately, the District's goal is to maintain the long-term stability and resiliency of its natural areas, therefore damage assessments must consider the long term effects of the pest infestation.

10.7 TOLERANCE LEVELS/THRESHOLD FOR ACTION

Tolerance levels vary greatly for invasive species; some species have much greater impacts on the environment than others, or they may be so completely mixed with native species such that control methods would result in unacceptable damage to native habitats or rare species, or simply be technologically impossible. The District's IPM approach for invasive species begins with establishing site-specific conservation goals, leading to a determination of the targeted actions with which specific individuals or populations can be managed to achieve the stated goals.

Tolerance levels and treatment methods for invasive species are based on the potential of the invasive species to degrade wildlife habitat and other natural resource values such that the long-term stability and resiliency of its natural areas are compromised. To do so, staff must consider worker health and safety, visitor safety, and the technical feasibility of meaningful control (i.e., a cost/benefits analysis). Because many of the District's invasive species populations are present across multiple preserves or present throughout the entire region, scale is an important variable in determining the feasibility and need for control and the selection of a treatment method. Unlike pest management in structural landscapes, invasive species tolerance levels must factor in the scale at which a management tool is both appropriate and effective. Treatments such as hand removal may have minimal negative unintended impacts when a few individuals are removed, but substantially greater impacts (e.g., soil erosion or damage to non-target species, injury to staff) when the same treatment is applied to large areas. Similarly, the control of large populations of invasive plants using mechanical control methods can be cost prohibitive, impractical, and dangerous. The population size and habitat conditions for which each management technique is useful and appropriate is discussed for each section below. Tolerance levels not only differ by species, but also location and spatial scales. All treatment method selections will balance the net negative impacts to the natural environment, safety of the public, District workers and contractors, and the visitor experience.

Establishing tolerance level for insipient and widespread invasive plants in common, widespread natural communities (e.g., yellow star-thistle in annual grasslands or French broom in oak woodlands) will be established on a case-by case basis by comparing the anticipated benefit against the cost and potential for success of the target invasive control efforts. As an example, tolerance levels for French broom in oak woodlands will be determined based on the total amount of infested areas within total oak woodlands on the subject preserve. As a general rule of thumb, the tolerance level for invasive plants will be exceeded where infestations exceed more than 10 percent of the total amount of a sensitive vegetation type, or 25 percent of the total amount of a common vegetation type. When tolerance levels are exceeded, District staff will then assess if active control is feasible by conducting a quick cost/benefit analysis. If staff determines that control is technically feasible and can be accomplished using existing staff and budgeting parameters, an Individual Pest Plan will be prepared (Chapter 3). If however, available pest control options are not likely to be successful, staff may elect not to implement active pest control.

For federal and state listed species, certain protections are required under the state and federal Endangered Species Acts, and tolerance levels will be linked to compliance with the ESA's. For wetlands, tolerance levels are linked to federal regulations under the federal Section 404 Clean Water Act and to state regulations as described in Section 401 Clean Water Act and in the Porter-Cologne Act. For natural communities, tolerance levels will be related to degree of rarity in the region (as indicated by experts such as the state California Natural Diversity Database, California Native Plant Society, and local experts); the relative rarity of the community on District lands; the technical and cost feasibility of the pest to be controlled; and the sensitivity of the natural community to pest damage.

Following procedures outlined in this Chapter, District staff will qualitatively and quantitatively determine the degree of pest damage to the natural resource, then determine if action is warranted.

10.8 TREATMENT OPTIONS

When all other options for preventing or actively reducing pest population levels to below specified tolerance levels have been exhausted, District staff will determine treatment options. Because natural area pest control (typically control of invasive plants) is one of the most expensive and time-consuming aspects of District preserve management, special attention will be given to selecting proven, technically feasible, and cost-efficient least environmentally disruptive and harmful pest control solutions. Refer to Chapter 3 for project prioritization procedures intended to maximize the effectiveness and efficiency of District pest control actions.

Staff will evaluate pests in natural areas as follows:

- Pests will be treated (eradicated or controlled) when their presence could directly threaten the health and safety of visitors and staff.
- For pest infestations that are affecting listed species, pest species will be treated to comply with state and federal Endangered Species Acts, and tolerance levels will be linked to compliance with the ESA's.
- For pests in wetlands, pest species will be treated to comply with the Federal Section 404 Clean Water Act, and state wetland regulations as described in Section 401 Clean Water Act and in the Porter-Cologne Act.
- Pest species may be considered for treatment (eradicated, controlled, or contained) if and when District staff determines that their presence is likely to result in the loss of the long-term stability and resiliency of the natural areas as a whole.
- Pest species may be considered for treatment (eradicated, controlled, or contained) if and when District staff determines that the pest could displace or degrade individual natural resources (e.g., where the presence of an invasive species is displacing a rare plant or animal population).
  - For natural communities, tolerance levels will be related to the sensitivity of the natural community to pest damage and the degree of rarity of the individual natural community in the region (as indicated by

experts such as the state California Natural Diversity Database, California Native Plant Society, and local experts)

  - For native species, tolerance levels will be related to the sensitivity of the individual species to pest damage and the relative rarity of the individual species in the region or on District preserves. (Note: rarity to be determined by experts such as the state California Natural Diversity Database, California Native Plant Society, and local experts)
- Pest species may not receive treatment when their presence is not likely to result in the loss or severe displacement or degradation of natural resources and/or when treatment is considered technically infeasible, unsafe, or harmful to the environment.

If the target pest exceeds specified tolerance levels, the District will begin to investigate pest control options. This includes the following general steps involved in pest control planning:

- delineate a project area;
- determine pest control objectives;
- identify any dispersal routes or mechanisms that may have helped the pest enter or spread onto District lands;
- identify a range of possible pest control options using information presented below;
- select a preferred pest control approach;
- prepare an Individual Pest Management Plan (if necessary- see Chapter 3);
- implement the selected pest control approach; and
- using adaptive management, monitor, report (see Chapter 3) and adjust the selected pest control approach to achieve project objectives.

10.8.1 INVASIVE ANIMALS IN NATURAL AREAS

NON-NATIVE FISH

Known species of non-native fish in the District include black bass (*Micropterus* sp.), sunfish (*Lepomis* sp.), catfish (*Ameiurus/Ictalurus* sp.) and mosquitofish (*Gambusia* sp.) (Anderson 2013). These species are generally found in man-made stock ponds and reservoirs but some also occur in natural sag ponds. The District does not actively manage non-native fish in man-made water bodies unless the water body also supports protected native species such as the California red-legged frog. In special cases where protected species are present, ponds are typically drained for sufficient time to eliminate all non-native fish species and then refilled. As most nonnative fish species are managed as game fish by the CDFW, special permits are typically obtained for their control.

BULLFROGS

The American bullfrog (*Rana [Lithobates] catesbeiana*) is a large, brilliant green amphibian that is native to eastern North America. Its natural range does not extend west of the Rocky Mountains and Great Plains but it is an increasingly common invasive animal in the western United States. Bullfrogs are sold throughout the world as food, pets, fish bait, and for educational purposes. They sometimes become unwanted pets or escape from frog farms and grocery stores, and as a result have readily established themselves in all suitable habitats throughout California.

Bullfrogs are classified by the CDFW as a game amphibian and are regulated by state fishing regulations. As a game amphibian, commercial and sport collection is permitted with commercial and sport fishing licenses, but individuals cannot be controlled as an invasive species unless they are specifically utilized for a purpose (i.e., wanton waste is prohibited by statute). State fishing regulations do not include any depredation conditions, so all bullfrog control efforts and programs require a specific Memorandum of Understanding or Special Permit from the CDFW (Kasteen, pers. comm., 2013).

American bullfrogs are most problematic in the District because they directly affect the federally Threatened California red-legged frog (*Rana draytonii*) (Lawler et al. 1999). In habitats where they exist together, large, overwintering bullfrog tadpoles can compete with California Red-Legged Frog tadpoles or even consume them directly. Adult bullfrogs consume California red-legged frogs in all forms (i.e., as tadpoles, metamorphs, or as adult frogs), in addition to other native wildlife species such as newts, salamanders, garter snakes, birds, and bats. Their voracious appetites have been implicated in the declines of many North American amphibian species.

In addition to competition and predation, bullfrogs spread chytrid fungus – a lethal skin disease known as chytridmycosis that impacts many of California's native amphibians (Schloegel et al. 2009). Chytrid fungus is a non-native fungal pathogen from Asia that has spread to decimate amphibian populations all over the world. Because bullfrogs are domestically raised for food and educational purposes worldwide, many that are imported to California each year carry the chytrid fungus from unregulated foreign frog farms. As these individual frogs are accidentally or intentionally released into the wild, they help to spread the fungal disease throughout native amphibian populations.

Pest Management Strategies for Bullfrogs

Prevention and control of American Bullfrogs is discussed below. Tolerance levels and treatment methods are also outlined in Table 10-5.

Prevention

- **Education.** Education can be an important tool for the District in preventing captive frogs from being intentionally released onto District lands. Some people feel ethically motivated to release captive pets and food animals back into natural environments for humane reasons or when they no longer wish to care for them. Public outreach and judiciously placed educational materials such as signs and brochures in District preserves with wetlands may be a useful strategy to curb intentional releases of animals.
- **Fencing.** Exclusionary fencing to keep bullfrogs from entering non-infested wetlands is a temporary tool for use while other control methods are applied concurrently. Fencing is not considered a long-term solution because it disrupts movement of other wildlife, can entrap non-target wildlife species, and may disrupt the natural processes of the wetlands. Exclusionary fences are useful during pond draining to limit the potential for dispersal of bullfrogs out of the treatment area. Exclusionary fencing may also be used in conjunction with funnel traps to collect bullfrogs as they attempt to disperse from drying ponds.

Physical Control

- **Gigging or shooting.** Gigging or shooting American bullfrogs (a pest species not native to California) are two methods that are implemented with small caliber air rifles and lead-free ammunition to eliminate individual adult bullfrogs. Gigging is the targeted spearing of fish or frogs with barbed tines mounted on a long pole. Both gigging and shooting are effective and humane methods for selective removal of target adult bullfrogs. However, this treatment method alone will rarely eradicate bullfrogs from the target area because only a portion of adults are usually found, and it does not control eggs or larval stages. Some studies have indicated that adult metamorph removal (i.e., removal of immature bullfrogs) is the most economical removal method for population suppression (Govindarajulu 2005). Egg masses can also be collected to remove additional life stages at the appropriate time of year.
- **Trapping.** Submerged funnel traps and floating cage traps can be used to control different life stages of American bullfrogs. Funnel traps designed for catching baitfish can be used to live capture bullfrog tadpoles. Floating cage traps have been successfully used to catch adult frogs. Trap designs for bullfrog removal are relatively recent and mainly rely on modifying Australian cane toad traps. Methods designed to trap multiple

life stages of frogs in parallel have proven to be effective for bullfrog management (Snow and Witmer 2011). Though trapping is a recently-developed treatment method for bullfrogs, it may be effective especially where other sensitive amphibian species are present to which impacts must be avoided.

- **Electrical currents.** Use of electrical currents (electroshocking) to temporary disable frogs in netting and gigging operations have proved to be effective in some control programs (Orchard 2011). 12v DC electroshockers that are typically used in fisheries management are mounted either on small boats or on backpacks, then the electroshock current applied to the surface of the wetland. This treatment is non-specific, and will affect all aquatic species within the range of the electroshocking ‘wand’. Electroshocking is not lethal, rather it shocks and lifts the affected individuals to the surface where they can be netted or otherwise collected. This treatment method, therefore, must be followed by another treatment method such as hand removal or gigging. Even with follow-up control of individuals found by electroshocking, this treatment method alone will rarely eradicate bullfrogs from the target area because only a portion of adults are usually found, and it does not control eggs or larval stages.
- **Habitat Manipulation.** Pond draining is one of the most common methods used for bullfrog control in California, especially in projects where protected species may be present such as the native California red-legged frog. American bullfrogs need a perennial water source to complete their lifestyle. In contrast, California red-legged frogs only need water during their breeding cycle. The USFWS California Red-legged frog Recovery Plan and others recommend draining ponds that contain both bullfrog and California red-legged frog species every other year to reduce the habitat suitability for bullfrogs (Grey 2009). Type conversion of permanent stock ponds to ephemeral wetlands can also reduce bullfrog populations across a landscape scale.
- **Exclusionary Fencing.** The District may install exclusionary fencing to keep bullfrogs from entering non-infested wetlands as a temporary preventive tool for use while other control methods are applied concurrently. Fencing is not considered a long-term solution because it disrupts movement of other wildlife, can entrap non-target wildlife species, and may disrupt the natural processes of the wetlands. Exclusionary fences are useful during pond draining to limit the potential for dispersal of bullfrogs out of the treatment area. Exclusionary fencing may also be used in conjunction with funnel traps (described below) to collect bullfrogs as they attempt to disperse from drying ponds.

Chemical Control

No toxicants or fertility control treatments are registered for use in controlling bullfrogs in California (Table 10-5).

Table 10-5 Treatment Methods for American Bullfrogs

Pest Category	Treatment Method Thresholds	Timing	Treatment	Treatment Constraints
American Bullfrogs	Incipient: < 25 individuals	Adults present in breeding ponds (February-July)	Hand removal of adults; gigging, shooting adults and metamorphs, egg mass collection	Small populations - accessible water bodies only
	Medium - Expanding Population	Adults and juveniles present in breeding ponds (February-August)	Funnel and cage trapping, exclusionary fencing	Requires combined trapping of tadpoles and adults
	Large - established populations in managed ponds	Adults present in breeding ponds (April-October)	Pond draining with exclusionary fencing	Not possible in wetlands or where other natural resource may be damaged by draining
	Large - established populations in wetland areas that cannot be drained	Adults present in breeding ponds and wetlands (April-October)	Electroshocking with boats and nets exclusionary fencing	

OTHER NON-NATIVE AMPHIBIANS AND REPTILES

Several species of non-native turtles are known to occur in District ponds and water bodies. These species are common food items for Bay Area ethnic communities and/or pet species. The red-eared slider (*Trachemys scripta elegans*) is the most common species known to occur within the District and an eastern snapping turtle (*Chelydra serpentina serpentina*) has been documented in at least one District pond. Red-eared sliders are managed as game fish species and snapping turtles are a restricted species in California. The District does not actively manage red-eared sliders unless the water body also supports protected, native species such as California red-legged frogs. The District will attempt to trap non-native turtles and remove them in compliance with CDFW when they share habitat with protected, native species. The District will attempt to trap restricted amphibian and reptile species in compliance with CDFW. Traps are designed specific to the target species and meant to capture the turtles without harm. Traps are checked daily for release and documentation of any native species and removal of any non-native species. A qualified biologist determines if any native species are present in the trapping area and consults with CDFW and USFWS if special status species are present. A qualified biologist complies with CDFW recommendations for restricted species since they are illegal to possess in California without a special permit. In special cases, ponds are drained for sufficient time to collect and eliminate non-native amphibian species (in compliance with CDFW Code) and then refilled. See information on pond draining presented above for bullfrogs.

FERAL PIGS

Feral pigs (*Sus scofra*) are one of the most destructive wildlife species in California and continue to expand their range throughout the entire United States. Feral domestic and wild Eurasian pigs are not native to North America but have been introduced in multiple events. These wild pigs have hybridized to become unique, abundant invasive pests in California, and they are thought to be one of the most prolific large mammals on earth (West et al. 2009).

Any pig living unassisted in the wild in California is classified as a game animal by current CDFW Code, which regulates the sport harvest of game animals in California. Pigs have extremely generous allowable methods of sport take, and can be harvested year-round in unlimited quantities with a hunting license and valid pig tag. Because they are also regulated as an agricultural pest in California by the USDA – APHIS Wildlife Damage Control Services and the CDFA, their management is often regulated by depredation permits from the CDFW. These permits can be obtained by private growers, ranchers, or other land owners and public agencies when proof of economic damage can be documented to the CDFW.

Pigs are mammals that are capable of extremely high reproductive rates when environmental conditions are favorable. In California's Coast Ranges, they can reach high populations densities because of cool weather, year-round access to water, and food (including acorns, a favored food source) through the winter months. Their invasive potential is largely because of their ability to quickly increase population size; they reach sexual maturity at young ages, females can have multiple litters each year, and natural mortality rates are generally low with few native predators. They can also disperse over large distances to invade new habitats and so cannot be managed effectively on a local basis.

Pigs cause damage to California agriculture and native fish and wildlife. Their destructive rooting behavior is visible in many natural areas. Rooting increases erosion and soil sedimentation, decreases water quality, directly reduces native plant species (e.g., ingestion of tubers, acorns), and promotes the establishment of non-native and invasive plants in disturbed soils (Seward et al. 2004, Kotanen 1995). They also create competition for food resources that would normally be consumed by native wildlife (especially winter acorns), spread disease to wildlife, and consume ground nesting birds, reptiles, amphibians and small mammals (The Nature Conservancy 2009, Barrett 1982). Wild pigs are also estimated to cause $1.5 billion of crop damage annually through the direct consumption and damage to crops, transmission of disease to livestock, and other damages to property and agricultural infrastructure (USDA 2009). The District has in the past conducted feral pig predation under a CDFW permit.

PEST MANAGEMENT STRATEGIES FOR FERAL AND WILD PIGS

Under the direction of the California Department of Fish and Wildlife, the District has developed a management program to capture feral pigs using baited traps and humane termination (shooting). As part of the program, the District coordinates with other regional land management agencies that are controlling feral pig populations. Since 2000, over 300 feral pigs have been dispatched and pig rooting, damage, and sightings have substantially decreased. Prevention and control of feral and wild pigs is discussed below. Tolerance levels and treatment methods are also outlined in Table 10-6.

Table 10-6 Treatment Methods for Feral and Wild Pigs

Pest Category	Treatment Method Threshold	Timing	Treatment	Treatment Constraints
Feral & Wild Pigs	Incipient: < 2 individuals	Year-round	Shooting incidentally observed individuals	Not possible in heavy visitor use areas
	Medium to large populations	Year-round	Cage and corral trapping program	

Prevention

- **Fencing.** Exclusion of pigs with pig-proof fencing can be effective in preventing high value areas from being invaded by pigs. Fencing must be maintained annually to be effective. Pig-proof fencing is usually very expensive to install and maintain and also has the possibility of restricting the movement of native animal species. It is an effective strategy for protecting extremely high value natural areas, agricultural lands, or archeological sites in small areas.

Physical Control

- **Shooting.** Shooting (either hunting or professional depredation) is the most common method for feral pig control throughout California (CDFW 2013). Though state sport hunting is regulated in such a way to offer some control of pig populations, there can still be a population increase above target levels because pigs often change their behaviors to avoid hunting pressure. Permitted depredation hunting with the assistance of tracking dogs or using nighttime vision aids and thermal imaging can increase the effectiveness of managing populations. Shooting methods should only employ lead-free, copper-based ammunition to reduce non-target mortality to pig carcass scavengers. Shooting has limited public appeal in and near recreational facilities and may not be a practical option for the District.
- **Trapping.** Trapping is the most effective means for regulating wild pig populations on a small landscape scale, although it must be done in perpetuity to maintain low population numbers. Cage- or corral-type traps are the most commonly used trap design in California. Snares have been found to be highly successful in Hawaii and Texas. Cage traps function by attracting single or multiple pigs into traps with bait through a one-way or guillotine trap door. Since pigs have large home ranges and they can disperse over large landscapes, effective trapping must focus on areas pigs are actively using. This requires the trapper to scout large landscapes or use a network of camera-traps to identify locations where pigs are actively travelling and feeding. Pre-baiting increases the effectiveness of live-catch traps. Trapping requires great effort and costs are typically high, but it is currently one of the most effective available methods for population control. All cage trap and snaring methods must be permitted through the CDFW on a project-by-project basis.

Chemical Control

- **Toxicants.** No toxicants are currently registered for the control of pigs, although some are in development for Federal registration through the EPA (Lapidge 2012).
- **Contraception.** Currently, no immuno-contraceptives are registered for use on wild pigs although some are in development. The Wildlife Society considers wild pig contraception controls to be impractical in the field (Fagerstone 2002), so they are likely not a viable treatment method for managing feral pigs on District lands.

FERAL PETS

As with non-native turtles, domestic animals are sometimes released by preserve visitors, or wander into preserves on their own. Some people feel ethically motivated to release captive pets and food animals back into natural environments for humane reasons or when they no longer wish to care for them. As a result, domestic cats, dogs, rabbits and other species end up living in preserves, and utilizing native rodents, plants, and insects for food.

Prevention

- **Education.** Education can be an important tool for the District in preventing pets from being intentionally released onto District lands. Public outreach and judiciously placed educational materials such as signs and brochures in District preserves may be a useful strategy to curb intentional releases of animals.

Live Capture

Utilize catch pole or otherwise trap dogs, cats, turtles, rabbits and other domesticated animals found escaped or released in the preserves and return them to their owners or turn them over to local animal control departments or animal shelters.

10.8.2 INSECT PESTS IN NATURAL AREAS

In general, insects are considered a natural component of the District's natural areas and do not warrant control. In some limited circumstances, such as restoration of a native habitat through active planting, short term insect control may be warranted (for example, to control stinging insects or Argentine ants within a specified area during clearing or planting to protect worker or volunteer safety, plant health, and promote native insect pollination). For information regarding control of insect pests in natural areas, refer to the Buildings section (Chapter 6).

10.8.3 INVASIVE PLANTS

The selection of physical control, chemical control, or other treatment methods for the District's target invasive plant species on over 60,000 acres of terrestrial and aquatic habitats in natural areas, various rangelands, and agricultural properties is an extremely complex task. This document is only intended to summarize generalized options for simplified management scenarios, and to provide decision-making tools for the thoughtful implementation of an IPM strategy. Staff who are selecting a project-level IPM strategy must take into account site-specific conditions, detailed life history information for a target invasive plant, project history, an understanding of the native vegetation where these plants occur, the impacts of the target plant, and the feasibility for safe and effective long-term control. Maintaining pest levels below a desired tolerance level will ultimately rely on several integrated methods for various stages of the project; rarely will a single method, pesticide or otherwise, suffice to achieve long-term success.

ANNUAL AND BIENNIAL INVASIVE PLANTS

Annual plants live for one growing season and germinate from seed. Only the dormant seed bridges the gap between one generation and the next. Biennial plants have a similar life history except they can live for several growing seasons before flowering and death. After germination, many species develop into prostrate (i.e., ground-hugging) basal rosettes. This growth form allows the plant to suppress germination of other plants near its root zone to maximize the solar energy reaching its leaves. After a critical amount of energy is collected and stored in the basal rosette form, the plant initiates its final growth stage and elongates or 'bolts' to produce a flowering stalk. Environmental cues that initiate bolting, flowering, and seed production include changes in day length, light and temperature, soil moisture and other stresses to the plant (Lanini 2002).

Many annual plants, both native and non-native, are considered 'weedy' because they have generalist rather than specialist life history traits. Annuals may be self-fertile or require pollination, or may utilize a combination of both pollination strategies. Often, invasive plants are highly successful because they produce many viable seeds with or without specialized pollination. In contrast, many native plants rely on specific native pollinators such as solitary native bees and cannot compete with the volume of seed production of invasive plants. Since annuals rely entirely on seed production for survival, the most successful invasive annual plants typically produce tremendous amounts of seeds each year. Many invasive (and native) species also have specialized seed coats that aid in seed dormancy in the soil, allowing the seed bank of a plant to persist in the soil for many years. Seed dormancy allows the plant to germinate only when environmental conditions ideal for growth are present and allows for seedling emergence over several decades instead of just one or a few years. The extended germination period of some invasive species can be problematic for control efforts, as follow-up treatments for new seedlings may be required for many years.

Within District lands there are two main growing seasons for annual and biennial invasive plants: referred to as early season and late season. Early season annuals and biennials germinate, flower, and seed between November and June, while late season annuals and biennials germinate, flower, and seed between February and August. Common annual invasive plants that the District currently manages include yellow star-thistle (*Centaurea solstitialis*), wooly distaff thistle (*Carthamus lanatus*), and Italian thistle (*Carduus pycnocephalus*). Biennials include purple star-thistle (*Centaurea calcitrapa*) and poison hemlock (*Conium maculatum*).

PERENNIAL INVASIVE PLANTS

Perennial plants persist for many growing seasons and have a great diversity of growth strategies. Perennials include ferns, bulbs, herbaceous plants, woody shrubs, and trees. Herbaceous perennial plants typically go dormant, die back, and or lose their leaves each winter and regrow from the root system the following spring. Evergreen perennial plants retain their above-ground stems and leaves throughout their life, except sometimes in cases of extreme stress (e.g., drought). Deciduous perennial plants retain their aboveground stems but lose their leaves seasonally when they are not actively growing. Trees and shrubs are perennial plants with woody stems, and can be either evergreen or deciduous.

Understanding the biology and reproduction method of perennials is essential to developing effective control strategies. Perennial plants can have multiple reproduction methods, including seeds, re-growing from vegetation fragments, or resprouting or colonizing from roots. In some cases species may use a combination of all these reproductive strategies for successful establishment and expansion. Perennial plants can spread vegetatively from many different portions of the plant (e.g., from runners, tubers or bulbs, root fragments) depending on species. Preventing seed production in perennial invasive species that rely exclusively on seeds for regeneration can deplete the existing seed bank, (as with annuals), but this strategy does not address the parent population which must also be controlled. Control of perennial plants often focuses on removal of the roots or other underground storage tissues, where energy reserves are stored. However, this treatment method may result in ground disturbance and/or soil erosion that must also be mitigated or avoided.

PEST MANAGEMENT STRATEGIES FOR INVASIVE PLANTS

Prevention and control of invasive plants is discussed below. Tolerance levels and treatment methods are also outlined in Tables 10-7 (Annual Plants) 10-8 (Perennial Plants), and 10-9 (Aquatic Plants).

Prevention

- Develop and implement an employee and contractor prevention training program; include invasive plant identification and cleaning protocols for clothing, tools, and vehicles.
- Inspect recreational facilities (e.g., parking lots, trails, visitor centers) that experience high visitor use often during target invasive plant flowering and seed production times. Treat any detected target invasive plant populations to prevent spread from the facility into the preserves.
- Establish and maintain cleaning and prevention facilities (e.g., boot cleaning stations) and post educational materials in parking lots and trailheads to encourage visitors to clean their boots, socks, pants, etc. before entering District lands.
- If target invasive plants have already begun to flower and set seed before management, consider manual control methods (e.g., cutting and bagging the flower/seed heads) intended to reduce the amount of new seed released. This type of active management is only feasible for small populations.
- Prevent the spread of plant fragments (roots, stems) of certain perennial species that can produce new plants from these plant fragments during soil disturbing activities such as trail and road maintenance.

Physical Control

Physical control of invasive plants includes actions that physically remove plants in part or in their entirely, including (but not limited to) hand pulling using weed wrenches, shovel; mechanical control using brushcutters, chainsaws, mowers and similar equipment; and other types of control to remove plants such as green flaming (i.e.,use of a propane torch on emergent seedlings), or grazing the plant using livestock. These types of controls are described in more detail below.

Table 10-7 Treatment Thresholds and Methods for Annual and Biennial Invasive Plants

Pest Category	Treatment Method Thresholds	Phenology	Timing	Treatment	Treatment Constraints - Assets
Annual/ Biennial Invasive Plants	Incipient/small: < 100 individuals	Basal rosette or bolting before seed production	February - May	Manual (Hand removal)	Use for small infestations only; worker hazards may occur when applied at larger scales
	Small to medium: < 5 acres	Bolt stage – flowering	March - June	Cutting (Mowing)	Not effective on most species - especially not biennials; to be used for suppression/containment goals only
	Small to medium: < 5 acres	Early seedling - from germination to appearance of first true leaves	November - January	Propane Torch (Green Flaming)	Narrow timing window; only appropriate for sparse vegetation with low ignition potential. Usually applied during rain events to reduce wildfire risk.
	Medium to large: > 5 acres	Seedling to pre-flowering grasses	December - April	Herbicide: clethodim	Highly selective to monocots only; rate selective for annual grasses only
		Seedling stage through late flowering/bud stage	December - April	Herbicide: glyphosate	Spot treatments; non-selective
		Pre-germination to flowering stage	November - July	Herbicide: imazapyr (pre/post emergent)	Spot treatments where residual control of seedlings is desired; non-selective
	Large: > 5 acres	Pre-germination to dicot seedling stage	December - February	Herbicide: aminopyralid (pre/post emergent)	Moderately selective for specific dicot plant families only; promotes grass and unaffected dicot species
		Later dicot seedling stages – bolting	January - March	Herbicide: clopyralid (pre/post emergent)	Highly selective for specific dicot plant families only; promotes grass and unaffected dicot species
		Bolt stage – flowering	March - June	Grazing	Effective on only some species; effectiveness varies by stock type, grazing season, grazing rotation and intensity

Table 10-8 Treatment Thresholds and Methods for Perennial Invasive Plants					
Pest Category	**Treatment Method Thresholds**	**Phenology**	**Timing**	**Treatment**	**Treatment Constraints - Assets**
Perennial Invasive Plants	Incipient/small: < 100 individuals	Herbaceous perennials - seedling to mature	Any time	Manual (Hand removal)	Use for small infestations only; worker hazards may occur when applied at larger scales
	Incipient/small: woody plants with trunk diameter < 2”	Woody plants/trees - Seedling to mature	Any time	Manual (Digging - Leveraged Pulling)	Use for small infestations only; worker hazards may occur when applied at larger scales
	Small to medium: < 5 acres	Flowering to bud stage	December - July	Cutting (Mowing)	Not effective on most species; for suppression/containment/pre-treatment goals only
	Small to medium: < 5 acres	Early seedling - from germination to appearance of first true leaves	November - January	Propane Torch (Green Flaming)	Narrow timing window; only appropriate for bare ground areas with no ignition potential
	Medium to large: > 5 acres	Seedling to pre-flowering grasses	December - April	Herbicide: clethodim	Highly selective to monocots
		Seedling stage OR late flowering/bud stage	December - July	Herbicide: glyphosate	Spot treatments; non-selective
		Seedling or actively growing	December - June	Herbicide: aminopyralid (pre/post emergent)	Moderately selective for specific dicot plant families only; good for difficult to control vines/brambles
		Seedling or actively growing	December - June	Herbicide: clopyralid (pre/post emergent)	Highly selective for specific dicot plant families only; good for difficult to control vines/brambles
		Pre-germination to flowering stage	November - October	Herbicide: imazapyr	Spot treatments where residual control of seedlings is desired or difficult to control species; non-selective
	Trees > 6” stump diameter	Actively growing, post-flowering	Anytime	Herbicide: glyphosate	Spot treatments; non-selective
		Actively growing, post-flowering	Anytime	Herbicide: imazapyr	Spot treatments where residual control of seedlings is desired or difficult to control species; non-selective; basal bark treatments
		Conifers – mature	Anytime	Cutting	Hand methods time consuming; mechanical harvesters for large areas > 10 acres

- Pulling of individual plants by hand before flowering and seed development. Given the stout taproot of many annuals and biennials, it is best to undertake hand removal after regular periods of rain when the soil is moist and the entire taproot can be easily removed. Grasp the plant at the base and pull straight up. Leaving the portion of the root deeper than a quarter to a half inch below the surface is usually acceptable for annual species as they are not likely to re-sprout from a remaining root fragment. Digging tools can also be used to loosen the root out of the soil, however, limit the amount of soil disturbance as much as possible.
- Cutting plants below the root crown with a pick or shovel before flowering or seed set (to be applied only to crown-sprouting plant species). Perennial invasive plants with large amounts of vegetative material are often be easier to control once the mass of above-ground vegetation is cut to near-ground level (e.g., large perennial grasses and shrubs) to improve access to the root system. For plants that can regenerate from underground root fragments, root and/or stem material would be carefully collected, then disposed of in compost or garbage offsite or completely covered (composted, solarized) onsite to prevent it from re-establishing onsite.
- Mowing of late season annuals/biennials when a very small percentage of plants are beginning to flower. Mow as close to the ground as is safe (hitting rocks with mowing equipment may cause sparks and risk start a fire). Follow-up mowing may be required at four- to six-week intervals. Mowing early season annuals/biennials, or mowing late season annuals/biennials too early will likely result in resprouting and formation of multiple flowering stalks during bolting (thereby increasing seed production).
- Green flaming of young seedlings with a hot propane flame immediately following germination. This method is typically applied in early winter, during or immediately after a rain event to reduce potential for wildfires. Green, referred to in this report as “green flaming” is only effective on some species of non-fire adapted herbaceous and shrub species (dicots), and it is not effective on grasses (monocots).
- Selective grazing to remove or suppress some species when grazing is timed for periods when the plants are both palatable to the selected type of livestock (e.g., goats for brush, cattle or sheep for grasses) and susceptible to grazing effects (i.e., when plants are very young and do not have substantial underground energy reserves built up to support re-sprouting).
- Hand removal of small insipient populations of perennial invasive plants. Hand-removal of mature plant parts would be accomplished using a weed wrench, or by digging up individual plants, including as much of the root system as possible. Multiple re-treatments would be required for the control of most invasive perennials, because their root systems are often large and challenging to pull manually and many species have regenerating roots, stolons, and rhizomes that can break off during the removal effort and regrow. Digging can also promote soil disturbance, a secondary effect that can promote the germination of new seedlings in disturbed soils areas.
- Burning to reduce greenwaste. After large stands of broom are pulled, the green plants would be stacked in piles no greater than six feet by six feet to dry out. The piles would be located on mineral soils with a 4-inch by 12-foot wide trench to catch debris and would not be located under the drip line of trees. Brush piles would be burned during the wet season on days that the Bay Area Air Quality Management District (BAAQMD) designates as “open burn status” and the piles would be monitored to ensure that all combustible material is consumed before leaving the site. Notification Form C for Hazard Reduction Fires would be filed with the BAAQMD, and all conditions of Hazard Reduction Fires per BAAQMD regulations would be followed.
- Use of tractor-mounted implements. Jawz is a hydraulic implement mounted onto an excavator or other tractor. Opposing jaws pinch the stalk of the plant and the arm of the excavator pulls the plant out by its roots and then drops it in a pile for future burning, chipping, or composting. The use of Jawz would be limited in steep terrain and areas where there is excessive soil. Removal of coyote brush is the most common species that Jawz are used for on District lands.
- Use of a masticator for brushing. A masticator is a high-rotation drum with fixed teeth mounted on the hydraulic arm of an excavator that pulverizes vegetation. A masticator would be used for structure brushing, road brushing, parking lot brushing, fuel breaks, and brush removal in grasslands. The masticator would cut

vegetation ranging from grass to 6-inch diameter trees and can reach up to 22 feet horizontally. Masticators leave behind mulch and pieces of shattered wood up to approximately 12 inches long and can require, depending on vegetation, follow-up use of chainsaws by field staff. Use of a masticator would be limited by terrain and soil moisture (i.e.,soft ground). A masticator would be used less than four miles per year.

- Hairy weevil biocontrol insects for yellow starthistle. Release of approximately 20,000 hairy weevils (*Eustenopus villosus)* on approximately 800 acres per year at Fremont Older, Monte Bello, Rancho San Antonio, Russian Ridge, Skyline Ridge and St. Joseph's Hill and possibly biocontrol at other preserves in the future. This form of biocontrol is intended to control seed production of yellow starthistle. Selected areas are typically heavily infested with yellow starthistle, and other forms of control were determined to be infeasible due to site access limitations, labor costs or staffing safety issues. In these instances, biocontrol is intended to keep the infestations from spreading or becoming denser, until such time as other methods can be utilized.

Chemical Control

Chemical control of annual and biennial weeds includes two strategies to treat different life stages: 1) post-emergent (i.e., direct application of herbicide to eliminate the plant), and 2) pre-emergent (i.e., treatment to prevent the germination of seeds). Herbicides are also classified as either selective or non-selective. Selective herbicides control plants in specific plant families or life stages, while allowing other plants to survive uninjured. Utilizing selective herbicides can be a powerful tool in balancing active management with protecting desirable, native vegetation types. Non-selective herbicides and application methods injure all plant species that are directly exposed to treatment, so should be directed only to the target species. Selectivity may be based on the chemistry of the herbicide, but can change with the timing of the application.

- **Aminopyralid,** the active ingredient in Milestone™, is a selective herbicide used to control broadleaf invasive plants, especially sunflower and bean plant families. Milestone™ is an EPA Reduced-Risk pesticide product that is considered to have low exposure risks associated with wildlife and humans, especially in natural areas where exposure levels will be of short duration and low total exposure rates (Appendix A). Plants in the nightshade, bean, rose, and sunflower families are particularly sensitive to this herbicide. However, grasses are not affected by the herbicide when used after grass seed germination, making it an attractive IPM option for annual plant control in grasslands. Aminopyralid controls plants by disrupting the normal hormone balance, targeting auxins, and causing uncontrolled growth in susceptible plants. Symptoms of effective aminopyralid application include bending and twisting of stems and petioles, swelling at nodes, stem elongation, leaf curling, chlorosis (yellowing) of growing points, and plant mortality within three to five weeks. Aminopyralid persists in the soil and is absorbed by plant roots, and thus prevents germination of new seeds after an initial treatment. It can be used before an invasive plant species germinates in a known population area, or well after seedlings emerge, making it a nimble tool for invasive species plant control.
- **Clopyralid,** the active ingredient in Transline™, is a selective herbicide used to control broadleaf invasive plants, especially thistles and clovers, and woody leguminous plants. Plants in the nightshade, bean, and sunflower families are particularly sensitive to this herbicide. Grasses are not affected by it, making it an attractive IPM option for annual invasive plant control of these susceptible broadleaf plants in grasslands. Clopyralid is a growth regulator, is rapidly transported through plants primarily through the phloem and accumulates in growing points. It is absorbed into the plant by leaves, stems, and roots. Symptoms of effective clopyralid application include bending and twisting of stems and petioles, swelling at nodes, stem elongation, leaf curling, chlorosis (yellowing) of growing points, and plant mortality within three to five weeks. Clopyralid can travel through soil and should not be used where soils have very rapid permeability, such as loamy sand to sand. Transline™ is very similar to Milestone™ but it is more selective (i.e., active on a narrower list of susceptible plant families). It is useful in controlling invasive thistles and legumes on rangelands, so is used in situations when the less-selective Milestone™ could impact desirable native plants.

Transline™ is also generally more effective than Milestone™ on later plant growth stages so it is a valuable backup for Milestone in certain conditions.

- **Glyphosate,** the active ingredient in both Roundup ProMax™ and Roundup Custom™ (formerly sold as Aquamaster™), is a non-selective herbicide used to control a wide variety of plants, including annual broadleaf plants, grasses, perennials, and woody invasive plants. It is absorbed through foliage and moves throughout the plant's growing points. Glyphosate's mode of action is to inhibit an enzyme involved in the synthesis of aromatic amino acids, making it effective on all herbaceous and woody growing plants, but not effective as a pre-emergent herbicide. It is a rather slow-acting herbicide with symptoms appearing within about a week, including yellowing and stunting of young leaves and growing points, however it may take up to two weeks for complete plant mortality. Young, actively growing plants are most susceptible to glyphosate treatments when applied during warm weather. Perennial woody plants are best treated in the late summer or fall when plants are moving carbohydrates into their underground storage tissues. Glyphosate is the most commonly used herbicide in invasive plant control in natural areas, and herbicide resistance is a growing problem in some annual species (Monsanto 2008).

  Roundup ProMax™ contains a surfactant (i.e., a substance that adhere pesticides to plant leaves) that enhances the absorption of glyphosate on treated leaves so it is considered by herbicide applicators to be an efficient product to mix and apply. Roundup Custom™ contains only glyphosate dissolved in water with no surfactant, and is thus recommended for use on plants in aquatic, riparian, and other sensitive habitats. It is often mixed with an appropriately labeled surfactant to enhance the spread, adhesion, and penetration to the target plant, thereby increasing effectiveness of the entire mixture.

- **Imazapyr,** the active ingredient in Stalker™ and Polaris™ /Habitat™, is a non-selective herbicide used to control a broad range of invasive plants including grasses, broadleaf herbs, woody plants, riparian plants, and emergent aquatic species. Imazapyr has a similar mode of action as glyphosate but acts on a different suite of essential amino acids. Imazapyr is absorbed by leaves and roots, and moves to growing points; it disrupts protein synthesis and interferes with cell growth and DNA synthesis, causing plant mortality. Unlike glyphosate, imazaypyr has pre- and post-emergent effects. It also has moderate soil persistence, which can be useful for difficult-to-control species for which glyphosate is less effective or when parallel treatments of the parent population and seedlings are desired.
- **Clethodim,** the active ingredient in Envoy Plus™, is a selective herbicide that provides post-emergent control of grasses. It does not affect broadleaf plants or sedges and has no uptake through roots or pre-emergent effect. Clethodim is a lipid-synthesis regulating herbicide that impacts chemical pathways that are only present in some monocots (e.g., grasses). Clethodim is most effective on young grasses, especially annuals, and thus is recommended for early season application only. Grass-specific herbicides are highly effective tools for problem invasive grasses that grow in complex native vegetation. They are effective tools for the elimination of annual and perennial grasses in broadleaf (dicot) dominated environments or in eliminating annual grasses from some perennial grassland systems.

AQUATIC INVASIVE PLANTS

Aquatic invasive plants, like terrestrial invasive plants, can arrive on District preserves from a variety of sources including migrating birds, animals, and humans or they are already present on properties that the District purchases. Often, a small seed or plant fragment stuck to a duck's foot or canoe paddle is all that is necessary to expose a wetland habitat to a new invasive aquatic species. Aquatic invasive plants are divided into two major groups; 1) emergent invasive plants and 2) submerged invasive plants. Each group requires a different control strategy. Emergent invasive plants, in general, are rooted in soil below shallow water from one inch to 24 inches deep, and extend leaves above the water surface at least seasonally; or they can grow in neighboring upland areas as long as their roots can easily reach the water table (Anderson 2002). Some emergent invasive plants are actually floating plants that need no soil contact. Submerged invasive plants are those that grow on the bottom of lakes, rivers, and streams and do not need exposure to the air to complete their life cycles.

Aquatic invasive plants can compromise both fish and wildlife habitat, promote flooding, provide breeding habitat for mosquitoes, and can impede or slow the distribution of water in irrigation canals/ditches (Thunberg 1992). All aquatic invasive plant control requires specialized expertise and equipment to effectively manage the target pest. Submerged invasive plants are especially difficult to control and often require specialty floating equipment and boats to access the plants.

Native aquatic plants can require management as well to maintain navigational, recreational and agricultural uses of water bodies. Native vegetation in ponds and other static water bodies decomposes to naturally fill-in to a point where they eventually cease to be water bodies. At times, the District manages water bodies to support aquatic wildlife and agriculture that requires occasional maintenance. Plants and sediments are mechanically removed to increase shoreline areas and sustain open water habitats.

PEST MANAGEMENT STRATEGIES FOR AQUATIC INVASIVE PLANTS

Prevention and control of aquatic invasive plants is discussed below. Tolerance levels and treatment methods are also outlined in Table 10-9.

Table 10-9 Treatment Thresholds and Methods for Aquatic Invasive Plants

Treatment Method Thresholds	Phenology	Timing	Treatment	Treatment Constraints - Assets
Incipient/small: < 10 individuals	Emergent perennials - seedling to mature	Varies by species	Manual (Hand removal)	Small amounts only; worker hazards at larger scales
Small to medium: < 5 acres	Emergent perennials - mature	Varies by species	Cutting (Mowing)	Not effective on most species; for suppression/containment/pre-treatment goals only
Small to medium: < 5 acres	All stages	Varies by species	Pond draining, pond skimming	Non-selective. Can be combined with aquatic animal control.
Large: > 5 acres	Floating perennials - mature	Varies by species	Harvesting	Requires specialized aquatic weed control machines

Prevention

- Develop and implement an employee and contractor training program; include aquatic invasive plant identification and cleaning protocols for clothing, tools, vehicles, and boats.
- Inspect recreational facilities that contain aquatic features often during target invasive plant flowering and seed production times. Treat any detected target invasive plant populations to prevent spread into District lands.
- Prevent the spread of plant fragments (roots, stems) of certain species that can produce new plants in irrigation ditches, canals, and streams.

Physical Control

- Pulling aquatic plants is similar to pulling terrestrial weeds, and requires removing the entire plant, including leaves, stems, and roots, and disposing of the material away from the shoreline. In wetlands and shallow water less than three feet deep, no special tools are required. Deeper water may require SCUBA divers equipped with mesh bags to collect plant fragments as they work. Additional precautions are required for staff working in aquatic locations to protect both the habitat and the staff.
- Specialized equipment can be used to excavate or 'harvest' floating or submerged aquatic vegetation. Generally these types of control efforts seek to clear waterways for adequate water flow or boat access

rather than completely eliminate the problem plant. They can be effective tools for the removal of biomass from flood control channels and navigable waterways.

- Pond draining may be implemented for small water bodies to eliminate invasive aquatic plants and invasive animals such as bullfrogs concurrently. Some plants have propagules that can remain viable during dry periods, so this method is only effective on some aquatic plant species. All projects that temporarily divert water and discharge sediment may require permits from regulatory agencies, and may require additional monitoring and reporting.

Chemical Control

Some of the herbicides included in the IPMP include those that are formulated for use in and near aquatic habitats (Roundup Custom™ for example, which can also be used with an added surfactant). The District on rare occasions may need to use chemical treatments within or very near to aquatic habitats including treatments in seasonal wetlands (during the dry season) to control pest species (e.g., to remove slender false brome or cattails). In these situations, the District would use herbicides suitable for aquatic habitats. The aquatic formulations for selected herbicides in the IPMP would most often be used in upland habitats within the District. These formulations are useful in upland areas for certain pest species because the surfactants included in the formulation provide increased adhesion to selected target plant species than the non-aquatic formulations and are, therefore, more effective at providing the desired control of the pest species.

- Roundup Custom™ contains only glyphosate dissolved in water with no surfactant, and is thus recommended for use on plants in aquatic, riparian, and other sensitive habitats.

- Imazapyr, the active ingredient in Stalker™ and Polaris™ /Habitat™, a non-selective herbicide used to control a broad range of invasive plants including grasses, broadleaf herbs, woody plants, riparian plants, and emergent aquatic species.

10.8.4 FOREST DISEASES

At present, the District manages forests primarily for ecological and recreational values (rather than for timber value), therefore management actions are focused on maintaining the long-term stability and resiliency of forests to disruptive changes such as climate change and forest diseases. The threshold for active management of forest diseases and invasive species focuses on the level of damage from a forest disease that could result in a substantial alteration in the forest species composition, extent, or density.

SUDDEN OAK DEATH

Sudden oak death (SOD) is plant disease caused by an exotic water mold (*Phytophthora ramorum*) that has been implicated in native oak and tanoak deaths throughout coastal California and Oregon (CA Oak Mortality Taskforce 2013). The disease often results in mortality of certain species of oaks, mainly tanoak (*Notholithocarpus densiflorus*), coast live oak (*Quercus agrifolia*), black oak (*Quercus kelloggii*), and canyon live oak (*Quercus chrysolepis*) but can also cause twig and foliar disease symptoms in many other native plant species. The wholesale loss of oak tree species in coastal forests can cause major ecosystem disruptions, especially because so many native species depend on oaks and their fall acorn masts. Sick and dying trees also greatly increase the wildfire risk in native coastal forests dominated by oaks.

It is still uncertain how the invasive forest pathogen *Phytophthora ramorum* causing sudden oak death (SOD) will impact the native forests and woodlands of the greater Bay Area. Methods such as selective removal of California bay laurel trees (known to harbor the pathogen), pesticide applications, and promoting conifers over hardwoods have all been proposed for local and landscape scale management of the SOD pathogen (Filipe 2012). The SOD pathogen is extremely difficult to detect until advanced infection and symptoms are visible in individual plants. Because this pathogen is a water mold, it can move great distances through the landscape using wind (e.g., windborne transport of spores) or through water (e.g., transport of spores in waterways and through fog drip) making management very difficult at any scale (Filipe and Cobb 2012). The landscape scale management of high value forested areas (e.g., selective removal of diseased trees, selective removal of host plants such as California bay laurel, replanting conifers and other disease-resistant tees) may be one of the few ways to slow the spread of the disease. District staff should consult the California Oak Mortality Task Force (http://www.suddenoakdeath.org) for the most recent information on effective control of SOD.

PEST MANAGEMENT STRATEGIES FOR SUDDEN OAK DEATH

At present, the District monitors and manages SOD on Rancho San Antonio, Monte Bello, El Corte de Madera Creek, Los Trancos, Russian Ridge, Skyline Ridge, Long Ridge and Saratoga Gap OSPs. It is unclear if the vegetation composition shift is a temporary phenomenon, or a more permanent result of the disease infestations. Because the long-term effect of the disease on California's forests are unknown, the District is working with the California Oak Mortality Task Force to further study and monitor the impacts of the disease on District lands. In 2006, the District adopted a ten-year Sudden Oak Death plan to map oak trees on District Preserves that are potentially resistant to the SOD pathogen, treat a selected number of specimen oak trees, and establish collaborative funding for SOD research to help guide land management decisions.

The following list outlines general steps that District staff will follow when managing SOD infestations:

- Track the effects of SOD disease (mapping dead oaks as staffing and budgeting permit), and share this information with the California Oak Mortality Task Force (www.suddenoakdeath.org) as staffing and funding allow.
- Removal of California bay trees or their branches within 15 feet of the trunks of high value oaks. Ongoing research at the District and other locations in the state are evaluating whether bay removal is effective for managing larger stands or forests infested with SOD or to prevent or slow down the spread of SOD. This option is costly and requires regular maintenance and monitoring and, therefore, is implemented in limited areas.
- For individual high value oaks such as very large mature oaks near picnic facilities, consider spot treatment of individual oaks with pest control sprays (e.g., Agri-Fos™) intended to reduce potential for SOD infection. Due to high cost, this option should not be applied on a landscape level.

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11 GLOSSARY

Active management — Physical actions intended to manage natural resources or built facilities for a desired outcome. Active management may include physical control (hand, mechanical control), or chemical control of pests or manipulation of their habitats. For example, mowing yellow star-thistle to remove it from an infested rangeland would be considered active management. In contrast, ***passive management*** includes design and cultural practices intended to change human behavior or the physical environmental in a manner that discourages pests from occurring. For example, installing boot cleaning stations, or requiring ranchers to inspect feed for yellow star-thistle seeds would be considered passive management.

Allelopathy/Allelopathic effect — The suppression of growth of one plant species by another because of the release of toxic substances. The effect of suppressing the growth around a plant resulting from the release of toxic substances.

Auxin — A class of substances that in minute amounts regulate or modify the growth of plants, especially root formation, bud growth, and fruit and leaf drop.

Basal rosette — A cluster of leaves spreading outward from the base of a low-growing plant. In thistles, such as yellow star-thistle, a basal rosette forms just before the plant bolts (i.e., sends up a main stem on which flowers are produced). Often, the timing of pest control treatment of plants is recommended for the "basal rosette stage."

Bolt stage — A plant developmental stage during which a young plant sends up a main stem on which flowers are produced. The timing of pest control treatment of plants is often recommended for either just before or just after "bolt stage"

Broadleaf — Plants possessing broad (as opposed to needlelike or grass-like) leaves. Most of the trees and shrubs on District preserves are broadleaves. Pest control treatments prescribe different treatments for broadleaf plants than for grasses, sedges, and needle-bearing trees such as pine trees.

Chlorosis — A condition in which leaves produce insufficient chlorophyll. As chlorophyll is responsible for the green color of leaves, chlorotic leaves are pale, yellow, or yellow-white. The affected plant has little or no ability to manufacture carbohydrates through photosynthesis and typically dies. Some pest control of plants induces chlorosis, thereby eliminating the pest plant's ability to survive and reproduce.

Containment — A pest control strategy that focuses on establishing a pest-free area (e.g., a mowed or cleared area around a well-established population of invasive plants), and ensuring, through active management, that the target pest does not move past the defined area into the surrounding (pest free) areas. Containment is typically used when eradication of a target pest is no longer considered a viable an option.

Control — A pest control strategy that focuses on reducing the number, amount, or extent of a pest over time to achieve a defined tolerance level. Control may result in full eradication of a pest, or reduction in the pest such that is no longer causes economic or environmental damage, or human health concerns.

Dicot — Dicotyledons, (also known as dicots), are a group of flowering plants whose seed typically produce two embryonic leaves or cotyledons when first germinating. Pest control techniques often prescribe different treatment for dicot plants than for ***monocots*** (i.e., grasses, sedges and bulbaceous plants that only produce one embryonic leaf)

Eradicate — A pest control strategy that focuses on eliminating all members of a target pest population.

Gigging — A pest control method typically used to kill bullfrogs, fish, and other aquatic pests whereby the animal is speared with a trident or spear while in water.

Herbicide — A pesticide (see definition below) intended for preventing, destroying, or controlling plant pests.

Herbivory — A type of predation typically used to describe the consuming of plants by animals. Herbivory has an impact on the health, structure, and diversity of natural plant communities. For example, low level herbivory can remove aging roots and leaves, allowing new growth of young roots and shoots resulting in healthy plant growth. At high levels, herbivory can damage plants, changing the composition, and reducing the quality of the natural plant community.

Homopteran Insect — A suborder of insects, including cicadas, aphids, and scale insects, having wings of a uniform texture held over the back at rest

Hypercalcemia — An abnormally high level of calcium in the blood. In pest control, hypercalcemia is usually associated with rodenticide use.

Injurious — The term “injurious wildlife” refers to a defined list of species identified in either the federal Lacey Act (18 U.S.C. 42) or related implementing regulations (50 CFR 16). The U.S. Fish and Wildlife Service Office of Law Enforcement plays a role in preventing the introduction of invasive species into the U.S. through the enforcement of the Lacey Act which makes it illegal in the United States to import injurious wildlife, or transport such wildlife between states without a permit. Species are placed on the list when they are determined to be injurious to: human beings; the interests of agriculture, horticulture, forestry, or wildlife; or wildlife resources in the U.S.

Insecticide — A pesticide (see definition below) intended for preventing, destroying or controlling insect pests.

Insipient (invasive population) — A population (usually referring to an invasive plant) that is small, but is beginning to reproduce and become established in a location or a region.

Metamorph (amphibian) — A major change in the form or structure of some animals or insects that happens as the animal or insect becomes an adult. For amphibians, a metamorph refers to the stage of development between larval and adult. For example, the stage between a tadpole and adult frog. Some pest control techniques recommend treatment timing before or after the metamorph stage.

Monocot — Monocotyledons, (also known as monocots), are a group of plants whose seed typically produce only one embryonic leaves or cotyledon when first germinating (e.g., grasses, sedges and bulbaceous plants). Pest control techniques often prescribe different treatment for monocot plants than for dicots (i.e., plants that produce two embryonic leaves when first germinating, such as flowering plants)

Non-Native Species — An introduced, alien, exotic, non-indigenous, or non-native species. Includes species living outside their native distributional range, which have arrived there by human activity, either deliberate or accidental. Some introduced species are damaging to the ecosystem they are introduced into, others have no negative effect and can, in fact, be beneficial as an alternative to pesticides in agriculture for example. Refer to the definition of pest and invasive species (below) to differentiate non-native species that cause harm from other non-native species.

Noxious weeds — A plant species that has been designated by country, state, provincial, or national agricultural authority as one that is injurious to agricultural and/or horticultural crops, natural habitats and/or ecosystems, and/or humans or livestock. These weeds are typically agricultural pests, though many also have impacts on natural areas. Many noxious weeds have come to new regions and countries through contaminated shipments of feed and crop seeds or intentional introductions such as ornamental plants for horticultural use.

Pest Species — Insects, animals, or plant species that are incompatible with the District's goal of protecting and restoring the natural environment, and with providing opportunities to enjoy and learn about the natural environment. Several categories of pest species are defined below:

- **Invasive species** are animal or plant species that invade and dominate sufficiently large areas, causing a reduction in biodiversity. They proliferate in the absence of natural control and interfere with the natural processes that would otherwise occur in natural areas. Once established, invasive species can become difficult to manage and can eliminate native species or otherwise alter the ecosystem. Invasive species are targeted in natural areas and rangelands. Invasive species can alter ecosystem processes by changing biotic ecosystem characteristics (such as plant community composition, structure, and interactions; trophic relationships; and genetic integrity) and abiotic characteristics and processes (such as fire regimes, erosion, sedimentation, hydrological regimes, nutrient, and mineral conditions, and light availability).
- **Structural and agricultural pests** include insect, plant, and animal pests that damage occupied buildings, formal landscapes, or agricultural crops, or pests that are a health threat to humans working in, living in, or visiting the buildings. Examples of structural pests include termites, ants, rodents, and stinging insects in buildings, and weeds in formal landscaped areas. Examples of agricultural pests include insects, weeds, and burrowing mammals such as moles and voles that damage crops. Structural and agricultural pests are targeted in buildings, recreational facilities, and agricultural properties.
- **Nuisance pest species** include species that commonly occur on District lands, such as stinging insects, but whose presence can be incompatible when their proximity or behavior conflict with human use of buildings and recreational facilities in the preserves. For example, hornets that locate their ground nests in trails must be removed if they are stinging hikers and horses using the trail. Branches and other types of vegetation must be trimmed back from trails, parking lots, picnic tables, and benches to allow safe visitor use. Similarly, vegetation must be cut back from the sides of roads to keep them open for patrol, maintenance, and emergency vehicles. Problem pest species are targeted in areas with focused visitor use.

Pesticide — A substance or mixture of substances intended for preventing, destroying or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals causing harm during or otherwise interfering with the production, processing, storage, transport or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs, or substances which may be administered to animals for the control of insects, arachnids or other pests in or on their bodies. Pesticide is a broad term that encompasses:

- ***Herbicides*** (substances intended to control plant pests),
- ***Insecticides*** (substances intended to control insect pests),
- ***Rodenticides*** (substances intended to control rodent pests),
- ***Other Substances,*** such as ***Fungicides*** (substances intended to fungus pests) and ***Surfactants*** (substances that adhere pesticides to surfaces such as plant leaves) and other substances often used with other pesticides to increase treatment results.

Phloem — The living tissue in plants that carries soluble organic material made during photosynthesis -in particular, sucrose, to all parts of the plant where it is used for growth and reproduction. Many pest control treatments focus on disrupting the phloem through mechanical or chemical means, thereby disrupting the flow of nutrients to the plants, causing plant death.

Pre-bait — A substance used to attract pests (e.g., rodents or other animals) to a feeding site as a preliminary step to use of a rodenticide or other pesticide to control the target pest.

Propagule — Any vegetative portions of a plant, such as a bud, stolon, root, tuber, rhizome, or other offshoot, that aids in the dispersal of the species and from which a new plant may grow. In pest control, follow-up treatments for invasive plants often focus on prevention and control of propagules after the initial mature plants are treated.

Rhizome — A modified subterranean stem of a plant that is usually found underground from which a new plant may grow. Plants often send out roots and shoots from these modified stems, resulting in vegetative (asexual) reproduction of a plant. In pest control, follow-up treatments for invasive plants often focus on prevention and control of rhizomes after the initial mature plants are treated.

Root Crown — The junction between the root and shoot portion of a plant. Crown sprouting is the ability of a plant to regenerate its shoot system after destruction of the above –ground portions of the plant. Crown sprouting plants typically have extensive root systems in which they store nutrients allowing them to survive after damage to the above-ground parts of the plant. In pest control, follow-up treatments for crown-sprouting plant species often focus on control of resprouting vegetation after the initial mature plants are treated.

Shooting — A plant that sends up shoots (new growth) from the underground portions of the plant. In pest control, recommended treatments are often timed for when invasive plants are actively 'shooting' or sending up new growth.

Seed Bank — In natural systems, the natural storage of seeds, often dormant, within the soil below the parent plant. In invasive plant control, treatment often focus on long-term management of plants that sprout from the seed bank, often years after the initial removal of mature invasive plants.

Stolon — A prostrate plant stem, at or just below the surface of the ground, that produces new plants from buds at its tips or nodes. In pest control, treatments for plants that produce stolons often focus on removal of existing stolons, and retreatment of new plants produced from any remaining stolons.

Taproot — A large, somewhat straight to tapering plant root that grows downward that forms a center from which other roots sprout laterally. The taproot system contrasts with fibrous root system, which typically have with many branched roots. Pest control of invasive plants often focuses on removal of the entire taproot to kill the target invasive plant.

Tolerance Levels — The level at which pests can be present without disturbing or disrupting natural processes, causing economic damage, degrading intended uses or human enjoyment of built facilities, or resulting

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Appendix A

Pesticide Technical Background Information

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Pesticide Technical Background Information

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Shaping the Future

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1 Introduction

The Midpeninsula Regional Open Space District (District) undertakes weed and vector management activities to control noxious and invasive weeds and mobile vectors such as mosquitoes, wasps, hornets, Argentine ants, cockroaches, rats, mice, and certain wildlife (e.g., skunks, raccoons, opossum) that are a nuisance or risk to human and ecological health on District lands.

Because of the importance of providing needed weed and vector control without causing undue adverse impacts to human and ecological health, the District intends to implement a modified Integrated Pest Management (IPM) Program that embodies the use of the most effective, least toxic, suite of treatment options.

IPM is an adaptive strategy developed and utilized to manage insect, weed, and pathogen pest species in production agriculture and urban landscaping environments. Using modified, but similar, IPM strategies to manage wild lands is a relatively new approach and has only been undertaken by a small number of land management agencies. The District intends to evaluate, recommend, and implement weed and vector management in an effective and least toxic manner using currently available and defensible new pest control approaches. The District intends to become a leader in this new application of IPM philosophy and implementation for District wild lands.

While this cutting edge approach to land management can provide safer, more effective approaches to controlling unwanted vegetative and pest vectors, it is essential to understand the physical and chemical characteristics, relative toxicity, and possible adverse impacts to non-target receptors (i.e., humans, domestic pets, non-target wildlife and vegetation) of any pesticides that may be used. The technical background presented in this appendix will provide the necessary information for each pesticide considered for use in the District's IPM to provide the following results when chemical methods are necessary to meet a pest control objective:

> Providing the most effective treatment of unwanted vectors while achieving the most appropriate and least toxic safe application techniques.

> Reducing the potential for human and non-target animal exposure to chemicals.

> Reducing the potential adverse impacts to humans, animals and non-target vegetation.

> Reducing the potential for human and non-target animal discomfort or injury from applications and from exposure to non-vegetative vectors.

This technical background appendix addresses these objectives for the pesticides being considered to support the IPM approach for the District. In order to comprehensively evaluate the potential safety of the selected pesticides, each candidate chemical (active ingredient or product) is reviewed and evaluated for its reported fate and transport in the environment (summarized for quick reference in Table 1.1) and toxicity to humans and non-target wildlife and vegetation (summarized in tables at the end beginning of each pesticide category section). The evaluations are grouped by the general categories of herbicide, fungicide, rodenticide, insecticide, and several chemicals incorporated as additives (surfactants and "inert" ingredients).

Table 1-1 Summary of Pesticides under Consideration for use by the District

The tables below provide a general overview of the characteristics of each of the pesticides used or being considered by the district. Each category in the table is supplemented in greater detail in tables included in sections four and five. This table is intended for a "quick look" evaluation of the potential effects and toxicity to humans, wildlife, and some physiochemical characteristics of each.

Herbicides- General term for Pesticides developed specifically to target unwanted vegetation

Product and Manufacturer	***Mode of Action***	***Purpose***	***Toxicity Rank-Humans***	***Toxicology Non-Target and Wildlife***	***Solubility and Half Life water***	***Persistence and Half-life soils***	***Food Web Issues?***	***Safe to Children?***	***MSDS Flags and Cautions***
Glyphosate – *Roundup Custom, Roundup ProMax* (Monsanto)	Amino acid synthesis inhibitor	Nonselective post-emergent broad-spectrum ***weed control***	Low- No evidence of carcinogenicity, neurotoxicity, immunotoxicity. Possible reproductive toxicity very large doses	Practically non-toxic to birds and aquatic invertebrates Surfactants may have toxicity to amphibians	High water solubility	Moderate Persistence Binds to soil Strong soil adsorption Binds to soils and sediment	Since *glyphosate* does not bioaccumulate in fish or other animals it is not likely to have impacts on the ecological *food chain*	Very low toxicity to children unless direct consumption of large amounts of chemical.	Practically non-toxic. No known heal hazard.
Aminopyralid *Milestone* Dow Agro	Auxin growth hormone mimic	post-emergent broad-spectrum ***weed control***	Low toxicity to humans. No evidence of carcinogenicity, neurotoxicity, immunotoxicity, or reproductive or developmental toxicity	Practically non-toxic to birds, fish, aquatic invertebrates amphibians, and honey bees.	Non-persistent in water and soil. Breaks down rapidly in water. Half life is about 0.6 days due to photolysis.	Very low persistence with aerobic half life of avg 103 days.	Due to its low persistence and rapid excretion in animals it is not likely to impact food chain uptake.	Very low toxicity to children unless direct consumption of large amounts of chemical.	Practically non-toxic. No real health hazard.
Clopyralid *Transline* Dow Agro	Auxin growth hormone mimic	Selective ***broadleaf weed control***	Low toxicity. Neurotoxicity caused by acute poisoning. No evidence of carcinogenicity, immunotoxicity, or reproductive or developmental toxicity	Practically non-toxic to birds, fish, aquatic invertebrate and honey bees	Degrades rapidly in water. Half-life @ 9-22 days	Low likelihood of leaching to ground water. Binds to soils. Half life @40 days.	Very little potential for bioaccumulation or food web impact.	Very low toxicity to children unless direct consumption of large amounts of chemical.	Practically non-toxic. No real health hazard.

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Imazapyr *Polaris* (Nufarm) *Stalker* (BASF)	Amino acid synthesis inhibitor	Nonselective pre-and post-emergent broad-spectrum weed control	Low toxicity. No evidence of carcinogenicity, neurotoxicity, immunotoxicity, or reproductive or developmental toxicity	Practically non-toxic to birds, fish, aquatic invertebrates and honey bees	Soluble in water and degraded quickly via photolysis. ½ life @3-8 days.	Moderate potential for soil leaching to groundwater. Moderate soil adsorption.	Rapidly excreted and little potential for bioaccumulation or food web impact.	Very low toxicity to children unless direct consumption of large amounts of chemical.	Practically non-toxic. No real health hazard
Clethodim *Envoy Plus* (Valent)	Fatty acid synthesis inhibitor	Selective post-emergent grass weed control	Low toxicity. No evidence of carcinogenicity, neurotoxicity, immunotoxicity, or reproductive or developmental toxicity	Slightly toxic to birds, fish, and aquatic invertebrates, practically non-toxic to honey bees	Insoluble in water. ½ life in water @128 days	Short half-life in soil, and unlikely to leach in ground water. ½ life in soil @1-2 days. @128days in sediment.	No apparent uptake via food web issues. Approved for applications to edible food crops.	Very low toxicity to children unless direct consumption of large amounts of chemical.	Practically non-toxic. No real health hazard

1.1 Review and Evaluation Process

Data encompassing the available acute and chronic toxicity of the various active ingredients to numerous mammalian, avian, fish, aquatic invertebrate, and non-target insect species are included herein. In many cases, manufacturers do not include or disclose the proprietary additional ingredients in a product. The product approved for use is tested as the label indicates. Acute data are derived from experiments in which the target organisms are exposed to a single dose/concentration of a compound, and the endpoint, usually survival, is measured 48 or 96 hours post-exposure. Chronic data are derived from experiments in which the experimental organisms are exposed to multiple doses of a compound over an extended period of time, ranging from weeks to months depending on the organism and endpoint of interest (e.g., development, reproduction, carcinogenicity).

1.1.1 Calculations, Uncertainty, Conservatism, and Extrapolations in Toxicity Data

The toxicity of a pesticide (i.e., herbicides, rodenticides, fungicides, and insecticides) is determined by the documented adverse laboratory and field effects to target and non-target organisms that occur after an exposure to that compound. Thus, the key to potential adverse (toxic) effects is the nature of the exposure to the compound, which is based on the specific amount of the compound that reaches an organism's target tissues (i.e., the dose). Several other factors are involved in an exposure, such as the duration of time over which the dose is received, the target tissue or physiological function affected, and the sensitivity of the organism of interest to the compound.

The toxicity of pesticides are generally measured in controlled laboratory or field studies in which the test organisms are exposed to contaminated food or doses of a test substance at several concentrations. Most regulatory studies are designed to evaluate toxic responses based on tiered increases of dose and to determine at what dose the onset of an adverse physiological or behavioral effect occurs. Toxicity studies commonly evaluate the Lethal Dose or LC_{50}, the dose/concentration that causes mortality in 50% of the test population and the: no observed adverse effect level NOAEL); or the lowest concentration that causes a measured adverse effect (LOAEL). Many toxicity tests, laboratory organisms are not provided alternative food sources, and as a result, these laboratory tests are not particularly representative of realistic exposures in the environment. Furthermore, effects in laboratory species many not adequately represent effects in environmentally relevant species due to genetic, physiological, and behavioral differences. For many pesticides, the suite of tests required for approval of a compound includes other types of exposure, such as dermal, inhalation, and dietary. All of these laboratory data are combined to develop the pesticide product label recommendations and restrictions, incorporating several "safety" factors to provide acceptable use of each product. As a result of the extensive use of safety factors, surrogate test species, and unrealistic exposures to the laboratory animals, the pesticide data available for evaluation of potential adverse impacts for these compounds are subject to uncertainty and conservatism in actual potential effects.

Numerous biological, chemical, and physical parameters that are not apparent in laboratory tests affect the behavior of a compound in the environment and its potential toxicity. The chemistry, and particularly the fate and transport of a compound, must be considered to estimate likely potential exposure. The fate and transport of a compound is determined by the physical and chemical properties of the compound itself and the environment into which it is released. Thus, the following characteristics of a compound are considered when estimating potential adverse effects: 1) its half-life in various environmental media (e.g., sediment, water, air), including its photolytic half-life; 2) lipid and water solubility; 3) adsorption to sediments and plants; and 4) volatilization. Environmental factors that affect fate and transport processes include temperature, rainfall, wind, sunlight, water turbidity, and water and soil acidity (pH). Each of these parameters can markedly influence the potential exposure to a pesticide by modifying its characteristics in the environmental media.

A certain level of exposure to a compound is necessary for potential toxic effects to occur, but an exposure does not, in itself, imply that adverse effects will occur. The potential toxicity of a pesticide can be reduced or mitigated by limiting or modifying the conditions of potential exposure to ensure that resulting doses are less than an amount that may result in adverse effects. The important characteristics of a pesticide are considered before and during any pesticide application by the District, which employs numerous best management practices (BMPs) to minimize the potential for unwanted adverse impacts to non-target species. The culmination of all this information, and its relation to the specific application considered, provides a proven foundation for assuring the most effective, yet relatively safe, use of pesticides when treatment is determined to be needed.

1.1.2 Toxicity Designations

The results of laboratory tests are reported as the highest dose that does not cause any adverse effects (No Observed Adverse Effects) and the dose where adverse effects first appear (Lowest Observed Adverse Effects, LOAEL) and the dose that results in mortality to 50% mortality (LC_{50}). **Figure 1**.

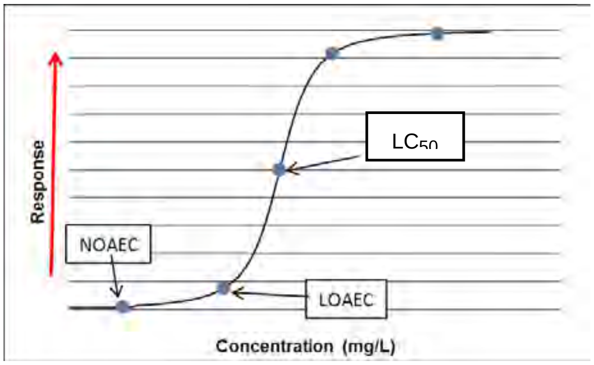


Figure 1. Relative doses reported in laboratory toxicity studies.(Generalized Sigmoidal Concentration-Curve).

1.1.3 Evaluation of Potential Human Health Impact

The information provided for each of the selected pesticides supports a defense of very low risk or "no significant adverse effects (NSAE)" on humans. Assessments include information about the ingredients reported in the Material Safety Data Sheet (MSDS), pesticide registration documents, and peer-reviewed scientific literature. Review of the pesticide formulations, label recommendations, and application procedures is used to evaluate their potential likelihood for exposure, toxicity, and bioaccumulation. For each pesticide evaluated, information herein includes the physiochemical characteristics of the product, including absorption, metabolism, and elimination, and any other specific reported evidence of acute and chronic effects including reproductive, developmental, or carcinogenic effects.

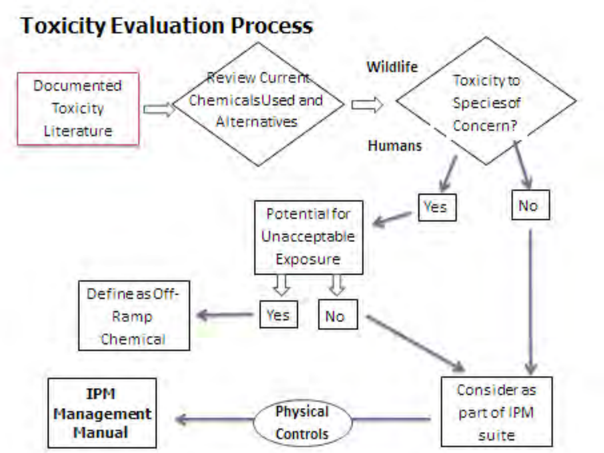
1.1.4 Evaluation of Potential Ecological Impact

Successful application of the IPM approach depends on defensible assessment of the hazards for each of the current reported application scenarios and an evaluation of the possible impacts to representative non-target wildlife (avian, aquatic vertebrate and invertebrate, amphibian, and bee species) and vegetation. This evaluation includes information relevant to the ultimate environmental fate and transport of active and certain "inert" ingredients (when available) as well as review and evaluation of the current toxicity literature (available field and laboratory studies) relevant to non-target ecological receptors impacts and the potential for increased exposure due to food web uptake and accumulation in higher trophic level animals or in vegetation (bioconcentration, bioaccumulation, or biomagnification).

The following use, efficacy, environmental fate and transport, water pollution potential, and toxicity information of the chemicals of interest for the District's IPM is based on available, documented, and validated government and peer-reviewed experiments and reports.

1.1.5 Ranking of Pesticide Toxicity

Pesticides are evaluated using documented toxicity and adverse effects to humans and animals (Figure 3) and sorted to develop the most effective, yet safe pesticides for use in specific application scenarios.



in IPM applications.

After determination of the toxicity of each pesticide of interest using the process in Figure 3, the toxicity information is used to rank each pesticide according to its potential to cause adverse effects in non-target organisms. The four levels (1-4) of relative toxicity (USEPA) for each general category of species is included in Table 1.2 below.

Each of the pesticides included in this review have been evaluated by USEPA and state agencies and the toxicity results are included in the several tables associated with each category of pesticide. Each pesticide has been ranked for target and non-target toxicity, potential bioaccumulation, food web transfer, and several physio/chemical characteristics, including half-life, solubility, and other parameters that may affect total exposure over time.

1.1.6 Toxicity Interactions and Alterations.

The toxicity of a pesticide is dependent on the concentration of active ingredients and the timing and duration of the exposure. The length of time that a pesticide persists after application is measured as its ½ life in water and/or soil. Although many earlier pesticides, primarily organochlorines like DDT and other highly toxic chemicals were shown to persist in media for months and even years. However, the current pesticides available for pest control have substantially shorter ½ lives and often remain for only a few days. However, when treating to impact a critical pest life stage, it may be necessary to use a more toxic product that does not last long in the environment. However, for the less toxic pesticides it is often best to utilize separate but successive applications to cover the pest's likely activity cycle.

Pesticide applications are based on two general chemical and physical properties of the pesticide intended for use in the control of specific pests. Efficacy (relative toxicity to the pest) and the persistence of the product in the treated area are evaluated and considered to provide the most effective treatment scenarios resulting in the least unwanted side effects.

Pesticide toxicity in laboratory tests is not always translated to the laboratory effects in actual use scenarios because laboratory tests generally utilize unrealistic exposures to an active ingredient without any possible alternative sources or exposures.

In some cases, it is preferable to use several very low application doses over time to make sure the target pests are adequately controlled. This increases the likelihood that the pesticide will be effective and any side effects (non-target effects) will be alleviated or minimized.

For those applications where it is critical to significantly eradicate a specific life stage, larger doses may be used with very specific focus rather than widespread applications.

In both of these application scenarios, care is taken using documented Best Management Practices and experienced applicators to select the appropriate timing and doses to achieve control of unwanted pest vectors.

Experienced and trained pesticide applicators, using the proper choice and doses of target-specific chemicals, can provide effective pest control with minimal to no unwanted side effects or impacts to non-target species or the environment.

Table 1.2. USEPA Categories Used to Rank Pesticide Toxicity

Route of Exposure	I: High Toxicity	II: Moderate Toxicity	III: Low Toxicity	IV: Very Low Toxicity
Acute Oral LD50	≤50 mg/kg	50-500 mg/kg	500 – 5000 mg/kg	>5000 mg/kg
Acute Dermal LD50	≤200 mg/kg	200 – 2000 mg/kg	2000 – 5000 mg/kg	>5000 mg/kg
Acute Inhalation LC50	≤0.05 mg/L	0.05 - 0.5 mg/L	0.5 - 2 mg/L	>2 mg/L
Primary Eye Irritation	Corrosive (irreversible destruction of ocular tissue) or corneal involvement or irritation persisting for more than 21 days	Corneal involvement or irritation clearing in 8-21 days	Corneal involvement or irritation clearing in 7 days or less	Minimal effects clearing in less than 24 h
Primary Skin Irritation	Corrosive (tissue destruction into the dermis and/or scarring)	Severe irritation at 72 h (severe erythema or edema)	Moderate irritation at 72 h (moderate erythema)	Mild or slight irritation (no irritation or slight erythema)

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2 Herbicides

Table 2-1 Human Toxicity Summary of Herbicide Active Ingredients

Active Ingredient	Mammalian Oral LD50 (mg/kg)[A]	Mammalian Dermal LD50 (mg/kg)[B]	Mammalian Inhalation LC50 (mg/L)[A]	USEPA Toxicity Rating	Carcinogenic	Reproductive or Developmentally Toxic	Neurotoxic	Immunotoxic	Endocrine Disruption
Glyphosate	>4,320 (technical); ≥5,000 (salts)	≥2,000 (tech); ≥5,000 (salts)	≥4.43 (tech); >1.3 (salts)	Oral, dermal, inhalation (III)	No	No	No	No	In human cell lines at very high doses
Aminopyralid	>5,000	>5,000	>5.79	Oral, dermal, inhalation (IV)	No	No	No	No	No
Clopyralid	>5,000	>5,000	>3.0	Oral, dermal, inhalation (III)	No (may contain hexachlorobenzene – potential human carcinogen)	No	Yes	No	No
Imazapyr	>5,000	>2,000	>1.3	Oral, dermal, inhalation (IV)	No	No	No	No	No
Clethodim	>5,000	>5,000	>3.9	Oral, dermal, inhalation (IV)	No (Envoy contains naphthalene – potential human carcinogen)	No	No	No	NA

Table 2-2 Ecotoxicity Summary of Herbicide Active Ingredients

Active Ingredient	Mammalian Oral LD50 (mg/kg)[A]	Mammalian Dermal LD50 (mg/kg)[B]	Mammalian Inhalation LC50 (mg/L)[A]	Avian LD50 (mg/kg)[C]	Fish LC50 (mg/L)[D]	Aquatic Invert EC50 (mg/L)[E]	Honeybee LD50 (µg/bee)	Other Receptors
Glyphosate	>4,320 (technical); ≥5,000 (salts)	≥2,000 (tech); ≥5,000 (salts)	≥4.43 (tech); >1.3 (salts)	>2,000	140 (tech); 1.3 to >1,000 (salts)	55 to 780	>100	Frog LC50 >17.9 mg/L; 1-yr dog NOAEL = 500 mg/kg/day
Aminopyralid	>5,000	>5,000	>5.79	>2,250	>100	>98.6	Contact >100; Oral >117	Northern leopard frog 96-h LC50 > 95.2 mg/L
Clopyralid	>5,000	>5,000	>3.0	>1,645	103-125	225	>100	Dog NOAEL = 100 mg/kg/day
Imazapyr	>5,000	>2,000	>1.3	>2,150	>100	>1,000	>100	1-yr dog NOAEL = 250 mg/kg/day
Clethodim	>5,000	>5,000	>3.9	>2,000	67-120	>120	>100	NA

A. Unless otherwise specified, values are for rats.

B. Unless otherwise specified, values are for rabbits.

C. Unless otherwise specified, values are for mallard duck or bobwhite quail.

D. Unless otherwise specified, values are for rainbow trout or bluegill sunfish.

E. Values are for Daphnia or similar species.

2.1 Glyphosate

GLYPHOSATE

Formulations: Roundup ProMax; Roundup Custom (previously Aquamaster)

> Human Toxicity: Low toxicity. Skin and eye irritation possible. No evidence of carcinogenicity, neurotoxicity, immunotoxicity, or toxicity. Reproductive toxicity at very high doses.

> Ecological Toxicity: Technical grade is practically non-toxic to birds, fish and aquatic invertebrates. POAE surfactant used in some formulations causes toxicity to amphibians.

> Water Pollution Potential: Moderate persistence in the environment. High water solubility, but strongly adsorbs to soil. Sometimes found in surface and ground water in locations of high use.

> Other Considerations: Glyphosate resistance has been documented in areas of high use.

2.1.1 Basic Use Information

> Products: *Roundup ProMax, Roundup Custom (previously Aquamaster)*

> Typical target pests: Grasses, Brush, Vines, Thistles, unwanted woody plants, Spurges

> Application rates:

General Weed Management: Grasses, Brush, Vines, Thistles

Material	Rate per 100 gal	Rate per gal (handheld)	Volume/acre
Adjust buffer	½ - 4 pints	To be used if water has pH >7	
Roundup ProMax*	0.4 – 1.5 gal	0.5 – 2 oz.	Spot spray – variable rate
Dye (as necessary)	0.25 gal (1 qt)	0.25 oz.	

*Do not exceed maximum use rate of 7 quarts (8 lbs acid) of product per acre per year.

Cut Stump: *Acacia, Baccharis, Cytisus, Eucalyptus, Genista, Ilex, Spartium*

Material	Rate per 100 gal	Rate per gal (handheld)	Volume/acre
Roundup ProMax*	50 gal	64 oz.	Cut stump variable rate
Dye (as necessary)	1 qt	0.25 oz.	

*Do not exceed maximum rate of 7 quarts (8 lbs acid) per acre per year – especially when treating dense stands of cut stumps.

Sponge/Wick: Grasses, Brush, Vines, Thistles

Material	Rate per 100 gal	Rate per gal (handheld)	Volume/acre
Roundup ProMax*	25-50 gal	32-64 oz.	Wiper/Sponge variable rate
Dye (as necessary)	1 qt	0.25 oz.	

*Do not exceed maximum rate of 7 quarts (8 lbs acid) per acre per year – especially when treating dense stands of vegetation.

Waxy Leaves: Spurges – *Euphorbia oblongata* and Vines

Material	Rate per 100 gal	Rate per gal (handheld)	Volume/acre
Roundup Custom	1.5 gal	2 oz.	Spot spray – variable rate
Liberate NIS	2 qt.	0.6 oz.	
Dye (as necessary)	0.25 gal (1 qt)	0.3 oz.	

***Do not exceed maximum use rate of 8 quarts (8 lbs. acid) of this product per acre per year.

Glyphosate [N-(phosphonomethyl)glycine] is a nonselective, post-emergent, and systemic herbicide registered for use in agricultural and nonagricultural areas. It is applied to a variety of food crops and agricultural drainage, sewage, and irrigation systems. There are several formulations of glyphosate, including an acid, monoammonium salt, diammonium salt, isopropylamine salt, potassium salt, sodium salt, and trimethylsulfonium or trimesium salt. It is highly effective for the control of weeds and invasive species. Glyphosate is a plant growth regulator that functions by targeting the plant-specific shikimic acid pathway, inhibiting the synthesis of the enzyme 5-enolpyruvylshikimic acid-3-phosphate synthase, leading to reductions in aromatic amino acids necessary for plant protein synthesis and growth (Miller et al., 2010). Glyphosate is not effective on submerged or mostly submerged foliage and therefore is only applied to control emergent foliage (Schuette, 1998; Siemering, 2005).

2.1.2 Exposure Considerations

Glyphosate is a broad spectrum, non-selective herbicide used by the District as the active ingredient in Roundup ProMax and Roundup Custom (previously named Aquamaster) to control invasive weeds including grasses, brush, vines, and thistles via foliar sprays or direct wipe/sponge onto the weeds. Both are used only in specific instances where other pest control methods such as hand pulling or mowing of weeds are not safe or effective options. These spray techniques involve highly localized and focused applications applied to specific, delineated areas with an emphasis on care and control of overspray or off-spray. They are applied at low pressure (30-70 psi) by hand held wands or guns only when wind is between 2-7 mph to reduce drift and never when there is a 40% or greater forecast of rain within 24 h of a planned application. The low and high rate foliar applications of both formulations are 0.5% v/v and 1.5% v/v, respectively, and the low and high rate wipe/sponge treatment rates are 25 and 50% v/v, respectively. Both formulations are also used for treatment of unwanted woody shrubs and trees. To reduce run-off and non-target exposure, they are applied (25% v/v) directly onto the inside (avoiding the exterior bark) of a woody stem/stump immediately following stump cutting and under the same restrictions as those for foliar applications using approved and BMP spray techniques.

Application sites are prohibited within defined critical habitats for the red-legged frog. For other rare plant and wildlife species, Applications may occur in certain conditions. A qualified biologist that can identify all rare plant and wildlife species present within the application area will supervise all applications of the pesticide to ensure non-target specie are not effected. Application is also restricted around water and wetlands. A buffer of at least 15 ft or greater from aquatic systems is typically implemented during Roundup ProMax use, as it contains the surfactant POAE. Roundup Custom does not contain this surfactant and is approved for use in/near aquatic systems. It is used in conjunction with the nonionic soybean-based surfactant Liberate NIS (discussed in sections 6.2 and 6.3).

2.1.3 Human Toxicity

The shikimic acid pathway is specific to plants and some microorganisms; therefore, glyphosate has very low acute toxicity to mammals. The USEPA classifies glyphosate as Category III for oral and dermal toxicity. The oral LD50 for technical grade glyphosate for rats is >4,320 mg/kg; the oral LD50 for the isopropylamine salt in rats is ≥5,000 mg/kg; and the oral LD50 for the ammonium salt in rats is 4,613 mg/kg (USEPA, 1993b). The dermal LD50 for technical grade glyphosate in rabbits is ≥2,000 mg/kg (USEPA, 1993b), and the dermal LD50 for rabbits is ≥5,000 mg/kg for both salts (Miller et al., 2010). The LC50 for technical grade glyphosate in rats is ≥4.43 mg/L based on a 4-hr, nose-only inhalation study (USEPA, 1993b); the 4-hr LC50 for rats exposed to the isopropylamine salt is >1.3 mg/L air; and the LC50 for rats exposed to the ammonium salt is >1.9 mg/L in a whole-body exposure (Miller et al., 2010).

No chronic adverse effects were observed in beagles exposed to daily doses of 500 mg/kg for one year. Glyphosate has not been shown to be carcinogenic or mutagenic (USEPA, 1993b). The USEPA has classified glyphosate in Group E –

evidence of non-carcinogenicity in humans. Developmental LOAELs range from 1,500-3,500 mg/kg/day in rats. Neither glyphosate nor its major metabolite aminomethylphosphonic acid (AMPA) bioaccumulate in animal tissue. Glyphosate is poorly biotransformed in rats and is excreted mostly unchanged in the feces and urine; 97.5% of the administered dose was excreted in the urine and feces of rats (Williams et al., 2000). The USEPA's Office of Pesticide Programs Reference Dose (RfD) Peer Review Committee has recommended that the RfD for glyphosate be established at 2 mg/kg/day.

Despite the documented scientific research used to evaluate the toxicity to dozens of species required by USEPA to register pesticides, public concern about the toxicity to mammals have been raised about the long-term safety of glyphosate. Only extremely high doses, far beyond any potential exposure that would be seen in actual application have been associated with adverse effects to mammalian sytems. In one study, forced ingestion of high doses of glyphosate was shown to alter the respiratory and hepatic systems of rats and caused damage to reproductive functions and fetal development (Clair et al., 2012). In another study, male rats fed a diet containing 25,000 and 50,000 mg/kg (unrealistically high doses of up to 25% of their total body weight) of 99% pure glyphosate for 13 weeks had significant reductions in sperm concentrations. Female rats in the 50,000 mg/kg group had slightly longer estrus cycles than the control group (Chan and Mahler, 1992). Each of these studies elicitied toxic effects only after unrealistically high doses of glyphosate

2.1.4 Ecological Toxicity

In toxicological studies, Glyphosate is practically nontoxic to birds. The oral LD50 for bobwhite quail is >2,000 mg/kg, and the 8-day sub-acute dietary LC50 is >4,640 ppm for mallard ducks and bobwhite quail. Glyphosate is also practically nontoxic to freshwater fish, and it is not expected to bioaccumulate. The 48-h LC50 for technical grade glyphosate is 140 mg/L for bluegill sunfish, 140 mg/L for rainbow trout, and 97 mg/L for fathead minnow (USEPA, 1993b). Formulations of the isopropylamine salt range from practically non-toxic to moderately toxic to fish (96-h LC50s range from 1.3 to >1,000 mg/L for various formulations). Technical grade glyphosate is practically nontoxic to slightly toxic to freshwater invertebrates with 48-hr LC50s ranging from 55 to 780 mg/L, and the isopropylamine salt ranges from practically non-toxic to moderately toxic. The 96-h LC50 for technical grade glyphosate is >17.9 mg a.e./L (the highest dose tested) in green frog (Howe et al., 2004). However, based on surrogate species information (primarily avian), USEPA has made a "may affect" or "likely to adversely affect" determination for the endangered California Red-legged Frog following chronic exposure to glyphosate at application rates of 3.84-7.5 lb a.e./acre and above (certain crops, forestry, areas with impervious surfaces and rights of way) (USEPA, 2008b). It is listed as "may affect but is not likely to adversely affect" endangered and threatened salmonids (Patterson, 2004). Glyphosate is practically nontoxic to honey bees. The acute oral and contact LD50 is >100 µg/bee (USEPA, 1993b).

Polyethoxylated tallowamine (POEA) is a surfactant used in some glyphosate formulations, including some Roundup mixtures. Several studies have indicated that the toxicity observed in tadpoles of various frog species exposed to different Roundup mixtures is due to this surfactant and not glyphosate itself; calculated LC50s for certain Roundup mixtures are an order of magnitude or more lower than technical glyphosate or formulations that do not contain POEA (Howe et al., 2004; Mann and Bidwell, 1999; Relyea, 2005). POAE has also been shown to be highly toxic to aquatic invertebrates and fish, and glyphosate formulations containing POAE are also more toxic than those without the surfactant (Brausch and Smith, 2007; Giesy et al., 2000). Roundup Custom, which is approved for use near and in water sources, is a formulation of glyphosate dissolved in water and does not contain POAE.

2.1.5 Physical Properties/Environmental Fate and Transport

The vapor pressure of glyphosate is very low, making it nonvolatile. It tends to partition to water rather than air. It is highly water-soluble. Glyphosate dissipates from surface water by partitioning into sediment. It is stable to hydrolysis and photodegradation in water and soil, and it is degraded primarily by microbial degradation in both water and sediment (Barrett and McBride, 2005; Newton et al., 1994). The major metabolite of glyphosate is AMPA. Degradation of AMPA is generally slower than that of glyphosate because AMPA likely adsorbs more strongly to soil particles and because it may be less likely to permeate the cell walls or membranes of soil organisms (Schuette, 1998). AMPA exhibits similar or less toxicity than the original parent glyphosate (Borggaard and Gimsing, 2008).

In soil, glyphosate is resistant to chemical degradation, is stable to sunlight, is relatively non-leaching, and has a low tendency to runoff (except as adsorbed to colloidal matter and sediment). It is relatively immobile in most soil environments and does not move vertically below the 6 inch soil layer. Glyphosate's primary route of decomposition in the environment is through microbial degradation in soil (t ½ = 8-25 days). The herbicide is inactivated and biodegraded by soil microbes at rates of degradation related to microbial activity in the soil and factors that affect this activity. The biological degradation process is carried out under both aerobic and anaerobic conditions (Schuette, 1998; USEPA, 1993b).

2.1.6 Water Pollution Potential

Glyphosate is very soluble in water; however, due to its strong soil adsorptive characteristics, limited amounts of glyphosate have been found in surface water as a result of runoff (Borggaard and Gimsing, 2008; Vereecken, 2005). Glyphosate has been detected in surface waters in areas of very high Roundup use, such as the Midwest, but at levels lower than the California drinking water standard for the compound (<0.7 mg/L). Glyphosate dissipates quickly in ponds and streams to below detection limit in 3-14 days (Schuette, 1998).

2.2 Aminopyralid

AMINOPYRALID

Formulations: Milestone

> Human Toxicity: Low toxicity. No evidence of carcinogenicity, neurotoxicity, immunotoxicity, or reproductive/developmental toxicity.

> Ecological Toxicity: Practically non-toxic to birds, fish, aquatic invertebrates, amphibians, and honey bees.

> Water Pollution Potential: Likely to be non-persistent in the environment. Highly photolabile in water.

2.2.1 Basic Use Information

> Products: *Milestone*

> Typical target pests: Thistles; Sweet Pea; Cape ivy.

> Application rates:

Material	Rate per acre	Rate per 1000 sq. ft	Volume/acre
Milestone*	3-7 oz.	Lo: 2 ml or 0.07 fl. oz. Hi: 4.8 ml or 0.16 fl. oz.	Variable - Applicator responsible to calibrate equipment for proper application rate
Liberate NIS	Variable per acre (0.5% v/v)	Variable	
Dye (as necessary)	Variable	Variable	

* Do not exceed maximum rate of 7 oz. (0.11 lb acid) of product per acre during a single growing season or 14 oz. (0.22 lb acid) per acre where no more than 50% of the acre is treated by spot spraying.

Aminopyralid (4-amino-3,6-dichloropyridine-2-carboxylic acid) is a pyridine carboxylic acid herbicide that provides systemic post-emergence broad-spectrum control of a number of noxious and invasive annual, biennial, and perennial weeds, as well as agronomic broadleaf weeds (USEPA, 2005). Aminopyralid is an auxin growth hormone mimic, affecting cell wall plasticity and nucleic acid metabolism. It has been classified as a low risk herbicide, meaning that USEPA has concluded that the use of aminopyralid as a replacement for other herbicides will decrease the risk to some non-target species (Syracuse Environmental Research Associates, 2007). Its manufacturer, Dow AgroSciences, indicates that aminopyralid is intended as an alternative to picloram, 2,4-D, dicamba, monosodium methanearsonate (MSMA), and metsulfuron methyl (Jachetta et al., 2004; Syracuse Environmental Research Associates, 2007).

2.2.2 Exposure Considerations

Aminopyralid, the active ingredient in Milestone, is used to control invasive broadleaf weeds including thistles, and sweet pea. It is selective for broadleaf plants and does not harm grasses if used after germination. It is not used when wind speeds are greater than 7 mph or when the chance of rain is 40% or greater within 24 h of the planned application. Milestone is used at a rate of 3 oz/acre for pre-emergent applications in winter and early spring and at 5 oz/acre for post-emergent applications. A special high rate of 14 oz/acre is used for spot treatment of cape ivy vines in riparian zone tree canopies during winter. It is used in conjunction with the nonionic surfactant Liberate NIS (discussed in sections 6.2 and 6.3).

Application sites are not within defined critical habitats for the red-legged frog; however, a qualified biologist that can identify all rare plant and wildlife species present within the application area will supervise all applications of the pesticide. It is not to be applied directly to water, and it is used only with a 15 ft or greater buffer between aquatic systems and application sites.

2.2.3 Human Toxicity

Due to the relative newness of aminopyralid, the only acute toxicity studies for the compound are those that were conducted as part of the initial USEPA registration process. Based on these studies, the USEPA has classified aminopyralid as having low acute oral, dermal, and inhalation toxicity (all Category IV). The oral and dermal LC50s for Milestone in rats are both >5,000 mg/kg, and the inhalation LC50 is >5.79 mg/L (USEPA, 2005). Chronic rat neurotoxicity studies and two generation reproductive studies have indicated NOAELs >1,000 mg/kg/day for both endpoints (USEPA, 2005).

The mechanism of toxicity to mammals has not yet been well-characterized. The most typical response of rats to aminopyralid appears to be cecal enlargement after prolonged oral exposure; however, the toxicological significance of this response is unclear (Syracuse Environmental Research Associates, 2007). Aminopyralid is rapidly excreted after exposure, likely by the well-characterized active transport mechanism via the kidneys seen after ingestion of similar herbicides such as picloram. Aminopyralid has not been shown to cause cancer, neurotoxicity, immunotoxicity, teratogenesis, reproductive effects, genotoxicity or mutagenicity in laboratory studies (Dow AgroSciences, 2006; Syracuse Environmental Research Associates, 2007). Due to its low toxicity, an acute RfD for aminopyralid is not required by the USEPA. The chronic RfD for aminopyralid is 0.5 mg/kg bw/day.

2.2.4 Ecological Toxicity

Aminopyralid is practically non-toxic to birds, fish, aquatic invertebrates, amphibians, and honey bees on an acute basis (Dow AgroSciences, 2006; USEPA, 2005). The acute LD50 for bobwhite quail is >2,250 mg/kg, and the dietary 5-day LC50s in bobwhite quail and mallard duck are >5,556 mg/kg diet and >5496 mg/kg diet, respectively. The 96-h LC50s for rainbow trout and bluegill sunfish are > 100 mg/L, and the 96-h LC50 for sheepshead minnow is >120 mg/L. The log KOW is <3 and thus aminopyralid is not expected to bioaccumulate in fish tissues. The 48-h LC50 in *Daphnia magna* is >98.6 mg/L; the 48-h EC50 for

Eastern oyster is >89 mg/L; and the 96-h LC50 for mysid is >100 mg/L. A single acute toxicity study has been performed for amphibians, and there was no indication that aminopyralid was toxic to northern leopard frog tadpoles (LC50 >95.2 mg/L) (Henry et al., 2003; Syracuse Environmental Research Associates, 2007). Aminopyralid is also practically non-toxic to honey bees with acute contact and oral LD50s of >100 µg/bee and >117 µg/bee, respectively. There are no known acute or chronic risks to non-target endangered or non-endangered fish, birds, wild mammals, terrestrial and aquatic invertebrates, algae, or aquatic plants (USEPA, 2005).

2.2.5 Physical Properties/Environmental Fate and Transport

Aminopyralid is essentially nonvolatile. In aquatic systems, it is highly photolabile. It is stable to direct hydrolysis, stable in anaerobic sediment-water systems, and weakly sorbs to soil. It is likely to be non-persistent and relatively immobile in the field with minimal leaching below the 15 to 30 cm soil depth. Under aerobic conditions, degradation results in the production of CO_2, ammonia, and non-extractable residues (USEPA, 2005). Aminopyralid is labile to photolysis at the soil surface but this process occurs at a much slower rate than it does in water (t ½ = 72 days in soil vs. 0.6 days in water).

2.2.6 Water Pollution Potential

Aminopyralid is quickly degraded via photolysis in aquatic systems (t ½ = 0.6 days), while degradation in the absence of photolysis occurs under aerobic conditions at a much slower rate (t ½ = 462-990 days). It has a low potential for groundwater contamination.

2.3 Clopyralid

CLOPYRALID

Formulations: Transline

> Human Toxicity: Generally low toxicity. Neurotoxicity caused by acute poisoning. No evidence of carcinogenicity, immunotoxicity, or reproductive/developmental toxicity.

> Ecological Toxicity: Practically non-toxic to birds, fish, aquatic invertebrates, and honey bees.

> Water Pollution Potential: Degraded rapidly in water. Low potential for leaching.

> Other Considerations: Very stable in compost piles, and thus is no longer used for lawn and garden applications in California and Washington.

2.3.1 Basic Use Information

> Products: *Transline*

> Typical target pests: Thistles; Clover

> Application rates:

Material	Low volume/acre	High volume/acre
Transline	10 oz. – winter rate on seedlings and pre-emergent plants	20 oz.- spring rate on basal rosettes, bolt stage

Clopyralid is a selective herbicide used for broadleaf noxious weed control. It is structurally similar to aminopyralid, which has an extra amino group, and it is also an auxin hormone mimic, causing abnormal growth that impairs proper nutrient transport throughout the plant. It is highly selective for terrestrial plants and appears to be relatively non-toxic to aquatic plants (Syracuse Environmental Research Associates, 2004).

2.3.2 Exposure Considerations

Clopyralid is the active ingredient in Transline. It is used to control broadleaf weeds such as thistle and clover. Similar to aminopyralid, it is selective for broadleaf plants and is not harmful to grasses when use post seed germination: however, it appears to be even more selective and effective than aminopyralid on post-emergent plants. It is applied at 10 oz/acre in the winter to pre-emergent invasive weeds and seedlings and at 20 oz/acre in the spring during the bolt (flowering) stage of unwanted plants. It is not used when wind speeds are greater than 7 mph or when the chance of rain is 40% or greater within 24 h of the planned application. It is used only with a 15 ft or greater buffer between aquatic systems and application sites.

2.3.3 Human Toxicity

Clopyralid is listed as a Category III compound for oral, dermal, and inhalation toxicity. The oral and dermal mammalian LD50s are both >5,000 mg/kg, and the mammalian inhalation LC50 is >1.3 mg/L. It is not metabolized extensively; 79-96% of parent clopyralid is excreted in rat urine (t ½ = 3 h) (Syracuse Environmental Research Associates, 2004). The NOEL in dogs is 100 mg/kg/day. Clinical signs of acute clopyralid poisoning include neurotoxicity, manifested as ataxia, tremors, convulsions, and weakness. Chronic studies in rats, mice, and dogs have noted general decreases in body weight and increases in liver and kidney weight, which are commonly observed in chronic toxicity studies and can indicate either an adaptive or toxic response. The USEPA OPP has established an acute RfD of 0.75 mg/kg/day and a chronic RfD of 0.15 mg/kg/day for clopyralid. The USEPA classifies clopyralid as a Group E human carcinogen (no evidence of carcinogenicity) because chronic studies in rats, mice, and dogs have shown no indication of carcinogenicity. However, technical grade clopyralid contains low levels of hexachlorobenzene (<2.5 ppm), which is classified as a potential human carcinogen (Syracuse Environmental Research Associates, 2004).

2.3.4 Ecological Toxicity

Clopyralid is practically non-toxic to slightly toxic to birds. The oral LD50 in mallard duck is >1,645 mg/kg. The dietary LC50 for both pure clopyralid and the monoethanolamine salt of clopyralid is >4,460 ppm in both bobwhite quail and mallard duck. Clopyralid is also practically non-toxic to fish and aquatic invertebrates. The 96-h LC50 in bluegill is 125 mg/L, and the LC50 in rainbow trout is 103 mg/L for technical grade clopyralid. The monoethanolamine salts are even less toxic to fish, with LC50s ranging from 700-1,645 mg a.e./L. There is no indication that clopyralid bioaccumulates in fish. The LC50 in Daphnia is 225 mg/L. In a chronic Daphnia reproduction study, the NOAEL was found to be 23.1 mg a.e./L (Syracuse Environmental Research Associates, 2004). Clopyralid is also practically non-toxic to honey bees; the contact LD50 is >100 µg/bee. Clopyralid residues are highly toxic to non-target broadleaf plants.

2.3.5 Physical Properties/Environmental Fate and Transport

Clopyralid is relatively nonvolatile and highly water soluble. It is stable to both hydrolysis and photolysis in aqueous systems but is degraded rapidly. It is degraded in soil primarily through microbial activity (t ½ = 40 days), and carbon dioxide is the major breakdown product (USDOE). It is very stable under anaerobic conditions. It is mobile and does not bind tightly to soil. Clopyralid is very stable in compost piles, and thus is no longer used for lawn and garden applications in California and Washington (California Department of Pesticide Regulation, 2004).

2.3.6 Water Pollution Potential

Clopyralid is very water soluble and is also degraded rapidly in water (t ½ = 9-22 days). Various monitoring studies have determined that the potential for leaching is very low due to its rapid degradation; only 0.1-0.6% of applied clopyralid was lost through leaching in various studies (Marin Municipal Water District Vegetation Management Plan, 2010; Syracuse Environmental Research Associates, 2004).

2.4 Imazapyr

IMAZAPYR

Formulations: Polaris, Stalker

> Human Toxicity: Low toxicity. No evidence of carcinogenicity, neurotoxicity, immunotoxicity, or reproductive/developmental toxicity.

> Ecological Toxicity: Practically non-toxic to birds, fish, aquatic invertebrates, and honey bees.

> Water Pollution Potential: Soluble in water and degraded quickly via photolysis. Moderate potential for leaching into groundwater.

> Other Considerations: Can be applied in areas where glyphosate is ineffective or not approved for use.

2.4.1 Basic Use Information

> Products: *Polaris, Stalker*

> Typical target pests: Grasses, Scotch broom.

Material	Low rate foliar	High rate foliar	Cut stump	Volume/acre
Polaris	0.5% v/v - spot treatment of annual wetland, non-crop weeds	1.5 – 5% v/v spot and low volume treatment of perennial wetland, non-crop weeds	10 % v/v	Variable

Material	Cut stump	Volume/acre
Stalker	10 -12 % v/v	Variable

Imazapyr is a systemic, nonselective, pre- and post-emergent herbicide used for the control of a broad range of terrestrial and aquatic weeds. It controls plant growth by preventing the synthesis of branched-chain amino acids. Imazapyr is applied either as an acid or as the isopropylamine salt and is approved for use on grasses, commercial and residential sites, and water bodies.

2.4.2 Exposure Considerations

Imazapyr is a broad-spectrum, non-selective herbicide that is used to control unwanted grasses, woody plants, and riparian plants. It is effective on both pre- and post-emergent (before and after sprouting) plants and can be used when glyphosate treatment is not efficacious or when multiple growth stages of a plant are present in the same location. It is the active ingredient in Stalker and Polaris commercial formulations. Polaris is used in low volume applications or spot treatments of perennial weeds at 1.5-5% v/v and a low foliar rate of 0.5% v/v for spot treatments of annual wetland and non-crop weeds. It is not used when wind speeds are greater than 7 mph or when the chance of rain is 40% or greater within 24 h of the planned application. Imazapyr is approved for use in and near aquatic systems. However, if suitable habitat for any endangered species is found, and if imazapyr use has the potential to affect the species, coordination with the California Department of Fish and Game, the U.S. Fish and Wildlife Service, and/or National Marine Fisheries shall occur before weed treatment activities may be conducted within this buffer or activities shall be canceled in this area. It is efficacious against aquatic plants when most of the plant is not submerged and can be used in lieu of glyphosate in aquatic systems. Polaris and

Stalker are both used as treatments on stumps immediately following tree cutting at 10% v/v.

2.4.3 Human Toxicity

Imazapyr exhibits low acute toxicity to mammals via oral (Category IV), dermal (Category III), and inhalation (Category II) exposure. The oral LD50 for rats is >5,000 mg/kg; dermal LD50 for rabbits is >2,000 mg/kg; and the inhalation LC50 for rats is >1.3 mg/L. The formulations used by the District are Category III for oral, dermal, and inhalation toxicity. Imazapyr is classified as a Group E chemical, with no evidence of carcinogenicity, and is not mutagenic (USDOE-Bonneville Power Administration, 2000). A NOAEL of 250 mg/kg/day (the highest dose tested) was identified in a one-year dog feeding study, indicating that imazapyr has very low chronic toxicity to mammals. The USEPA has determined that the risk to humans of dietary and incidental exposure is below the level of concern (USEPA, 2006).

2.4.4 Ecological Toxicity

Imazapyr is practically nontoxic to birds, fish, Daphnia, and honey bees. The oral LD50 is >2,150 mg/kg for mallard duck and bobwhite quail. The 96-hr LC50 is >100 mg/L for rainbow trout and bluegill sunfish, and the 48-hr LC50 for Daphnia magna is >1,000 mg/L. The LD50 for honey bees is >100 µg/bee (USDOE-Bonneville Power Administration, 2000). Imazapyr is not expected to bioaccumulate in aquatic organisms because it exists as an anion at typical environmental pH (USEPA, 2006). Although there are no risks of concern to terrestrial birds, mammals, bees or aquatic invertebrates and fish, imazapyr does pose an ecological risk to non-target terrestrial and aquatic vascular plants, which can be reduced by applications that minimize spray drift and limitations on spraying near certain water bodies (USEPA, 2006).

2.4.5 Physical Properties/Environmental Fate and Transport

Imazapyr is an ionic, organic acid that is nonvolatile and is both moderately persistent and mobile in soil. Commercial formulations contain either imazapyr acid or the imazapyr isopropylamine salt, both of which are dissolved in a water solution. Imazapyr is mainly in ionic form at typical environmental pH levels, and the behavior of the acid and salt forms are similar. Upon direct application, or indirect release into surface water, imazapyr is degraded by photolysis, with a half-life of approximately 3 to 5 days in surface water. It is essentially stable to hydrolysis, aerobic and anaerobic soil degradation, and aerobic and anaerobic aquatic metabolism. In soil, it is degraded primarily by microbial activity, and has a moderate soil adsorption coefficient.

2.4.6 Water Pollution Potential

Imazapyr is soluble in water and is quickly degraded by photolysis (t ½ = 3-8 days). There is moderate potential for leaching into groundwater (USDOE-Bonneville Power Administration, 2000)

2.5 Clethodim

CLETHODIM

Formulations: Envoy Plus

> Human Toxicity: Low toxicity. No evidence of carcinogenicity, neurotoxicity, immunotoxicity, or reproductive/developmental toxicity.

> Ecological Toxicity: Slightly toxic to birds, fish, and aquatic invertebrates. Practically non-toxic to honey bees.

> Water Pollution Potential: Insoluble in water. Very short half-life in soil, and unlikely to leach in ground water.

> Other Considerations: Envoy contains small amounts of naphthalene, which is listed as a Group 2B (possibly carcinogenic) compound by the USEPA and a carcinogen under California Proposition 65.

2.5.1 Basic Use Information

> Products: *Envoy Plus*

> Typical target pests: Annual and perennial grasses.

> Application rates:

Material	Low volume/acre	High volume/acre
Envoy Plus	16 oz. – early/mid season annual grasses – spot and broadcast in non-crop areas	32 oz. – early/mid season annual grasses – spot and broadcast in non-crop areas

Clethodim is a selective, post-emergence herbicide used for the control of annual and perennial grass weeds. It functions by inhibiting fatty acid synthesis in plants.

2.5.2 Exposure Considerations

Clethodim is the active ingredient in Envoy Plus and is highly selective for post-emergent grass control. It is not toxic to broadleaf or pre-emergent plants, and it is therefore highly effective in controlling invasive grasses that grow within broadleaf habitats and in eradicating annual unwanted grasses from perennial grasslands. It is used in early to mid season spot and broadcast applications at a high rate of 32 oz/acre on perennial grasses and a low rate of 16 oz/acre on annual grasses.

2.5.3 Human Toxicity

Clethodim is listed as Category IV for oral, dermal, and inhalation toxicity. The mammalian oral and dermal LD50s are both >5,000 mg/kg, and the acute inhalation LC50 is >3.9 mg/L. It is a Category III eye irritant and skin irritant and is a dermal sensitizer (USEPA, 1995). Chronic toxicity has been shown to increase liver weights and anemia in rats. There is no evidence of reproductive toxicity or carcinogenicity for pure clethodim. However, Envoy contains small amounts of naphthalene, which is listed as a Group 2B (possibly carcinogenic) compound by the USEPA and a carcinogen under California Proposition 65 (Valent, 2006).

2.5.4 Ecological Toxicity

Clethodim is reported as practically nontoxic to slightly toxic to birds; the bobwhite quail LD50 is >2,000 mg/kg. In longer term reproductive studies, the NOAEL in quail was found to be 300 ppm while in mallard ducks it is 1,000 ppm. Clethodim is slightly toxic to fish and aquatic invertebrates. The 96-h LC50 of Envoy Plus in bluegill is 120 mg/L; the 96-h LC50 in rainbow trout is 67 mg/L; and the 48-h LC50 in Daphnia is >120 mg/L. It does not bioaccumulate in fish. Clethodim is practically non-toxic to honey bees (LD50 >100 µg/bee) (USEPA, 1990b, 1995).

2.5.5 Physical Properties/Environmental Fate and Transport

Clethodim is relatively nonvolatile. In soil, it is non-persistent, mobile, and weakly binds to soil particles. It is broken down in soil through primarily aerobic processes (t ½ = 1-2.6 days). Its degradation under anaerobic conditions is slow in both water (t ½ = 128 days) and sediment (t ½ = 214 days).

2.5.6 Water Pollution Potential

Clethodim is not soluble in water. Because it is has a very short half-life in soil (1-3 days), it is unlikely to leach into and contaminate ground water sources (USEPA, 1990a).

3 Fungicide

Table 3-1 Human Toxicity Summary of Fungicide Active Ingredient

Active Ingredient	Mammalian Oral LD50 (mg/kg)[A]	Mammalian Dermal LD50 (mg/kg)[B]	Mammalian Inhalation LC50 (mg/L)[A]	USEPA Toxicity Rating	Carcinogenic	Reproductive or Developmental Toxicity	Neurotoxic	Immunotoxic	Endocrine Disruption
Potassium salts of phosphorus acid	>5,000	>5,000	> 2.06	Oral and dermal (III), inhalation (IV)	No	NA	NA	NA	NA

Table 3-2 Ecotoxicity Summary of Fungicide Active Ingredients

Active Ingredient	Mammalian Oral LD50 (mg/kg)[A]	Mammalian Dermal LD50 (mg/kg)[B]	Mammalian Inhalation LC50 (mg/L)[A]	Avian LD50 (mg/kg)[C]	Fish LC50 (mg/L)[D]	Aquatic Invert EC50 (mg/L)[E]	Honeybee LD50 (µg/bee)	Other Receptors
Potassium salts of phosphorus acid	>5,000	>5,000	> 2.06	>1,060	>544.6	>544.6	>13.3	NA

A. Unless otherwise specified, values are for rats.

B. Unless otherwise specified, values are for rabbits.

C. Unless otherwise specified, values are for mallard duck or bobwhite quail.

D. Unless otherwise specified, values are for rainbow trout or bluegill sunfish.

E. Values are for Daphnia or similar species.

3.1 Potassium salts of phosphorus acid

POTASSIUM SALTS OF PHOSPHORUS ACID

Formulations: Agri-Fos

> Human Toxicity: Low toxicity. No evidence of carcinogenicity, neurotoxicity, immunotoxicity, or reproductive/developmental toxicity.

> Ecological Toxicity: Practically non-toxic to birds, fish, and freshwater invertebrates. Toxic to bees.

> Water Pollution Potential: High water solubility, but unlikely to contaminate water due to use practices.

> Other Considerations: Formulation is used via injection or directed spray in targeted applications, reducing exposure and risk to non-target species.

3.1.1 Basic Use Information

- Products: *Agri-Fos*
- Typical target pests: *Phytophthora ramorum,* cause of sudden oak death
- Application rates:

Material	Basal bark treatment
Agri-Fos	49 % v/v

Potassium salts of phosphorus acid are the active ingredient of Agri-Fos, a fungicide that is used to help prevent infection, or increase infection resistance by the oomycete plant pathogen *Phytophthora ramorum*, which causes sudden oak death. The fungicide functions by inhibiting oxidative phosphorylation in the fungus, and some evidence suggests that phosphorous acid has the indirect effect of stimulating the plants natural defense response against pathogens. Agri-Fos is applied via injection in the oak bark or by a localized spray onto the bark. When applied by spray, it is used with the organosilicone surfactant Pentra-bark.

3.1.2 Exposure Considerations

Potassium salts of phosphorus acid are the active ingredient in the fungicide Agri-Fos, which is used to prevent sudden oak death. It is applied directly to the bark of forest trees at a 49% v/v application rate. The surfactant Pentra-bark is used with Agri-Fos to increase the uptake of the fungicide by the tree, thereby increasing its efficacy and decreasing its potential to impact non-target species. The basal bark application method also decreases the potential for drift, deposition in water, and exposure to non-targets because the fungicide is sprayed directly onto the bark and quickly taken up by the tree.

3.1.3 Human Toxicity

Potassium salts of phosphorus acid are Category III for oral and dermal toxicity and Category IV for inhalation (USEPA, 1998). The mammalian oral and dermal LD50s are both >5,000 mg/kg, and the inhalation LC50 is >2.06 mg/L. Potassium salts are Category III eye irritants. They are not dermal sensitizers. There is no evidence of genotoxicity. Further, because there are no food uses associated with these compounds, dietary risk is minimal (Health Canada, 2012).

3.1.4 Ecological Toxicity

Potassium salts of phosphorus acid are practically non-toxic to birds, fish, and freshwater invertebrates. The acute LD50 in bobwhite quail is >1,060 mg/kg, and the 8-day dietary LC50 in mallard ducks is >5,000 ppm (734.2 mg a.i./kg bw/day). For rainbow trout and *Daphnia magna*, the LC50 is >544.6 mg/L. These compounds are highly water soluble and are not expected to bioaccumulate in fish. The LD50 for honey bees is >13.3 µg a.i./bee (Health Canada, 2012).

3.1.5 Physical Properties/Environmental Fate and Transport

Little information regarding the environmental fate and transport of potassium salts of phosphorus acid or Agri-Fos exist. They will produce phosphite ions when in contact with water, and these phosphite ions can be directly taken up by plant roots, slowly transform to phosphate, or bind with other substances in the soil. Microbial transformation in soil is likely to be very slow.

3.1.6 Water Pollution Potential

Potassium salts are very water soluble. Due to the directed application of Agri-Fos, introduction into the water or soil environment is unlikely, and thus, the water pollution potential of this compound is negligible (USEPA, 1998).

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4 Rodenticides

Table 4-1 Human Toxicity Summary of Rodenticide Active Ingredient

Active Ingredient	Mammalian Oral LD50 (mg/kg)[A]	Mammalian Dermal LD50 (mg/kg)[B]	Mammalian Inhalation LC50 (mg/L)[A]	USEPA Toxicity Rating	Carcinogenic	Reproductive or Developmental Toxicity	Neurotoxic	Immunotoxic	Endocrine Disruption
Cholecalciferol	43.6	2,000	NA	NA	No	No	No	No	No

Table 4-2 Ecotoxicity Summary of Rodenticide Active Ingredient

Active Ingredient	Mammalian Oral LD50 (mg/kg)[A]	Mammalian Dermal LD50 (mg/kg)[B]	Mammalian Inhalation LC50 (mg/L)[A]	Avian LD50 (mg/kg)[C]	Fish LC50 (mg/L)[D]	Aquatic Invert EC50 (mg/L)[E]	Honeybee LD50 (µg/bee)	Other Receptors
Cholecalciferol	43.6	2,000	NA	2,000	NA	NA	NA	Dog oral LD50 = 88 mg/kg

A. Unless otherwise specified, values are for rats.

B. Unless otherwise specified, values are for rabbits.

C. Unless otherwise specified, values are for mallard duck or bobwhite quail.

D. Unless otherwise specified, values are for rainbow trout or bluegill sunfish.

E. Values are for Daphnia or similar species.

4.1 Cholecalciferol

CHOLECALCIFEROL

Formulations: NA

> Human Toxicity: High acute toxicity to mammals.

> Ecological Toxicity: Moderate toxicity to avian species. Lower risk of secondary poisoning to non-target birds.. Generally toxic to rodents with one ingestion.

> Water Pollution Potential: Unlikely to enter aquatic systems due to use of tamper-resistant bait stations.

> Other Considerations: Use of anchored tamper-resistant bait stations minimizes risk to non-target wildlife, domestic pets, or children.

4.1.1 Basic Use Information

- Products: *Cholecalciferol (Vitamin D_3) Quintox, Rampage, Hypekill*
- Typical target pests: Rats, mice
- Application rates:

Material	Rate
Cholecalciferol	0.075% in bait

Cholecalciferol is used to control Norway rats (*Rattus norvegicus*), roof rats (*Rattus rattus*), and several species of mice, including house mice (*Mus musculus*), and field mice (*Peromyscus spp.*) in and around homes, industrial buildings, and similar man-made structures. Formulation types include pellets and blocks. Cholecalciferol is a sterol (vitamin D3) and its ingestion results in hypercalcemia from mobilization of calcium from bone matrix into blood plasma leading to metastatic calcification of soft tissues (USEPA, 2011).

4.1.2 Exposure Considerations

Cholecalciferol is the active ingredient (commonly 0.075%) of rodent baits and is applied using tamper-resistant bait stations. The use of bait stations offers protection to non-target organisms, particularly birds, because loose pellets are not available to other animals that might attempt to consume the bait. These bait stations are designed to stop access to the bait by other animals and small children. They are anchored at treatment locations (e.g., by wires or stakes) to ensure that they cannot be dragged away by non-target wildlife, domestic pets, or children. Bait placements must be inside or within 50 or 100 feet of buildings (distance dependent upon particular product formulation). The amount of bait used in each bait station varies depending upon the target pest.

4.1.3 Human Toxicity

Cholecalciferol is acutely toxic to target rodents. The oral LD50 for cholecalciferol is 42.5 for mice, 43.6 mg/kg for rats, and 88 mg ai/kg for dogs (Marshall, 1984). However, subsequent studies have indicated that the dog LD50 may be much lower (USEPA, 2004). In rats and mice fed 0.075% cholecalciferol, 100% mortality occurred within 3 to 6 days and was found to be efficacious in warfarin-resistant rats. The dermal LD50 of the finished bait product (0.075% cholecalciferol) is 2,000 mg/kg for rabbits (Marshall, 1984).

The parent compound and metabolites are fat soluble and stored in adipose tissue. Enterohepatic recirculation of cholecalciferol and metabolites occurs. After a massive intake of cholecalciferol, excess calcifediol is produced in the liver. Because of their high lipid solubility, cholecalciferol and its metabolites are eliminated from the body very slowly (primarily through bile and feces). Two mechanisms occur with consumption of large doses of cholecalciferol. First, more calcium is absorbed from the intestines. Second, cholecalciferol metabolites stimulate phosphorus transfer from bone to plasma. The increased plasma calcium concentrations result in vomiting, lethargy, and muscle weakness. Specific organ effects include acute renal tubular necrosis, gastrointestinal stasis, gastric acid secretion, decreased skeletal muscle responsiveness, and decreased neural tissue responsiveness. The increase in plasma calcium causes soft tissue mineralization resulting in loss of functionality of kidneys, cardiac muscle, etc. (Morrow, 2001).

4.1.4 Ecological Toxicity

Cholecalciferol is considered of lower hazard to avian species compared to other rodenticides. The oral LD50 for mallard ducks >2,000 mg/kg (30% a.i.), equating to >600 mg/kg, and the mallard and northern bobwhite dietary LC50 are 1190 and 528 ppm, respectively (Marshall, 1984; USEPA, 2004). The USEPA has made an effects determination of “may affect, and likely to adversely affect” for the endangered salt marsh harvest mouse based on risk of consuming the compound via bait blocks (USEPA, 2011). In the only secondary avian toxicity study available for cholecalciferol, two turkey vultures and one red-tailed hawk were offered rats or mice fed for 1-day with 0.075% a.i. bait, and no adverse effects were observed in the birds (Marsh and Koehler, 1991). When cholecalciferol-poisoned prey were offered to dogs and cats for five days, no death occurred in either species and while some signs of toxicosis were observed in the dogs, these symptoms were reversible after exposure and all animals recovered (Eason et al., 2000).

4.1.5 Physical Properties/Environmental Fate and Transport

No environmental fate and transport data for cholecalciferol have been submitted to USEPA. Based on physical/chemical properties of the compound, it is expected to be nonvolatile, essentially insoluble in water, and immobile in soil (USEPA, 2011). Information on biotic and abiotic degradation is not available.

4.1.6 Water Pollution Potential

Because cholecalciferol is used in tamper-resistant bait stations, it is unlikely to enter aquatic environments via runoff or spray drift. Thus, the water pollution potential of cholecalciferol is negligible.

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5 Insecticides

Table 5-1 Human Toxicity Summary of Insecticide Active Ingredients

Active Ingredient	Mammalian Oral LD50 (mg/kg)[A]	Mammalian Dermal LD50 (mg/kg)[B]	Mammalian Inhalation LC50 (mg/L)[A]	USEPA Toxicity Rating	Carcinogenic	Reproductive or Developmental Toxicity	Neurotoxic	Immunotoxic	Endocrine Disruption
d-trans allethrin	860	11,332	NA	NA	No	No	Yes	No	No
Phenothrin	>5,000	>2,000	>2.1	Oral and inhalation (IV), dermal (III)	No	No	Yes	No	No
Indoxacarb	<1,000	>5,000 (rat)	>5.5	Oral (II), dermal and inhalation (IV)	No	No	No	No	No
Hydroprene	>5,000	>5,000	>5.2	Oral (IV), dermal and inhalation (III)	Not enough data to classify	No	No	NA	NA
Fipronil	97	>2,000 (rat); 354 (rabbit)	0.390 – 0.682	Oral and inhalation (II), dermal (III)	Possible human carcinogen	Yes (reproductive)	Yes	NA	NA
Sodium tetraborate decahydrate (borax)	>5,000 (Prescription ant bait)	>5,000 (Prescription ant bait)	>0.16 (boric acid)	Oral and dermal (III)	No	Yes, at high doses (reproductive)	NA	NA	NA
Diatomaceous earth	>5,000	>2,000	> 0.859	Oral (IV), dermal (III), inhalation (II)	NA	NA	NA	NA	NA

Table 5-2 Ecotoxicity Summary of Insecticide Active Ingredients

Active Ingredient	Mammalian Oral LD50 (mg/kg)[A]	Mammalian Dermal LD50 (mg/kg)[B]	Mammalian Inhalation LC50 (mg/L)[A]	Avian LD50 (mg/kg)[C]	Fish LC50 (mg/L)[D]	Aquatic Invert EC50 (mg/L)[E]	Honeybee LD50 (µg/bee)	Other Receptors
d-trans allethrin	860	11,332	NA	>5,620 (8-day dietary)	0.0094 (coho salmon) to 0.027 (channel catfish)	NA	Contact – 3.4; Oral – 4.6 to 9.1	2-yr Dog dietary NOEL = 50 mg/kg/day
Phenothrin	>5,000	>2,000	>2.1	>5,000 (dietary)	0.0158 to 0.0942 (inland silverside)	0.000025 (mysid) - .0044	NA, likely toxic	NA
Indoxacarb	<1,000	>5,000 (rat)	>5.5	98	0.65	0.0542 (mysid) – 2.94	Contact - 0.18; Oral - practically non-toxic	90-d Dog LOAEL = 19 mg/kg/day
Hydroprene	>5,000	>5,000	>5.2	NA	>100	NA	Adult - 1000; larval - 0.1	3-month rat LOAEL = 250 mg/kg/day
Fipronil	97	>2,000 (rat); 354 (rabbit)	0.390 – 0.682	11.3; 31 (pheasant)	0.083 to 0.246	0.020 (LOAEL)	Highly toxic	NA
Sodium tetraborate decahydrate (borax)	>5,000 (Prescription ant bait)	>5,000 (Prescription ant bait)	>0.16 (boric acid)	>2,510 (boric acid)	41; 12,000 (mosquito fish)	133 (boron)	100 (boron)	Frog LC50 = 414 to 529 mg borax/L
Diatomaceous earth	>5,000	>2,000	> 0.859	Practically nontoxic	Practically nontoxic	Practically nontoxic	NA	NA

A. Unless otherwise specified, values are for rats.

B. Unless otherwise specified, values are for rabbits.

C. Unless otherwise specified, values are for mallard duck or bobwhite quail.

D. Unless otherwise specified, values are for rainbow trout or bluegill sunfish.

E. Values are for Daphnia or similar species.

5.1 D-trans allethrin

D-TRANS ALLETHRIN

Formulations: Wasp-Freeze

- Human Toxicity: Low toxicity. Dermal and eye irritation possible. Neurotoxicity caused by acute poisoning. No evidence of carcinogenicity, immunotoxicity, or reproductive/developmental toxicity.
- Ecological Toxicity: Practically non-toxic to birds. Highly toxic to fish and aquatic invertebrates.
- Water Pollution Potential: Rapidly degraded in the environment and not likely to leach into groundwater.
- Other Considerations: Not used in/near aquatic systems due to high fish and aquatic invertebrate toxicity.

5.1.1 Basic Use Information

- Products: *Wasp-Freeze*
- Typical target pests: Wasps
- Application rates:

Material	Formulation	Rate
Wasp-Freeze	0.10% a.i.	One 17.5 oz ready to use spray can/wasp nest

Allethrins are first generation or Type I synthetic pyrethroids that contain three asymmetric carbons and, thus, eight potential isomers; however, four isomers are present in the greatest concentrations in product formulations. One of the stereoisomers, d trans of the d isomer (d-trans allethrin), is recognized as being the most insecticidally active and toxicologically important, and it is the active ingredient (along with phenothrin, discussed below) in Wasp-freeze. Pyrethroids bind to neuronal voltage-gated sodium channels, preventing them from closing; this persistent activation of the channels then leads to paralysis.

5.1.2 Exposure Considerations

D-trans allethrin and phenothrin (discussed below) are the active ingredients in Wasp-Freeze. Each compound is approximately 0.1% of the pesticide formulation. Wasp-freeze is a ready-to-use formulation in a 17.5 oz spray can. The pesticide is applied by hand directly onto the nests of unwanted wasps, hornets, or bees. Because pyrethroids are highly toxic to fish, Wasp-Freeze is not applied to water; the District maintains a 15 ft or great buffer between aquatic systems and application areas. It is not used when wind speeds are greater than 7 mph or when the chance of rain is 40% or greater within 24 h of the planned application.

5.1.3 Human Toxicity

The toxicity of allethrin varies with the amounts of different isomers present. The LD50 of d-trans allethrin in rats is 860 mg/kg, and the dermal LD50 in rabbits is 11,332 mg/kg. Dermal exposure results in itching, burning, tingling, and numbness. Large doses by any route can cause physical symptoms such as nausea, vomiting, diarrhea, tremors, convulsions, and coma. A chronic dosage of 50 mg/kg/day for two years produced no detectable effect in dogs. Allethrins are not known to cause reproductive, teratogenic, mutagenic, carcinogenic, or endocrine disrupting effects in mammals (EXTOXNET, 1993; World Health Organization, 2002).

5.1.4 Ecological Toxicity

D-trans allethrin is practically nontoxic to birds, but it is highly toxic to fish and invertebrates. The 8-day acute dietary LC50 in bobwhite quails and mallards is >5,620 ppm. The LC50 for fish ranges from 9.4 (coho salmon) to 27 µg/L (channel catfish). The bioaccumulation potential of allethrin is unknown. The LD50 of allethrin to honey bees is 3.4 µg/bee via contact and 4.6-9.1 µg/bee via ingestion (World Health Organization, 2002).

5.1.5 Physical Properties/Environmental Fate and Transport

Allethrins were the first pyrethroids developed, and they are incredibly photolabile (USEPA, 2009). The photolysis half-life is 8-19 hours (WHO, 1989; World Health Organization, 2002). It is stable to hydrolysis at a neutral pH (t ½ = 500 days) but not at pH 9 (t ½ = 4.3 days) (World Health Organization, 2002).

5.1.6 Water Pollution Potential

D-trans allethrin is not soluble in water and is expected to adhere moderately to soil containing organic matter. It rapidly degrades in the environment and is not expected to leach into and contaminate ground water.

5.2 Phenothrin

PHENOTHRIN

Formulations: Wasp-Freeze

- Human Toxicity: Low toxicity. Dermal and eye irritation possible. Neurotoxicity caused by acute poisoning. No evidence of carcinogenicity, immunotoxicity, or reproductive/developmental toxicity.
- Ecological Toxicity: Practically non-toxic to birds. Highly toxic to fish and aquatic invertebrates.
- Water Pollution Potential: Rapidly degraded in the environment and not likely to leach into groundwater.
- Other Considerations: Not used in/near aquatic systems due to high fish and aquatic invertebrate toxicity.

5.2.1 Basic Use Information

- Products: *Wasp-Freeze*
- Typical target pests: Wasps
- Application rates:

Material	Formulation	Rate
Wasp-Freeze	0.10% a.i.	One 17.5 oz ready to use spray can/wasp nest

Phenothrin is a first generation, or Type I, pyrethroid that is the active ingredient (along with d-trans allethrin, discussed above) in Wasp-freeze. It has been registered by the EPA since 1976. It functions in the same manner as d-trans allethrin, causing a persistent opening of neuronal sodium channels, leading to paralysis and death.

5.2.2 Exposure Considerations

Phenothrin and d-trans allethrin (discussed above) are the active ingredients in Wasp-Freeze. Each compound is approximately 0.1% of the pesticide formulation. Wasp-freeze is a ready-to-use formulation in a 17.5 oz spray can. The pesticide is applied by hand directly onto the nests of unwanted wasps, hornets, or bees. Because pyrethroids are highly toxic to fish, Wasp-Freeze is not applied to water; the District maintains a 15 ft or great buffer between aquatic systems and application areas. It is not used when wind speeds are greater than 7 mph or when the chance of rain is 40% or greater within 24 h of the planned application.

5.2.3 Human Toxicity

Phenothrin exhibits low acute toxicity by oral (Category IV), dermal (Category III), and inhalation (Category IV) exposure routes, and it is a mild eye irritant (Category III). The rat oral LC50 is >5,000 mg/kg; the dermal LC50 is >2,000 mg/kg; and the inhalation LC50 is >2.1 mg/L (USEPA, 2008a).

Neurotoxic effects were observed in developmental toxicity studies but not observed in other acute, chronic, and subchronic toxicity studies done in rats and dogs up to the highest dose of 20,000 mg/kg/day. In rats, decreased parental weight gain and decreased weight gain during lactation of pups was observed in animals exposed to 150 mg/kg/day for up to 6 months (USEPA, 2008a).

5.2.4 Ecological Toxicity

Phenothrin is practically nontoxic to avian species. The LC50 for avian dietary toxicity is above 5,000 ppm (USEPA, 2008a). Phenothrin is highly toxic to freshwater, estuarine, and marine fish. LC50s range from 15.8 - 18.3 µg/L for freshwater fish and from 38.3 - 94.2 µg/L for estuarine and marine fish. The chronic NOAEL in fish is 1.1 µg/L. It is also very highly toxic to freshwater invertebrates. The EC50 for freshwater invertebrates is 4.4 µg/L. The lowest LC50 for phenothrin is 0.025 µg/L, based on a 96-h mysid test (SWRCB, 2012). Chronic data for phenothrin show adverse reproductive effects for freshwater invertebrates at a NOAEL of 0.47 µg/L. Estuarine invertebrates are even more sensitive than freshwater invertebrates, with an EC50 of 0.025 µg/L. Chronic effects to estuarine and marine invertebrates are expected based on the chronic reproductive toxicity to freshwater invertebrates and the acute effects to estuarine and marine invertebrates (USEPA, 2008a). Exposure to phenothrin in terrestrial non-target listed or non-listed species mammals is not expected to result in acute or chronic risks.

5.2.5 Physical Properties/Environmental Fate and Transport

Phenothrin has a relatively high affinity for binding to soils, moderate persistence in surface soils, and low water solubility. The major routes of dissipation in the environment are photolysis in water (t ½ = 6.5 days) and aerobic metabolism (t ½ = 36 days in aquatic environments and 18.6-25.8 days in soil). Phenothrin is moderately persistent under aerobic conditions and is persistent under anaerobic conditions (USEPA, 2008a).

5.2.6 Water Pollution Potential

Phenotrhin is likely to remain immobile in soil. It has low leaching potential and is unlikely to cause groundwater contamination (USEPA, 2008a). Phenothrin has a high affinity for sediments or suspended solids in the water column and thus may persist if applied to aquatic systems.

5.3 Indoxacarb

INDOXACARB

Formulations: Advion gel baits

> Human Toxicity: Low toxicity. Eye irritation possible. No evidence of neurotoxicity, carcinogenicity, immunotoxicity, or reproductive/developmental toxicity.

> Ecological Toxicity: Moderately toxic to birds. Moderately to highly toxic to fish and aquatic invertebrates.

> Water Pollution Potential: Rapidly degraded in the environment and not likely to leach into groundwater.

> Other Considerations: Designated as a low risk pesticide. Potential for exposure to non-target species is very low due to use of the pesticide in contained bait stations.

5.3.1 Basic Use Information

- Products: *Advion gel baits*
- Typical target pests: Cockroaches, ants.
- Application rates:

Material	Formulation	Low rate	High rate
Advion gel baits	0.60% a.i	0.5 g bait/10 linear feet	0.5 g bait/2 linear feet

Indoxacarb is proposed for use on structural pests such as ants and cockroaches. It possesses both larvicidal and ovicidal activity. It functions by blocking sodium channels, leading to impaired nerve function, paralysis, and ultimately death of lepidopteran pests (California Department of Pesticide Regulation, 2006; USEPA, 2000). It must be metabolized to elicit its toxicity. Indoxacarb is considered an organophosphate replacement (USEPA, 2000). Formulations often contain indoxacarb and its R-enantiomer.

5.3.2 Exposure Considerations

Indoxacarb is the active ingredient of Advion gel bait, which is applied indoors to cracks and crevices, along and inside access points to treat cockroach infestations. The baits contain 0.6% indoxacarb. For heavy cockroach infestations, 0.5 g bait/2 linear feet is applied, and for lighter infestations, 0.5 g bat/10 linear feet is used. These baits are not used near aquatic systems (>15 ft buffer) or where surface water may be present.

5.3.3 Human Toxicity

Indoxacarb is classified as a Category II oral toxicant; the rat acute oral LD50 is <1,000 mg/kg, with large variation in toxicity between male and female rats (843 and 179 mg/kg, respectively). It is a Category IV dermal and inhalation toxicant; the rat dermal LD50 is >5,000 mg/kg and the inhalation LC50 is >5.5 mg/L. It is a moderate eye irritant (Category III). In a 90-day oral toxicity study in dogs, the LOAEL was determined to be 19 mg/kg/day based on impacts to various blood parameters. There is no evidence that indoxacarb is carcinogenic or mutagenic (California Department of Pesticide Regulation, 2006; USEPA, 2000).

5.3.4 Ecological Toxicity

Indoxacarb is moderately toxic to birds. The LD50 in bobwhite quail is 98 mg/kg, and the subacute 5-day LC50 in bobwhite quail is 808 mg/kg in the diet. It is moderately to very acutely toxic to freshwater, estuarine, and marine fish. The LC50s for rainbow trout, carp, and channel catfish are 0.65, 1.02, and 0.29 mg/L, respectively. It is moderately to very highly acutely toxic to freshwater, estuarine, and marine invertebrates. The acute LC50s in *Daphnia carinata* and *Daphnia magna* are 2.94 and 0.60 mg/L, respectively. The LC50 in Eastern oyster is 0.203 mg/L, and the LC50 in mysid shrimp is 0.0542 mg/L. Chronic toxicities range from 0.003 to 0.25 mg/L for fish and invertebrates (California Department of Pesticide Regulation, 2006). Indoxacarb is practically non-toxic to honey bees by dietary intake but is highly toxic by contact (LD50 = 0.18 µg/bee).

5.3.5 Physical Properties/Environmental Fate and Transport

Indoxacarb is relatively non-volatile and has a low vapor pressure. In water, it is degraded primarily via photolysis, and to a lesser extent, hydrolysis (the hydrolysis half-life is about ten times longer than the photolysis half-life of three days). It is stable to photolysis in soil. It is immobile in soil and is also moderately persistent under both aerobic and anaerobic conditions (California Department of Pesticide Regulation, 2006).

5.3.6 Water Pollution Potential

Indoxacarb is degraded quickly in water. The water pollution potential of this active ingredient is negligible as it is used in contained bait stations.

5.4 Hydroprene

HYDROPRENE

Formulations: Gentrol Point source baits

> Human Toxicity: Low toxicity; does not pose acute dietary risk. No evidence of neurotoxicity, carcinogenicity, immunotoxicity. May be developmentally toxic at very high doses.

> Ecological Toxicity: Practically non-toxic to fish, aquatic invertebrates, and adult honey bees. Some toxicity to larval honey bees.

> Water Pollution Potential: Used indoors, so groundwater contamination is unlikely.

> Other Considerations: Only used in directed applications in response to cockroach infestations indoors.

5.4.1 Basic Use Information

> Products: *Gentrol Point source baits*

> Typical target pests: Cockroaches, beetles, moths.

> Application rates:

Material	Formulation	Low rate	High rate
Gentrol Point source baits	91% a.i.	1 bait/75 sq. ft.	2 baits/75 sq. ft.

Hydroprene is an insect growth regulator that functions by mimicking insect juvenile hormones. It is used against cockroaches, beetles, and moths. It is not applied to plants.

5.4.2 Exposure Considerations

Hydroprene is the active ingredient in Gentrol Point source bait, which is used to control cockroaches. The bait stations contain 91% hydroprene. To treat heavy infestations, two bait stations per 75 sq. ft are used, and to treat light infestations, one bait station per 75 sq. ft is used. These bait stations are permitted for use indoors only, so exposure to wildlife in their natural habitat is highly unlikely.

5.4.3 Human Toxicity

Hydroprene is listed as a Category IV oral toxicant and Category III for dermal and inhalation routes of exposure. Based on the available acute toxicity data, the USEPA has determined the hydroprene does not pose any acute dietary risks. The mammalian oral and dermal LD50s are both >5,000 mg/kg, and the inhalation LC50 is >5.2 mg/L. The USEPA has determined that the parental toxicity LOAEL is 7,500 ppm for the rat reproductive toxicity study based on parental weight gain reductions (Federal Register, 1997). The NOEL for pup development was 1,500 ppm. In a three-month feeding study in rats, the LOAEL based on vacuolated ovarian luteal cells in females was 250 mg/kg/day. There is no evidence for genotoxicity or mutagenicity. It is classified as a Group D compound – not classifiable as to human carcinogenicity. Based on chronic rat studies, the Rfd for hydroprene is 0.1 mg/kg/day (Federal Register, 1997).

5.4.4 Ecological Toxicity

There are no data available regarding the toxicity of hydroprene to birds. It is practically non-toxic to fish, with LC50s >100 mg/L. It is practically non-toxic to adult honey bees by oral and contact routes (LD50 >1,000 μg/bee); however, it is highly toxic to larval honey bees (LD50 = 0.1 μg/bee) (Federal Register, 1997).

5.4.5 Physical Properties/Environmental Fate and Transport

There is a paucity of data regarding the environmental fate and transport of hydroprene because it is only used indoors. Hydroprene is insoluble in water, and it is rapidly degraded in soil (t ½ = days) (National Pesticide Information Center, 2001).

5.4.6 Water Pollution Potential

Because hydroprene is only used indoors, the EPA does not anticipate any contamination of drinking water.

5.5 Fipronil

FIPRONIL

Formulations: Maxforce bait stations

- Human Toxicity: Moderate toxicity. No evidence of neurotoxicity or immunotoxicity. Possible human carcinogen.
- Ecological Toxicity: Highly toxic to fish, aquatic invertebrates, bees, and some bird species.
- Water Pollution Potential: Degrades rapidly in water and unlikely to leach from soil.
- Other Considerations: Bait stations are used in response to ant infestations indoors so risk to non-target species is low.

5.5.1 Basic Use Information

- Products: *Maxforce bait stations*
- Typical target pests: Argentine ants
- Application rates:

Material	Formulation	Low rate	High rate
Maxforce bait stations	0.01% a.i.	3 baits/room	6 baits/room

Fipronil is a non-systemic insecticide registered for use to control ants, beetles, cockroaches, fleas, mole crickets, ticks, termites, and other insects in a variety of agricultural and residential uses. It functions by blocking GABA-gated chloride channels in the central nervous systems of pests.

5.5.2 Exposure Considerations

Fipronil, the active ingredient in Maxforce bait stations, is used to control Argentine ants. The bait stations contain 0.01% fipronil. The bait stations are restricted to placement indoors at rates of 3 or 6 baits per room, respectively. Fipronil baits are not used outside and the District does not employ spray applications, so exposure to wildlife is highly unlikely.

5.5.3 Human Toxicity

Fipronil exhibits moderate acute toxicity (Category II) by the oral and inhalation routes in rats. The oral LD50 in rats is 97 mg/kg. The acute oral LD50 of fipronil-desulfinyl in rats is 15 and 18 mg/kg for females and males, respectively. The 4-h inhalation LC50 ranges from 0.390 to 0.682 mg/L in rats. By the dermal route, it is of moderate toxicity in rabbits and low toxicity (Category III) in rats. The dermal LD50 is 354 mg/kg in rabbits and >2,000 mg/kg in rats. It is relatively non-irritating to the skin (Category IV) and eye (Category III) of rabbits and is not a dermal sensitizer. In a one-year chronic rat feeding study, responses included reduced feeding and food conversion efficiency, reduced body weight gain, seizures and seizure-related death, changes in thyroid hormones, increased mass of the liver and thyroid, and kidney effects. It is not mutagenic. However, fipronil has been classified as a Group C, possible human carcinogen, based on increases in thyroid follicular cell tumors in both sexes of the rat. Fipronil does not cause these tumors in mice. Based on chronic rat studies, the chronic Rfd for humans is 0.0002 mg/kg/day (USEPA, 1996).

5.5.4 Ecological Toxicity

Fipronil is highly toxic to some birds. The LD50 in bobwhite quail is 11.3 mg/kg and in pheasants is

31 mg/kg. The five-day dietary LC50 in bobwhite quail is 49 mg/kg in feed. However, it is practically non-toxic to mallard ducks with no documented acute (LC50 >5,000 mg/kg in 8-day dietary study), sub-acute, or chronic effects. It is highly to very highly toxic to marine and freshwater fish. The 96-h LC50 is 0.246 mg/L for rainbow trout, 0.083 mg/L for bluegill sunfish, and 0.130 mg/L for sheepshead minnow. Fipronil-sulfone is three-six times more toxic than the parent compound in fish, and fipronil has been shown to bioconcentrate in fish. Fipronil is highly toxic to freshwater invertebrates. In Daphnia, the 48-h LC50 = 248 µg/L. The LOAEL in Daphnia is 20 µg/L, and fipronil-sulfone and fipronil-desulfinyl are almost seven and two times more toxic, respectively, than parent fipronil. It is highly toxic to honey bees by contact and ingestion when it is applied to plants (USEPA, 1996).

5.5.5 Physical Properties/Environmental Fate and Transport

Fipronil is nonvolatile. It degrades rapidly in water under UV light. The primary photodegradate is fipronil-desulfinyl. Under aerobic conditions in soil, it is subjected to microbial degradation, which results in the production of fipronil-sulfone (USEPA, 1996). It can also be hydrolyzed to form fipronil-amide. These degradates are persistent and immobile in soil (National Pesticide Information Center).

5.5.6 Water Pollution Potential

Fipronil degrades rapidly in water under UV light (t ½ = 3 days). It is not likely to leach from soil into ground or surface water. The fipronil-containing bait stations used by the are used indoors, and thus the water pollution potential is negligible.

5.6 Sodium tetraborate decahydrate (borax)

SODIUM TETRABORATE DECAHYDRATE (BORAX)

Formulations: Prescription Treatment and Terro Ant Killer II

> Human Toxicity: Low toxicity. Eye irritation possible. No evidence of neurotoxicity, carcinogenicity, immunotoxicity, or reproductive/developmental toxicity.

> Ecological Toxicity: Practically nontoxic to slightly toxic birds, fish, and aquatic invertebrates, and it is relatively nontoxic to beneficial insects

> Water Pollution Potential: Naturally present in water.

> Other Considerations: Used in targeted response to ant infestations.

5.6.1 Basic Use Information

> Products: *Prescription Treatment and Terro Ant Killer II*

> Typical target pests: Argentine ants

> Application rates:

Material	Prescription Formulation	Terro Ant Killer Formulation
Borax	1.3% a.i.	5.4% a.i.

Sodium tetraborate decahydrate, also known as borax, was first registered for use as a pesticide by the USEPA in 1948. It is the active ingredient in Prescription Treatment and Terro Ant Killer II. It functions by disrupting the water balance of insects. The USEPA has determined that, because boric acid and its sodium salts are of low toxicity and occur naturally, they should be exempted from the requirement of a tolerance (maximum residue limit) for raw agricultural commodities (USEPA, 1993a). Additionally, relatively small amounts of borax and boric acid are used for pesticide purposes. Because of its minimal usage and low potential toxicity, very little experimental data exist for borax.

5.6.2 Exposure Considerations

Borax is the active ingredient in Prescription Treatment and Terro Ant Killer II baits. Prescription Treatment ant baits contain 1.3% borax and are approved for use both indoors and outdoors. Terro Ant Killer II liquid contains 5.4% borax and can be used indoors and outside near buildings. These products are not used within 15 ft of aquatic systems.

5.6.3 Human Toxicity

Borax is listed as a Category III compound for oral and dermal toxicity and skin irritation. For Prescription ant bait, the rat oral LD50 is >5,000 mg/kg, and the rabbit dermal LD50 is >5,000 mg/kg (BASF, 2009). Terro liquid ant bait has a similar lack of toxicity to mammals: the rat acute oral LD50 is >5,000 mg/kg and the rabbit acute dermal LD50 is > 2,000 mg/kg (Senoret Chemical Company, 2009). It is listed as a Category I eye irritant. The USEPA has classified boric acid as a Group E carcinogen, indicating that there is evidence of noncarcinogenicity to humans (USEPA, 1993a).

5.6.4 Ecological Toxicity

Technical boric acid and borax are reported to be practically nontoxic to slightly toxic birds, fish, and aquatic invertebrates, and it is relatively nontoxic to beneficial insects (USEPA, 1993a). The LD50 for boric acid in bobwhite quail is >2,510 mg/kg. Bluegill appear to be the most sensitive fish to borax, with a 24-h LC50 of 41 mg/L, while mosquito fish are the least sensitive (24-h LC50 = 12,000 mg/L). In *Daphnia magna*, 48-h LC50s range from 133-530 mg boron/L when exposed to boric acid or borate salts. LD50 values for frogs and toads range from 414 to 529 mg borax/L (National Pesticide Information Center).

5.6.5 Physical Properties/Environmental Fate and Transport

Due to the fact that significant amounts of boron are naturally present in soil and water, the fate and transport of borax is not well elucidated. Boron salts also occur naturally in low concentrations in most unpolluted waterways. There is no data to show that borates or boric acid are transformed or degraded in the atmosphere through photolysis or hydrolysis.

5.6.6 Water Pollution Potential

Boron is ubiquitous and naturally present in water. The water pollution potential of borax is negligible.

5.7 Diatomaceous earth

DIATOMACEOUS EARTH

Formulations: NA

> Human Toxicity: Low toxicity. Mild skin and eye irritation possible. No evidence of neurotoxicity, carcinogenicity, immunotoxicity, or reproductive/developmental toxicity.

> Ecological Toxicity: No evidence of toxicity to wildlife.

> Water Pollution Potential: Insoluble in water.

> Other Considerations: This natural compound consists of the fossilized remains of hard shelled algae known as diatoms.

5.7.1 Basic Use Information

> Products: *N/A*

> Typical target pests: All insects

> Application rates:

Material	Use	Rate
Diatomaceous earth	Fill in crack/voids/interior walls, claimed to be non-toxic insecticide and additive.	Various rates

Diatomaceous earth is a natural compound that also functions through disrupting the water balance of insects. It is practically non-toxic to humans and wildlife, and it is not of environmental concern. The USEPA has identified it as a compound to deregulate due to its lack of toxicity.

5.7.2 Exposure Considerations

Diatomaceous earth applied to cracks, interior walls, voids, and bulk food storage to control unwanted insects. It is used at various rates depending on the target nuisance insect and level of infestation. Because it is not selective, it is used in very directed and specific applications. It is not used within 15 ft of aquatic systems.

5.7.3 Human Toxicity

The LD50 in rats is >5,000 mg/kg (Category IV); the dermal LD50 is >2,000 mg/kg (Category III); and the acute inhalation LD50 is > 0.859 mg/L, the highest dose tested in the study (USEPA, 1984). Diatomaceous earth may cause mild eye and skin irritation in some people.

5.7.4 Ecological Toxicity

There is no evidence of toxicity to wildlife exposed to diatomaceous earth.

5.7.5 Physical Properties/Environmental Fate and Transport

Diatomaceous earth is insoluble in water.

5.7.6 Water Pollution Potential

The water pollution potential of this active ingredient is negligible.

6 Adjuvants/Surfactants

Table 6-1 Human Toxicity Summary of Adjuvant/Surfactant Active Ingredients

Active Ingredient	Mammalian Oral LD50 (mg/kg)[A]	Mammalian Dermal LD50 (mg/kg)[B]	Mammalian Inhalation LC50 (mg/L)[A]	USEPA Toxicity Rating	Carcinogenic	Reproductive or Developmental Toxicity	Neurotoxic	Immunotoxic	Endocrine Disruption
Modified Vegetable Oil/Methylated Seed Oil	>5,000 (Competitor)	>5,000 (Competitor)	NA	NA	NA	NA	NA	NA	NA
Lecithin	>5,000 (Liberate)	>2,000 (Liberate)	NA	NA	NA	NA	NA	NA	NA
Alcohol Ethoxylates	600 to >10,000	2,000 to >5,000 (rat)	1.5 – 20.7	NA	No	No	NA	NA	NA
Alkylphenol ethoxylate (APE)	low	low	NA	NA	NA	Yes	NA	NA	Yes

Table 6-2 Ecotoxicity Summary of Adjuvant/Surfactant Active Ingredients

Active Ingredient	Mammalian Oral LD50 (mg/kg)[A]	Mammalian Dermal LD50 (mg/kg)[B]	Mammalian Inhalation LC50 (mg/L)[A]	Avian LD50 (mg/kg)[C]	Fish LC50 (mg/L)[D]	Aquatic Invert EC50 (mg/L)[E]	Honeybee LD50 (µg/bee)	Other Receptors
Modified Vegetable Oil/Methylated Seed Oil	>5,000 (Competitor)	>5,000 (Competitor)	NA	NA	95 (Competitor)	>100 (Competitor)	NA	NA
Lecithin	>5,000 (Liberate)	>2,000 (Liberate)	NA	NA	17.6 (Liberate)	9.3 (Liberate)	NA	NA
Alcohol Ethoxylates	600 to >10,000	2,000 to >5,000 (rat)	1.5 – 20.7	NA	0.25 - 100	0.100 – 100	NA	NA
Alkylphenol ethoxylate (APE)	low	low	NA	NA	0.135 (fathead minnow) – 110 (killifish)	0.18 to 1.5	NA	NA

A. Unless otherwise specified, values are for rats.

B. Unless otherwise specified, values are for rabbits.

C. Unless otherwise specified, values are for mallard duck or bobwhite quail.

D. Unless otherwise specified, values are for rainbow trout or bluegill sunfish.

E. Values are for Daphnia or similar species.

6.1 Modified vegetable/seed oil

MODIFIED VEGETABLE/SEED OIL

Formulations: Competitor MSO

> Human Toxicity: Low toxicity. No evidence of neurotoxicity, carcinogenicity, immunotoxicity, or reproductive/developmental toxicity.

> Ecological Toxicity: Slightly toxic to fish and practically non-toxic to freshwater invertebrates.

> Water Pollution Potential: Biodegradable and insoluble in water.

> Other Considerations: Limited toxicity and fate and transport data are available.

6.1.1 Basic Use Information

> Products: *Competitor MSO*

> Application rates:

Material	Surfactant Low Rate	Surfactant High Rate	Diluent Use	Volume/acre
Competitor MSO	0.5% v/v spot, low volume, and broadcast treatments	1% v/v spot and low volume treatments	90% v/v for stump cut treatments	Variable

Modified vegetable seed oil is one of the active ingredients in Competitor MSO. These oils act as adjuvants to decrease surface tension, increase herbicide uptake, and enhance wetting and spreading. They are used in conjunction with and to help the efficacy of aquatic pesticides.

6.1.2 Exposure Considerations

Competitor MSO is used as a surfactant with other active ingredient herbicides at a high foliar rate of 1% v/v for spot and low volume treatments. It is used at a low foliar rate of 0.5% v/v for spot, low volume, and broadcast treatments. It is also used as a diluent (90% v/v) with other herbicides for cut stump treatments. The same BMPs and precautions utilized for active ingredient herbicides are also utilized for this surfactant.

6.1.3 Human Toxicity

Competitor MSO exhibits very low toxicity to mammals. The rat oral and rabbit dermal LD50 are both >5,000 mg/kg. It is minimally irritating to eyes (Competitor MSO MSDS). It is not listed as a carcinogen.

6.1.4 Ecological Toxicity

Competitor MSO is reported to be slightly toxic to fish; the 96-h LC50 in rainbow trout is 95 mg/L. It is practically non-toxic for freshwater invertebrates, with a 48-h EC50 of >100 mg/L for daphnids (Washington State Department of Agriculture, 2009).

6.1.5 Physical Properties/Environmental Fate and Transport

Very little information exists about the environmental fate and transport of these oils.

6.1.6 Water Pollution Potential

According to the product sheet for Competitor MSO, it is biodegradable and is relatively insoluble in water. Thus, the water pollution potential of this compound is low.

6.2 Lecithin

LECITHIN

Formulations: Liberate NIS

> Human Toxicity: Low toxicity. No evidence of neurotoxicity, carcinogenicity, immunotoxicity, or reproductive/developmental toxicity.

> Ecological Toxicity: Slightly toxic to fish and moderately toxic to freshwater invertebrates.

> Water Pollution Potential: Registered for use near/in water and recognized as safe by the USDA.

> Other Considerations: NA.

6.2.1 Basic Use Information

> Products: *Liberate NIS*

> Application rates:

Material	Low Foliar Rate	High Foliar Rate	Volume/acre
Liberate NIS	0.25% v/v spot, low volume, and broadcast treatments	0.5% v/v spot and low volume treatments	Variable

Lecithin is a general term used to describe yellow-brownish fatty substances occurring in animal and plant tissues. It is often derived from soybeans. It is one of the ingredients in Liberate, a nonionic surfactant, which also contains alcohol ethoxylates, discussed below (Washington State Department of Agriculture, 2009). Liberate is an uptake enhancing surfactant that is used in conjunction with other herbicides and pesticides.

6.2.2 Exposure Considerations

Liberate NIS is used as a surfactant with other active ingredient herbicides at a high foliar rate of 0.5% v/v for spot and low volume treatments. It is used at a low foliar rate of 0.25% v/v for spot, low volume, and broadcast treatments. It is commonly used as a surfactant with Roundup Custom. The same BMPs and precautions utilized for active ingredient herbicides are also utilized for this surfactant.

6.2.3 Human Toxicity

Lecithin is metabolized by mammals and is non-toxic when ingested. It is used as a food additive and is recognized as safe by the USFDA. The acute oral LD50 of Liberate for rats is >5,000 mg/kg, and the acute dermal LD50 in rabbits is >2,000 mg/kg. It is not an eye irritant and not a skin sensitizer. It is not listed as a carcinogen (Liberate MSDS, 2012).

6.2.4 Ecological Toxicity

The 96-h LC50 for Liberate in rainbow trout is 17.6 mg/L (slightly toxic), with a NOAEL of 12.5 mg/L. Liberate is moderately toxic to freshwater invertebrates: the 48-h LC50 for daphnids is 9.3 mg/L, and the NOAEL is 7.5 mg/L (Liberate MSDS, 2012).

6.2.5 Physical Properties/Environmental Fate and Transport

Little is known about the fate of lecithin in the environment (Tu et al., 2001). It is relatively insoluble in water.

6.2.6 Water Pollution Potential

Lecithin is registered for use near/in water, is insoluble in water, and is recognized as safe by the USDA. The water pollution potential of lecithin is negligible.

6.3 Alcohol ethoxylates

ALCOHOL ETHOXYLATES

Formulations: Liberate NIS

> Human Toxicity: Low toxicity. No evidence of neurotoxicity, carcinogenicity, immunotoxicity, or reproductive/developmental toxicity.

> Ecological Toxicity: Slightly toxic to fish and moderately toxic to freshwater invertebrates.

> Water Pollution Potential: Registered for use near/in water and recognized as safe by the USDA.

> Other Considerations: NA.

6.3.1 Basic Use Information

> Products: *Liberate NIS*

> Application rates:

Material	Low Foliar Rate	High Foliar Rate	Volume/acre
Liberate NIS	0.25% v/v spot, low volume, and broadcast treatments	0.5% v/v spot and low volume treatments	Variable

Alcohol ethoxylates are a constituent of Liberate, along with lecithin. They are also commonly used in laundry detergents and household cleaners.

6.3.2 Exposure Considerations

Liberate NIS is used as a surfactant with other active ingredient herbicides at a high foliar rate of 0.5% v/v for spot and low volume treatments. It is used at a low foliar rate of 0.25% v/v for spot, low volume, and broadcast treatments. It is commonly used as a surfactant with Roundup Custom. The same BMPs and precautions utilized for active ingredient herbicides are also utilized for this surfactant.

6.3.3 Human Toxicity

Alcohol ethoxylates exhibit low toxicity to mammals via oral, inhalation, and dermal routes of exposure. Oral LD50 values for rats range from 600 mg/kg to >10,000 mg/kg depending on the structure of the compound. One- to four-hour inhalation LC50 values range from 1.5 to 20.7 mg/L in rats. Acute dermal LD50 values range from 2,000 to >5,000 mg/kg in rats (HERA, 2009). They may be irritating to eyes and skin. There are no data indicating that alcohol ethoxylates are genotoxic, mutagenic, or carcinogenic. They are also not categorized as reproductive or developmental toxicants. See above section for Liberate toxicity information.

6.3.4 Ecological Toxicity

The toxicity of alcohol ethoxylates differs depending on the branching and number of carbons in the specific compound. No toxicity data are available for birds. The 96-h LC50s in fish vary widely, from 0.25 – 100 mg/L (HERA, 2009). EC50s for invertebrates range from 0.1 to 100 mg/L. See above section for Liberate toxicity information.

6.3.5 Physical Properties/Environmental Fate and Transport

Alcohol ethoxylates are readily biodegradable under aerobic and anaerobic conditions. Total measured removal rates in wastewater treatment plants vary from 99.6 to 99.9%. They have low vapor pressure and are relatively nonvolatile. As they increase in carbon number, their water solubility decreases. They are able to sorb to soils. Hydrolysis in water and photolysis in water or soils is unlikely (HERA, 2009).

6.3.6 Water Pollution Potential

Alcohol ethoxylates are permitted for use in/near aquatic systems and are readily biodegradable. Therefore, the water pollution potential of these compounds is low.

6.4 Alkylphenol ethoxylates

ALKYLPHENOL ETHOXYLATES

Formulations: Pentra-bark

> Human Toxicity: Low toxicity. Irritating to skin and eyes. No evidence of neurotoxicity, carcinogenicity, or immunotoxicity. Potential estrogen-mimicking behavior of some congeners.

> Ecological Toxicity: Toxic to fish and aquatic invertebrates.

> Water Pollution Potential: Persistent in sediment and stable to photolysis and hydrolysis.

> Other Considerations: Formulation is used via injection or directed spray in targeted applications, reducing exposure and risk to non-target species.

6.4.1 Basic Use Information

> Products: Pentra-bark

> Application rates:

Material	Basal bark treatment	Volume/acre
Pentra-bark	2.5% v/v oak treatment in forests	Variable

Alkylphenol ethoxylates (APEs) are used as detergents, wetting agents, dispersants, emulsifiers, solubilizers and foaming agents. They are constituents of Pentra-Bark, a nonionic wetting agent, which is used in conjunction with Agri-Fos to prevent sudden oak death. Use of Pentra-Bark with Agri-Fos eliminates the need for aerial applications, reducing exposure to non-target systems.

6.4.2 Exposure Considerations

Alkylphenol ethoxylates are the active ingredients in the surfactant Pentra-bark, which is used with Agri-Fos to increase the uptake of the fungicide by the tree, thereby increasing its efficacy and decreasing its potential to impact non-target species. Pentra-bark is used at a rate of 2.5% v/v. Agri-Fos and Pentra-bark are applied by the basal bark method, which decreases the potential for drift, deposition in water, and exposure to non-targets because the fungicide is sprayed directly onto the bark and quickly taken up by the tree.

6.4.3 Human Toxicity

The toxicity of APEs usually increases as the length of the hydrophobic chain increases. Nonylphenol (NP), a well-studied APE, is of low acute oral and dermal toxicity but is highly irritating and corrosive to the skin and eyes (USEPA, 2010). Concern exists regarding the estrogen-mimicking behaviors of APEs (USEPA, 2010). NP and nonylphenol ethoxylate (NPE) are of particular interest and concern to the public and the EPA. The USEPA (USEPA, 2010) has recently recommended that this suite of chemicals be evaluated further due to their wide-spread use (past and present), persistence, and possible estrogen-mimicking behavior.

6.4.4 Ecological Toxicity

Toxicity of APEs to aquatic organisms increases with alkyl chain length. The 48-h LC50 for APEs in brown trout is 2.7 mg/L, and the 48-h LC50 in Daphnia is 1.5 mg/L (Argese et al., 1994). NP is bioaccumulative and toxic to aquatic organisms.

NPEs, though less toxic than NP, are also highly toxic to fish, aquatic invertebrates, and aquatic plants (USEPA, 2010). The 96-h LC50 of NP in fathead minnow is 0.135 mg/L (Holcombe et al., 1983), and the 48-h LC50 in Daphnia is 0.18 mg/L (Comber et al., 1993).

6.4.5 Physical Properties/Environmental Fate and Transport

Alkylphenol ethoxylates are essentially nonvolatile. They degrade faster in the water column than in sediment. Aerobic conditions further facilitate biotransformation of APE metabolites as compared to anaerobic conditions (Ying et al., 2002). Primary degradation of APEs in the environment generates more persistent shorter chain APEs and alkylphenols (i.e., nonylphenol, octylphenol, and mono- to triethoxylates), some of which may mimic natural hormones and disrupt endocrine function in wildlife and humans (Ying et al., 2002).

6.4.6 Water Pollution Potential

The solubility of APEs decreases with increasing carbon number. They are stable to photolysis and hydrolysis in water, though labile to biodegradation under aerobic conditions ($t_{½}$ = 4-24 days). APEs bind strongly to aquatic particles in river and coastal environments and are persistent in sediments. Due to the basal park application of Pentra-bark, the water pollution of this formulation is negligible.

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8 List of Abbreviations/Acronyms/Definition

a.e.	Acid equivalent-The acidic level of a chemical in solution
a.i.	Active ingredient-The primary chemical in a products that is the toxic chemical of concern.
AMPA	Aminomethylphosphonic acid
APE	Alkylphenol ethoxylate
BMP	Best Management Practice- Documented approaches to conducting field applications that have been demonstrated to mimimize any unwanted adverse effects to the environment.
bw	Body weight- The weight of an individual, usually expressed in grams for toxicology rankings to wildlife species impacted or in kilograms for humans.
K_{OW}	Octanol-water partitioning coefficient of an organic compound. A dimensionless concentration ratio whose magnitude expresses the distribution of a compound between equal volumes of n-octanol and water.
LC_{50}	Median lethal concentration. A statistically derived concentration of a substance that can be expected to cause death in 50% of the test animals when administered by the indicated route (oral, dermal, inhalation). Usually expressed as the amount of substance per amount of solution (e.g., mg/L).
LD_{50}	Median lethal dose. A statistically derived concentration of a substance that can be expected to cause death in 50% of test animals when administered by the indicated route (oral, dermal, inhalation). Usually expressed as a weight of substance per unit weight of animal (e.g., mg/kg).
LOAEL	Lowest observed adverse effect level. The lowest dose/concentration of a compound that causes a significant predetermined adverse effect in an experimental population.
µg	Micrograms One thousandth of a gram.
µg/g	Micrograms per gram of substance.
mg/kg bw	Milligrams per kilogram of body weight- General metric used for determining dose.
mg/L	Milligrams per liter-
MSDS	Material safety data sheet- Publlshed documentation of all available information about a chemical, including toxicity to humans and wildlife, known hazards and special conditions required for use.
NOAEL	No observed adverse effect level. The highest dose/concentration of a compound that causes no significant predetermined adverse effects in an experimental population.
NSAE	No significant adverse effects
IPM	Integrated Pest Management- An approach to pest management that combines BMPs, use of appropriate application scenarios, and minimal chemical use to achieve desired pest control.
POAE	Polyethoxylated tallowamine

RfD	Reference dose. The RfD is an estimate of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.
t ½	Half-life. The period of time required for the amount of a substance undergoing decay to decrease by half.
USEPA	United States Environmental Protection Agency

Glossary

Table of USEPA Toxicity Categories

Route of Exposure	I: High Toxicity	II: Moderate Toxicity	III: Low Toxicity	IV: Very Low Toxicity
Acute Oral LD50	≤50 mg/kg	50-500 mg/kg	500 – 5000 mg/kg	>5000 mg/kg
Acute Dermal LD50	≤200 mg/kg	200 – 2000 mg/kg	2000 – 5000 mg/kg	>5000 mg/kg
Acute Inhalation LC50	≤0.05 mg/L	0.05 - 0.5 mg/L	0.5 - 2 mg/L	>2 mg/L
Primary Eye Irritation	Corrosive (irreversible destruction of ocular tissue) or corneal involvement or irritation persisting for more than 21 days	Corneal involvement or irritation clearing in 8-21 days	Corneal involvement or irritation clearing in 7 days or less	Minimal effects clearing in less than 24 h
Primary Skin Irritation	Corrosive (tissue destruction into the dermis and/or scarring)	Severe irritation at 72 h (severe erythema or edema)	Moderate irritation at 72 h (moderate erythema)	Mild or slight irritation (no irritation or slight erythema)

Table of Fate and Transport of Active Ingredients Used by the District

Active Ingredient	Air	Water	Soil
Glyphosate	Nonvolatile	> Very soluble > In aquatic systems, sediment appears to be the major sink for glyphosate residue > Broken down by microbial degradation > Stable to hydrolysis and photolysis > T½ ≈ 8 days	> Strongly adsorbs to soil particles; remains in top 0-6" of soil > Low tendency to leach or runoff > Resistant to chemical degradation and photolysis > Biodegraded by microbes under aerobic (t½ = 1-2 days) and anaerobic conditions (t½ = 8-25 days)
Aminopyralid	Nonvolatile	> Degraded by photolysis; t½ = 0.6 days > Stable to hydrolysis > Susceptible to degradation under aerobic conditions; t ½ = 462-990 days	> Weakly sorbs to soil > Minimal leaching below the 15-30 cm soil depth > Non-persistent > Degraded by photolysis but much more slowly than in water; t ½ = 72 days > Susceptible to degradation under aerobic conditions; t½ = 31-533 days
Clopyralid	Relatively nonvolatile	> Very soluble > Degraded rapidly > Stable to hydrolysis and photolysis > T½ = 9-22 days	> Does not bind tightly to soil; mobile > Primarily degraded by microbes > Low leaching potential > Stable in compost > T½ = 8-250 days
Imazapyr	Nonvolatile	> Degraded by photolysis; t½ = 3-8 days > Stable to hydrolysis > Stable to aerobic and anaerobic aquatic metabolism	> Moderately persistent > Mobile > Primarily degraded by microbes; t ½ = 14-150 days > Stable to hydrolysis > Stable to aerobic and anaerobic degradation > May leach to groundwater
Clethodim	Nonvolatile	> Very persistent	> Non-persistent; t ½ = 3 days > Weakly bound to soil; mobile > Degraded through aerobic processes
Potassium salts of phosphorus acid	na	> Very soluble > Rapidly dissociate to yield hydrogen and phosphite ions	> Microbial transformation is very slow
d-trans allethrin	na	> Insoluble > Degraded rapidly by photolysis; t ½ < 8 h > Stable to hydrolysis	> Adheres moderately to soil containing organic matter

Active Ingredient	Air	Water	Soil
Phenothrin	na	> Low water solubility > Stable to hydrolysis > Degraded rapidly by photolysis; t ½ = 6.5 days > Degraded by aerobic metabolism; t ½ = 36 days	> High affinity for binding to soils and moderate persistence in surface soils > Low leaching potential; relatively immobile > Aerobic metabolism t ½ = 18-26 days
Indoxacarb	Nonvolatile	> Degraded primarily via photolysis; t ½ = 3 days > Relatively stable to hydrolysis at pH 5 and 7; t ½ > 30 days > Susceptible to hydrolysis at pH 9; t ½ = 1 day	> Moderately persistent > Immobile > Degraded under aerobic conditions; t ½ = 4-7 days > Stable to photolysis; t ½ = 139 days
Hydroprene	Nonvolatile	> Insoluble	> Rapidly degraded; t ½ ≈ 3 days
Fipronil	Nonvolatile	> Degrades rapidly under UV; t ½ = 3 days	> Under aerobic conditions, broken down by microbes > Photodegradation t ½ = 34 days > Low potential for leaching
Sodium tetraborate decahydrate (borax)	Nonvolatile	> Soluble	na
Diatomaceous earth	Nonvolatile	> Insoluble	na
Modified Vegetable Oils and Methylated Seed Oil	na	> Insoluble	na
Lecithin	na	> Insoluble	na
Alcohol Ethoxylates	Nonvolatile	> Solubility decreases with increasing carbon > Rapidly biodegraded under aerobic conditions; t ½ = 4-24 h > Stable to hydrolysis and photolysis	> Rapidly biodegraded under aerobic conditions > Stable to hydrolysis and photolysis
Alkylphenol ethoxylates	Nonvolatile	> Degrades faster in water than in soil; t ½ = 4-24 days > Solubility decreases with increasing carbon	> Bind strongly to particulates and are persistent in sediments > Aerobic conditions facilitate biotransformation; t ½ = 4-320 days

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Appendix B

Forms

Attachment 2

Midpeninsula Regional Open Space District New Pest Control Recommendation

Submitting Person

Date

Preserve

Location

Species

Common Name

Calflora Record Number

Date Last Assessed

Known Site Conditions

- ☐ Access Issues
- ☐ Aquatic Areas (within 15 feet)
- ☐ Preserve Boundary (within 100 feet)
- ☐ Steep Slopes (Erosion Potential)
- ☐ T&E Species (within 30 feet)
- ☐ Other

Site History

Attachment 2

Proposed Treatment

Year 1			
Work Force	☐ Contractors	Hours	
	☐ Staff	Hours	
	☐ Volunteers	PP days or ARMS Hours	

Year 2			
Work Force	☐ Contractors	Hours	
	☐ Staff	Hours	
	☐ Volunteers	PP days or ARMS Hours	

Year 3			
Work Force	☐ Contractors	Hours	
	☐ Staff	Hours	
	☐ Volunteers	PP days or ARMS Hours	

ENVIRONMENTAL SITE REVIEW FORM

Biologist ______________________ Date: ______________

Preserve ______________________ Treatment Site ______________________

Photo Filename ______________________

GIS Filename ______________________

Target Species ______________________

Vegetation Type		Grassland		Brush		Wooded	
% Cover - Target Sp	0	0-1	1-5	5-25	25-50	50-75	75-100
Treatment Method		Manual		Mechanical		Chemical	

Sensitive Plant Species	
Sensitive Animal Species	
Cultural Resources	
Aquatic Features	
Erosive Conditions	
SOD Symptoms	

Specific BMPs or other site conditions needs

Work Performed

Date: ______________________ Preserve ______________________

Reporter ______________________ Treatment Site ______________________

% Area Treated ______________________ Target Species ______________________

Person Hours ______ X ______ = ______

# of People | Project Hours | Person-Hours

Herbicide Use

Product | Method | Amount of Concentrate (oz)

Post Treatment Survey

Surveyor ______________________

Photo Filename ______________________ Date ______________________

Signs of Herbicide Damage (Target)

Signs of Herbicide Damage (Non-target)

New Environmental Issues

Recommendations for next treatment

Additional Comments

Project ID

Safe	
Human Health	
The proposed method is the safest method for workers at that location.	
There are human occupied facilities nearby (trails, parking lots, buildings, school, etc.).	
Environmental Health	
The pest provides habitat for beneficial species.	
Removal method would cause a seed bank flush or erosion issues.	

Prevents and Controls Most Destructive Pests	
Prevent	
The species is listed as a State or Federal noxious weed.	
The species is listed as a Cal-IPC Alert and/or Cal-IPC or District watch list.	
The species' Cal-IPC rating is …	
Control	
This is the only population of the species at the preserve.	

Protects Biodiversity	
The removal will …	
assist in the recovery of a Special Status Species.	
protect a sensitive ecological community (wetlands, serpentine grassland, coastal prairie).	
actively protect against spread of pathogens.	
assist in retaining a bio-diverse community.	
The species is allopathic or can change the soil chemistry.	

Provides for Public Engagement	
The project has significant public interest and/or support.	
The project provides for the participation or education of the public.	

Feasible and Effective	
The project be done with existing staffing and/or funding.	
There is a high level of anticipated outcome (Cost/Benefit)	
The treatment method is considered the most effective.	
The project method will reduce the overall maintenance of the area.	

Comment

APPENDIX D

Burn Unit Maps

[APPENDIX D FORTHCOMING]

APPENDIX E

Pre-Fire Plans

[APPENDIX E FORTHCOMING]

APPENDIX F

Monitoring Implementation Plan Forms and Annual Reporting Template

Monitoring Implementation Plan for [Name of Project]

Date Prepared:

Prepared By:

Project Type (circle all that apply):

Shaded Fuelbreak	Helicopter Landing Zone
Non-Shaded Fuelbreak	Fuel Reduction Area
Ingress/Egress Fuelbreak	Prescribed Fire
Defensible Space	Wildland Fire Event

Dates of Activity:

Open Space Preserve and Treatment Site (and attach map):

Description of Baseline Condition

Vegetation Type:

Grassland	Brush	Wooded

Rare Plant Species:

Special-Status Animal Species:

Nesting Habitat:

High	Medium	Low

Cultural Resources:

Aquatic Features, Including Jurisdictional:

Erosive Conditions or Landslide Present:

SOD or other Forest Disease Symptoms:

Monitoring Prescriptions

Use the following table to identify monitoring requirements by project phase. Identify the parameters that are relevant to the existing conditions and type of activity. Use Table 7-11 through Table 7-14 from Section 7:6: Reporting and Adaptive Management of the Monitoring Plan for guidance.

Parameters include:

- Wildlife Presence
- Wildlife Mortality
- Special-Status Wildlife Species
- Vegetation and Habitat
- Rare Plants
- Erosion/Soils
- Water Quality
- Fuel Load
- Disease Presence
- Invasive Species
- Intensity of Fire
- Weather

APPENDIX F

Parameter	Timing of Monitoring (pre-activity, during-activity, post-activity)	Objective of Monitoring	Method or Protocol (attach write-up of monitoring method or protocol for parameter, if appropriate)	Personnel and Qualifications of Monitor or Specialist

Ongoing or Cyclical Monitoring Implementation Plan Guidance

This section includes the content of monitoring efforts or programs designed for longer-term, on-going or cyclical review. A monitoring implementation plan should be prepared for larger efforts as well and should include the following components.

Question or Objective:

Monitoring Parameters (Wildlife Presence, Fuel Load, Invasive Species, Forest Disease):

Geographic Extent to be Monitored (Open Space Preserves, Region, etc.):

Monitoring Protocol and Methods:

Monitoring or Specialty Staff and Estimated Hours:

Reporting Requirements:

Annual Monitoring Report Template

1. Introduction

Summarizes the year of monitoring and a summary of the Wildland Fire Resiliency Program and its goals.

2. Projects Implemented During Calendar Year

Identifies the projects under the Wildland Fire Resiliency Program that were implemented in the previous calendar year, including location, open space preserve, methods used, manpower and equipment used, herbicide used, acreage treated, etc.

3. Summary of Parameters Monitored and Monitoring Results by Project

Identifies the parameters monitored based on the individual monitoring implementation plans prepared and carried out. Summarizes the results from each of the monitoring reports prepared for all of the projects undertaken in the previous year.

4. Summary of On-Going or Cyclical Monitoring Activities and Results

Describes any additional long-term, regional, district-wide, or other monitoring effort or program not related to a specific activity or project. This section could describe larger-scale songbird monitoring efforts, or SOD spread, for example. Results of these monitoring efforts or programs to-date, should be presented.

5. Successes in Reaching Treatment Objectives and Meeting Requirements

Identify which activities resulted in achieving the project goals and objectives. Identify the monitoring requirements that were met. Describe positive trends towards plan success, where observed.

6. Difficulties in Reaching Treatment Objectives and Meeting Requirements

Identify where intended results or desired conditions were not achieved, the reasons for difficulties, and what aspect of the activity resulted in the difficulty. Describe any trends away from desired conditions and successes, where observed.

7. Recommendations for Changes in Future Efforts to Increase Success

Based on successes and difficulties, describe any modifications to the activities undertaken that could result in continued successes and that can reduce or eliminate any unintended consequences or difficulties. Explain why recommendations are made and how they should e implemented during the next year’s effort.

APPENDIX G

Monitoring Methods and Protocols

Monitoring Methods and Protocols

Acronyms and Abbreviations

A

AVHRR	Advanced Very High Resolution Radiometer
AOI	area of interest

C

CAL FIRE	California Department of Forestry and Fire Protection
CCH2	Consortium of California Herbaria 2
CCRWQCB	Central Coast Regional Water Quality Control Board
CDFW	California Department of Fish and Wildlife
CNPS	California Native Plant Society
CSE	Common Stand Exam

D

DBH	diameter at breast height
DEM	Digital Elevation Model
DSM	Digital Surface Model
DTM	Digital Terrain Model

E

EDDR	Early Detection Rapid Response

F

FAM	National Division of Fire and Aviation Management
FGDC	Federal Geographic Data Committee
FVS	Forest Visualization Simulator

G

GEE	Google Earth Engine
GIS	Geographic Information Systems
GPS	Global Positioning System

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GRTS Generalized Random Tesselation Stratified

I

ICF ICF International

IPMP Integrated Pest Management Program

M

MMU minimum mapping unit

MODIS Moderate Resolution Imaging Spectroradiometer

N

NAIP National Agriculture Imagery Program

NASA National Aeronautics and Space Administration

NDVI Normalized Difference Vegetation Index

NOAA National Oceanic and Atmospheric Administration

NPS National Park Service

NRCS National Resources Conservation Service

O

OBIA object-based image analysis

OSP Open Space Preserve

OWEB Oregon Watershed Enhancement Board

R

RAWS Remote Access Weather Stations

RdNBR Relative Differenced Normalized Burn Ratio

S

SCCWRP Southern California Coastal Water Research Project

SMAP Soil Moisture Active Passive

SMMNRA Santa Monica Mountains National Recreation Area

SWRCB State Water Resources Control Board

T

TLS Terrestrial LiDAR Systems

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U

UAV	Unmanned Aerial Vehicle
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

V

VHP	Santa Clara Valley Habitat Plan

APPENDIX G

Purpose and this Document

The purpose of this document is to present several available protocols to monitor various parameters identified in the Wildland Fire Resiliency Program, Chapter 7. These protocols are only meant to be a resource and not all protocols may be required, nor are these the only protocols that may be implemented. Monitoring requirements will vary depending on the activity undertaken and the conditions in the area where the activity is to occur. Monitoring and reporting may also be required as part of the mitigation adopted with the Final Environmental Impact Report for the program or any permits obtained to perform specific work activities under the program. Individual monitoring protocols will be determined on a case-by-case basis for each project at the discretion of professional Midpen staff and/or as required by mitigation.

Monitoring Methods for Biodiversity and Wildlife Presence

Overview

The monitoring methods described here should be applied, as appropriate, to understand wildlife presence and diversity before, during, and after treatments or fire events. Key animals to be monitored include bird, butterfly, American badger, dusky-footed woodrat, and reptile and amphibian species.

Avian Monitoring

Overview

The standardization of avian monitoring began in earnest in the 1980s and has produced highly useful methods for estimating bird population sizes and changes over time. There is a deep literature on these subjects, and methods for population estimation can generally be split into those that involve distance sampling, and those that do not. Distance-sampling methods (such as point counts) are generally considered to produce robust density estimates because of the ability to calculate species detection probabilities. Conversely, non-distance sampling methods, such as area searches and produce abundance indices, until recently were not considered as statistically robust as distance-based density estimates. For all methods, techniques such as double-sampling and using double observers can improve estimates of population size (Bart et al. 2004). Ensuring that there is annual training in distance estimation and species identification is also critical. Overall, different monitoring methods are used depending on the goals of the monitoring, the terrain and vegetative cover of the study or management area, and the bird species to be monitored (see review in Buckland et al. 2001).

Both point count and area search methods could be utilized for collecting baseline information on avian populations on the open space preserves (OSPs) of Midpen. However, a thorough review of the goals of the monitoring, the species to be monitored, and the details of any planned monitoring method should be conducted before monitoring is started, so that the most rigorous program can be developed to detect changes in bird populations over time, given the funding available. The software package “Distance” (Thomas et al. 2010) provides a survey design feature, and helps managers consider all aspects of developing a statistically sound monitoring program.

Point counts that involve the measurement of distances to observed birds are useful for assessing species population trends and treatment responses because such sampling can produce density estimates in challenging field conditions, and because there are robust statistical tools for analyzing such data (e.g., program "Distance"; Buckland et al. 2001, Thomas et al. 2010). Point counts can also be modified to sample and estimate the population size of special-status bird species, such as rails or other birds requiring playback for counts, or can be conducted with driving between points instead of walking, so that wide-ranging raptor species can be counted (e.g., Fuller and Mosher 1981) or more area can be covered (e.g., as for Breeding Bird Surveys; Sauer et al. 2017). Thus, point counts offer a flexible method for application to many different situations. Statistical methods for analyzing count data for rare species now exist as well (e.g., N-mixture models; Royle 2004).

Bird area searches—which are not a distance-sampling method--are a method of determining bird species abundance and richness and can be conducted in a standardized way. N-mixture model analyses have been developed which can analyze abundance data for uncommon or rare species across spatially replicated counts (Royle 2004), and so this method has more utility now.

Both point count and area search methods require that observers be able to identify all birds on Midpen lands by sight, and for passerine counts, that observers also be able to identify breeding songbirds (and wintering birds, if desired) by vocalizations (e.g., songs and calls). Both methods can incorporate and train volunteers and Community Scientist participants. Volunteers can shadow primary observers during point counts and area searches to learn the methodology and to practice their identifications, as long as they do not add to or distract from the work of the primary observers. Both methods can be used as vehicles for Midpen to educate the public about science and natural history through their involvement in monitoring, which can translate to enhanced community support for Midpen.

Point Count Method for Bird Population Sampling

Background

The point count methodology has been standardized by various researchers, notably C.J. Ralph and colleagues (e.g., Ralph et al. 1993, Ralph et al 1995). This methodology has been used by researchers and others all over the world in thousands of projects designed to enumerate and monitor bird populations. The method is recommended especially for areas with rugged topography and/or dense vegetation, where physical exertion and/or difficulty seeing birds make using a point-sampling method desirable (Ralph et al. 1995). However, the point count method (also referred to as the point transect method) is also effective in open areas, including along roads, and has been the method used across the U.S., Canada, and Mexico since the 1960s for the Breeding Bird Survey (Sauer et al. 2017; although in Breeding Bird Survey, distances to observed birds are not measured, which encouraged the development of N-mixture model analysis; Royle 2004). Analyses of bird data collected via the point count method were improved with the development of software that calculates densities using species- and observer-specific detection probabilities (detectability curves; Buckland et al. 2001). As discussed above, updated N-mixture analyses that can estimate abundances for species with small population sizes and fewer detections have also been developed (e.g., Yuichi et al. 2016).

The NPS, Channel Islands National Park, California (hereafter "the Park"), has been monitoring terrestrial birds on five Channel Islands since 1993. Transects were established on Anacapa, Santa Barbara, Santa Cruz, San Miguel, and Santa Rosa in 1993, but in 2000, the Park underwent a comprehensive review of its monitoring program. As a result, the Park established point count stations across the five islands, retaining some transects for long-term data comparisons. The resulting monitoring program is comprised of more than 300-point count stations and 10 transects across five islands, with points stratified by vegetation type (Fancy et al. 2009, Coonan et al. 2011, Coonan and Dye 2016, Hall et al. 2018). The associated monitoring protocol was developed based on material from the NPS National Inventory and Monitoring Program and at least six other protocols published between 2004 and 2010 and covering the Sonoran Desert, North Coast and Cascades, Great Lakes, Klamath area, and Sierra Nevada (Coonan et al. 2011). The Channel Islands point count protocol has become a model for the NPS and, in 2016, was adopted for avian monitoring in the Santa Monica Mountains National Recreation Area (SMMNRA; Hall and Mateos 2018). Although the SMMNRA counting protocol is the same, the method for point establishment was updated (a Generalized Random Tesselation Stratified [GRTS] analysis [Stevens and Olsen 2004] was used to randomly generate 1,500 spatially-balanced point locations in the Santa Monica Mountains along secondary and tertiary trails). Community Scientists are currently monitoring birds at one hundred of these points annually (Hall and Mateos 2018).

Thus, the point count protocol used by the NPS at two Park Units in California has been vetted and utilized over the past 20 years and provides a standardized methodology for Midpen. The point count method lends itself well to the great variety of OSPs in Midpen, as well as to the variability in trails, vegetation types, and topography, and will be a useful avian monitoring system for Midpen.

Methodology

Point counts involve an observer standing in one spot and recording all birds seen or heard at a fixed or unlimited distance from the center of the point. Point establishment was discussed initially in Ralph et al (1993, 1995), and included the recommendation that the minimum distance between point count stations in wooded (or otherwise dense) vegetation types be 250 m. In open environments, this minimum distance should be increased because of the greater detectability of birds; and along roads, where travel by vehicle is possible, distances of 500 m or more should be used (Ralph et al. 1993). Recent variations on establishing points have been developed, including points arranged in 4 x 4 grids of 16 points, with 250 m spacing between points, and with grids selected using a spatially balanced sampling algorithm (McLaren et al. 2019). Stratification of points by vegetation type or another factor is common (e.g., Coonan et al. 2011), but is not always used (e.g., McLaren et al. 2019). Once points are established, the following point count protocol can be used (from Coonan et al. 2011, from the NPS Channel Islands National Park Landbird Monitoring Protocol). It is recommended that all points be counted at least three times per season (Ralph et al. 1995), but this also depends on the goals of the monitoring project.

Point Count Sampling Protocol

1. Prior to the day of the counts, determine which plots will be sampled in which order, and make certain that the coordinates for those points are in the global positioning system (GPS) unit. As a backup, bring a list of coordinates for each point.
2. Wear earth-tone colors (browns, greens, dark blues, grays). Do not wear bright colors (reds, yellows, whites, etc.).
3. The point counts should only be conducted if conditions meet the following criteria:
    a. Visibility is greater than 150 m.
    b. Wind is 10 knots or less (i.e., less than 4 on the Beaufort scale).
    c. It is not raining.
    d. No one has walked or driven through the area to be counted within 30 minutes prior to the count.
    e. Only one observer is within the count circle (no additional persons may accompany the observer).
    f. The count must be the first priority. If anything else is done in addition (e.g., transporting some materials), it must not in any way detract from the time and attention you are giving the survey, nor should it affect the pace at which you cover the survey route.
4. Sampling will occur in the morning; monitoring begins when there is enough light to see a distance of at least 400 m and ending no later than 4 hours after official sunrise. Singing rate for most species is usually highest before or near official sunrise and then declines slowly for the next four hours.
5. Do not conduct the count during high winds or heavy rains because these conditions inhibit bird activity and impair your ability to see and hear birds. Counts should not be conducted if wind strength on the Beaufort Scale is a sustained 4 or greater (see below), or if it is raining hard or snowing (rain code ≥4 below). If you encounter these conditions, wait until the weather improves or else cancel the sampling for today and try again on another day.
6. Navigate to the coordinates of the next plot on the list using the GPS. If the hike to the point was extremely strenuous, rest away from the point (e.g., 100 m) for a few minutes, then continue to the point. At the first point on each survey day, fill in the survey information at the top of the form. At the first and last survey points, fill in the survey condition data.
7. Conduct the point as a “snapshot” in time. The survey results should represent the actual distribution of the birds relative to the point. The underlying theory of distance sampling requires that each point be recorded as close to a “snapshot in time” as possible. Some movement is acceptable, as long as a bird is only counted

once and the observer does not cause movement. Any birds that flush upon approaching the point, or birds that seem to be attracted by the presence of the surveyors, should be noted in the comments.

8. Use a laser rangefinder to estimate distances to birds whenever possible; the closer the bird, the more accurate the distance estimation should be.
9. Remember: **The goal is not the largest count possible, but the most accurate count possible. Stick to the methodology described in this protocol.** Do not bend the rules to include more birds because you think that you do not have enough. Do not list a bird unless you are sure of its identification.
10. The accuracy and integrity of the count can only be maintained by minimizing variations in methodology. This is accomplished by rigorously following the established count procedures.

Weather Conditions During the Survey

The following information must be filled in at the beginning of each survey morning:

- **Temperature (°C):** Record the ambient temperature during the ten-minute count in degrees Celsius, rounded off to the nearest degree. The thermometer should be placed above the ground and allowed to adjust to ambient air temperature.
- **Wind (0–6):** Record the wind code (0 through 6) as it applies to the strength of the wind during the first and last eight-minute count. Record the average wind conditions for each count, not the maximum condition (e.g., periods of gusty winds) (Table 1). **Do not count when winds are 4 or greater.**
- **Rain (0–5):** Record the appropriate code (Table 2).
- **Cloud cover (%)**: Visual estimate of the percent cloud cover, rounded off to the nearest 10%. This should be a number between 0 (no clouds) and 100 (completely overcast). If there are patches of clouds in different areas of the sky, try to picture gathering all of them together into one part of the sky and recording what percent of cloud cover that would represent. If you are in thick fog, record 100 percent, even if it is a bright sunny day up above the fog layer that you are conducting the count in (keeping in mind the 150-meter visibility minimum for sampling).
- **Noise (0–3):** Record the noise code that applies to background-noise conditions during the count, as it affects your ability to hear birds (Table 3).

Table 1 Wind Codes - Beaufort scale (used to record wind strength during bird counts)

Wind Code	Definition
0	calm, smoke rises vertically (< 2 km/h)
1	smoke drifts (2-5 km/h)
2	light breeze felt on face, leaves rustle (6-12 km/h)
3	leaves and twigs in constant motion (13-19 km/h)
4	small branches move, raises loose paper, dust rises (20-29 km/h)
5	fresh breeze, small trees sway (30-39 km/h)

6	strong breeze, large branches moving, wind whistling (40-50 km/h)

Table 2 Rain Codes (used to record precipitation during bird counts)

Rain Code	Definition
0	no rain
1	mist or fog
2	light drizzle
3	light rain
4	heavy rain; difficult to hear birds
5	Snow

Table 3 Noise Codes (used to record level of background noise as it affects the observer's ability to hear birds)

Noise Code	Definition
0	quiet; normal background noises; no interference
1	low noise; might be missing some high-pitched songs/calls of distant birds
2	medium noise; detection radius is probably substantially reduced
3	high noise; probably detecting only the loudest/closest birds

Approaching the Point and Beginning the Count

1. Approach the plot vigilantly, and if you observe a bird close to the center of the plot that flushes as a result of you approaching the plot, you should record the initial distance from the plot center to that bird on the data form. The reason for this is that a critical assumption of the distance methodology is that any bird directly at (or very close to, e.g., <5-10 m) the plot center will always be detected, i.e., g(0) = 1. If the data are analyzed as grouped data (as recommended), this is not a problem if the bird does not move beyond the first grouping interval. However, if a bird that otherwise would have been recorded in the plot during the count flushes prior to the beginning of the count as a result of the approach of the observer, abundance will be underestimated for that species. The alternative approach is to wait for several minutes after reaching the plot before starting the count, but this approach is likely to underestimate bird density near the plot because of birds flushing as the observer approaches. This latter approach may be necessary if you created a lot of disturbance getting into the site in dense vegetation.
2. Once you arrive at the plot center, begin the count as soon as possible. You should have time to fill in the location, event, and weather conditions information at the top of the form during the count. If not, these can be filled in at the end of the 10-minute count.

3. Use your watch and record the time for each observation. Make sure you determine the end of 10 minutes, stopping the count at the end of the tenth minute.
4. Conduct the 10-minute count without interruption, being sure to fill in all the fields for each bird/flock detected. Occasionally, aircraft noise can be loud and can last for up to 30 seconds. In these instances, increase the count period by the amount of time for which the count was disturbed. If excessive noise interrupts the count for more than 2 minutes, then start the survey again after the disturbance has passed.
5. Once you have noted the time and begun the 10-minute counting period, record all birds heard or seen during the ten minutes, regardless of their distance from the center of the point. At each point, you will record the following information only once for each bird or flock of birds observed during the 10-minute active period:
    a. **Time** (hh:mm): Write in the hour and minute in which the bird was detected. Use military time format for times after noon (e.g., 13:05, 14:26, unlikely with morning count limits).
    b. **Species**: Record the four-character code for the species detected. Examples are WEME for Western Meadowlark, HOLA for horned lark, and WIWA for Wilson's Warbler. If no birds are detected during the 10-minute count, you should enter data for the first line of the form and record the code "NONE" in the Species column. Birds that you cannot positively identify to species should be recorded as "UNKN" for unknown bird (you may be able to identify it later during the 10-minute count, and you will have the proper time of detection recorded for it). When you review and then turn in data sheets later the day of sampling, cross out any UNKN that were not identified during the count or before you review your data sheet.
    c. **Distance (m):** Record the horizontal distance in meters between the point center (where you are standing), and the location of the bird where you first detect it. Use a laser rangefinder whenever possible to get as accurate a distance as possible. **Do not round off numbers to the nearest five meters; estimate the distance to the nearest meter**. Many birds are heard and not seen. If you cannot see the bird, estimate the distance to some object (tree, bush, rock) near where you think the bird is located. If the bird is flying directly at you and then lands nearby, record the distance to where you first saw it flying toward you, not the distance to where it landed. For species that occur in clusters or flocks, record the distance from the observer to the center of the flock. If a bird is high in a tree, imagine dropping a plumb bob from the bird down to the ground, and measure the horizontal distance to that spot on the ground. Indicate flyovers (birds that fly above the top of the vegetation canopy, never

touch down in your field of view, and do not appear to be foraging, displaying, or behaving in any other way that might suggest a link to the habitat below them or the habitat you are sampling) by entering -9999 in the distance column.

d. **DT (Detection type):** The detection type corresponds to the first detection of that individual (refer to Attachment 1, Area Search Data Form). The three possible entries for the first detection are "C" for Call, "S" for Song, and "V" for Visual. If you hear the bird and then later see it, add a "V" to the right of the "C" or "S" that you initially recorded, so that the Detection Type becomes "CV" or "SV". The detection type code will be used later in various analyses. For example, distances to birds that are seen are probably more accurate than those to birds that are only heard. Recording the detection type makes it possible to develop distance histograms to compare birds seen versus those that are only heard.
e. **Flock Size**: For most observations, each individual bird will be treated independently as a separate observation with a Flock Size of one (1), but for species that usually occur in clusters or flocks, the appropriate unit is the cluster or flock size, and not the individual bird. For example, if you observe a flock of 15 house finches moving as a group during a count, it is not appropriate to record 15 distances and treat them as independent observations in the analysis. For flocking species, record the distance to the center of the flock and the number of birds in the flock, rather than the distance to each individual bird.
f. **Sex**: If you are able to see a sexually dimorphic species, record either "M" (male) or "F" (female) on the form; otherwise, leave blank. Leave the "sex" field blank for all auditory detections and for flocks that contain both males and females.
g. **Age (Class):** If you are able to determine that a bird is a juvenile based on its plumage or vocalization, enter a "J" for Juvenile; otherwise, leave blank.
h. **Prev(ious) Point**: Place an "X" in this column if the bird was already detected at a previous point. Bias caused by repeated counting of the same individual from more than one point is usually small unless repeated counting is common during a survey (Buckland et al. 2001:37) or in cases where a rare bird is counted from multiple points. By recording whether a bird is thought to have been counted at a previous point, the data can later be analyzed in two different ways, depending on which is most appropriate.
i. **Comments**: Record any comments that seem appropriate and that might help someone interpret and analyze the data correctly.

After the 10-Minute Active Period

1. Review the data form and fill in all fields on the data form before departing for the next point. Also, search the area to ensure that no equipment is left behind.
2. Record observations of other notable plant and animal species on a separate "Incidental Observations" data form, or at the bottom of your datasheet (see Attachment 1 for datasheet).

Area Search Method for Bird Population Sampling

Background

The area search methodology was described by Ralph et al. (1993). This methodology is essentially a timed, intensive survey of a delineated area. The area search method does not involve estimating distances to birds, so does not give an estimate of density, but it can be used to determine the number (or abundance) of birds per species per sampling unit, which can be converted to a density value (i.e., number of birds/unit area). These values can be used to examine trends in species' abundances over time. Area searches can also be used to make species lists and determine richness for survey units (Ralph et al. 1993).

The National Protocol Framework for the Inventory and Monitoring of Nonbreeding Waterbirds and Their Habitats (Loges et al. 2017) recommended the use of direct whole-area counts for tallying the number of individual waterbirds by species (where waterbirds were defined as predominantly waterfowl, shorebirds, wading birds, and other birds closely associated with wetland habitats). Many other species can be sampled by this methodology—passerines and terrestrial non-passerines, including raptors—if the unit sizes are large enough to accommodate their activity areas.

Methodology

Ralph et al (1993) recommended that three 20-minute counts be conducted in standardized areas across the region; this way, comparisons can be made among sampled units. A review of sampling units shows projects conducting searches in <1 hectare to >10-hectare blocks or circles. For water birds, Loges et al. (2017) recommended that an observer be able to visually assess >70 percent of the surface area of a management unit, and if the observer cannot visually assess that much area, additional vantage points should be added in lieu of splitting the management unit into multiple survey units. Loges et al. further recommended that while multiple observation points can be established around the perimeter of the unit to meet this criterion, observers should bear in mind the need to complete the count on the unit within a single morning and to minimize multiple counting of individual birds. During each area search, the observer moves consistently and methodically through the unit, identifying all birds observed, tracking down unfamiliar calls, and looking particularly for quiet, secretive, or rare birds.

Ralph et al. (1993) recommended that at least three sampling plots be established per vegetation type for adequate representation. They suggested that plot sizes of about 3 hectares in forest or dense woodland, 10 hectares or more in more open habitats, and 1 to 2 hectares in very dense forest. The search areas can have adjoining boundaries or can be in completely separate regions of the plot. More than three search areas can be established within a plot, but as for all methods that provide bird data for trend analyses, the boundaries (or points, or transects, etc.) should be fixed through the sampling season and across years to ensure data comparability (Loges et al. 2017).

Similar to point counts, the time of day when counts are conducted must be standardized annually to allow for comparisons across years. Ralph et al. (1993) suggested that because of the intensive nature of this method it could be carried out longer into the morning than other methods. However, it should continue no later than 5 hours after dawn. In addition, Ralph et al. recommended that the observer should walk through each sampling plot for exactly 20 minutes in each search area, stopping or moving to investigate sightings or calls when appropriate. The observer should record numbers of birds of each species seen, heard, or both seen and heard in the search area during this time, and concentrate on finding as many birds as possible within the plot.

In 2010 Klamath Bird Observatory developed standard protocols for their monitoring program, in cooperation with the NPS, Klamath Network, and they have shared their widely used protocols through the Avian Knowledge Network (http://avianknowledge.net). Their "Landbird Monitoring Area Search Protocol" is provided below (from Stephens et al. 2010).

Area Search Sampling Protocol

One or more observers walk a 20-minute route, noting all birds seen or heard. The person who is the best birder should conduct the survey; the other surveyors should practice as time allows. The observer should be reasonably familiar with most (if not all) bird species likely to be encountered at the site. This method allows the observer to track down unfamiliar birds. Walking the site before a survey with a person familiar with the birds allows the less experienced observer to be more efficient.

Walk in an approximate circle or oval for exactly 20 minutes in each search area, stopping or moving to investigate sightings or calls when appropriate. Do not spend more than a minute looking for a difficult bird. If there is an unknown bird that cannot be identified, record it on your form as unknown (UNKN). Record numbers of birds of each species detected within and outside the search area as appropriate on the Area Search Data Form (Attachment 1). Record birds outside the search area, as defined by the route you take, separately on your data sheet, but concentrate on finding as many birds as possible within the site.

The form includes separate boxes within each row for recording distinct detection events with a detection type code and number of individual birds so detected. A detection event is any single detection (e.g., V, S, F, etc.) that may include any number of individuals. For example, a bird singing would be recorded as S1 in a single box; then, two birds (not including the first detected individual) of the same species seen would be recorded as V2 in a subsequent box of that species' row. If all boxes of a species' row are used then a second, and more as necessary, row for that species should be used. The detection type recorded is the first behavioral cue that alerted the observer to the presence of the species. If subsequent behavior observed has a greater hierarchal breeding status category than the initial observation, then it should be noted as such in the Breeding Status field. The location of the initial detection determines whether it was "On" or "Off" the area. The bird's location at the time of detection is determined as a flat plane from the observer (i.e., imagine a plumb bob suspended from the bird to the ground). For birds heard singing or calling, you may have to estimate whether they are inside your area or not. Note that this 20-minute time constraint is an extremely important component of the technique, as the data are to be used for monitoring.

Regional Avian Monitoring

There are current regional land bird monitoring efforts conducted by Point Blue Conservation Science (formerly the Point Reyes Bird Observatory) and the National Park Service. The data from this monitoring provides valuable regional information, which may help with monitoring efforts on Midpen lands. The Landbird Monitoring Program includes protocol documents and monitoring/trend reports (NPS 2018).

Assessment of Butterfly Relative Abundance

Butterfly abundance may be assessed using timed area surveys or linear transects. The methods to conduct these surveys are outlined by Kadlec et al. (2012).

Assessment of American Badger Populations

American badger density may be assessed using trapping and radiotelemetry or camera traps and individual identification. These methods for surveys are outlined in Gould and Harrison (2018) and Brehme et al. (2014).

Assessment of Woodrat Populations

Dusky-footed woodrat density may be assessed locating woodrat houses and then using trapping and identification of individuals. These methods for surveys are outlined in Innes et al. (2007), Sakai and Noon (1993), and similar studies.

Assessment of Reptile and Amphibian Species

Several methods are available to determine populations of reptiles and amphibians. Methods may include time-constrained searches, surveys of coarse woody debris, coverboard, or pitfall trapping as laid out in USFS (1990). Each method varies in success dependent upon the species and overall accuracy.

Trail Camera Monitoring of Mammalian Species

Midpen is in the process of developing a camera monitoring program. Monitoring protocols will be developed as part of the Wildland Fire Resiliency Program.

Wildlife Mortality Monitoring Methods

Locations of known wildlife mortality helpful in identifying larger scale potential issues. This can include mortality due to vehicles, domestic animals (dogs), or potential incidental poisoning. The locations of dead wildlife can be mapped using ESRI Arc Collector (https://www.esri.com/en-us/arcgis/products/collector-for-arcgis/overview). Collector for the GIS application, ArcGIS, provides intuitive map centric field data collection. Most of your time in Collector for ArcGIS will be spent interacting with the map, which typically contains a basemap and at least one editable feature layer. When viewing the map, you can collect data, get directions, measure features, and initiate other capabilities of the application.

The general workflow for ArcGIS Collector is shown below and can be applied to known locations in the field, beyond wildlife mortality mapping.

1. Identify data to be collected.
2. Create an empty feature class
3. Share the feature class as an editable feature layer
4. Create a web map for data collection
5. Collect the data; The high-level steps for collecting data with Collector for ArcGIS are as follows:
   a. Sign into your ArcGIS Online organizational account.
   b. Open the web map you have created to be used for data collection.
   c. Collect data (features and attributes).
      i. Manually (without GPS), by tapping the location on the map with your finger
      ii. Automatically, by using your current position as identified by your phone's built-in GPS (location services)
   d. Save your data to ArcGIS Online.

Special-Status Species Protocols for Monitoring

Several special-status plants and animals may be found on Midpen land. Certain methods and protocols should be used when monitoring or surveying for individual species. Some special-status species could be surveyed using methods outlined for wildlife, such as those identified for butterflies and birds. A selection of the methods for the most likely species that may require monitoring are as follows:

- Special-status plants and sensitive vegetation communities – Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Sensitive Natural Communities (CDFW 2018)
- San Francisco garter snakes – Distribution and Demography of San Francisco Gartersnakes (*Thamnophis sirtalis tetrataenia*) at Mindego Ranch, Russian Ridge Open Space Preserve, San Mateo County, California (Kim et al. 2017)
- California red-legged frog – Revised Guidance on Site Assessments and Field Surveys for the California Reg-legged Frog (USFWS 2005b)
- Foothill yellow-legged frog – A standardized Approach for Habitat Assessments and Visual Encounter Surveys for the Foothill Yellow-Legged Frog (*Rana boylii*) (Seltenrich and Pool 2002)
- California tiger salamander – Interim Guidance on Site Assessment and Field Surveys for Determining Presence or a Negative Finding of the California Tiger Salamander (USFWS 2003)
- Western pond turtle – USGS Western Pond Turtle (*Emys marmorata*) Visual Survey Protocol for the Southcoast Ecoregion and USGS Western Pond Turtle (*Emys*

marmorata) Trapping Survey Protocol for the Southcoast Ecoregion (USGS 2006a, USGS 2006b)

- Special-status bats – Assessing Bat Detectability and Occupancy with Multiple Automated Echolocation Detectors (Gorresen, et al. 2008) and Mist Net Effort Required to Inventory a Forest Bat Species Assemblage (Weller and Lee 2007)

Vegetation and Habitat Monitoring Methods and Protocols

Overview

Monitoring of vegetation is important to understand short- and long-term changes to vegetation structure, type, and associated habitat values and fire risk. Vegetation monitoring can occur at the local (stand or individual tree or plant level) up to the county or region of interest. The methods below describe a range of approaches which can be used to monitor vegetation at a range of scales. Ultimately the method(s) selected should produce the types of information within available fiscal and temporal constraints.

Available Mapping and Data

Global Information System

Use of available GIS data is one method to monitor vegetation condition, distribution, and changes. A variety of data is available or will be available that Midpen can use, as summarized here.

- **Existing Organizational (Midpen) Enterprise Geodatabase:** At the core of the Midpen monitoring effort is the existing Midpen Enterprise Geodatabase. This database contains all known spatial data associated with Midpen lands as well as other ancillary datasets (streams, roads, buildings) produced by non-Midpen entities but relevant to Midpen land stewardship. Within this geodatabase, all data are stored within feature datasets, which enforce a specific and uniform spatial data projection. For metadata, users should fill attribute data as completely as possible, understanding that they may not know everything. Most feature classes have editor tracking enabled, and the geodatabase is running in a versioned environment. It is essential to keep this database updated with up to date treatment activity information as well as any other planned or unplanned changes or projects occurring on Midpen lands. Further discussion is needed on data editing standards and other protocols related to the Enterprise Geodatabase. The overall goal of the database is to create web-based applications where subject matter specific experts can take ownership of specific feature classes.
- **Existing Vegetation Map:** An up to date, LiDAR-based and ground-truthed detailed vegetation map is in progress for Santa Clara and Santa Cruz Counties. The map will include the information below and used to represent current vegetation conditions once available.
  - Fine scale vegetation map
  - Vegetation classification scheme development, key, and description

  - ¼ acre minimum mapping unit (MMU) for wetlands and riparian areas, 1-acre MMU for upland areas
  - 60-80 vegetation classes
  - Lifeform mapping (e.g. trees, shrubs, grasslands)
  - Relative hardwood vs conifer cover for forested stands
- **Google Earth Engine®:** Google Earth Engine® ("GEE") is a free to use online platform for remote sensing applications. Google has archived extensive satellite imagery from NASA onto their own servers, allowing users to develop change detection algorithms on any of the available imagery. Of interest to Midpen would be the Landsat 5, 7, & 8 data sets which begins in 1984 and is updated regularly (~2 weeks) at 30 m spatial resolution. Additionally, Sentinel-2 imagery from the ESA is available which provides coverage at 10m resolution beginning in mid-2015. Earlier Landsat missions provide imagery back to 1972. Though it should be noted this imagery is at 80 m resolution and has different spectral resolutions than the other Landsat missions, which is more applicable to a coarser scale analysis. Analysis of vegetation change in GEE allow analysis of trends in vegetation cover back in time (to 1984) and automated regular monitoring into the future. Examples of Google Earth Engine® based analysis tools can be found here (https://sig-gis.com/service-applications/) with more information here https://developers.google.com/earth-engine/datasets
- **Planet Labs®:** Planet Labs® is a private company that provides high resolution satellite imagery taken at regular intervals. Currently they offer daily imagery at 3 m and 72 cm resolution for any place on the planet. Similar to Google Earth Engine, they also have an online platform that can be used to detect change of desired attributes (vegetation, bare soil) between image sets. This system is proprietary and requires additional cost to purchase imagery and use the platform. Planet Labs® is one alternative for accessing near real time imagery after a major disturbance event such as a wildfire, landslide, or flood. (https://www.planet.com/). Planet Labs® does allow access to imagery for research and non-commercial use to university affiliated faculty, students and researchers through its Education and Research Program https://www.planet.com/markets/education-and-research/
- **Relative Differenced Normalized Burn Ratio (RdNBR):** The RdNBR is a measure of burn severity in vegetation. It can be expressed as the percent loss of canopy cover or basal area using commonly accepted analysis approach (Miller et al 2009). The RdNBR maps are produced for fires over 1,000 acres, with the data made public at this site https://www.mtbs.gov/ or https://www.fs.usda.gov/detail/r5/landmanagement/gis/?cid=STELPRDB5327833 (see various datasets under "Vegetation Burn Severity). RdNBR may also be calculated using the following methods (Miller et al. 2009)
- **Online Dashboards for Ecosystem Health, Project Implementation, and Monitoring:** ESRI® provides an easy way to summarize geospatial data into

dashboards. These can be used to monitor implementation of projects by OSP or any other spatial data collected over time. This requires data be captured in Midpen's enterprise geodatabase and is why centralization of spatial data is so imperative for business continuity (see Attachment 2).

- A dashboard is data driven view of geographic information that helps you monitor event and activities. Dashboards are composed of elements, such as maps, lists, charts, gauges, and indicators, and occupy 100 percent of the application browser window. Elements can be stacked or grouped together in various ways. You can either create a blank dashboard using an existing template or you can be created from Map Viewer or the gallery, content, or item page. Once it's created you have several configuration options.
- Elements from the library of charts, indicators, gauges, lists, maps, and more can be easily added. These visual elements can be moved, docked, resized, grouped, and stacked. The only elements that can't be rearranged are the header and side panels. These occupy a predefined space on a dashboard (although a side panel can be retractable at run time), and a dashboard can only have one of each. These dashboards can be built in ArcGIS® for Portal® using the operations dashboard template (https://www.esri.com/en-us/arcgis/products/operations-dashboard/overview) (see Figure 1).

Figure 1 ESRI® Dashboard Showing Fuel Treatment Acres Accomplished for Region 5 of the United States Forest Service

Aerial LiDAR

On Midpen management areas of interest (AOIs), existing LiDAR imagery may be used to assess stand structure before treatment using the general steps below (Figure 2 through Figure

4) with post-treatment updates provided by three-dimensional point cloud data generated by a Unmanned Aerial Vehicles (UAV).

1. Utilize LANDFIRE Total Fuel Change tool (LFTFC) to update/improve LANDFIRE fuels layers in Midpen AOIs where high density LiDAR has been acquired.
2. Perform an EcObject segmentation in Midpen management AOIs where high density LiDAR has been acquired.
3. Calculate direct LiDAR derivatives (i.e., canopy cover and different height slices) and assimilate into EcObject segmentation.
4. Synthesize updated fuel information and any other meaningful raster-based vegetation information with EcObject segmentation.
5. Apply satellite-based vegetation disturbance and recovery tracking workflows to assess where substantial vegetation changes have occurred (both disturbed and recovered).
6. Utilize UAV technologies to then fly those areas to generate a PhoDAR based point cloud.
7. Run EcObject and LFTFC workflows on PhoDAR point clouds.
8. Stitch new information in existing EcObject dataset.
9. Analyze, package, and present changes.

Figure 2 LiDAR Based EcObject Classification of Canopy Cover

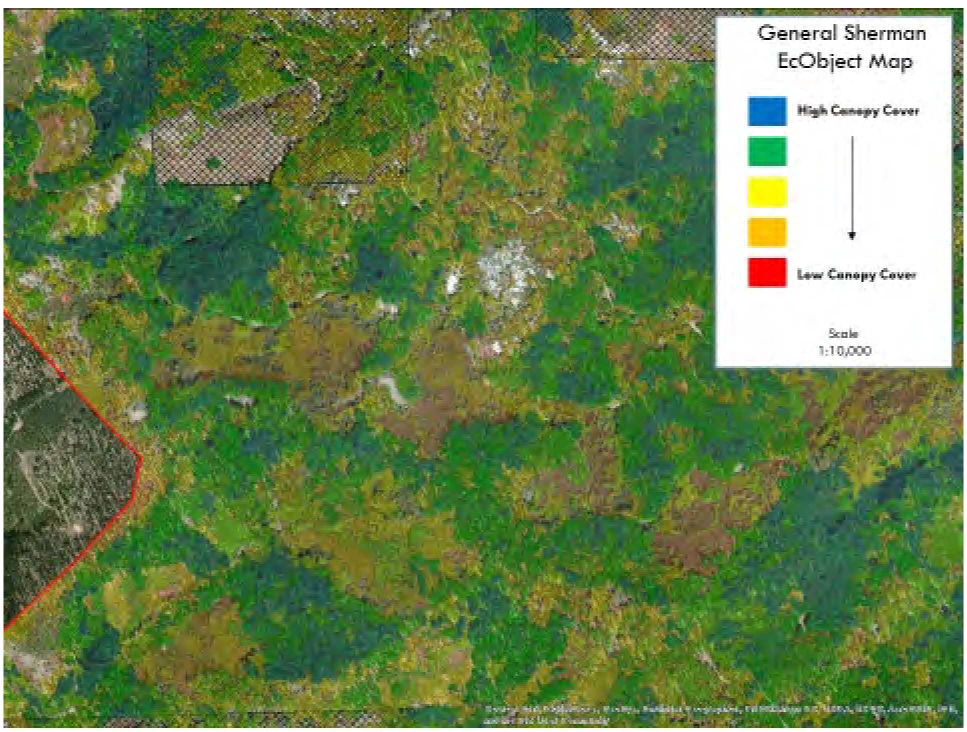

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Figure 3 LiDAR based EcObject Classification of Forest Clump Distribution

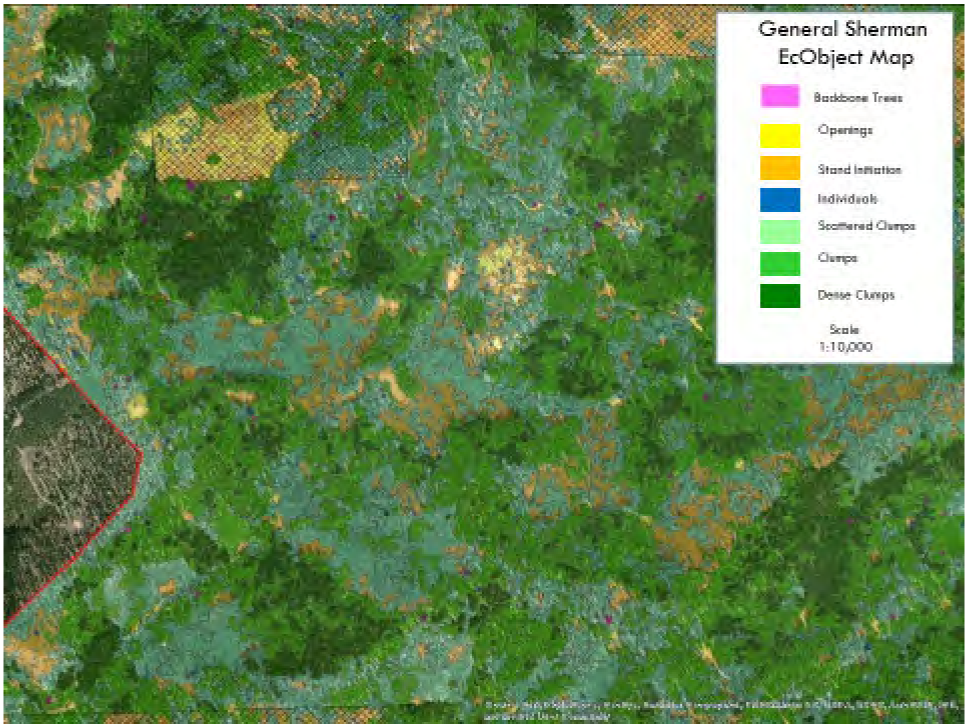
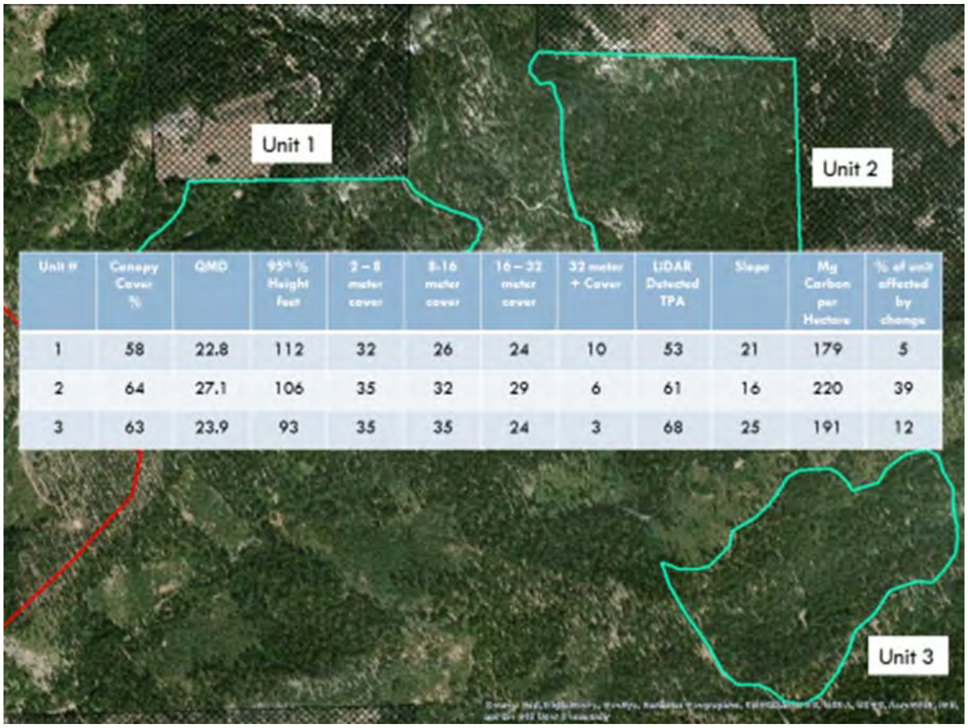


Figure 4 LiDAR based EcObject Classification of Treatment Unit Level Stand Structure



Unit #	Canopy Cover %	QMD	95th % Height feet	2 – 8 meter cover	8-16 meter cover	16 – 32 meter cover	32 meter + Cover	LiDAR Detected TPA	Slope	Mg Carbon per Hectare	% of unit affected by change
1	58	22.8	112	32	26	24	10	53	21	179	5
2	64	27.1	106	35	32	29	6	61	16	220	39
3	63	23.9	93	35	35	24	3	68	25	191	12

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Methods to Collect Data

Species and Guild Data Collection

Specific to characterization of natural communities and rare plant habitat during monitoring efforts, data categories will include plant taxa and guild information as preferred by Midpen. This will provide a richer dataset from which to analyze vegetation and rare plant population recovery, and/or change, resulting from vegetation management.

Guild categories include native status (native, non-native), life history (annual, biannual, perennial), and stature (forb, grass, rush/sedge, shrub, and tree). Since this program may encounter pyrophytic plant species, an additional guild for fire followers should be included based on Keeley and Davis (2007), the fire follower database developed by Bartosh and Peterson (2014), and locally rare plant lists (Corelli and Bartosh 2019; Neubauer 2013).

Species and guild categories will be assigned vegetative cover values by plot. Cover is measured by estimating the aerial extent of the living plants, or the "bird's-eye view" looking from above. Cover estimates exclude the openings plants may have in the interstitial spaces (e.g., between leaves or branches). Generally, cover can be reliably estimated by polygons. The California Native Plant Society (CNPS) provides a diagram to aid in estimating cover (CNPS 2001).

Relevé Sampling Method

The preferred method in California for mapping, classifying, and monitoring change detection of Natural Communities, endorsed by CNPS and CDFW, is based on National Vegetation Classification System's (FDGC 2008) hierarchy of alliances and associations (Sawyer et al. 2009). This method can be applied to all vegetation types (forest, woodland, riparian, shrub, herbaceous, etc.) using a relevé. A relevé is a record of a sample of vegetation that is homogenous in species composition and structure, is in a uniform habitat, and is sufficiently large to contain a large proportion of the species typically occurring in the stand being sampled. The relevé sample method is plot based, with each species in the plot and its cover being recorded along with other environmental related data such as geology, soils, etc. Relevé sizes are adjusted based on the structure of the natural communities being sampled (CNPS and CDFW 2019).

Post-Fire Monitoring for Pyrophytic Plant Species

In the event prescribed burning is implemented as a part of this program, a specific monitoring methodology should be employed (primarily for chaparral) for the purpose of evaluating the presence of fire following plant species, vegetation recovery, possible type conversion of shrub composition, geophyte response, response of stump sprouting species, and invasive weed establishment. This methodology employs use of belt transects for measuring fire severity, species richness, and vegetative cover (Bartosh and Peterson 2014).

Technology Available to Collect Data

UAVs may be used to collect data to monitor vegetation and habitats. The use of UAVs shall be conducted within compliance of Federal Aviation Administration (FAA) rules, as well as Midpen policy. Two primary UAVs may be used to conduct monitoring.

- **Quadcopter UAV:** A quadcopter (Figure 5) is generally the lowest cost approach to acquiring imagery over a relatively small area. UAVs can also come in hex (6), octo (8) and other rotor configurations These UAV's can capture imagery down to an area of ~1/10th acre up to 25 acres in a single flight. Quadcopters, such as The Mavic Pro®, can take high resolution imagery that can be used to generate point clouds over 25 acres in a 30-minute flight (one battery). Lower resolution imagery (no point cloud) can be acquired over ~40 acres over the same duration (30 minutes). Multiple flights can be implemented to cover larger areas but generally total area for a quadcopter to cover in a day over 3 flights is ~100 acres.
- **Fixed Wing UAV:** A fixed wing UAV (Figure 6) allows data capture over a larger area when compared to a quadcopter. The Ebee can take high resolution imagery that can be used to generate vegetation cover and topography over 200 acres in a 45-minute flight (one battery). Higher resolution imagery 100 acres over the same duration (45minutes), which can be used to generate three-dimensional point clouds and Digital Surface Models (DSMs). Multiple flights can be implemented to cover larger areas but generally total area for an Ebee® to cover in a day over 3 flights is ~300-600 acres depending on resolution of imagery taken.

Both UAV types (fixed wing and quadcopter) can be used to generate the different geospatial products described below:

- ***High-resolution Orthomosaics*** – Creates extremely crisp and clear aerial photographs (~3cm resolution) that are accurately aligned with the earth's surface. These images provide a clear top-down view of the ground surface or tree canopies over that surface.
- ***Digital Surface Model (DSM)*** – A DSM captures the natural and built features on the Earth's surface and are useful in 3-dimensional modeling. DSM give you the elevation value of each pixel for aboveground features.
- ***Digital Elevation Model (DEM)/Digital Terrain Model (DTM)*** – A DEM is synonymous with Digital Terrain Model and is a 3-dimensional representation of the bare earth's surface. When you filter out non-ground points such as trees, bridges, buildings, and roads, you get a smooth digital elevation model. Like DSM, DEM/DTM gives the elevation value of each pixel.
- ***Contour Lines*** – Utilize DSM/DTM/DEM data to provide a simplified representation of topography, and display with elevation values. From the UAS data one can produce a DTM which interpolates the ground level from the point cloud. The DTM produced is what is used to create the contours in Pix4D.

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- ***Three-Dimensional (3D) Textured Model*** – Generation of a full three-dimensional triangular mesh with a photo draped texture allows for three-dimensional visualization of urban and natural settings. This provides a continuous image surface draped over a 2.5-dimensional surface constructed from the methods outlined above.
- ***Volume Calculations and Cross-Sections*** – For landslide debris volume applications, pile volumes can be calculated to improve project planning. For stream restoration practitioners, DEM/DTM may be used to rapidly characterize channel morphology (cross sections) along any point interest along a stream.
- ***Image Timeseries and Change Detection*** – Repeat visits to a site of interest can be used to: 1) verify project progress, 2) compliance with regulatory and safety requirements, or 3) to monitor and quantify change in features of interest (e.g., aquatic invasive species abundance and distribution, stream channel morphology, riparian and forest vegetation, or recovery from natural disturbance such as wildfire or flooding, etc.).
- ***Custom Feature Extraction, Mapping, and Quantification*** – Using object-based image analysis (OBIA) procedures, including automated feature extraction, or manual feature delineation that integrates other GIS data can generate monitoring information.

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Figure 5 The Mavic Pro® quadracopter UAV

Figure 6 The Ebee® Fixed wing UAV

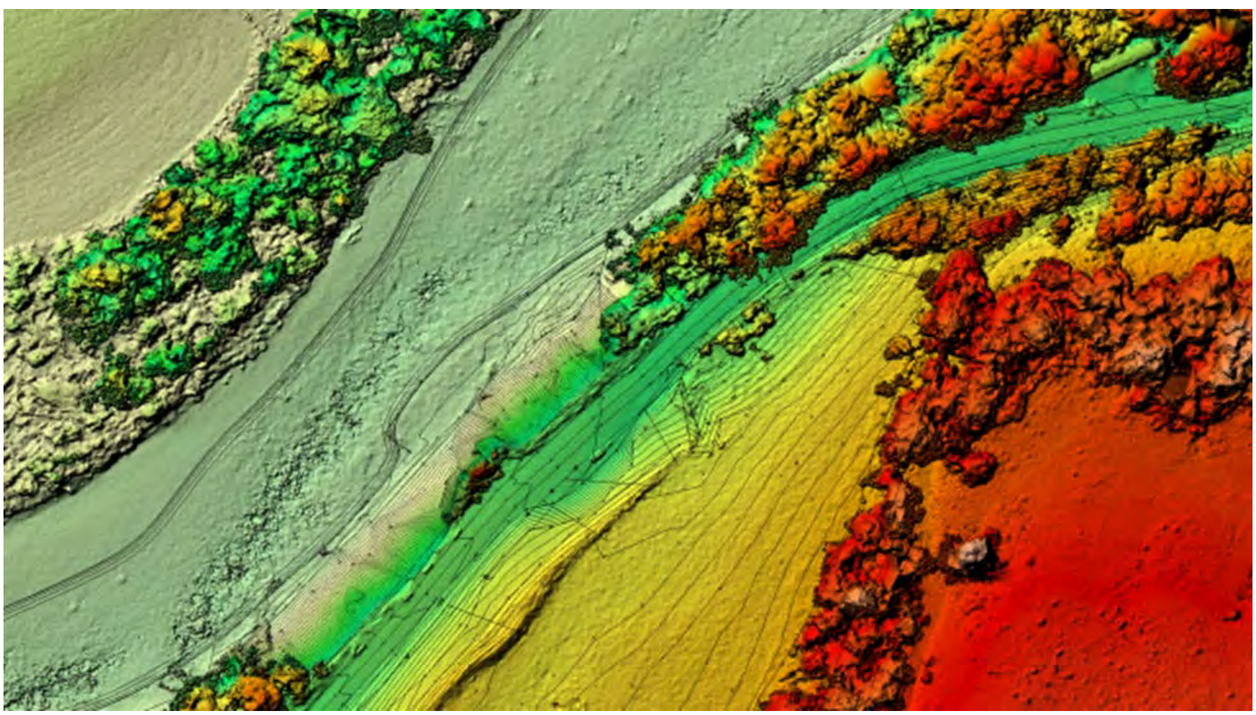
- ***360-degree View*** – The Hangar 360 application (free) to produce a 360-degree view of your area of interest from 300 feet aboveground. The finished product, a 360-degree panoramic image, allows user to pan side to side and up and down, and scroll in and out for a unique birds-eye view. Examples of Hanger 360 images from Midpen lands can be found at the following links:
  - Russian Ridge: https://viewer.hangar.com/360?productId=krqkZy8Y
  - Teague Hill: https://viewer.hangar.com/360?productId=6reOGwKY
  - Windy Hill: https://viewer.hangar.com/360?productId=drgwNZQr
- ***Aerial video and still images*** – The UAV can capture professional quality aerial video and/or photos to complement your visualization or other needs.

Use of UAVs also allows for the safe and rapid collection of change detection and site monitoring data before, during, and after treatments or disturbance. The imagery can be used to develop not only a high-resolution photographic record but can also be used to create changes in topography due to landslides, flooding, or three-dimensional point clouds that can be used to update LiDAR based calculations. UAV-based imagery can provide high resolution imagery and topography beyond that available to standard online two-dimensional imagery (Figure 7 through Figure 9). These images can be an improvement over National Agriculture Imagery Program (NAIP), as with other imagery sources, are available at specific temporal scales, and my not be appropriate for the desired application. For instance, a slip-out may have happened since the date of the imagery. The increased spatial resolution and color balance are key advantages of UAV-acquired images. Three-dimensional images from UAVs can be used to compute volumes, heights, and other changes in topography and vegetation.

Figure 7 Riverside Image with Topography over Standard NAIP Imagery Available Online

Figure 8 Riverside Image with Topography over UAV-Acquired Image

Figure 9 Riverside Image with Topography Represented in Three-Dimensions as Captured Using an UAV



Emerging Analysis, Sensor, or Software Applications for Monitoring

There are a wide range of additional techniques that can be utilized to detect current vegetation or changes to vegetation at multiple scales. Various sensors and approaches are always being developed and deployed. Prior to undertaking a remote sensing-based monitoring effort, a brief review of current or emerging technology and its application to specific monitoring goals should be explored.

Monitoring Target Rare Plant Species Methods and Protocols

Monitoring by Geography

The information in Table 4 summarizes the various target species and data sources of location information for these targets by geographic area.

Table 4 Target Plant Species by Geographic Area

Geographic Area	Target Species	Data Sources
Entire Midpen Preserve System	Federally and State Listed rare plant species	USFWS 2019 CDFW 2019
	California Rare Plant Rank Species	CNPS 2019 CDFW 2019
	Sensitive Natural Communities	CDFW 2018
	Biologically-Highly Significant Communities	Midpen 2014a
San Mateo County	Locally Rare Plants List	Corelli and Bartosh 2019 CCH2 2019
Santa Clara County	Covered Plants of the Santa Clara Valley Habitat Plan: Tiburon Indian paintbrush (*Castilleja affinis* subsp. *neglecta*), coyote ceanothus (*Ceanothus ferriseae*), Mount Hamilton thistle (*Cirsium foniniale* var. *campylon*), Santa Clara Valley dudleya (*Dudleya abramsii* subsp. *setchelii*), fragrant fritillary (*Fritillaria liliacea*), Loma Prieta hoita (*Hoita strobilina*), smooth lessingia (*Lessingia micradenia* var. *glabrata*), Metcalf Canyon jewelflower (*Streptanthus albidus* subsp. *albidus*), *most beautiful jewelflower* (*Strepthanthus albidus* subsp. *peramoenus*).	ICF 2012
Santa Cruz County	Locally Rare Plants List	Neubauer 2013 CCH2 2019

To voluntarily assist the Santa Clara Valley Habitat Agency with collecting status and distribution information on these covered plants species within Midpen OSPs, data collected in the field would need to conform to reporting requirements appearing in Chapter 5 of the VHP, "Incorporating Covered Plant Populations in the Reserve System" (ICF 2012). The following information is excerpted from the VHP (ICF 2012). To ensure that the VHP adequately protects covered plants, site inventories conducted in reserves will document the presence, absence, and condition (as defined below) of occurrences of covered plants.

The VHP aims to have covered plant occurrences, within the Reserve System, that are in good condition. A covered plant occurrence that is in "good condition" is defined as an occurrence that has a high potential to increase in size with improved management. The condition of a plant occurrence is to be assessed in the field by a qualified botanist on the basis of the characteristics listed below. The six relevant characteristics include:

- ***Physical Health:*** Individuals in good or excellent physical health (e.g., little or no signs of disease, viruses, severe herbivory, nutrient deficiencies) are more likely to survive, achieve an average or above-average lifespan, and reproduce successfully than individuals in poor physical condition. Plants in good physical health generally also indicate a highly suitable site.
- ***Age Structure:*** Occurrences of perennial species with an age distribution that includes many seedlings or juvenile plants relative to adults suggests a stable or positive rate of occurrence growth. Additionally, for annual and perennial species, seeds or bulbs in the soil (i.e., the seed bank) are also part of a plant occurrence's age structure, but this component is generally very difficult to assess.
- ***Reproductive Success:*** Occurrences with evidence of average or above average reproductive success for the species (e.g., production of flowers per plant, seed production per flower or per plant, proportion of seeds that appear to be viable based on visual observations) are more likely to be increasing than occurrences with below-average reproductive success, because this is often a key component of occurrence growth rate. If reproductive success cannot be measured, plant size or other physical features may be an appropriate surrogate in some covered species.
- ***Availability of Suitable Habitat:*** In order for a plant occurrence to remain stable or grow, enough suitable habitat must be present. Occurrences near unoccupied suitable habitat or without evidence of shrinking suitable habitat areas (e.g., nonnative plant populations that may be expanding, native shrubs that may be advancing) will be considered in better condition than occurrences without these indicators.
- ***Diversity of Suitable Habitat:*** Occurrences that occupy a wide range of microhabitats for the species may exhibit relatively high genetic diversity and therefore occurrence condition. Occurrences that occupy unusual microhabitats for the species may indicate unusual genetic composition or adaptations that should be protected.
- ***Threats:*** Threats to occurrences within the Reserve System will be assessed to ensure that protection and improved management will not be undermined by external factors such as disease, severe herbivory, recreational uses, or adjacent land uses. Occurrences in danger from threats that can be addressed should be considered in better condition than those that cannot be addressed.

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Monitoring by Lifeform

Rare Annual Plant Population Monitoring

Overview of Methods

The monitoring methods for annual rare plant populations will depend on the size of the population, the area a population occupies, and the goal of monitoring. In most cases the number of individuals is a suitable metric for evaluating long-term persistence of an annual plant population, as number of individuals infers fecundity of the current season and seed set into the seed bank for subsequent generations. However, due to annual population fluctuations including an evaluation of a nearby reference population is an important part of monitoring annual and geophytic rare plant species. This ensures the size of the population observed in a treatment area are relative to the size of the reference population because seasonal precipitation and climate patterns can influence germination, abundance, and plant size. An evaluation of reference populations using one of the methodologies below should be paired with populations in an affected area.

Direct Count (Small Area of Occupancy)

In cases where a population occupies a very small area counting each individual by hand is the simplest way to monitor an annual plant population. This can be aided by flagging, establishing transects, or laying out grids to avoid miscounting individuals.

Simple Random Coordinate Method (Moderate Sized Area of Occupancy) (Elzinga et al. 1998)

For rare plant populations of moderate size, occupying approximately 0.5 to 1 acre a simple random coordinate method should be employed. This method utilizes x and y axes to cover the occupied area. Random coordinates are derived within these axes to randomly sample the number of individuals within that quadrat location in the grid. The number of individuals is then extrapolated for the occupied habitat based on a representative number of sampling locations.

Grid Cell Method (Large Area of Occupancy) (Elzinga et al. 1998)

When a rare plant population is multiple acres in size, a two-stage sampling methodology should be utilized. This is done by establishing a necessary number of macroplots, derived in GIS, to cover the monitoring area in a grid. Within these macro plots, quadrats are randomly placed, and the target species is enumerated within the quadrats. The number of individuals is then extrapolated based on a representative number of sampling locations by the area sampled.

Remote Sensing Method Using Multispectral Imagery Analysis (Landscape-scale Area of Occupancy) (Nomad 2017)

In few cases, rare plant populations occur on a landscape-scale and are visible to high resolution multispectral aerial imagery, such as smooth lessingia. Although impacts to this grassland species from this program are not likely, this methodology could be employed. The methodology relies on the availability of on-demand aerial imagery which is then examined using image analysis software through an object-based approach. This utilizes segmentation algorithms to cluster pixels into like polygons that may then be analyzed for various attributes like spectral band averages and heterogeneity of pixel values. Data collected in the field on cover and abundance at a relevant number of data points is utilized to extrapolate the population size.

Rare Geophyte Population Monitoring (Elzinga et al. 1998)
Monitoring of geophyte populations with the goal of abundance tracking can follow the above methodologies for annual plant species based on area of occupancy. However, it should be noted that in some years, resulting from annual precipitation and climate conditions or physiological factors, geophytes will not become reproductive. Instead they will only produce basal leaves to recharge their bulbs. In these cases, it may not be possible to conduct monitoring of these taxa if a positive identification of the individual, based on leaf morphology alone, is not possible. Therefore, it is important to also pair monitoring plots of geophytes with reference populations.

Depending on the rarity and endangerment of the geophyte, it may also be necessary to assess the reproductive success and seed set for each individual. This would be accomplished by including the number of inflorescences or flower, which could then be used to estimate the number of seeds potentially set by each plant for that growing season.

Rare Herbaceous Perennial Population Monitoring
Occurrence
In most cases rare herbaceous perennials occur on the landscape as discrete individuals that are easily enumerated using the area of occupancy methodologies described above. However, some types of herbaceous perennials require different monitoring methodologies. This is because rhizomatous individuals are difficult to determine without digging them up and accounting for mature and immature biennials implies fecundity of a population.

Rhizomatous Herbaceous Perennial Monitoring (Nomad 2017)
The goals of this monitoring method are to get an estimate of the area of occupancy by percent cover of the area occupied and the number of inflorescences produced of the entire population. Estimating vegetative cover can be accomplished utilizing the relevé method above. Counting individuals can be accomplished using a modified grid cell method.

Biennial Monitoring (Elzinga et al. 1998; Nomad 2017)
The goal of biennial monitoring is to understand the age and reproductive success of a population that has an approximately 2-year life cycle. To accomplish this any of the population monitoring techniques described above for annuals can be utilized but the addition of the number of vegetative versus reproductively mature individuals is necessary. A visual estimate of the number of flowers of the population is also beneficial to estimate seed set for subsequent generations.

Rare Shrub Population Monitoring
Occurrence
Rare shrubs known to occur on the San Francisco Peninsula include several manzanita bush mallow, and ceanothus species. Often, species of these genera form impenetrable vegetation communities of their own which makes monitoring difficult. In these situations, monitoring

utilizing a combination of remote sensing data and ground-based field work is necessary. If rare shrub communities are subject to vegetation management activities, especially prescribed fire, it is important to evaluate germination response of the soil seed bank as well. When rare shrubs do not form these communities monitoring can be accomplished utilizing the methods described above.

Aerial Imagery Supported Monitoring (Nomad 2016)
The goals of rare shrub monitoring, when these communities are left largely intact after management activities, is to get an accurate estimate of population health (including potential Phytophthora infestations from unintentional introductions) and number of individuals in these communities. This monitoring can be accomplished utilizing existing aerial imagery (satellite or piloted) or drone produced imagery in tandem with ground-based field measurements. Data collected on the ground requires taking length and width measurements of a representative number of individual shrubs to get an average area each individual occupies. Utilizing aerial imagery to calculate the percent cover of individuals (if visible on the imagery), within population boundaries, will give a refined area of occupancy. The number of individuals can be calculated comparing average area an individual occupies to refined area of occupancy. This can be especially efficient in shrub communities in more than 2 years of post-fire recovery.

Seedling and Stump Sprout Monitoring (Elzinga et al. 1998)
The goal of seedling and stump sprout monitoring is to assess germination response of the seed bank and stump sprouting of lignotubers of rare shrub species to evaluate regeneration response to fire (or other vegetation management activities) and any potential type conversion of the community from one shrub species to another. This can be accomplished using a modified grid cell method by estimating cover of seedlings and stump sprouts by species.

Rare Tree Population Monitoring
A small number of rare tree species are growing in Midpen lands. These trees are fire adapted conifers therefore the goals of monitoring are to evaluate the number and condition of mature trees left unaffected, as well as any seedlings resulting from vegetation management activities, especially prescribed fire. Seedling recruitment can be assessed using the seedling and stump sprout monitoring methodology (Elzinga et al. 1998).

Ground or Field-Based Methods for Monitoring Vegetation Condition, Distribution, and Change in Rare Plants

The approach to sensitive botanical resources monitoring described below assumes that project-level rare plant surveys have been conducted prior to vegetation management activities associated with the Wildland Fire Resiliency Program. As a result of these surveys, rare plant species presence within prescription areas would be known and applicable monitoring methods applied. However, in the event that a management activity occurs in a vegetation type that is not feasible to conduct rare plant surveys (e.g., chaparral), or rare plants emerge from the soil as a result of the management activity, a two-step approach should be applied. Following the management activity, the first step would be to conduct rare plant surveys during the appropriate blooming period(s) if suitable rare plant habitat is present. If rare plant populations are observed during appropriately timed surveys, the second step is to select the appropriate monitoring methodology, generally based on lifeform, and carry out the relevant method. If rare plant surveys are not observed during these surveys, then vegetation monitoring can either follow the suggested methodologies for natural communities monitoring. However, if sensitive natural communities are affected by vegetation management activities the natural communities Monitoring methods below should be employed. All monitoring related to rare plants, fire followers, and sensitive natural communities should occur for a minimum of three years following management activities.

Spanning three counties (San Mateo, Santa Clara, and Santa Cruz), the habitats that Midpen lands include support a large number of rare plant species. These rare plants represent a variety of lifeforms such as trees, shrubs, herbaceous perennials, geophytes, and annuals. Monitoring various types of rare plants require specific methodologies based on lifeform, size of the population, area a population occupies, and conservation status. In addition to utilization of specific monitoring protocols for statewide and locally rare plant species and sensitive natural communities, the Santa Clara Valley Habitat Plan outlines monitoring methods for specific species that are covered in this plan. The following information is first categorized by geography to indicate what should be considered as monitoring targets, followed by monitoring methods addressing each lifeform (ICF 2012).

Hydrology, Soil Infiltration, and Sedimentation Monitoring Methods

Overview

Wildfires alter land surfaces, land-atmosphere interactions, and runoff (Debano 2000; Moody and Martin 2001; Beringer et al. 2003; Prater and DeLucia 2006; Cydzik and Hogue 2009; Pierson et al. 2008; Montes-Helu et al. 2009; Burke et al. 2010 as cited in Kinoshita et al 2013). Following high-intensity fires, soil hydrology is altered, and duff, litter, and vegetation layers are removed exposing soil to rapid erosion events, which in turn overwhelm riparian areas, streams, and rivers (Campbell et al. 1977 as cited in Amato et al 2011). These extreme changes in the landscape can drastically influence surface runoff and sediment transportation. Removal of the forest duff layer causes increased runoff and subsequent increases in peak flow and sediment transport (Foltz et al 2009). Post-wildfire hazards and impacts related to erosions include (General Accounting Office 2003, cited in Robichaud and Elliot 2006):

- Flood runoff
- Peakflows
- On-site erosion
- Off-site sedimentation
- Mud and debris flows
- Damage to natural habitats
- Damage to roads, bridges, reservoirs, and irrigation systems

Erosion in the first year after a wildfire can be up to three orders of magnitude greater than the erosion from undisturbed forests (Robichaud and Elliot 2006).

Wildfire alters both vegetation and soil, which are factors that are directly related to erosion. Vegetation reduces erosion on the landscape by intercepting precipitation, covering bare ground with liter and duff that captures and facilitates infiltration, and roots stabilize the soils. Heat from wildfire increases and deepen hydrophobicity in the soil layer. Soil hydrophobicity is the tendency of the soil to resist wetting or infiltration of moisture. A relatively thin hydrophobic layer can form in an unburned forest, due to the leaching of organic matter from the duff into the soil. During wildfire, the hydrophobic layer can shift downward in the soil and increase in thickness (USDA 2016). These factors contributed to increased runoff and erosion post-wildfire. Monitoring methods related to erosion have been grouped into three categories 1) hydrology – to quantify the increase in runoff and peak flows post-wildfire, 2) soil infiltration – to quantify the decrease in infiltration of precipitation into the soil, and 3) sedimentation – to quantify the increase in material that is eroded off of the landscape post-wildfire in the following sections.

Hydrology Monitoring

Changes in the hydrology downstream of burned areas can be identified by looking at gage data. Few watersheds have active gages, even in urban areas. Hydrology models are used to predict discharge in watersheds that are not gaged. Methods are provided in the table below to quantify hydrology in catchments for both gaged and ungagged streams. After a fire, peak flow flood potential is 10 to 10,000 times greater than pre-fire levels (Berry et al 2014). The following table lists methods for assessing impacts from wildfire (Table 5).

Table 5 Hydrology Monitoring

Method	Direct Measurement or Indirect Indicator	Spatial Scale	Reference
Stage measurement at gaging stations	Direct measurements	Local, regional	Sauer, V.B., and Turnipseed, D.P., 2010
Discharge measurements at gaging stations	Direct measurements	Local, regional	Turnipseed, D.P., and Sauer, V.B., 2010
V-notch weirs	Direct measurement	Local, regional	Rantz, S.E., and others. 1982
Water Erosion Prediction Project (WEPP)	Indirect indicator	Local, regional	Elliot et al 2000–2002
Models	Indirect indicator	Local, regional	Foltz et al 2009, USDA 2016, Kinoshita et al 2013

Soil Infiltration Monitoring

Quantification of soil infiltration is easier measured in the field. A summary of methods is provided in the table below (Table 6). Systematic sampling should be conducted throughout the Midpen management area to identify pre-wildfire conditions.

Table 6 Soil Monitoring

Method	Direct Measurement or Indirect Indicator	Spatial Scale	Reference
Soil Hydrophobic Conditions	Direct Measurement	Local	USDA 2016
Single-ring infiltrometer	Direct Measurement	Local	Herrick et al. 2005

Sedimentation Monitoring

Direct measurement of erosion is time consuming, can be expensive (depending on the method), and dependent on pre- and post-wildfire water year types (dry, normal, or wet). Models are often also used to quantify impacts from wildfire. Methods for both direct observation and measurement and modeling are provided in the table below to quantify sediment impacts pre- and post-wildfire (Table 7). Systematic sampling could be conducted throughout the Midpen management area to identify pre-wildfire sedimentation rates and to calibrate pre-wildfire modeling results. Post-fire erosion rates may be up to more 100 times greater than rates on a well-vegetated watershed (Radtke, 1983 as cited in Berry et al 2014). Sediment from increased erosion, clogs, dams, and changes water courses, add to flooding hazards (Berry et al 2014).

Table 7 Sedimentation Monitoring

Method	Direct Measurement or Indirect Indicator	Spatial Scale	Reference
Visual indicators of erosion	Indirect indicator	Local, regional, and national	Ypsilantis, W.G. 2011
Erosion bridge	Direct measurement	Local	
Erosion plots	Direct measurement	Local	
Close-range photogrammetry	Direct measurement	Local	
Silt fence catchments	Direct measurement	Local	Robichaud, P. R. and R. E. Brown. 2002, Robichaud, P. R. 2005
Water Erosion Prediction Project (WEPP) Erosion Risk Management Tool (ERMT)	Indirect indicator	Regional	Elliot et al. 2000–2002

Method	Direct Measurement or Indirect Indicator	Spatial Scale	Reference
Erosion Risk Management Tool (ERMT)	Indirect indicator	Regional	Robichaud et al. 2006

Soil Temperature Monitoring

Soil temperatures can be assessed in the field at the soil surface or at desired depths in the soil profile based on the monitoring question. For surface measurements (single point in time) a simple handheld Infrared Thermometer or soil thermometer can be used (Figure 10). These units allow the user to point the temperature "gun" at any surface and obtain a reading of temperature of that surface. Additional single point in time readings at shallow depths can be obtained by using a traditional glass or digital soil thermometer. For recordings over time, digital thermometers that record data continuously or at set intervals over time are available from such brands as Hobo®.

Figure 10 Soil Sample Plot Showing Soil Corer, temperature, and in this Photo, Nitrogen Sampling Bags

Soil Moisture Monitoring

As with soil temperature, soil moisture can be assessed in the field at single point in time measurements or over time with a data recorder and probe. A range of off the shelf equipment to assess soil moisture is available.

In 2015, NASA launched the "Soil Moisture Active Passive" (SMAP) satellite. This transmits available data on soil moisture and other variables globally (Figure 11), though the resolution (3 km) prevents it from being easily applied at fine scale in the field. More information is available here https://smap.jpl.nasa.gov/data/.

Figure 11 Data available from the NASAs SMAP satellite

Product	Description	Gridding (Resolution)	Latency**	
L1A_Radiometer	Radiometer Data in Time-Order	-	12 hrs	Instrument Data
L1A_Radar	Radar Data in Time-Order	-	12 hrs	
L1B_TB	Radiometer T_B in Time-Order	(36x47 km)	12 hrs	
L1B_TB_E	Radiometer T_B Optimally Interpolated on EASE2.0 grid	9 km	12 hrs	
L1B_S0_LoRes*	Low Resolution Radar σ_o in Time-Order	(5x30 km)	12 hrs	
L1C_S0_HiRes*	High Resolution Radar σ_o in Half-Orbits	1 km (1-3 km)	12 hrs	
L1C_TB	Radiometer T_B in Half-Orbits	36 km	12 hrs	
L1C_TB_E	Radiometer T_B in Half-Orbits, Enhanced	9 km	12 hrs	
L2_SM_A*	Soil Moisture (Radar)	3 km	24 hrs	Science Data (Half-Orbit)
L2_SM_P	Soil Moisture (Radiometer)	36 km	24 hrs	
L2_SM_P_E	Soil Moisture (Radiometer, Enhanced)	9 km	24 hrs	
L2_SM_AP*	Soil Moisture (Radar + Radiometer)	9 km	24 hrs	
L2_SM_SP	Soil Moisture (Sentinel Radar + Radiometer)	3 km	Best effort	
L3_FT_A*	Freeze/Thaw State (Radar)	3 km	50 hrs	Science Data (Daily Composite)
L3_FT_P	Freeze/Thaw State (Radiometer)	36 km	50 hrs	
L3_FT_P_E	Freeze/Thaw State (Radiometer, Enhanced)	9 km	50 hrs	
L3_SM_A*	Soil Moisture (Radar)	3 km	50 hrs	
L3_SM_P	Soil Moisture (Radiometer)	36 km	50 hrs	
L3_SM_P_E	Soil Moisture (Radiometer, Enhanced)	9 km	50 hrs	
L3_SM_AP*	Soil Moisture (Radar + Radiometer)	9 km	50 hrs	
L4_SM	Soil Moisture (Surface and Root Zone)	9 km	7 days	Science Value-Added
L4_C	Carbon Net Ecosystem Exchange (NEE)	9 km	14 days	

Compaction (Bulk Density) Monitoring

Compaction of soils is typically assessed by measuring the bulk density of soils in a core of fixed volume and depth. Cores are extracted using a soil core sampler (Figure 10). Soil compaction may also be measured in the field using a soil penetrometer (Figure 12). These units provide a continuous measure of compaction to a fixed depth at any point a sample is taken. Both measures can require either extensive time to prepare and analyze. Soil cores are typically weighed, dried, and re-weighed to calculate moisture and bulk density. Soil penetrometer data must be analyzed using additional statistical analysis to determine compaction levels at varying depths (Moghaddas and Stephens 2008; Moghaddas and Stephens 2007).

Figure 12 A Soil Penetrometer Being Used in the Field to Assess Compaction in Forested Ecosystems.

Water Quality Monitoring Methods

Prescribed burns and other fire management approaches are designed to decrease the intensity of future wildfires by reducing fuel reserves. Prescribed burns have the added benefit of returning ecosystems back to a condition under which they operated for thousands of years (or more) before European influence. However, prescribed burns could also present short-term and long-term water quality impacts. The goal of this section is to describe and reference generally accepted protocols for monitoring water quality before and after prescribed burn related activities. The following steps are intended as an outline to guide the necessary water quality monitoring efforts:

1. Develop a focused water quality sampling plan (OWEB 2000). Consideration should be given to the following factors:
    a. Monitoring objectives and questions to be answered
    b. Scale of monitoring activity
    c. How management activities might impact water quality

2. Select sites according to best practices (OWEB 2000)
3. Determine stated beneficial uses, impairments, and water quality criteria of potentially impacted water bodies (SFBRWQCB 2017, CCRWQCB 2019, SWRCB 2019)
4. Finalize list of constituents to be measured based on monitoring questions (OWEB 2000, SCCWRP 2009)
5. Where applicable, compare constituent method detection limits to basin plan criteria to make sure the chosen methods can detect concentrations below established criteria
6. Collect water quality data according to water quality sampling plan (OWEB 2000, USGS 2019, NRCS 2003 (part 614)). Consideration should be given to the following factors:
   a. Collection of data to establish baseline prior to fire management activities
   b. Collection of data over multiple seasons to account for seasonal variability
   c. Collection of data over multiple years to account for annual variability and progression over time
   d. Collection of data during the same season, time of day, and similar stream flow for comparisons between baseline and post-project conditions
7. Data analysis and reporting (OWEB 2000, NRCS 2003 (part 615))

These steps are meant to provide general guidance and should be revisited as focused water quality monitoring plans are developed and further consideration is given to the objectives of the sampling efforts. This will help guide the selection of monitoring sites, constituents that should be monitored, as well as, timing and duration of the sampling effort. A summary of references that may be used to guide development of water quality monitoring plans and collection of sample data is provided in Table 8.

Table 8 Water Quality Monitoring References

Subject	Reference
Guidance on creating a water quality sampling plan	OWEB 2000
Guidance for the collection of water quality data	OWEB 2000, USGS 2019, NRCS 2003 (part 614)
Guidance for post-fire water quality monitoring	SCCWRP 2009
Guidance for data quality, storage, and analysis	OWEB 2000, NRCS 2003 (part 615)
Beneficial uses of water bodies	SFBRWQCB 2017, CCRWQCB 2019
Clean Water Act list of impaired water bodies	SWRCB 2019

Forest Inventory, Surface Fuel Loading, Large Woody Debris, and Disease Monitoring Methods

Several methods can be employed to conduct forest inventories and monitor for surface fuel loading, large wood debris, and spread of forest diseases.

Plot Level Vegetation Monitoring Using Terrestrial LiDAR Systems

Ground-based or Terrestrial LiDAR Systems (TLS) can be used to augment or replace traditional forest transects and inventory plots in more open vegetation types, such as redwood or mature oak. Terrestrial LiDAR produces a high-resolution LiDAR image at the ground level (Figure 13), allowing monitoring for the following conditions.

- Detailed quantification of unique tree (diameter at breast height [DBH], height) and fuel metrics (surface fuel loading) critical for vegetation and fire behavior analysis
- Automation of workflows, analysis, and summary of TLS data into usable information as specified for a particular project.
- Integration of TLS information with aerial LiDAR data to produce a comprehensive and highly accurate dataset across Midpen management areas.

Figure 13 A Terrestrial LiDAR Unit Used to Capture Post Treatment Data in a Treated Forest Stand

Forest Inventory

The Common Stand Exam (CSE) Protocols (USDA 2019a) provide a comprehensive approach to measuring forest and woodland vegetation. These protocols are set to allow easy conversion of files into the Forest Visualization Simulator (FVS) (USDA 2019b), which in turn can be used to quantify forest carbon, fire risk, stand structure data, model treatment, with near endless functionality. There is some training required to use these systems, but they are free and updated at no cost to the user.

Surface Fuel Loading and Large Woody Debris Monitoring

Surface fuel loading can be assessed using fuel transects as described by Brown (1974) and Brown and Johnston (1982). Large woody debris can be assessed using methods described in Stephens and Moghaddas (2005). Both methods allow for plot-level assessments of surface fuel and large woody debris.

Disease Monitoring
Tree mortality can be monitored at no cost using data provided by via the California Tree Mortality Task Force (CAL FIRE 2018). Data is available from 2012 through 2018 and is typically based on annual aerial surveys. Monitoring of tree mortality pre- and post-treatment at smaller scales (<250 acres) can be completed using a fixed wing UAV or quadracopter type UAV for areas <50 acres.

Forest Carbon Monitoring
The State of California has official protocols for assessing forest carbon (Climate Action Reserve 2019). It should be noted that while carbon calculations can be made using the CSE inventories with data processed in FVS, developing forest carbon values that are verifiable and marketable within the states cap and trade system are highly complex and costly to complete.

Photo Points Monitoring
Photo points can range in complexity and application but can quickly convey change from treatments, disturbance, or time. Photo monitoring can be utilized with historic photos, where they can be retaken using features in the photo that exist today (Figure 14 and Figure 15). Photo monitoring may also be conducted by establishing fixed photo point or taking photos from locations that are easily relocated within 5 to 10 years. In general, it is recommended to at a minimum take pre-/post-treatment photos from a location that is readily revisited, such as a point along a trail, from a powerline, or along a road. More detailed photo monitoring protocols are described by Hall (2001).

Custom Photo Series or Photo Books Monitoring
For vegetation condition assessments, custom or existing photo series can be utilized to help estimate indicators such as fuel load, stem or tree density, and canopy cover. Photo series have been built for many vegetation types across California, including the East Bay Hills (Wright and Vihnanek, 2014). The photo points and associated data for the existing photo series can be viewed and utilized at this website https://depts.washington.edu/nwfire/dps/.

For training local field staff, it may be useful to create a simple local (Midpen) custom photo series that show areas of potential high fire risk for different vegetation types, post treatment desired conditions, or high levels of mortality.

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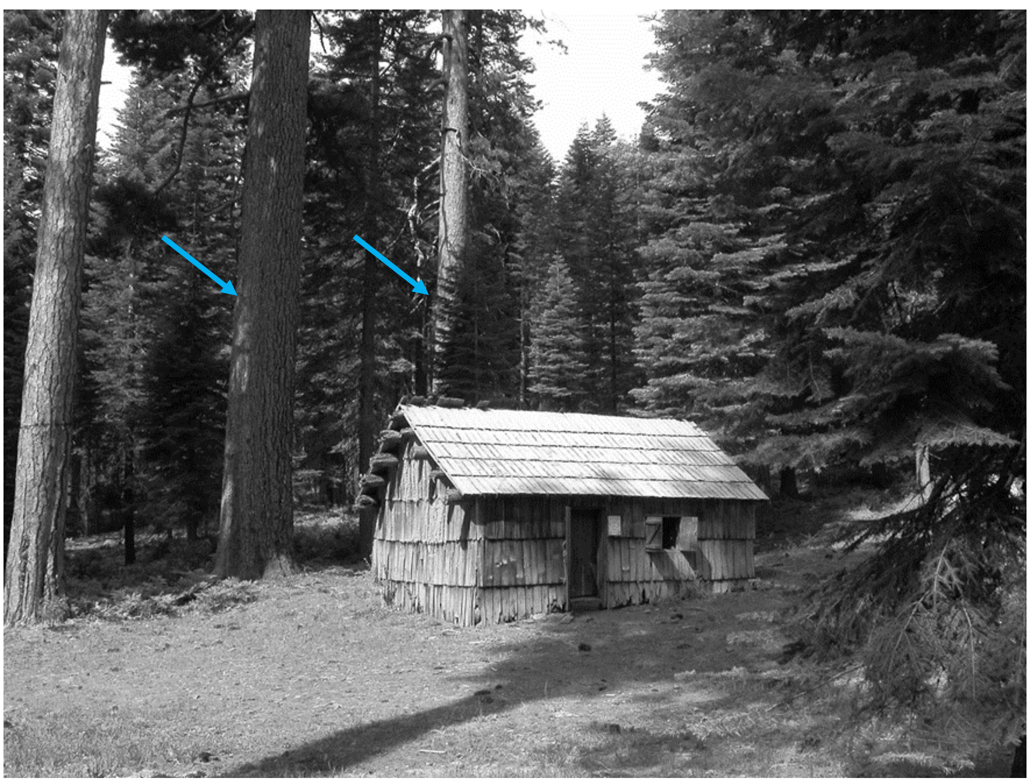
Figure 14 Photo of the Historic Bear Creek Guard Station on the Plumas National Forest ~1915

Figure 15 Photo of the historic Bear Creek Guard Station on the Plumas National Forest ~2005



Invasive and Nonnative Species Monitoring Method

Invasive species may be observed during monitoring for special-status and rare plants. Specific monitoring for invasive species is conducted using the Early Detection Rapid Response (EDRR) method. The EDRR method involves conducting regular surveys of those areas where weed invasion is most likely, and periodic surveys in remote areas where new weed invasions are likely to be less frequent. The surveys are performed by trained surveyors and weed locations are mapped in GIS. EDRR staff pull, cut, or dig out newly discovered invasions. A database of all EDRR populations is maintained and used to facilitate follow-up visits ensuring that the invasion was eliminated. Sites are revisited and retreated annually until there are 5 consecutive years with no weed observations recorded. Midpen's ongoing control of the invasive species population is accomplished through implementation of methods identified in the IPMP (Midpen 2014b).

Wildfire Location Monitoring Methods

Many tools and sources of information are available to monitor for locations of new wildfires, which can also be used to identify the ignition source. The following bullets provide details on the variety of tools and data sources.

- **Local Online Cameras:** Local online camera can be used to monitor smoke conditions or potential wildfires in the area (Figure 17). There are currently four cameras covering areas in vicinity of Midpen lands, but there may be potential to add more. The camera feeds can be accessed at this site: http://www.alertwildfire.org/southeastbay/index.html.
- **Monitoring Fire Intensity (Flame Length):** Flame lengths can be monitored using a camera placed at a location that allows near complete view of a burn unit. Within a burn unit, T-post can be placed at fixed locations within the field of view to determine flame length as recorded at the point where the T-post is placed. It should be noted that this method can be easily impacted by smoke when it obscures the cameras view. Passive flame height sensors may be used-there are variations of this method but generally a string is saturated with borate and placed on a secure re-bar post. The varying levels of burning and scorch of the string can be translated to flame height as described by Ryan (1981) and Kobziar and Moghaddas (2007). It should be noted that this method can be very labor intensive.
- **MODIS (or Moderate Resolution Imaging Spectroradiometer):** MODIS is a key instrument aboard the Terra (originally known as EOS AM-1) and Aqua (originally known as EOS PM-1) satellites. Terra's orbit around the Earth is timed so that it passes from north to south across the equator in the morning, while Aqua passes south to north over the equator in the afternoon. Terra MODIS and Aqua MODIS are viewing the entire Earth's surface at least once every 24 hours. This is a public dataset that provides regular estimated areas that are burning or have recently burned and have a detectable heat signature (Figure 17) (NASA 2019).

- **Google Online Crisis Mapping:** Google® provides free online maps for wildfires and weather event warnings (Figure 18). These can be viewed here: https://www.google.org/crisismap/weather_and_events.
- **Inciweb (Federal Incidents):** Inciweb typically provides the most consistent up to date summaries of wildfire incidents where a federal agency is the lead agency. Inciweb can be found here https://inciweb.nwcg.gov/.
- **CAL FIRE Incidents:** Incidents where CAL FIRE is the lead agency can be found here. https://www.fire.ca.gov/incidents/.
- **Local Social Media:** Most local sheriffs' departments, highway patrol, and fire agencies may post a range of evacuation or incident updates on their own Facebook® and Twitter® Feeds. Sometimes specific Twitter® or Facebook® pages will be set up for a specific incident. These sources often provide near real time information, though it is not always organized in an easy structure to decipher and take action from, as it can be hundreds or thousands of individual posts.
- **Local Fire Incident Radio Feed:** During major incidents, a separate live radio feed from the incident can be accessed at Broadcastify® (https://www.broadcastify.com/listen/). These can be a bit confusing to decipher given the volume of radio traffic, but also can be useful for very localized on the ground current conditions. In previous incidents (2017 Tubbs Fire), volunteers hand typed the entire radio feed into Facebook posts so it could easily be followed by anyone with internet access. The current Kincade Fire transcribed radio feed can be found here https://www.facebook.com/SCScanner/posts/3616036398410243?__tn__=K-R.
- **Historical Ignition Sources:** Understanding historical and current trends in wildfire ignition sources (i.e. human or lighting caused fires) can be useful in preventing future ignitions. Historical ignition patterns have been analyzed regionally for the State of California by Keeley and Syphard (2018). These regional trends in ignitions are broadly applicable to Midpen lands and the South Bay Region. Additional local or OSP level analysis of ignitions can be completed using ignition data (1970 through 2018) available from the National Division of Fire and Aviation Management (FAM 2019).

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Figure 16 Screenshot from Online Local Alert Wildfire® Camera Feed

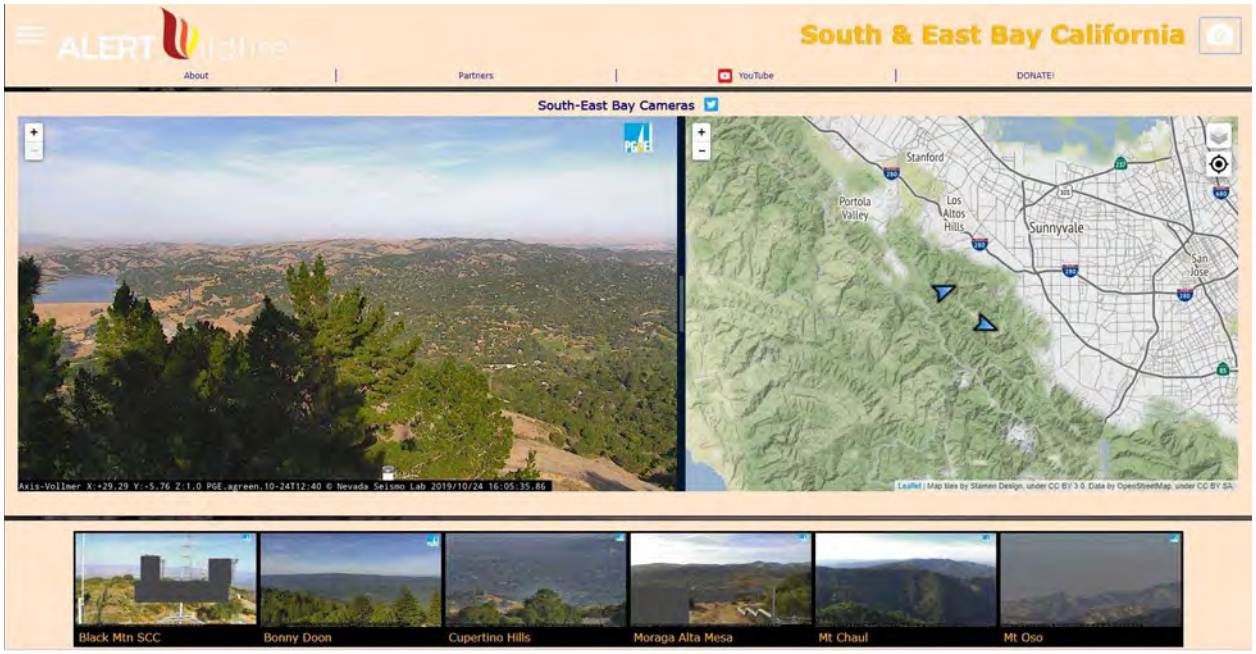


Figure 17 MODIS Imagery Showing 2019 Kincade Fire

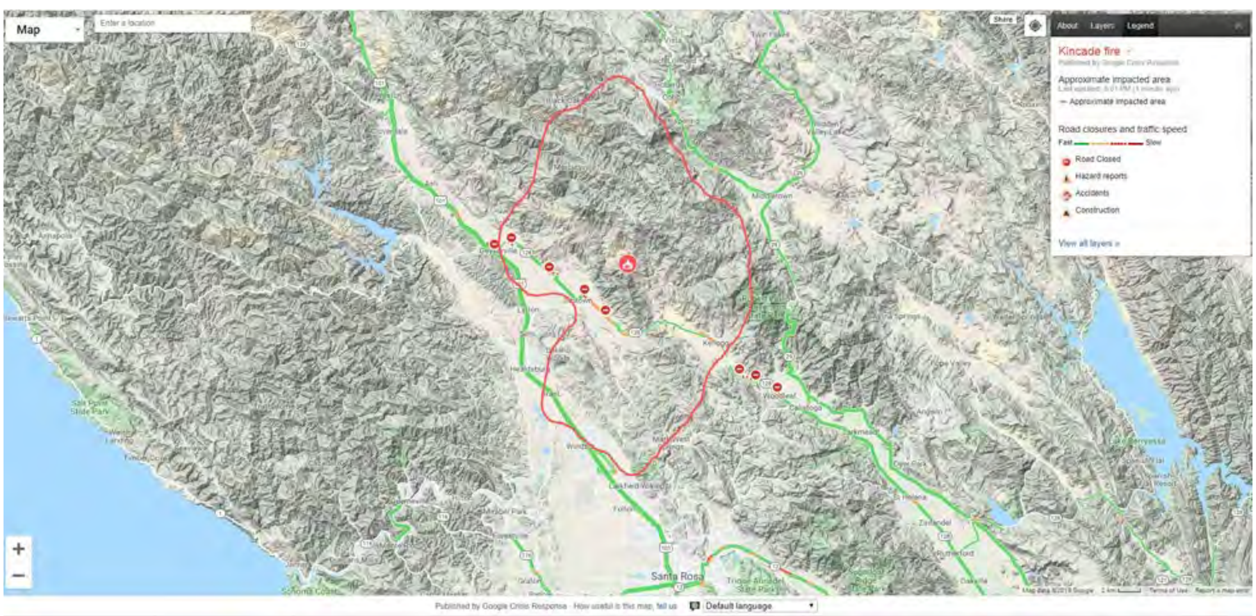
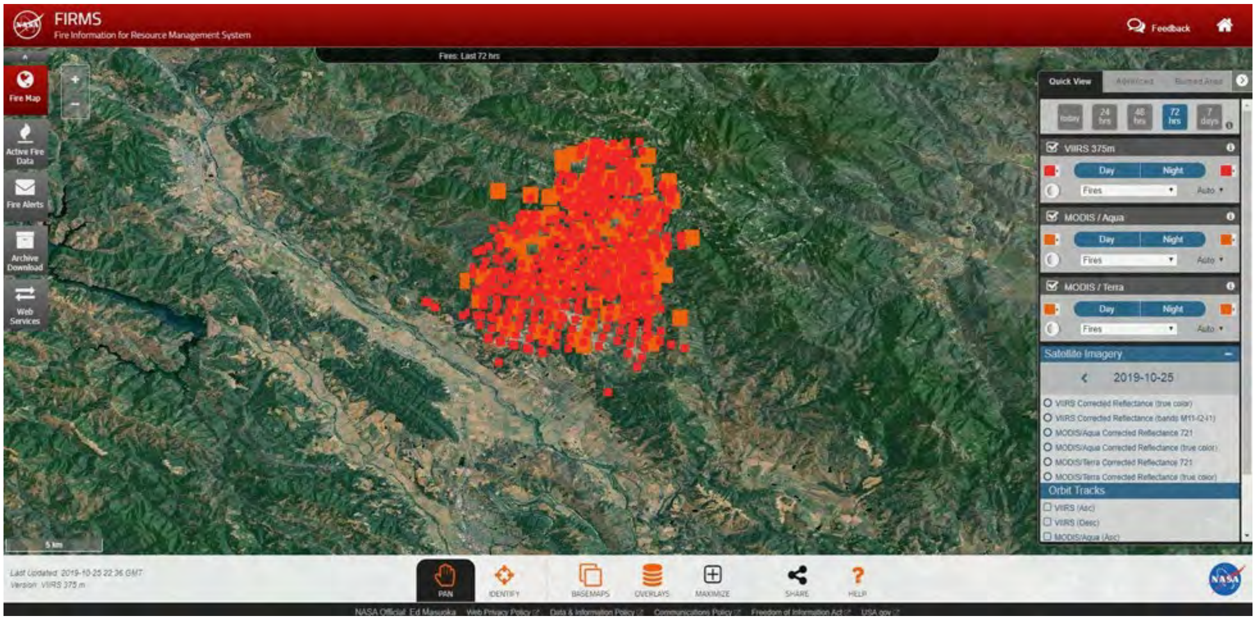


Figure 18 Google Crisis map showing the Kincade fire



Weather and Fire Weather Monitoring Methods

Overview

Three factors contribute to an increased potential for wildfire ignition, including the weather, topography, and fuel load. Monitoring to identify days when fire risk is greater can be conducted using real-time data and forecasts.

Point in Time Measures of Weather Indicators

Weather indicators such as temperature, relative humidity, and windspeed can be measured at single points using simple to use handheld devices. These types of instruments are useful when assessing project level local conditions for project implementation.

Fuel Moistures (Live and Dead)

Live and dead fuel moistures can be obtained from field level measurements, some RAWS stations, as well as satellite imagery. Local measures of live fuel moisture include collection, weighing, drying, and re-weighing samples to determine live fuel moisture content. Digital moisture meters and probes may also be used to assess point in time fuel moistures. Fuel sticks may be used to assess 10-hour fuel moistures as well. At a landscape scale, satellite imagery can be used to assess overall live fuel moistures (USFS 2019a).

Remote Access Weather Stations (RAWS)

Local RAWS stations can provide historical and near real time weather readings, including windspeed, direction, air temperature, relative humidity, and in some cases fuel moisture. RAWS data may be downloaded and analyzed locally using Fire Family Plus (Main et al. 1990). RAWS stations may be part of a larger existing network or new local RAWS can be established on a temporary or permanent basis (NOAA 2019a).

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Fire Weather Forecast

The local fire weather forecast provides fire specific weather forecasts typically for morning and afternoon periods (NOAA 2019b).

Fire Danger and Related Metrics

The Wildland Fire Assessment System (USFS 2019b) provides regularly updated information on a range of fire danger and related metrics including:

- **Fire Potential / Danger**
  - Fire Danger Rating
  - Haines Index
  - Dry Lightning
  - Potential Lightning Ignition
  - Lightning Efficiency
  - NDFD Fire Danger Forecasts
- **Weather**
  - Fire Weather
  - Map Data
  - Google Earth Map Data
- **Moisture / Drought**
  - Dead Fuel Moisture
  - Growing Season Index
  - AVHRR NDVI
  - Keetch-Byram Index
  - Palmer Index
  - National Fuel Moisture Database

Wind Data

Earth® and Windmap® are two sites that provide maps of local windspeeds and directions that incorporate topography (Earth 2019; Windmap 2019) (Figure 19). While the data is mostly for visualization purposes, it is useful to monitor the site during high wind events to gain improved understanding of the local effects of topography on local windspeeds.

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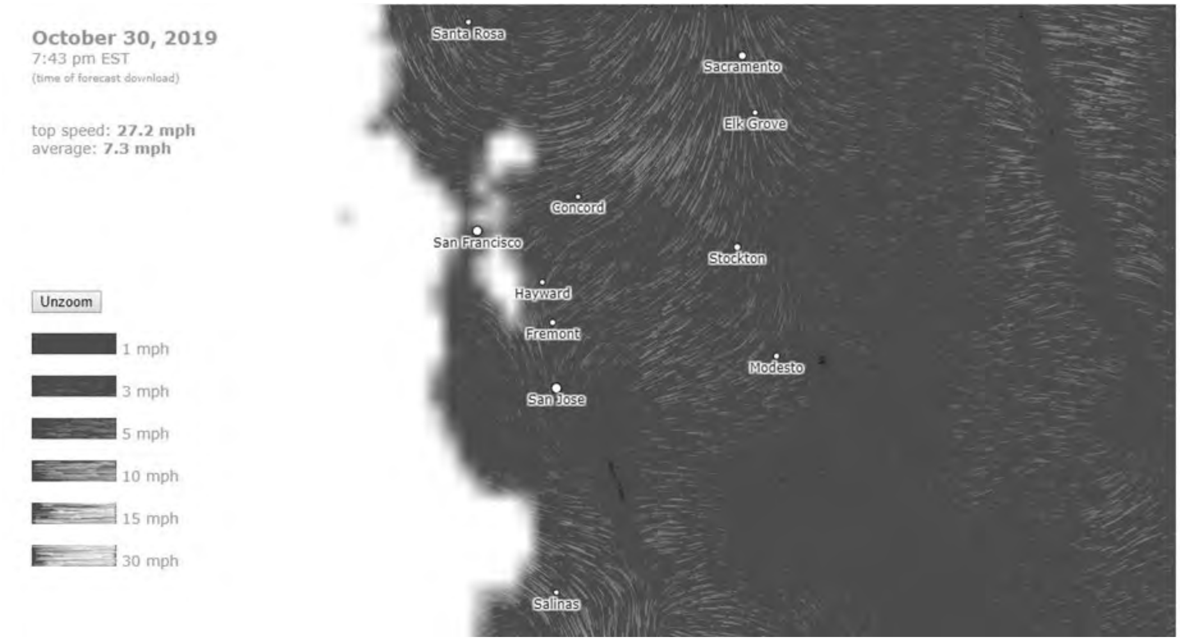
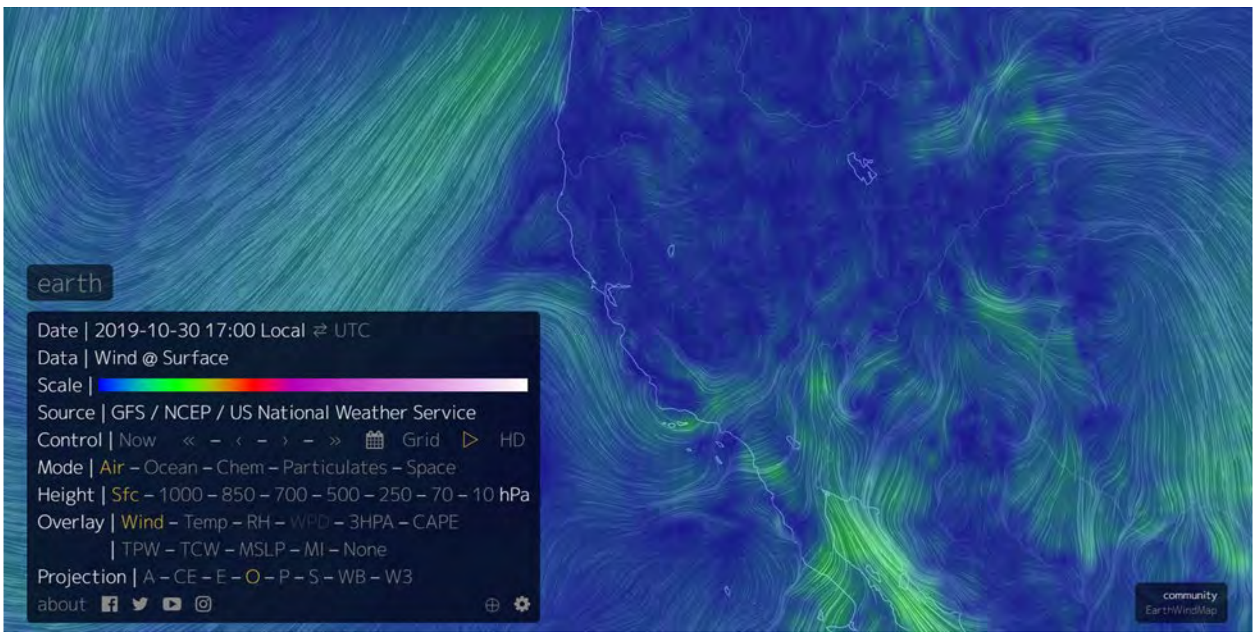
Figure 19 Examples of Windmaps from Earth® and Windmap®





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APPENDIX G, ATTACHMENT 1

Avian Sampling Data Sheets

CHIS Landbird Surveys Point Counts

Figure SOP 5-1

Island: ______ Site Code: _______ **LT PC** Date (mm/dd/yyyy): ____________ Observer Name: __________________

Conditions: Temp. (C): ________ Clouds (0-100): ________ Wind (0-6): ________ Noise (0-3): ________ Precip (0-5): ________

Start Time (hh:mm): _____________ Weather Comments ____

Time	Species	Dist. (m)	DT	Flock Size	Sex	Age	Prev. Point	Comments

Area Search Data Form

Month-Day-Year: The date of the survey using two numbers for month and day and four numbers for year.

Obs. Initials: The first, middle, and last name initials of the observer.

Secondary Obs. Initials: The first, middle, and last name initials of secondary observers.

Temp. (C): The temperature at the beginning of the survey recorded in degrees Celsius.

Cloud Cover %: The estimated percent of cloud cover at the beginning of the survey.

Ppt: The type of precipitation at the beginning of the survey. N = None, F = Fog, M = Mist, D = Drizzle, R = Rain.

Wind: The wind at the beginning of the survey using the Beaufort Wind Scale class. 0 = calm, 0-1 mph, smoke rises vertically, and the sea is mirror smooth. 1 = light air, smoke moves slightly with breeze and shows direction of wind. 2 = you can feel wind on your face and hear the leaves start to rustle. 3 = gentle breeze, small branches start to sway, wind extends a light flag. 4 = moderate breeze, loose dust or sand on the ground will move and larger branches will sway. >4 = Do not survey, too much wind.

Start Time: The time (using a 24-hour clock) that you started your 20-minute search.

Duration: Duration of survey in minutes, 20.

Species Code: The standard four-letter species code.

Species Name Abr: The full common name or a clear abbreviation for the bird.

On Area Detection Type and Count: The detection type and count for a single detection event on or within the search area should be recorded in each box. The detection type [S = Song, C = Call, V = Visual, W = Wing (e.g., Mourning Dove or Hummingbird wing whir), D = Drumming, F = Fly over] followed by the total number of individuals involved in the detection event, (e.g., V2, S1, F57).

Off Area Detection Type and Count: The detection type and count for a single detection event off or outside of the search area should be recorded in each box. The detection type [S = Song, C = Call, V = Visual, W = Wing (e.g., Mourning Dove or Hummingbird wing whir), D = Drumming, F = Fly over] followed by the total number of individuals involved in the detection event, (e.g., V2, S1, F57). Birds flying over the site (excluding those aerial foraging within the search area) should be counted here.

Breeding Status: Any breeding evidence observed during the count. N = current year's Nest found in the study area with eggs or young, in the process of being built, or already depredated or abandoned. M = adult seen gathering or carrying nesting Material to a likely nest site in the study area. F = adult seen carrying Food or Fecal sac to or from a likely nest site in the study area. D = Distraction display or injury feigning by an adult bird. L = a young bird incapable of sustained flight (a "Local") in the study area or very young (stub-tailed) fledglings being fed by parents in the study area. Y = local (incapable of sustained flight) Young detected. C = Copulation or Courtship observed of a species within its breeding range. T = other Territorial behavior observed. S = territorial Song or drumming heard.

Notes: Record any survey notes here (e.g., noise disturbance, location information, other sightings, etc.).

Observer's Full Names: The full name (first, middle initial, and last) in the Obs. Initials and Secondary Obs. Initials fields.

Checked: The first, middle, and last name initials of the observer who has checked the current survey page for completeness and accuracy.

Copied: The first, middle, and last name initials of the observer who has made a photocopy of the current survey page.

Entered: The first, middle, and last name initials of the observer who has entered the current survey page into a digital source file.

ATTACHMENT 1

Area Search Data Form

Page ____ of ____

State ____ Project/Region ____ Site Code ____ Site Name ____ Point ____ Month ____ Day ____ Year ____

Obs. Initials ____ Secondary Obs. Initials ____ Temp. (C) ____ Cloud Cover (%) ____ Ppt ____ Wind ____ Start Time (24 hr) ____ Duration (minutes) ____

		On Area		Off Area		
Species Code	Species Name Abr.	Detection Type	Total	Detection Type	Total	Breeding Status

Notes:

rev. 20070424 JLS

Precipitation (Ppt): **N** = None, **F** = Fog, **M** = Mist, **D** = Drizzle, **R** = Rain. Wind (Beaufort): **0** = calm, **1** = light air, **2** = leaves start to rustle, **3** = small branches start to sway, **4** = moderate breeze, >4 Do not survey

Detection Type: **S** = Song, **C** = Call, **V** = Visual, **W** = Wing, **D** = Drumming, **F** = Fly over. Breeding Status: **N** = active Nest, **M** = carrying nesting Material, **F** = carrying Food or Fecal sac,

D = Distraction display/feigning, **L** = Local young (limited flight or stub-tailed fed by parents), **C** = Copulation or Courtship observed, **T** = Territorial behavior, **S** = territorial Song or drumming

Observer's Full Names ____________ Checked ________ Copied ________ Entered ________

APPENDIX G, ATTACHMENT 2

List of Geospatial Datasets Useful for Vegetation, Wildfire, Wildlife, Hydrology, Soils, and Carbon Monitoring

ATTACHMENT 2

The table below includes a list of potential geospatial datasets relevant to monitoring, including the data set name, scale, description, and current website. This list is intended to provide report users sources of geospatial data relevant to the overall question of fuel treatments and forest carbon dynamics covered in this assessment.

Dataset Name	Spatial Scale	Description of Dataset	Source Website
LANDFIRE	Landscape	LANDFIRE delivers vegetation, fuel, disturbance, and fire regimes geospatial data products for the entire nation. Methods are based on peer-reviewed science from multiple fields. LANDFIRE products are consistent, comprehensive, and standardized, resulting in multiple applications to fire, fuel, and natural resources.	http://www.landfire.gov/version_comparison.php
LANDFIRE, Vegetation	Landscape	LF existing vegetation layers describe the following elements: existing vegetation type (EVT), existing vegetation canopy cover (EVC), and existing vegetation height (EVH). These layers are created using predictive landscape models based on extensive field-referenced data, satellite imagery and biophysical gradient layers using classification and regression trees. LF potential vegetation layers describe the following elements: bio-physical settings (BPS) and environmental site potential (ESP). These layers are created using predictive landscape models based on extensive field-referenced data and biophysical gradient layers using classification and regression trees.	http://www.landfire.gov/vegetation.php
LANDFIRE, Disturbance	Landscape	Disturbance products are developed to help inform updates to LANDFIRE data to reflect change on the landscape caused by management activities and natural disturbance. They are a compilation of data from: Landsat satellite imagery, Burned Area Reflectance Classification (BARC), Rapid Assessment of Vegetation Condition after Wildfire (RAVG), Monitoring Trends in Burn Severity (MTBS), LANDFIRE Refresh events, User contributed data, Other ancillary data	http://www.landfire.gov/disturbance.php
LANDFIRE, Fuel	Landscape	LANDFIRE fuel data describe the composition and characteristics of surface and canopy fuel. LANDFIRE fuel products provide consistent fuel data to support fire planning, analysis, and budgeting to evaluate fire management alternatives and supplement strategic and tactical planning for fire operations	http://www.landfire.gov/fuel.php

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Dataset Name	Spatial Scale	Description of Dataset	Source Website
LANDFIRE, Topographic	Landscape	Topographic data serve as input to the Landscape (.LCP) file which is used in models to predict wildland fire behavior and effects.	http://www.landfire.gov/topographic.php
The Web-Enabled Landsat Data (WELD) 5-year Land Cover Land Use Change (LCLUC)	Landscape	The Web-Enabled Landsat Data (WELD) 5-year Land Cover Land Use Change (LCLUC) is a composite of 30 m land use land change product for the contiguous United States (CONUS). The data were generated from five years of consecutive growing season WELD weekly composite inputs from April 15, 2006, to November 17, 2010. WELD data are created using Landsat Thematic Mapper Plus (ETM+) Terrain Corrected data. This product includes data about tree cover loss and bare ground gain, which are composited over the five year period. WELD LCLUC is distributed in Hierarchical Data Format 4 (HDF4). The WELD project is funded by the National Aeronautics and Space Administration (NASA) and is a collaboration between the United States Geological Survey (USGS) Earth Resources Observation and Science (EROS) Center and the South Dakota State University (SDSU) Geospatial Sciences Center of Excellence (GSCE).	EarthExplorer: http://earthexplorer.usgs.gov/
Global Land Survey (GLS)	Landscape	The Global Land Survey (GLS) collection of Landsat imagery is designed to meet a need from scientists to use a carefully coordinated collection of high resolution imagery for global modeling, including for the climate and carbon cycles. GLS replaces GeoCover, which was collected first into three epochs around 1975, 1990 and 2000. The GLS collection improves upon GeoCover by using more accurate elevation data (SRTM) for terrain correction and also by adding another epoch centered around 2005. Imagery from all seven Landsat sensors, plus the Landsat experimental sensor, ALI, are included in the collection.	EarthExplorer: http://earthexplorer.usgs.gov/ or GloVis: http://glovis.usgs.gov/

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Dataset Name	Spatial Scale	Description of Dataset	Source Website
Global Land Cover	Landscape	These global land cover layers are the product of a collaboration between USGS and the University of Maryland, Department of Geographical Sciences. 30-m resolution raster data layers for circa 2010 tree cover and bare ground and a persistent surface water layer 2000-2012, have been derived from Landsat 7 ETM+ data. The tree cover and bare ground data are per pixel estimates, 1 to 100% (given as integers values 1-100), the water layer is a thematic layer (2 = water). Hansen et. al 2013	http://landcover.usgs.gov/glc/
Hazardous Fuel Treatment Reduction	Stand	The Forest Service's Natural Resource Manager (NRM) Forest Activity Tracking System (FACTS) is the agency standard for managing information about activities related to fire/fuels, silviculture, and invasive species. FACTS is an activity tracking application for all levels of the Forest Service. This layer represents activities of hazardous fuel treatment reduction that are polygons. All accomplishments toward the unified hazardous fuels reduction target must meet the following definition: "Vegetative manipulation designed to create and maintain resilient and sustainable landscapes, including burning, mechanical treatments, and/or other methods that reduce the quantity or change the arrangement of living or dead fuel so that the intensity, severity, or effects of wildland fire are reduced within acceptable ecological parameters and consistent with land management plan objectives, or activities that maintain desired fuel conditions. These conditions should be measurable or predictable using fire behavior prediction models or fire effects models."	ESRI geodatabase: http://data.fs.usda.gov/geodata/edw/edw_resources/fc/S_USA.Activity_HazFuelTrt_PL.gdb.zip Shapefile: http://data.fs.usda.gov/geodata/edw/edw_resources/shp/S_USA.Activity_HazFuelTrt_PL.zip
Timber Harvests	Stand	Depicts the area planned and accomplished acres treated as a part of the timber harvest program of work, funded through the budget allocation process and reported through the FACTS database. Activities are self-reported by Forest Service Units.	ESRI geodatabase: http://data.fs.usda.gov/geodata/edw/edw_resources/fc/S_USA.Activity_TimberHarvest.gdb.zip Shapefile: http://data.fs.usda.gov/geodata/edw/edw_resources/shp/S_USA.Activity_TimberHarvest.zip

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Dataset Name	Spatial Scale	Description of Dataset	Source Website
FRAP Vegetation (FVEG15_1)	Landscape	An accurate depiction of the spatial distribution of habitat types within California is required for a variety of legislatively-mandated government functions. The California Department of Forestry and Fire Protection's CALFIRE Fire and Resource Assessment Program (FRAP), in cooperation with California Department of Fish and Wildlife VegCamp program and extensive use of USDA Forest Service Region 5 Remote Sensing Laboratory (RSL) data, has compiled the "best available" land cover data available for California into a single comprehensive statewide data set. The data span a period from approximately 1990 to 2014. Typically the most current, detailed and consistent data were collected for various regions of the state. Decision rules were developed that controlled which layers were given priority in areas of overlap. Cross-walks were used to compile the various sources into the common classification scheme, the California Wildlife Habitat Relationships (CWHR) system.	http://frap.fire.ca.gov/data/frapgisdata-sw-fveg_download
Existing Vegetation-CALVEG	Landscape	A mapping methodology has been developed to capture vegetation characteristics using automated, systematic procedures that efficiently and cost-effectively map large areas of the state with minimal bias and is supplemented with onsite field visits when appropriate. Map attributes consist of vegetation types using the CALVEG classification system and forest structural characteristics such as tree and shrub canopy cover and tree stem diameters.	http://www.fs.usda.gov/detail/r5/landmanagement/resourcemanagement/?cid=stelprdb5347192
West Wide Fire Assessment	Landscape	The Council of Western State Foresters and the Western Forestry Leadership Coalition (WFLC) are developing a wildfire risk assessment of all lands for the 17 western states and selected Pacific Islands. This assessment is known as the "West Wide Wildfire Risk Assessment, or "WWA".	https://www.thewflc.org/resources/west-wide-wildfire-risk-assessment-final-report
CalAdapt Climate Tools	Landscape/Region	Explore charts, maps, and data of observed and projected climate variables for California. The tools show projections for two possible climate futures, one in which emissions peak around 2040 and then decline (RCP 4.5) and another in which emissions continue to rise throughout the 21st century (RCP 8.5).	http://cal-adapt.org/data

ATTACHMENT 2

Dataset Name	Spatial Scale	Description of Dataset	Source Website
Modis Burned Area Product	Landscape	The Burned Area product contains burning and quality information on a per-pixel basis. Produced from both the Terra and Aqua MODIS-derived daily surface reflectance inputs, the algorithm analyzes the daily surface reflectance dynamics to locate rapid changes and uses that information to detect the approximate date of burning, mapping the spatial extent of recent fires only.	https://modis.gsfc.nasa.gov/data/dataprod/mod45.php
Georgetown Climate Center Adaptation Clearinghouse	State/City/ Municipality	The Adaptation Clearinghouse seeks to assist policymakers, resource managers, academics, and others who are working to help communities adapt to climate change. Content in the Adaptation Clearinghouse is focused on the resources that help policymakers at all levels of governments reduce or avoid the impacts of climate change to communities in the United States. The Adaptation Clearinghouse tends to focus on climate change impacts that adversely affect people and our built environment.	http://www.adaptationclearinghouse.org/
Fire Return Interval Departure	Landscape	This polygon layer consists of information compiled about fire return intervals for major vegetation types on the 18 National Forests in California and adjacent land jurisdictions. Comparisons are made between pre-Euroamerican settlement and contemporary fire return intervals (FRIs). Current departures from the pre-Euroamerican settlement FRIs are calculated based on mean, median, minimum, and maximum FRI values. This map is a project of the USFS Pacific Southwest Region Ecology Program.	https://www.fs.usda.gov/detail/r5/landmanagement/gis/?cid=STELPRDB5327836
Web Soil Survey (SSURGO)	Landscape	Operated by the USDA Natural Resources Conservation Service (NRCS), this data portal contains spatially-explicit information about soil type and tree productivity site index across the United States and its territories that can be used for: growth and yield modeling when investigating above- and belowground carbon sequestration or fuels treatment effectiveness & longevity; identifying limitations affecting recreational or structural development; water capacity and flooding frequency. Soil data was collected on a geographic scale ranging from 1:12,000 - 1:63,360.	https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

ATTACHMENT 2

Dataset Name	Spatial Scale	Description of Dataset	Source Website
MTBS: Fire Occurrence, Extent, and Burn Severity Mosaic	Landscape	Monitoring Trends in Burn Severity (MTBS) is an interagency program that offers free geospatial products related to wildfire management in the United States, including Alaska and Hawaii. Users are able to download fire perimeters of all fires, both wildfires and prescribed fires, from 1984 to present that burned 1000 acres or more. Fire severity mosaics derived from 30m Landsat data, is also available for those fires.	https://www.mtbs.gov/viewer/index.html
FIA Database	Landscape	Information about a region's forest structure and composition can be obtained from the USDA Forest Service's Forest Inventory and Analysis program. This tabular data is quantified from annual on-ground vegetation sampling plots with approximate ("fuzzed") survey locations. Data includes overstory and understory species, size, mortality status, and harvest removals, plus coarse woody debris loading.	https://apps.fs.usda.gov/fia/datamart/datamart.html
PRISM Climate Data	Landscape	Oregon State University's Northwest Alliance for Computational Science and Engineering hosts climate data of the conterminous United States. Geospatial climate data is available summarized monthly or by 30-year "normals" at a resolution of 4km - 800m resolution. This data is central to time series comparisons and can serve as important variables when modeling drivers of contemporary forest structure or conditions under climate change. Note, interpolation between weather stations may be less accurate than localized data collection.	http://prism.oregonstate.edu/
RAWS Weather Data	Landscape	The Western Regional Climate Center hosts Remote Automated Weather Stations (RAWS) data for western United States, including daily and monthly weather summaries and station metadata. Weather reports contain measurements on air temperature, solar radiation, wind speed and direction, fuel moisture, relative humidity, and precipitation. These metrics are useful for understanding fire weather, climatology, air quality management, planning for noxious weed control; and other natural resource management goals.	https://wrcc.dri.edu/

ATTACHMENT 2

Dataset Name	Spatial Scale	Description of Dataset	Source Website
National Geospatial Data Asset (NGDA) Datasets	Landscape	Other Geospatial Datasets available are county lines, roads/rails, national structure database, wetlands, hydrography (incl. dams), and other information that may impact where/when fuels treatments are conducted	https://www.fgdc.gov/ngda-reports/NGDA_Datasets.html

Variable	Description	Source
Forest Carbon	Fire Lab Tree List: This dataset was built using a modified Random Forests technique to impute FIA plot data to 30-meter grid cells for all forested areas in the western U.S. Each forested grid cell contains reference to one FIA plot. The tree list for each plot is contained in the associated database. Users will need to adapt tree lists and generate associated stand-level info for use in the growth model, or CAL FIRE can provide data for a user's project area in FVS-ready format. Users should note that the dataset is intended to provide accurate estimates of tree size and species composition for a specific year (2009 for the current version).	GGRF meth: https://ww3.arb.ca.gov/cc/capandtrade/auctionproceeds/calfire-fh-finalqm-17-18.pdf 6:55 PM Fire lab tree list: https://www.fs.usda.gov/rds/archive/Product/RDS-2018-0003
	Carbon mapper web application	https://web.tplgis.org/carbonmap/

APPENDIX H

Glossary of Terms

GLOSSARY OF TERMS

Term	Definition
All terrain vehicle (ATV)	Vehicles designed to be used off paved road, in all terrains. Examples include dirt bikes, 4-wheelers, side by sides, and quads.
Best management practices (BMPs)	Measures designed to broad implementation with the intent to protect many different resources, including water quality from soil erosion and runoff.
Burn Boss	Ensures that all Burn Plan specifications are met before, during, and after a prescribed fire.
Control lines	Linear areas used to control a fire and maintained to provide wildland firefighters a location to perform wildfire suppression activities. Control lines include treatments such as disclines, and firelines. New control lines are typically 1-foot to 6-foot wide, depending on location, vegetation type, and type of equipment used to construct the line.
Critical infrastructure	Communications towers, evacuation centers, fire stations, Incident Command Posts (ICP), medivac sites, Shelter-in-Place (SIP) locations, water collection points, and water tanks. These are Federal Emergency Management Agency (FEMA) Target Hazards important for emergency response, and/or disaster recovery functions.
CWPP Priority Areas	Locations defined in Community Wildfire Protection Plans as priority areas for hazardous fuel reduction treatments.
Defensible space	The buffer created between a building and the grass, trees, shrubs, or any wildland area that surround it. This space is needed to slow or stop the spread of wildfire and it protects buildings from catching fire—either from direct flame contact or radiant heat. Defensible space is also important for the protection of the firefighters defending buildings. There are three defensible space zones with different treatment requirements; within 5 feet, within 30 feet, and within 30 to 100 feet from buildings.
Discline	A treatment of 10 feet or more created using an agricultural disc or bulldozer to create an area of bare mineral soil without flammable vegetation. See "control lines".
Eucalyptus removal	Removal of trees in the genus "Eucalyptus". The most common species is Blue Gum Eucalyptus, *Eucalyptus globulus*. Control is accomplished by mechanical removal of standing trees followed by herbicide treatment.
Emergency Staging Areas	Areas defendable from wildfire which are large enough to stage firefighting equipment, supplies, and personnel prior to deployment to a wildfire. Staging areas must be located where equipment, supplies, and personnel can reach the fireline within 1 hour.
Emergency Landing Zones	Also known as a "Helispot". Areas where wildfire helicopters can land and take off safely with equipment, supplies, personnel, and water. Some helispots are suitable for refueling and firefighting water filling.
Evacuation Routes (Primary and Secondary)	Evacuation routes were designated by the following plans: Woodside Evacuation Plan, King Hill Plan, Skyline Ridge Evacuation Plan, Redwood West Lexington Pre-Plan, Las Cumbres Evacuation Plan, Santa Clara County Plan, and East Lexington Basin Fire Pre-Plan. Some Primary and Secondary Evacuation Routes specific to Midpen Lands are designated in this plan which were not defined in another local plan.
Firelines	A break in fuel, made by cutting, scraping, or digging. See "control lines".

GLOSSARY OF TERMS

Term	Definition
Fire Effects Monitor	Responsible for collecting incident status information and providing this information to the Burn Boss. The information may include fire perimeter location, on-site weather, fire behavior, fuel conditions, smoke, and fire effects information needed to assess firefighter safety and whether the fire is achieving established incident objectives and requirements.
Fire Management Logistics Areas	Locations where firefighting planning and efforts occur, including helispots, fire lookouts, safety zones, and staging areas.
Firing Boss	Leads ground ignition operations and is responsible for the safety and coordination of assigned resources on prescribed fire and wildfire incidents.
Fuelbreak	An area where fire fuels are modified to change the behavior of a fire in order to reduce the flame lengths and energy output. A fuelbreak acts as an achor point for indirect attack on wildfires, operational tool for firefighters to create backfires, and supports safer ingress/egress for emergency responders and the public. Fuelbreaks may be around Wildland Type 3 ingress/egress routes, evacuation routes, and other trails and roads.
Fuel Reduction Area (FRA)	An area where specific fuel management prescriptions are applied. FRAs are less permanent than fuelbreaks and are typically implemented in more natural areas where fuel load reduction achieves a combination of habitat enhancement goals and wildland fire risk reduction.
Helispot	See "Emergency Landing Zones".
Incident Command Post (ICP)	The location where primary command functions are executed by the Incedent Commander and his/her team.
Ingress/egress route (i.e., Wildland Type 3 ingress/egress)	Unimproved roads and trails capable of allowing transit by a Wildland Type 3 fire engine. These roads and trails are typically 8 to 12 feet wide.
Mop Up	To make a fire safe or reduce residual smoke after the fire has been controlled by extinguishing or removing burning material along or near the control line, felling snags, or moving logs so they won't roll downhill.
Non-shaded fuelbreak	A non-shaded fuelbreak is used in a swath of land where fuels are reduced in areas without a tree canopy, typically at a change in vegetation type, such as from forest or shrubland into grassland, or within grasslands. Non-shaded fuelbreaks are most often maintained in grasslands or shrublands versus wooded areas, although they can be implemented at a transition, particularly near homes if deemed critical for fire safety or necessary to meet defensible space requirements. See "fuelbreak".
Pile burn	A fuel treatment where brush and trees are cut or pushed with a machine, and then piled and burned.
Prescribed fire/burn	Any fire ignited by management actions under certain, predetermined conditions to meet specific objectives related to hazardous fuels or habitat improvement. A written, approved prescribed fire plan must exist, and all regulatory requirements must be met prior to ignition.

GLOSSARY OF TERMS

Term	Definition
Prescribed Fire Plan (PFP)	A document that provides the prescribed fire burn information needed to implement an individual prescribed fire project.
Primary evacuation route	If not defined in a local plan, Primary Evacuation Routes are defined as major roadways which will channel most if not all traffic out of a large area.
Resource Advisor	Provides professional knowledge and expertise for the protection of natural, cultural, and other resources within an incident environment.
Safety zone	An area cleared of flammable materials used for escape in the event a fireline is outflanked or in case a spot fire causes fuels outside the control line to render the line unsafe. In firing operations, crews progress so as to maintain a safety zone close at hand allowing the fuels inside the control line to be consumed before going ahead. Safety zones may also be constructed as integral parts of fuelbreaks; they are greatly enlarged areas which can be used with relative safety by firefighters and their equipment in the event of a blowup in the vicinity. See "control lines".
Secondary evacuation route	If not defined in a local plan, Secondary Evacuation Routes are defined as either local or neighborhood feeder roads or routes alternate to Primary Evacuation Routes. Generally, individual driveways are excluded; however, there are exceptions.
Shaded fuelbreak	A type of fuelbreak used in forested areas. Enough tall tree canopy is retained to maintain shade, reduce the potential for rapid re-growth of shrubs and sprouting hardwoods, and minimize erosion. Ladder fuels and woody understory vegetation are thinned out. The purpose of a shaded fuelbreak is to reduce ladder fuels and increase base canopy height of trees for the purpose of preventing fires from spreading from the forest floor into the forest canopy. See "fuelbreak".
Staging area	A location set up at an incident where resources can be placed while awaiting a tactical assignment on a three-minute available basis. Staging areas are managed by the operations section.
Structure Type 1 (tender) Route	Roads and trails capable of allowing transit by a Type 1 (or Class A) fire engine. A Type 1 fire engine is most common in a metropolitan communities. Large cities rely on Type 1 fire apparatus based on flexibility, staffing, and the ability to operate at homes, apartments, businesses, and high rise buildings. Technically, a Type 1 fire engine is designed for structural firefighting. It will typically include a pump that operates at 1,000 gallons per minute (GPM) and includes a 400 gallon tank, 1,200 feet of 2 1/2-inch hose, 400 feet of 1 1/2-inch hose, 200 feet of 1-inch hose, 20+ feet of ladder, a 500 GPM Master Stream, and minimum staffing of typically four firefighters.
Target hazards	Facilities in either the public or private sector that provide essential products and services to the general public, are otherwise necessary to preserve the welfare and quality of life in the community, or fulfill important public safety functions. Target hazards include assisted living facilities, campsites, hospitals, community centers, schools, and mobile home parks.
Vegetation management (fuel management)	The practice of removing or modifying live and dead vegetation to reduce the potential spread of wildland fire ignitions, overall rates of wildland fire spread, flame lengths, and catastrophic fire severity. Vegetation management activities typically occur within vegetation management areas (see below).

GLOSSARY OF TERMS

Term	Definition
Vegetation management area (VMA)	A broad area where vegetation management is implemented. Types of VMAs include defensible space, disclines, FRAs, and fuelbreaks.
Vegetation Management Plan (VMP)	A document intended to mitigate the risk of wildfire by reducing flammable vegetation in wildlands and around structures in the WUI. For the Wildland Fire Resiliency Program, the VMP defines the suite of vegetation management activities that Midpen may implement to reduce the potential for ecologically-catastrophic wildland fires while also preserving biodiversity and minimizing effects on the environment. This VMP focuses on what is referred to as "non-fire" vegetation management. Only manual, mechanical, conservation grazing, and limited chemical methods of vegetation management are considered
Wildland Fire Pre-Plan/Resource Advisor Maps	Map-based documents that can aid CAL FIRE and other firefighting agencies in their firefighting efforts in the event of a wildland fire.
Wildland Type 3 Fire Engine	A Type 3 fire engine is the most popular fire engine in California due to the easy road access of most fires. A Type 3 fire engine traditionally has four-wheel drive to make driving over rough terrain easier, but can also be produced with standard rear wheel drive. The cab can either be two- or four-door holding up to five people. Type 3 fire engines are required to have a minimum of 500 gallons of water and be able to pump 150 gallons per minute at a pressure of 250 pounds per square inch (1,700 kPa). They have a typical gross vehicle weight rating (GVWR) of 26,000 pounds.

APPENDIX I

Key to Terms

Key to Terms Used in the Program and Appendix B Mapsets

Table Treatment Categories	Mapset Treatment Categories	Summary of Treatment Locations
Shaded Fuelbreaks	Shaded Fuelbreak	Along evacuation and other routes, and around structures
Non-Shaded Fuelbreaks	Non-Shaded Fuelbreak	Around selected meadows, grasslands, and parking lots; and along evacuation and other routes
Evacuation Routes, Critical Infrastructure, Fire Management Logistics Fuelbreaks	Fuelbreak 200-Foot [a]	Around evacuation routes, driveways for emergency egress, helispots, staging areas, water tanks, communication locations, driveways for emergency egress, and sensitive resources
Target Hazards Fuelbreaks	Fuelbreak 300-Foot	Around schools, mobile home parks, assisted living facilities, camp sites, and community centers
Fire Agency Recommended Fuelbreaks	Fire Agency Recommended	Near residential uses at Pulgas Ridge and Teague Hill OSPs, along Crazy Pete's Road at Coal Creek OSP, and along Loma Prieta Road at Sierra Azul OSP
Ingress/Egress Route Fuelbreaks	Wildland Type 3 Ingress/Egress	Around Wildland Type 3 fire engines routes
Disclines	Discline	Around selected meadows, grasslands, and parking lots; and along evacuation and other routes
Midpen Structures and Facilities Defensible Spaces	• Defensible Space 100-foot • Defensible Space 30-foot	Around Mipen structures and facilities
Emergency Staging Areas, Emergency Landing Zones, and Other Fire Management Logistics Areas [b]	Fire Management Logistics • Helispot • Staging Area	Within staging areas and landing zones (e.g., helispots)
Eucalyptus and Acacia Removal	Eucalyptus and Acacia Removal	Within eucalyptus and acacia groves
Fuel Reduction Areas	Fuel Reduction Area	Within native forests or woodland areas of at least 100 acres

Notes:

[a] Includes some smaller ≤40-foot fuelbreaks around driveways.

[b] The 200-foot fuelbreak around emergency staging areas, emergency landing zones, and other fire management logistics areas are addressed under "Evacuation Routes, Critical Infrastructure, and Fire Management Logistics"

Midpeninsula Regional Open Space District

PLANNING AND NATURAL RESOURCES COMMITTEE

R-19-127
September 24, 2019

AGENDA ITEM 2

AGENDA ITEM

Wildland Fire Resiliency Program – Public Meetings and Resource Management Policy Update

GENERAL MANAGER'S RECOMMENDATIONS

1. Receive updates on the development of the Wildland Fire Resiliency Program.

2. Review public feedback on the development of the Wildland Fire Resiliency Program.

3. Forward the recommended updates to the Resource Management Policies, as they relate to Wildland Fire, to the full Board of Directors for consideration.

SUMMARY

The Midpeninsula Regional Open Space District (District) is developing a Wildland Fire Resiliency Program (Program) to address the Board of Director's (Board) Fiscal Year (FY) 2019-20 Strategic Goals and Objectives that include working with fire agencies and surrounding communities to strengthen the prevention of, preparation for, and response to wildland fires. To engage the public and receive early feedback in the process of developing the Program, the District held three public open houses. Consultants (working closely with District staff, partners, and stakeholders) have reviewed, identified gaps, and recommended several changes to the District's Resource Management Policies (RMP) that address the changing reality of California's wildland fires and reflect the latest science of ecosystem resiliency

BACKGROUND

The Board approved the FY2019-20 Strategic Goals and Objectives that include working with fire agencies and surrounding communities to strengthen the prevention of, preparation for, and response to wildland fires. In response, District staff began developing a robust, strategic, and comprehensive fire management program. The District entered into contract with two consultants, Spatial Informatics Group, Inc., (SIG) and Panorama Environmental, Inc., (Panorama) to assist in the development of a Prescribed Fire Program in the summer of 2018, which then expanded to the development of a more comprehensive Wildland Fire Resiliency Program (Program) (R-19-52; R-19-69). The Program will address four main components of the District's Wildland Fire Management activities:

1) Wildland fire risk reduction through non-fire fuel reduction activities;
2) Monitoring of District lands;
3) Preparation of pre-fire plans with Resource Advisor maps; and

4) Use of prescribed fire to manage wildland fire fuels, reintroduce fire as a natural and cultural process, and provide staff and local fire agency fire training opportunities.

DISCUSSION

Public Open Houses

During the week of August 19, 2019, the District held public open houses in Half Moon Bay, Los Gatos, and Woodside with assistance from SIG, Panorama, local fire agencies, CAL FIRE, and firesafe councils. The objective of these meetings was to communicate the District's Program components and invite early public comment on the development of program elements. Outreach and notices prior to the events included 1,441 postcards to preserve neighbors, posting on the District's August eNews, sending an Interested Parties e-blast, event posting on Facebook and through Evite, updates to the project webpage on the District's website, and personal invites to fire agency partners (e.g. CAL FIRE, Woodside Fire, Santa Clara County Fire, Firesafe Councils).

The format of the event was a 45-minute presentation to describe fire ecology and history within the San Francisco Bay Area, explain what the District currently does for fire preparedness, outline the framework of the new developing Program, and inform how the public can get further involved. This presentation is currently on the District website for public viewing. After the presentations, the public was invited to review and comment at four workshop-style stations: 1) non-fire fuels management, 2) protection and monitoring of the environment, 3) pre-fire and resource advisor maps, and 4) an informational station about actions the public can do to protect themselves from fire.

Overall, the feedback from the public was overwhelmingly positive with appreciation expressed to the District for engaging the public early in the process of developing the Program. Multiple people expressed concern for fuel reduction locations or escape routes next to local communities (e.g. Grandview/Espinosa Community, Heather Heights, Redwood Estates, Blackberry Hill Community). Support was expressed about the intentional objectivity through the use of science for prioritizing fuel breaks as many people were unaware of the decision-making process. Some requested that work be conducted prior to completing the full Project analysis. Attachment 1 highlights and summarizes comments and feedback received at each station. This information will be used to further develop Program components as well as guide public outreach and education on wildland fire.

Board of Forestry and Fire Protection – California Vegetation Treatment Program (CalVTP)

On June 24, 2019, the California State Board of Forestry and Fire Protection released the CalVTP Draft PEIR for a 45-day public review and comment period, ending on August 9, 2019. The CalVTP identifies, among other treatment actions, prescribed burning (i.e. pile burning and broadcast burning). Staff from the Natural Resources and Planning Departments reviewed and commented on the proposed program. Comments included general support for the CalVTP and a request for two modifications to the Program: expansion of the geographic scope and the inclusion of an Invasive Species Biologist during project planning.

Of particular interest, the District may be able to tier off the Cal VTP and associated PEIR for future prescribed fire burns in conjunction with CAL FIRE, potentially affecting Program and CEQA work currently contracted with SIG and Panorama to complete. District staff is deferring some aspects of the prescribed fire portion of the Program until the CalVTP Final PEIR has been certified and adopted (anticipated in early 2020 if SB 632 (Galgiani) is signed by Governor Newsom, which specifies a February 1, 2020 deadline). Once the PEIR has been certificated and adopted, the District will analyze the current scope of work with SIG and Panorama to determine if the CAL FIRE program provides a full analysis and what, if any, additional environmental evaluation by the District is warranted.

Resource Management Policies (RMP) and Goals
The RMPs document defines the policies and practices used by the District to protect and manage resources on District lands. The word "resources", as used in this document, includes plants, animals, water, soil, terrain, geologic formations, historic, scenic, and cultural features. The RMPs comprise a "living" document that grows and changes regularly, based on new experience and information. It is reviewed and updated every five to ten years and chapters amended as needed to respond to ever-changing resource conditions (e.g. insect or disease out-breaks, large cataclysmic events, climate change etc.). A review of the RMPs by SIG and Panorama determined that the goals and components of the District's Program are generally supported by the RMPs.

SIG and Panorama also performed a detailed review of other relevant documents and policies, including external agency documents (e.g. CALFIRE) in collaboration with stakeholder organizations (e.g. Sierra Club, Amah Mutsun Tribal Band) to further inform the District's Program development. SIG and Panorama prepared a report, *Wildland Fire Resiliency Program-Resource Management Policies Analysis and Recommendations* (Attachment 2) which presents the methods and results (including a gap analysis) of the District's RMP review and provides recommendations for revised and additional policies that will support the overarching objectives and goals of the District Wildland Fire Resiliency Program. The primary recommended additions or modifications to the existing RMP policies and implementation measures that will support the new Program are:

- Create or augment existing policy to define and support programmatic planning efforts for wildland fire resiliency activities and the removal of regulatory barriers.
- Create or augment existing policy to acknowledge consideration of the adopted Community Wildfire Protection Plans for San Mateo and Santa Clara Counties, and the implementation of actions that are consistent with District practices.
- Add ecosystem resiliency to the Wildfire Management policies and a recommendation to identify acceptable levels of change to the environment that allow for establishment and maintenance of resiliency at the landscape level.
- Augment existing policies to incorporate the definition and importance of adaptive management and decision-making flexibility that responds to ecological feedback.
- Expand the focus of non-fire fuel management actions as a strategy to reduce fire risk.
- Add existing policy and implementation methods to acknowledge the need for new technology and tools to effectively support management methods.
- Add existing policy to address post-fire restoration and response.
- Allow for acceptable levels of visual change at the landscape scale resulting from fuels management actions under Scenic and Aesthetic Resource policies to protect from catastrophic biodiversity and aesthetic impacts resulting from large fire events.

- Add and modify Climate Change policies to allow for trade-offs between some upfront carbon sequestration loss and greenhouse gas emissions in exchange for fuel reduction projects, prescribed burns, and development of ecological resiliency to prevent large scale, catastrophic fires that would result in greater overall greenhouse gas impacts.

FISCAL IMPACT

Review of the draft policy changes and summary of community response has no direct fiscal impact. An explanation of future implementation costs will be presented to the full Board when the final Wildland Fire Resiliency Program is brought before them for consideration.

BOARD COMMITTEE REVIEW

No prior Board Committee review has occurred for this item. The full Board was provided an informational update on the Prescribed Fire Program in February of 2019 in which changes to the Project scope were discussed, resulting in Board approval to proceed with a more comprehensive Wildland Fire Resiliency Program (R-19-03). The Board approved amending the contract with SIG at the April 24, 2019 Board meeting (R-19-52), to provide fire ecology services and a detailed project description for the Program. The Board approved amending the contract with Panorama, at the May 22, 2019 Board meeting (R-19-69), to provide environmental review services for the Program.

PUBLIC NOTICE

Public notice was provided as required by the Brown Act. Public notice was also sent to the Resource Management and Wildland Fire interested parties list by postal or electronic mail.

CEQA COMPLIANCE

The District's existing RMPs were adopted in 2011 and evaluated in an Initial Study/Mitigated Negative Declaration. Updates to the policies may require additional CEQA evaluation, depending on the guidance provided by the Planning and Natural Resources Committee and direction provided the Board. Any further CEQA evaluation would be presented to and considered by the Board when it considers adopting changes to the Policies.

NEXT STEPS

Comments received from the open houses will be incorporated, where appropriate, into Program components, as well as guide public outreach and education on wildland fire. If supported by the Planning and Natural Resources Committee, the draft recommended RMP changes will be forwarded to the full Board for consideration, anticipated in Quarter 3 of FY2020. If the CalVTP Draft PEIR is certified and adopted, staff would issue a FYI to the Board or return to the PNR Committee to discuss how it affects the District's proposed Program. Staff will return to PNR in October of 2019 to discuss the Non-Fire Fuels Management Plan.

Attachments:

1. Public Comment Summary Report
2. Resource Management Policies Analysis and Recommendations
3. Comment Letters Received

Responsible Department Heads:
Kirk Lenington, Natural Resources Manager
Korrine Skinner, Public Affairs Manager
Matthew Andersen, Chief Ranger and Visitor Services Manager
Michael Jurich, Land and Facilities Manager

Prepared by:
Coty Sifuentes-Winter, Senior Resource Management Specialist, Natural Resources

Midpeninsula Regional Open Space District

MIDPENINSULA REGIONAL OPEN SPACE DISTRICT
PLANNING AND NATURAL RESOURCES COMMITTEE

Administrative Office
330 Distel Circle
Los Altos, CA 94022

Tuesday, September 24, 2019

2:00 PM

APPROVED MINUTES*

CALL TO ORDER

Chair Kishimoto called the meeting of the Planning and Natural Resources Committee to order at to order at 2:00 p.m.

ROLL CALL

Members Present: Jed Cyr and Yoriko Kishimoto

Members Absent: Karen Holman

Staff Present: General Manager Ana Ruiz, General Counsel Hilary Stevenson, District Clerk/Assistant to the General Manager Jennifer Woodworth, Natural Resources Manager Kirk Lenington, Senior Resources Management Specialist Coty Sifuentes-Winter

ORAL COMMUNICATIONS

No speakers present.

ADOPTION OF AGENDA

Chair Kishimoto reported the minutes would be discussed at the end of the meeting.

Motion: Director Cyr moved, and Chair Kishimoto seconded the motion to adopt the amended agenda.

VOTE: 2-0-0 (Director Holman absent)

COMMITTEE BUSINESS

Item 1 was heard after Item 2.

*Approved by the Planning & Natural Resources Committee on October 22, 2019

1. Approve the September 17, 2019 Planning and Natural Resources Committee Minutes

Motion: Director Cyr moved, and Director Holman seconded the motion to approve the minutes for the September 17, 2019 Planning and Natural Resources Committee meeting.

VOTE: 3-0-0

2. Wildland Fire Resiliency Program – Public Meetings and Resource Management Policy Update (R-19-127)

Senior Resource Management Specialist Coty Sifuentes-Winter provided the staff presentation describing partner, stakeholder, and public outreach and wildland fire resiliency program components. Mr. Sifuentes-Winter described the public outreach meetings held in communities throughout the District and feedback received at those meetings from members of the public and partner agencies, including proposed emergency evacuation routes, impacts on wildlife, and concerns raised regarding tree removal to reduce fire risk.

Director Holman arrived at 2:21 p.m.

Tania Treis, District consultant with Panorama Environmental, provided an overview of the policy review, including the purpose of the policy review, program objectives and goals, methods used, and a summary of recommended changes to the policies.

Mr. Sifuentes-Winter reviewed the proposed timeline for the project and the General Manager's recommendation.

Director Cyr commented that by having this program in place, the District will be better prepared to address wildland fires and their effects when they occur.

Director Holman requested additional information regarding the proposed scenic and aesthetic changes.

Ms. Treis commented the proposed policy changes would allow for limited scenic and aesthetic changes due to vegetation control for fuel management.

Director Holman suggested increased communication when fuel is cleared to alert the Board and members of the public to the change and the reasoning behind it. This includes when the District learns of clearances not on District land.

Director Kishimoto inquired regarding the number and size of fire breaks on District lands.

Mr. Sifuentes-Winter reported the District's fire break locations are often determined on an ad hoc or opportunistic basis using recommendations by District or other partner agency staff. The size of the fire break also depends on topography and vegetation. Mr. Sifuentes-Winter also commented that the program seeks to address the issue as a whole for the region including the need for fuel breaks on District land and neighboring properties.

Director Holman inquired regarding dynamic mapping of projects both on and off District lands.

GIS Data Analyst Nathan Grieg reported the District does maintain active maps of projects, and the District currently shares and receives data from other agencies. Currently staff is working to improve the sharing of data to create a more active and dynamic sharing environment.

Public comment opened at 2:59 p.m.

Karen Maki with the Sierra Club requested the District put a higher priority on carbon sequestration in order to combat climate change and reduce the occurrence of wildfires.

Public comment closed at 3:02 p.m.

Director Holman spoke in favor of placing a higher priority on carbon sequestration, including considering an incentive program to encourage grazing tenants to change feedstock to reduce methane production.

Natural Resources Manager Kirk Lenington reported staff has explored this issue as part of the Climate Action Plan, including carbon offsets for methane production. The District's current policy allows for other grazing options besides cattle, but there are no current operations for other grazing options on the San Mateo Coast.

General Manager Ana Ruiz noted that managing vegetation to reduce catastrophic fires and managing forests for increased carbon sequestration are addressed in Policy CC-3.

Director Cyr commented staff may further study carbon sequestration options and more information may come forward as the topic is studied further.

Mr. Sifuentes-Winter suggested additional monitoring of carbon emissions to help provide additional data on carbon sequestration.

Chair Kishimoto spoke in favor of highlighting the District's role in carbon sequestration in the preamble for the specific climate change policy.

The Committee members offered suggested edits and areas for clarification, which are outlined below:

- Fourth bullet in Policy WF-1: Work cooperatively with these groups to permit as appropriate installation and maintenance of new~~needed~~ infrastructure
- Second bullet in Policy WF-3: Implement fire clearance recommendations and defensible space on District-owned properties (e.g., residences owned by the District) adjacent to the preserves, as appropriate.
- Fourth bullet in Policy WF-8: *Add language related to use of dynamic mapping and sharing of information with partner agencies.*
- Fifth bullet in WF-8: *Clarify and clean up this bullet and separate into a few different ideas. Address dynamic and interactive mapping and data sharing as well as technology to monitor conditions on the watershed.*
- Fourth bullet in Policy CC-3: Improve data on carbon sequestration in District lands with a goal to pursue and maximize opportunities.

Motion: Director Cyr moved, and Director Holman seconded the motion to forward the recommended updates to the Resource Management Policies, as they relate to Wildland Fire, to the full Board of Directors for consideration with the addition and changes described by the Committee.

VOTE: 3-0-0

ADJOURNMENT

Chair Kishimoto adjourned the meeting of the Planning and Natural Resources Committee of Midpeninsula Regional Open Space District at 1:59 p.m.

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Jennifer Woodworth, MMC
District Clerk

Midpeninsula Regional Open Space District

Ecologically Sensitive Vegetation Management

Ecologically sensitive vegetation management is primarily focused on maintaining and improving high biodiversity and ecological health on the landscape.

The Midpeninsula Regional Open Space District's land management practices include vegetation management to improve native species habitat, maintain patrol routes and reduce wildland fire risk.

Midpen staff consider the following practices a each project site to minimize impacts and maximize benefits to natural resources when performing vegetation management in Midpen preserves:

- Conducting pre-management surveys for special status species and nesting birds
- Providing a biological monitor during work when needed
- Designate refugia for wildlife
- Leaving tree canopies intact
- Leaving buffers around special-status species' habitat
- Leaving buffers around bodies of water
- Seasonally timing work to decrease potential impacts to birds, bats and other wildlife
- Prioritizing the treatment of invasive species over native species
- Minimizing ground disturbance
- Minimizing the presence of people and mechanized/motorized equipment in wildlands during vegetation management
- Matching source material for nursery plants and seed to site specific requirements to maintain genetic diversity while taking climate change into account
- Consider the changing climate and its impacts to habitats
- Mowing in patterns that allow any wildlife present to easily and safely move away
- Mimicking natural disturbance processes to maintain rare habitats
- Avoiding the spread of invasive non-native species and disease with cultural controls such as cleaning boots and equipment prior to and after work

Midpeninsula Regional Open Space District

PLANNING AND NATURAL RESOURCES COMMITTEE

R-19-141
October 28, 2019

AGENDA ITEM 1

AGENDA ITEM

Wildland Fire Resiliency Program – Vegetation Management Plan

GENERAL MANAGER'S RECOMMENDATIONS

1. Review and provide feedback on the proposed Vegetation Management Plan, including the criteria to determine the location and prioritization for vegetation management areas.

2. Forward the proposed Vegetation Management Plan to the full Board of Directors for consideration of approval with any changes requested by the Committee.

SUMMARY

The Midpeninsula Regional Open Space District (District) is developing a Wildland Fire Resiliency Program (Program) to address the Board of Director's (Board) Fiscal Year (FY) 2019-20 Strategic Objective of working with fire agencies and surrounding communities to prevent, prepare for, and respond to wildland fires. Fire is a fact of life in California and the District's role is to manage open space lands for public safety and ecological health. District land is comprised of fire adapted and/or fire obligate vegetation. One of the best options for managing fire risk is to reduce fuel loads within the Wildland Urban Interface (WUI) and focus on vegetation management along evacuation corridors, populated areas, and areas adjacent to critical infrastructure. Due to past land uses, fire management practices, and disease (such as Sudden Oak Death), reducing fuel loads in certain habitats can make the ecosystem more resilient to wildland fire. Although fuel reduction does not necessarily stop fires from spreading, it may allow time for fire personnel to respond and for private residents in the WUI to evacuate.

A proposed Vegetation Management Plan (VMP) has been prepared to guide the District's ongoing vegetation management work. To complete the VMP, the District needs to establish criteria for locating and prioritizing vegetation management areas. At this meeting, staff will present the proposed VMP and the recommended criteria to the Planning and Natural Resources Committee (PNR) for confirmation. Once confirmed, staff will use this criteria and work with the consultant to locate and prioritize vegetation management areas that address public safety and ensure ecosystem resiliency. The prioritized vegetation management areas will be incorporated into the VMP, along with any amendments requested by the PNR, and forwarded to the full Board when they consider approving the CEQA project description for the Wildland Fire Resilience Program. Funding to implement the VMP would be requested as part of the annual Budget and Action Plan process starting in FY2020-21. The amount of work planned each year will be dependent on staff capacity, funding, and other resource availability, and will need to be balanced with other District priorities that further the mission, annual Strategic Goals & Objectives, and Vision Plan.

BACKGROUND

One component of the District's mission is to "protect and restore the natural environment" within Open Space Preserves (OSPs). Intense wildfires can be destructive to people, communities, and infrastructure, as well as to native plants and wildlife. Conversely, attempts to reduce or suppress wildfire can result in unintended impacts to habitats and decrease biodiversity. The District works with local fire agencies to manage vegetation and reduce fuels on District lands in San Mateo, Santa Clara, and Santa Cruz counties while protecting natural and cultural resources entrusted to the District by the public. Fuel management is the practice of removing or modifying vegetation to reduce the risk of wildfire ignitions, rates of wildfire spread, and fire intensity. Vegetation management to reduce fuels is a complex process that must balance the needs of human communities with natural resource protections.

The primary need for vegetation management for public safety is to reduce fuels that contribute to fire risks along critical roads that allow for ingress and egress, and to provide a buffer from which fires can be fought. In addition, fuel reduction helps to protect critical infrastructure and enable the District to be a good neighbor to adjacent private properties. Vegetation management to reduce fuels can also restore ecosystems by removing invasive plant species and/or dead and dense vegetation that has accumulated due in part to past fire suppression. In addition, impacts from forest disease (e.g. Sudden Oak Death) can be mitigated.

Current Vegetation Management for Public Safety
The District's Integrated Pest Management (IPM) Program allows the District to perform up to 450 acres of non-grazing[1] vegetation management to reduce fuels. The Board approved a transfer of 225 acres to the Fuel Management Category from other categories in July 2019 (R-19-90). Approximately 1,800 person-hours are annually set aside to maintain existing fuelbreaks within the IPM Program. Existing vegetation management work includes, but is not limited to:

- 55 acres of defensible space around District-owned, occupied buildings;
- 51 acres of disc lines; and
- 47 landing zones.

The location and priority of fuelbreaks on District land has at times lacked a strategic regional focus and prioritization, and has instead been largely based on historic practices initiated by prior owners and ad hoc requests from 12 separate fire agencies. As part of the work to develop a more strategic land management approach under the VMP, the District analyzed current vegetation management activities to identify gaps in vegetation management activities. This evaluation was guided by the assistance of outside consultants and input from partner agencies while being mindful of the changing climate and historic fire management (i.e. fire suppression).

Creation of the Wildland Fire Resiliency Program
The District entered into contract with two consultants, Spatial Informatics Group (SIG) and Panorama Environmental, Inc., (Panorama), to develop a Prescribed Fire Program in the summer of 2018 (R-18-72; R-18-120). Later that year, the Board approved a FY2019-20 Strategic Objective of working with fire agencies and surrounding communities to strengthen the prevention of, preparation for, and response to wildland fires. In response, District staff modified the original, narrow program focus (prescribed fire) to be more robust, strategic, and comprehensive, establishing the Wildland Fire Resiliency Program (Program) and

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[1] The Conservation Grazing Program encompasses 11,111 acres (or 18% of the preserves) with one objective to reduce fuel loads in grasslands.

correspondingly amended the contracts with SIG and Panorama (R-19-52; R-19-69). This broader Program encompasses the following four components (includes prescribed fire):

1. VMP (Attachment 1)
    a. Public Safety
    b. Ecosystem Resiliency
2. Monitoring Plan
3. Pre-fire Plan with Resource Advisor Maps
4. Prescribed Fire Plan

During the week of August 19, 2019, the District held public open houses in Half Moon Bay, Los Gatos, and Woodside with assistance from SIG, Panorama, CAL FIRE, and local fire agencies and firesafe councils. The objective of these meetings was to communicate the District's Program components and invite early public comments on its development. Multiple people expressed the desire for increased vegetation management locations and highlighted the importance of escape routes next to local communities (e.g. Grandview/Espinosa Community, Heather Heights, Redwood Estates, Blackberry Hill Community). Support was expressed about the intentional objectivity in using science to prioritize the location of vegetation management work based on the severity of wildfire risk.

On September 24, 2019, District staff presented to the Planning and Natural Resources Committee on the Program background and development. The Committee recommended several Resource Management Policy changes and areas for clarification, which included the following (Attachment 2; R-19-127):

- Add ecosystem resiliency to the Wildfire Management policies and a recommendation to identify acceptable levels of change to the environment that allow for establishment and maintenance of resiliency at the landscape level.
- Expand the focus of non-fire vegetation management actions as a strategy to reduce fire risk.

DISCUSSION

As many as 90% of wildland fires are caused by human activities, according to the U.S. Forest Service. Fire is a fact of life in California and everyone plays a role in living safely with it. The District manages open space lands for public safety and ecological health, while closely coordinating with local fire departments responsible for fire suppression. The community's role is to prevent wildland fire ignitions and protect private property (e.g. homes). Specific actions that local communities and residents can take include:

- Hardening homes against fire, creating defensible space, and having an evacuation plan (local fire safe councils provide resources);
- Signing up for county emergency alerts;
- Being aware of red flag warning weather when fire danger is highest and planning accordingly;
- Enjoying open space wildlands safely by following smoking, campfire and firearm bans, as well as other public safety rules; and
- Recreating safely while outdoors so emergency resources are available to respond to fires: staying cool, bringing plenty of water, or considering other fire-safe activities during fire weather events.

The proposed VMP focuses on what is referred to as "non-fire" vegetation management and is composed of two components: Public Safety and Ecosystem Resiliency. Only manual, mechanical, grazing, and limited chemical methods of vegetation management are considered in this plan. Prescribed fire to reduce fuel loads and for ecosystem resiliency will be described in detail in a separate Prescribed Fire Plan (anticipated in Spring of 2020).

At this time, District staff is requesting PNR Committee review of the proposed VMP and confirmation of the recommended criteria for locating and prioritizing vegetation management areas (Attachment 3). Once confirmed, staff will work with the consultant team to use criteria for locating and prioritizing vegetation management areas, including fuelbreaks. This information will then be incorporated into the VMP, along with any changes requested by the PNR Committee, prior to forwarding the VMP to the full Board for consideration as part of the CEQA project description for the Wildland Fire Resilience Program.

Public Safety VMP
The Public Safety VMP defines and prioritizes vegetation management activities (e.g. fuelbreaks, defensible space) on District land to reduce wildland fire risks, while also preserving biodiversity and minimizing environmental effects. Vegetation management for fuels reduction will not stop a fire from spreading, but may allow additional time for responding fire personnel to arrive on scene and engage the fire and/or allow private residents in the WUI to evacuate. The Public Safety VMP more specifically identifies the following:

- Vegetation/fuel types and fire regimes present on the preserves;
- Historical and current practices of vegetation management on the preserves;
- Types of vegetation management areas;
- Prioritization and location of vegetation management areas and projects;
- Planning process for undertaking vegetation management projects;
- Methods for creating and maintaining vegetation management areas; and
- Best management practices and environmental protection measures for vegetation management projects.

To create a fuelbreak, vegetation is managed to reduce the continuity of live and dead fuels both horizontally and vertically. Width varies depending on the presence of sensitive resources, the location of habitat transitions, slope, expected fire behavior, and features or infrastructure that need protection. The proposed VMP utilizes environmental analysis to prioritize vegetation management areas for public safety.

<u>Methodology for Locating and Prioritizing Public Safety Treatments Areas</u>
Wildland fire behavior is influenced by three main factors: weather, fuels, and topography. Vegetation management is intended to decrease the risk of extreme wildland fire behavior, slow the spread of a wildland fire, aid in the suppression of a wildland fire, and/or reduce the impacts of wildland fire should it occur. Fuel loads are the primary factor that the District can change to alter the behavior of a wildland fire. The proposed criteria to locate and prioritize vegetation management areas is described in detail within the proposed VMP, section 4.3.3: "Locations of New Vegetation Management Areas" and summarized below:

- Proximity to occupied Midpen structures, vulnerable populations, and along designated Midpen evacuation routes;
- Fire risk (based on CAL FIRE's map wide map) and field recommendation by professional fire staff;

- Proximity to critical emergency response infrastructure (e.g. communications tower, fire station, helicopter landing zone);
- Known presence of sensitive resources or diseases such as Sudden Oak Death where treatment would favorably benefit the resources; and
- Sites that are adjacent to other fuelbreaks or vegetation management areas and increase the effectiveness of work done on Midpen lands.

Ecosystem Resiliency VMP
Fuel Reduction Areas (FRAs) are locations where the density of fuels is manually or mechanically reduced and modified for habitat enhancement reasons, but not to the same extent as fuelbreaks. FRAs are less permanent than fuelbreaks and are typically implemented in more natural areas where modifications to the fuel load achieves a combination of wildland fire risk reduction and habitat enhancement goals. FRAs can be areas of managed vegetation adjacent to fuelbreaks and can also occur in areas where fuel loading is particularly problematic, such as areas affected by forest disease. The proposed VMP includes a maximum of 1,000 acres per year and no more than 5,000 acres every ten years of FRAs.

FISCAL IMPACT

The VMP will guide the implementation of vegetation management and treatment actions for both ecosystem resiliency and public safety by locating and prioritizing the work. The scheduling and timing of vegetation management and treatment actions will be dependent on annual staff capacity, funding, and other resource availability. The allocation of resources to complete this work will need to be balanced with other District priorities that further the mission, annual Board-approved Strategic Goals and Objectives, and Vision Plan.

The adopted FY2019-20 operating budget includes $140,000 for additional vegetation management for fire, not including ongoing annual vegetation management activities or staff time. Funding to implement the VMP would be requested annually and considered by the Board as part of the yearly Budget and Action Plan process.

BOARD COMMITTEE REVIEW

On September 24, 2019, the Planning Natural Resources (PNR) Committee received a presentation on the proposed approach for developing the Wildland Fire Resiliency Program and reviewed early public feedback on Program development, including the VMP (R-19-127).

PUBLIC NOTICE

Public notice was provided as required by the Brown Act. Notices were also sent to interested parties, including partner agencies, staff of elected officials, adjoining neighbors, and individuals with interest in Wildland Fires and Resource Management, by postal or electronic mail.

CEQA COMPLIANCE

District staff and consultants will perform a CEQA analysis of the VMP along with the other components of the Program after the Board has approved the project description.

NEXT STEPS

Comments received from the PNR Committee will be incorporated into the draft VMP, including any changes to the criteria that determine the location and prioritization of vegetation management areas. Staff working with the consultant team will use the PNR-confirmed criteria to determine appropriate locations and prioritization for vegetation management areas. Staff will then forward the revised VMP to the full Board when they consider approving the CEQA project description for the Wildland Fire Resilience Program to begin the CEQA review process. The revised VMP will include site specific maps showing potential treatment areas based on prioritization criteria.

Attachments:

1. Proposed DraftVegetation Management Plan
2. Planning and Natural Resources Committee Report, R-19-127
3. Criteria for Locating and Prioritizing Treatments Areas
4. Comment Letter Received

Responsible Department Heads:
Kirk Lenington, Natural Resources Department Manager, Natural Resources
Matthew Anderson, Chief Ranger and Visitor Services Manager
Michael Jurich, Land and Facilities Manager

Prepared by:
Coty Sifuentes-Winter, Senior Resource Management Specialist, Natural Resources

4 Vegetation Management Plan

4.1 Introduction and Purpose and Need

4.1.1 Background

The Midpeninsula Regional Open Space District (Midpen) has the goal of protecting the natural values in their Open Space Preserves (OSPs) while also protecting public safety. Fuel management is the practice of removing or modifying live and dead vegetation to reduce the potential spread of wildfire ignitions, overall rates of wildfire spread, flame lengths, and fire severity. In addition, vegetation management may aid in suppression of fires and reduce potential impacts and rehabilitation needs associated with fire suppression activities. Vegetation management may help make evacuation routes less prone to being directly impacted by wildfire. Vegetation management for fuels reduction is a complex process that must balance the needs of human communities with natural resource goals. Vegetation management may also be used to reduce dead fuels in areas affected by diseases such as Sudden Oak Death ("SOD"). The best locations for managing fire risk and reducing fuel loads using non-fire vegetation management methods on Midpen lands is to focus active management in the Wildland Urban Interface (WUI), along evacuation corridors, near developed communities, and adjacent to critical infrastructure.

4.1.2 Purpose and Need

Changing climatic conditions, past land uses, and years of fire suppression have increased fuel loads and fire-prone conditions that could contribute to larger more intense wildland fires. The highest priority for Midpen is public safety (both inside or outside the OSPs) for Midpen staff, firefighters, visitors and people in nearby communities, especially those in the WUI.

The primary need for vegetation management is to reduce fuel loads along critical roads that allow for ingress and egress and to provide a buffer from which fires can be fought. In addition, fuel reduction is needed to protect communities and other critical infrastructure near Midpen lands.

Vegetation management also helps to restore ecosystems closer to pre-fire suppression conditions through the removal of dead and accumulated vegetation and treatment of forest disease and invasive species. Prior to the mid to late 20th century, landscapes in the Bay Area were either managed through natural fire or through Native American practices of prescribed burning that kept fuel loads down. Prior to European contact, the spread of invasive species that alter ecosystems and increases fire risks was also much less of a concern.

The purpose of this Vegetation Management Plan (Plan) is to define the activities that Midpen will implement to increase vegetation management practices that reduce wildland fire risks, while also preserving biodiversity and minimizing effects on the environment. This plan identifies the:

- Historic regional vegetation and fire regimes;
- History of vegetation management on OSPs and current practices;
- Types of vegetation management areas that will be created;
- Locations and prioritization of vegetation management areas and projects;
- Planning process for undertaking vegetation management projects;
- Methods for creating and maintaining vegetation management areas; and
- Best management and environmental protection measures to be implemented during vegetation management projects.

The Plan focuses on what is referred to as "non-fire" vegetation management. Only manual, mechanical, grazing, and limited chemical methods of vegetation management are considered in this plan. Prescribed fire to reduce fuel loads and restore natural ecological processes in interior areas of OSPs, away from the WUI and other infrastructure, will be described in detail in the upcoming Prescribed Fire Plan (to be available in Spring 2020). Implementing vegetation management outlined in this Plan will expand on the work that already occurs by creating and maintaining various types of fuelbreaks, Fuel Reduction Areas (FRAs), and defensible space.

4.1.3 Overall Plan Structure

The plan will describe vegetation management work completed for public safety as well as treatments which may also enhance ecosystem resiliency. While there is some general overlap between methods used to create fuelbreaks, treatments created for public safety will be generally considered semi-permanent and maintained every 3-5 years (as needed). Those treatments created for ecosystem resiliency will be focus on general fuel reduction but not necessarily maintained on a regular basis.

Overall Plan Structure:

1) Fuel Treatments For Public Safety
    a. Permanent Fuelbreaks (Shaded, defensible space, landing zone, etc.)
    b. Maintenance every 3 to 5 years
2) Treatments for Ecosystem Resiliency
    a. Fuel Reduction Area
    b. Temporary
    c. Objective to make fire resilient forests by reducing fuel loads (disease)

Up to [To Be Determined after comments have been received from the Planning and Natural Resources Committee Meeting] acres of permanent fuelbreaks will be created and maintained. New fuelbreaks will be prioritized and established based on projected long-term staffing and financial resources to ensure Midpen will have the resources necessary for long-term fuelbreak maintenance and management. In addition, this Plan will allow up to 1,000 acres per year, but no more than 5,000 per every 10 years, of treatment in FRAs for ecosystem resiliency.

4.2 Vegetation Management History

4.2.1 Historic and Current Vegetation, Management and Fire History

Prior to European contact, Native American tribes actively managed vegetation within their communities and surrounding areas using prescribed fire. These fires were lit intentionally at various times of the year to enhance vegetation growth, facilitate food collection, and improve forage for animals they hunted. In addition, Native American tribes did not actively suppress lightning ignitions at a landscape scale, which resulted in those fires often burning for days, weeks, and even months, shaping the patterns of vegetation cover and composition over the centuries (Anderson 2005). A detailed fire history study was conducted in the Santa Cruz Mountains, San Mateo County, Huddart Park, and McGarvey Gulch. These studies found that fires burned redwood forests every 12 years, on average. There were intervals both shorter and longer (2-43 years) without fire (Stephens and Fry, 2005). These findings are consistent with studies that have documented extensive human and lightning caused wildfire burning in the state of California. In addition, the composition of the vegetation in the region was shaped by a variety of disturbance pressures including fire and grazing by large herds of ungulate animals.

The arrival of Europeans, including Spanish and Anglo settlers, dramatically changed the management of vegetation communities, particularly grasslands. Major changes included tilling the grasslands for crop production, logging, introduction of cattle herds from Europe, and reduced populations of native grazing animals. The introduction of nonnative plants and animals resulted in changes to grassland species composition from primarily perennial, native plant species to annual, nonnative plant species. Some nonnative species (invasive species) now compete with the native plants in the same ecosystems, reducing the abundance and diversity of native species.

Historic land use and management practices have resulted in higher fuel loads on and adjacent to Midpen lands. The policy of fire suppression has further exacerbated the issue, reducing biodiversity on Midpen land. Invasive plant species continue to spread to adjacent, undeveloped grasslands and other plant communities. Since the 1990s, SOD has infected oak woodlands, resulting in succession of habitats and increased fuel loads. Grasslands and oak woodlands are decreasing due to spread of brush and forest species. Coastal scrub and chaparral habitats are aging with minimal new growth. The understory of redwood and Douglas fir forests, and mature oak woodlands have been converted from low-density plants to denser, taller brush and young trees. Second-growth forests feature higher densities of smaller diameter trees than old growth forests.

Today, in the absence of fire for decades, in some areas both live and dead fuels have accumulated creating higher surface fuel loads, vegetation density, and varied species composition from what was seen prior to European contact.

4.2.2 Current Practices of Fuels Management

Midpen undertakes several actions and activities on their lands to prepare for fire season. The actions related to fuel maintenance and reduction include:

- Maintaining existing fuelbreaks in OSPs closest to people, including but not limited to Pulgas Ridge, Windy Hill, Sierra Azul, Saratoga Gap, and Monte Bello OSPs;
- Defensible Space clearing around 117 Midpen owned structures
- Maintaining hundreds of miles of fire roads; and
- Implementing over 11,000 acres of conservation grazing in part to manage fuels.

Midpen's Integrated Pest Management Program (IPMP), adopted in 2014 with addendum certified and adopted in January 2019, prescribes pest management activities on Midpen lands for a 10-year period covering five major categories of work, including vegetation management. Vegetation management prescriptions address vegetation management within the WUI and around structures to reduce the potential rates of spread and flame lengths of wildfires, particularly within treated areas. In addition, vegetation management may reduce the threat of wildfires that originate in and around buildings. This work is accomplished primarily through mechanical means, using handheld power tools or heavy equipment. The currently implemented treatments, methods, locations and acreages are identified in

Table 1. These treatments are implemented in grasslands, shrublands, forests, and agricultural land. While the IPMP allows for some degree of vegetation management for fuel reduction, it currently only covers maintenance of existing fuelbreaks and does not allow for construction of major new fuelbreaks or vegetation management areas. Table 2 summarizes the vegetation management projects conducted Midpen-wide in 2018.

Locations of existing fuelbreaks, defensible space, helicopter landing zones, and disc lines that have been maintained within the last 5 years are shown in Figures xx through xx in Appendix xx (figures and appendix to be added after PNR Committee review).

Table 1 Current IPM Treatments and Annual Application for Fuels Management

Treatments	Treatment Type	Treatment Method	Locations	Annual Application [a]
Grasslands: Annual mowing **Shrublands:** Thin brush and mow tall grasses, increase spacing between shrub clusters **Forests:** Limb up trees to a height of 8 to 10 feet, thin brush, and mow tall grasses **Agricultural land:** Mowing and brush thinning along roads, discing along borders of agricultural and rangeland properties, conservation grazing	Manual and Mechanical	Mowing and Cutting	Defensible space, fuelbreaks, emergency helicopter landing zones	136 acres[b]
		Discing and Cutting	Disc lines	75 acres over approximately 30 miles
	Chemical	Glyphosate Round-Up ProMax	Defensible space, disc lines, fuelbreak	2 gallons concentrate
			Defensible space	5.2 gallons concentrate over 14 acres

Notes:

[a] 1 percent increase annually in treatment is allowed with the value presented as the 2014 allowance.

[b] For 2019, an additional 225 acres of treatments was approved from other programs to increase the vegetation management capacity while this Plan as being prepared.

Source: (Ascent Environmental, 2014)

Table 2 Summary of Vegetation Management Projects District-Wide in 2018

Purpose	Acres		Total Area
	Foothills	Skyline	
Defensible Space	21.9	33.2	55.1
Landing Zones	6.5	5.3	11.8
Shaded Fuelbreak	36.8	22.7	59.5
Other Fuelbreak	--	14.4	14.4
Total	65.2	75.6	140.8

Source: (Midpeninsula Regional Open Space District, 2019)

4.3 Creation of New Vegetation Management Areas

4.3.1 Overview

Midpen would like to expand its ability to create and treat vegetation management areas and associated total acres per year. This section of the Plan identifies the types of high priority vegetation management areas and their locations.

Wildland fire behavior is influenced by three main factors: weather, fuels, and topography. Wind, temperature, and humidity are important weather variables used to predict fire behavior. The arrangement and type of the vegetation, amount and distribution of smaller-diameter fuels, and the ratio of live-to-dead material factor into how fuels affect wildland fire behavior. Slope and angle of sun exposure affects how a fire will burn. A north-facing slope supports lower fire activity than a south-facing slope but under very dry and windy conditions can burn with high intensities due to higher fuel loading found on these hillsides. Fires burn more rapidly uphill than downhill if sufficient vegetation is available. The steeper the slope, the faster the fire travels in the uphill direction.

Vegetation management is intended to decrease the risk of extreme wildland fire behavior, slow the spread of a wildland fire, aid in the suppression of a wildland fire, and/or reduce the impacts of wildland fire should it occur. Fuel loads are the primary factor that Midpen can change to alter the behavior of a wildland fire. Dead vegetative material on the ground surface, referred to as surface fuels, can be removed.

Generally, vegetation management techniques involve reducing vegetation. Shrubs, small trees, and grass that can act as fuel ladders, allowing a surface wildland fire to travel up into the tree canopy, can be removed, reduced in density, or cut back/mowed. Grasses can be mowed or grazed to manage fuel loads. Small trees and shrubs can be thinned with the aim of leaving larger diameter trees, often having thick fire-resistant bark. The key management areas are fuelbreaks, defensible space, and FRAs. Fuelbreaks and defensible space would be regularly maintained, whereas FRA's would be implemented, then maintained as needed based on field inspections from qualified staff and/or consultants.

4.3.2 Types of Vegetation Management Areas

Overview

This section describes the types of Vegetation Management Areas that comprise the Vegetation Management System for public safety and/or ecosystem resiliency. Vegetation Management Areas for public safety require periodic maintenance to operate as intended. If not regularly maintained, the level of effort and cost required to re-establish the desired conditions begins to approach that of new construction. Developing design standards and dimensions for Vegetation Management Areas are part of Midpen's strategy to reduce the intensity of wildland fire.

Types of Vegetation Management Areas for Public Safety:

1) Fuelbreaks

Definitions

Fuelbreaks are wide strips of land where trees, vegetation, and dead material have been reduced or removed. These areas can slow, and even stop, the spread of a wildland fire because fewer fuels are present to combust. These areas also provide firefighters with zones to take a stand against a wildland fire, or retreat from fire if the need arises. For the purposes of this Plan, fuelbreaks encompass a range of fuel reduction intensities, depending on the resources being protected and the ecological setting.

Terminology:
Fuel Types

1-hour fuels: very fine fuels (such as needles and leaves) that are easily ignited and burn quickly. Less than 0.25 inch in diameter.

10-hour fuels: larger, less combustible fuels (such as small branches and woody stems). These can readily carry fires when moisture is low. From 0.25 to 1.0 inch in diameter.

100-hour fuels: typically twig and branch material from 1.0 to 3.0 inches in diameter

1,000-hour fuels: larger limbs and tree boles that are greater than 3.0 inches in diameter, and classified as "sound" or "rotten"

Ladder fuels: shrubs or other vegetation that can be ignited at or near the ground level and carry fire into the branches of adjacent trees.

Typically, fuelbreaks are strategically located considering terrain, existing roads, communities, infrastructure, evacuation routes, vulnerable populations, and sensitive resources. Future fuelbreaks on Midpen land will generally be located along primary and secondary roads, around critical infrastructure, and adjacent to communities. Fuelbreaks can vary in width from approximately 15 feet around minor ingress and egress routes to up to 200 feet around major routes of travel or associated with regional vegetation management treatments. Additional areas can be included near fuelbreaks as FRAs, as described below. Fuelbreaks can reduce fire intensity and severity. They typically do not stop fires without fire department response and regardless of fuelbreak size, extreme fire weather, fire behavior or other confounding scenarios (e.g. multiple ignition events) can carry fire over or through fuelbreaks. Alternative means to protect homes, such as home hardening, are important for individual landowners to implement.

Table 3 Fuelbreak Widths by Habitat Type

Habitat Type	Fuelbreak Width (feet)	Fuel Reduction Areas Width (feet)
Grass	100	100
Shrub	100	200
Oak woodland	200	150
Redwood or Douglas-Fir forest	200	200

Fuelbreaks function as potential anchor points to control lower intensity fires, flank higher intensity fires, and provide firefighter safety. Vegetation is managed to reduce the continuity of live and dead fuels both horizontally and vertically in fuelbreaks

a. Shaded Fuelbreaks

A shaded fuelbreak is an area where the tree canopy is thinned to reduce the potential for a fire to move quickly through an area and/or to reduce fire spread into or through the canopy. Enough tall tree canopy is retained to maintain shade, reduce the potential for rapid re-growth of shrubs and sprouting hardwoods, and minimize erosion. Ladder fuels and woody understory vegetation are thinned out. A shaded fuelbreak can be created manually or by using heavy equipment. Shaded fuelbreaks require follow-up maintenance. Maintenance of shaded fuelbreak along roads includes annual mowing in grasslands adjacent to the road, clearance of brush and dead vegetation, and removal of ladder fuels to the canopy in forested areas. Shaded fuelbreaks included in this plan may be up to 200 feet wide. Width varies depending on the presence of sensitive resources, the location of habitat transitions, slope, expected fire behavior, and the features or infrastructure that need protection.

b. Non shaded Fuelbreaks

A fuelbreak without shade is used in areas without a tree canopy, typically at a change in vegetation type, such as from forest or shrubland into grassland. Non-shaded fuelbreaks include swaths of land where there is no vegetated canopy, such as a grassland. Since an opening is essentially cleared to create a non-shaded fuelbreak, heavy equipment is typically used for construction, except on steep slopes, where manual treatments are employed. Non-shaded fuelbreaks are most often maintained in grasslands or shrublands versus wooded areas, although they can be implemented at a transition, particularly near homes (see figure x1).

Figure x1. A non-shaded fuelbreak (orange outline) implemented between homes and dense trees on El Granada Boulevard in San Mateo County to reduce the risk of wildfire spread.

Before After

c. Ingress/Egress/evacuation routes

Due to limited resources, challenging terrain, and/or variable vegetation patterns, it is not always possible to maintain fuelbreaks at an optimal width related to flame length along all routes on Midpen lands. An Ingress/Egress Fuelbreak is a 10-30-foot zone located on both sides of those roads identified as critical for emergency vehicle passage, typically accommodating a smaller Type 3 Wildland Fire Engine. Vegetation management in this zone improves access and reduces radiant heat during a wildland fire, allowing improved fire fighter access during a wildland fire. Ingress/Egress Fuelbreaks are typically cleared of all understory vegetation for the 10 to 30 feet from edge of the road on either side and then mowed annually.

d. Disclines

Disclines are a type of mechanical vegetation treatment that utilize an agricultural cultivator attachment for a tractor to cut and overturn many parallel small trenches in the soil 6 to 12 inches deep. By turning over the soil and leaving mostly a dirt surface, a discline is intended to slow or stop progression of a fire. A discline is typically placed along the perimeter of undeveloped land, ranches, and roadways. There are potential impacts to ground dwelling species as well as erosion and invasive species consequences to disclines. Given this, they are only installed in limited locations after a thorough evaluation of benefits and consequences. Disclines have been previously documented to stop ignitions on Midpen lands (Figure x2)

Figure x2. Photo of a fire originating from a powerline that was stopped due to an existing discline.

2) Defensible Space

Defensible space is the area immediately surrounding a structure, parcel, development, neighborhood, or community where vegetation management measures to reduce fuels are implemented, providing the key point of defense from an approaching wildfire, or defense against escaping structure fires. This zone is an area where fuel loads are reduced within 100 feet of the structure or parcel, comprised of three zones. Zone 0 removes all vegetation within 5 feet of occupied structures and allows non-flammable hardscaping or similar techniques. Zone 1 involves removal of all dead matter and dense fuels within 30 feet of occupied buildings, decks, and other structures. Zone 2 involves mowing, removal of ladder fuels, and thinning of vegetation extending from 30 to 100 feet out from buildings and structures (California Government Code 51182, and Public Resources Code Sections 4290 and 4291). Midpen has developed a Defensible Space Permit Program and Clearing Guidelines for adjacent property owners, tenants, homeowners' associations, educational institutions, civic groups and other organizations to create defensible space on Midpen land surrounding their homes and other qualifying structures. Defensible space surrounding Midpen-owned structures is maintained by Midpen and/or their tenants.

Manual and mechanical clearing of flammable vegetation to provide defensible space will occur on an annual basis around an estimated 117 structures by Midpen staff and/or by residential, commercial or agricultural/rangeland tenants. Along the perimeter of Midpen lands, additional vegetation treatment may be required by other agency regulations or ordinances (e.g. Woodside Fire Protection District's Perimeter Property Line Clearance: 2016 CFC sec 304.1.1.A). Defensible space of private property, including private homes located adjacent to Midpen lands, is the responsibility of the person that owns, leases, controls, operates, or maintains the building or structure.

3) Existing Grazing Management Areas

Midpen manages approximately 11,000 acres under its current Conservation Grazing Program. Midpen uses conservation grazing to manage vegetation (flammable vegetation) for fire protection; enhance the diversity of native plants and animals; help sustain the local agricultural economy; and foster the region's rural heritage. More about Midpen's grazing program can be found here https://www.openspace.org/our-work/resource-management/grazing

4) Emergency Staging Areas and Emergency Helicopter Landing Zones

Emergency staging areas are key areas during a fire where fire suppression resources may safely park, gather crews, or land a helicopter during a wildland fire. In addition, staging areas may serve as a temporary refuge area during a wildland fire. Sites that are proposed to be designated as emergency staging areas include an additional 200 feet of shaded and non-shaded fuelbreaks surrounding existing parking areas, landing zones, and lookouts. Emergency helicopter landing zones are maintained annually or bi-annually via mowing with a tractor or brushcutter at 47 locations on Midpen lands.

Types of Vegetation Management Areas for Ecosystem Resiliency:

1) **Fuel Reduction Areas**

Fuel Reduction Areas (FRAs) are locations where fuels are manually or mechanically removed but not to the same extent as fuelbreaks. FRAs are less permanent than fuelbreaks and are typically implemented in more natural areas where fuel load reduction achieves a combination of wildfire risk reduction and habitat enhancement goals. FRAs can be areas of managed vegetation adjacent to fuelbreaks and can also occur in areas where fuel loading is particularly problematic, such as areas affected by forest disease. FRAs could be used in oak woodlands adjacent to a non-shaded fuelbreak where understory fuels and over-topping conifers, such as Douglas fir, are removed or in grasslands where shrubs are removed. Fuel ladders and surface fuels are greatly reduced, and overstory and understory vegetation is spatially separated so that a ground fire will not, under normal fire conditions, burn too hot and/or climb into the canopy and turn into a crown fire.

4.3.3 Locations of New Vegetation Management Areas

Methodology for Locating Potential Fuel Management Areas for Public Safety

The following criteria will be used to identify the locations of potential new fuel management areas on Midpen lands. Areas classified as "water" or "wetland" are excluded from treatment:

a) Adjacent to or near existing or planned fuels treatment areas;
b) Identified by Midpen or other fire management or vegetation management professional staff as important areas for fuels treatment;
c) Up to 300 feet from vulnerable populations (school, hospital, nursing home);
d) Up to 100 feet from existing occupied Midpen buildings;
e) Up to 200 feet from emergency response infrastructure (communications tower, fire station, police station, medivac location, evacuation center, critical water infrastructure, such as storage tanks and pumps for fire suppression);
f) Up to 200 feet from a designated expanded fire response/fire monitoring clearing zone (safety zone, parking area, staging area, helicopter landing zone, lookout);
g) Within 200 feet of sensitive resources or other Midpen High Value Asset that would benefit from and/or respond favorably to treatment or at risk of loss in the event of a wildfire;
h) Within 200 feet of a designated Midpen evacuation route;
i) Within 10-25 feet (depending on flame length) of primary Midpen designated emergency access roads accessible by a Wildland Type 3 fire engine; and

j) Areas that enhance the ability to efficiently conduct fire suppression by providing infrastructure (e.g. staging areas, disc lines) and ingress/egress of fire suppression equipment.

Methodology for Prioritizing Vegetation Management Areas for Public Safety

Prioritization is established by assigning points for each of the following factors. The areas with the most points (up to XX) receive the highest priority ranking. Prioritization of vegetation management areas that are currently in the Conservation Grazing Program will be reduced by 1 point recognizing the beneficial reduction of fuel loads that results from grazing activities.

- Within 300 feet of vulnerable populations (schools, hospitals, nursing homes);
- Within 300 feet of designated Midpen evacuation routes;
- Within 100 feet of designated occupied Midpen buildings;
- Within 300 feet of critical emergency response infrastructure (communications tower, fire station, police station, medivac location, pre-planned Incident Command Post, evacuation center);
- Within 300 feet of Midpen designated fire response/fire monitoring clear zones (safety zone, parking area, staging area, helicopter landing zones, Lookout);
- Vegetation treatments identified in the field by professional fire staff;
- Within 300 feet of sensitive resources that would benefit from and/or respond favorably to treatment;
- Within 500 feet or adjacent to current and planned fuel management treatments;
- Within high fire risk areas - CALFIRE Very High, Santa Cruz High C-Fire M-Fire;
- Within 1,000 feet or adjacent to current and planned fuel management treatments;
- Within 300 feet of other high value assets or potential treatment areas identified by Midpen staff (including strategic regional fuelbreaks and cooperative efforts with neighboring property owners); and
- Within 200 feet of sites designated as having SOD Midpen data.

The fuelbreak prioritization criteria will be integrated into a Geographic Information Systems (GIS) along primary and secondary public, paved roads, around critical infrastructure, Midpen infrastructure, and adjacent to communities in the WUI, focusing on the Very High Fire Hazard Zones. Initial fuelbreaks are mapped per the "Methodology for Locating Fuels Treatments for Public Safety". Fuelbreaks are assigned as shaded, non-shaded, or ingress/egress fuelbreaks with a maximum width indicated in the GIS. FRAs are also identified in each fuelbreak, where applicable for each OSP, as are existing and any new areas of defensible space.

Methodology for Locating Potential Fuel Reduction Areas for Ecosystem Resiliency

The location of new FRAs on Midpen lands are confined to native forests or woodland areas of at least 100 acres in size. Areas classified as "water" or "wetland" are excluded from treatment.

Methodology for Prioritizing Fuel Reduction Areas for Ecosystem Resiliency

Prioritization is established by assigning points for each of the following factors. The areas with the most points (up to X) receive the highest priority ranking.

- Within 300 feet of sensitive resources that would benefit from and/or respond favorably to treatment;
- Within high fire risk areas (Priority zones: CALFIRE Very High, Santa Cruz High C-Fire M-Fire);
- Within 500 feet of points designated as having mortality due to forest disease, such as SOD;
- Identified by Midpen or vegetation management professional staff as important areas for fuels treatment for ecosystem resiliency;
- Where past land use history has increased the number of trees per acre to unnatural conditions;
- Identified as an area for prescribed fire for natural resource benefits;
- Promotes late-seral habitat conditions; and
- Site is experiencing vegetation encroachment that is changing the fuel regime or converting the vegetation type.

Mapping and Description of New Vegetation Management Areas

The Vegetation Management Plan for Public Safety covers a maximum of up to [To Be Determined after comments have been received from the Planning and Natural Resources Committee Meeting] acres, or approximately [To Be Determined after comments have been received from the Planning and Natural Resources Committee Meeting] percent of the OSPs. In addition, the Vegetation Management Plan for Ecosystem Resiliency will allow up to 1,000 acres per year, but no more than 5,000 per every 10 years, of treatment in FRAs. The entire vegetation management system is shown in a series of figures in Appendix A. The following table summarizes the acreage and characteristics of the prioritized vegetation management areas in the overall system by OSP. Given the size of the proposed system, in any given year, only a subset of the system will be built and maintained based on annual staff capacity, funding, and other resource availability. A discussion of the prioritization and the annual planning requirements are presented in the following section.

Figure 1 CalFire Fire Hazard Severity Zones ***(To be updated with appropriately scaled map for Midpen Owned Lands)***

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Table 4 summarizes the acreage of Vegetation Management Areas by type as well as existing Midpen treatments by OSP. See Appendix A for proposed treatment areas by OSP.

Table 4 Vegetation Management Areas by Preserve

Preserve Name	Treatment Category	Ingress/Egress Fuelbreaks (Acres)	New Non-Shaded Fuelbreak (Acres)	New Shaded Fuelbreak (Acres)	New Fuelbreak Total (Acres)	Existing MROSD Treatment (Acres)

4.4 Cyclical Maintenance of Non-Fire Vegetation Management Areas

4.4.1 Overview

Vegetation management to maintain fuelbreak function is performed as it is needed to keep the fuelbreak functional over time. The time between treatments depends on how fast the vegetation in the fuelbreak grows, if invasive species colonize the disturbed area (2014 IPMP CEQA and 2019 IPMP Addendum), the likelihood of an ignition and fire spread, and/or the proximity to buildings and other high value assets. For example, areas such as defensible spaces around structures with grassy fuels, or ingress/egress road corridors with rapidly growing woody weeds, need to be treated annually. Similarly, areas adjacent to picnic facilities also require frequent maintenance. Cyclical maintenance is performed using combinations of different treatment techniques to ensure that the maintenance work is efficient and performed in a timely manner while minimizing ecological impacts. Techniques include a combination of cutting with heavy equipment, mowing, and/or hand tools as well as onsite mastication, mulching, and pile burning. Some chemical methods may also be used in limited circumstances. These techniques are described in detail in Section 4.6.

4.4.2 Maintenance Strategies for Vegetation Management Areas

Vegetation Management Areas Maintained by Midpen

The maintenance requirements of Midpen's vegetation management system (fuelbreaks, defensible space, and FRAs) is related to the structure and composition of the vegetation retained within and surrounding it. Fuelbreaks with large numbers of perennial, fast-growing weeds in or adjacent to them require more frequent maintenance than those without. Should invasive species take hold in fuelbreaks, they can compromise surrounding natural areas by serving as a seed source for invasive species that may spread.

Fuelbreaks, defensible space, and FRAs areas that border or traverse largely intact ecosystems still dominated by native species can be maintained with low-intensity brushing, performed as needed based on field inspections. Frequency of maintenance can vary from annual for fuelbreaks in grass-dominated vegetation types, to approximately once every 3 to 10 years depending on vegetation type, the fuel conditions, and their regrowth. Disposal of brush material is minimal when larger material (e.g., trees and limbs) is chipped or sectioned and scattered on-site. Fuelbreaks bordering intact ecosystems will likely be absent of invasive species or show signs of persistent but small populations of perennial weeds. In intact ecosystems, the likelihood for the spread of invasive species into surrounding areas is not a significant concern; however, these fuelbreaks will be treated annually with Early Detection Rapid Response (EDRR) through the IPMP to detect and remove any invasive species that arise.

Fuelbreaks and defensible space areas that are bordered or traversed by degraded ecosystems dominated by weeds need a different and more intensive maintenance prescription to reduce the spread of weeds in the fuelbreak and into surrounding areas. Fuelbreaks with non-native species are maintained with annual brushing of the fuels and dominant weeds; disposal of brush is accomplished via chipping, pile burning, or hauling. Invasive species treatment is addressed in Midpen's IPMP. The types and methods of invasive species treatment are stipulated in the IPMP and IPM EIR. The IPMP, however, does not address the acreages of mowing and the quantities of pesticides needed for fuelbreak maintenance. The acreages treated and quantities of pesticide needed to address fuelbreak creation and maintenance are therefore included in this plan and discussed under **Section 4.6**.

Midpen mows 135 miles of roadside to eliminate weeds and unwanted vegetation and allow access for Type 3 Wildland Fire Engines. These activities will continue on an annual basis, as defined in the IPM and covered under that plan.

Fuelbreaks Maintained by Others

Fuelbreaks completed by other individuals or entities may or may not be on lands owned by Midpen. An outside party, such as private landowners, owners of leases or easements, NGOs, or public landowners, retain the responsibility to maintain these fuelbreaks.

Three types of private landowners adjoin Midpen lands: (1) those who have existing assets (i.e., properties or structures) within 300 feet of Midpen boundaries and are within a fuelbreak, (2) those with existing assets within 300 feet but are not within a fuelbreak, and (3) those who have no assets within 300 feet but could propose a new fuelbreak within 300 feet. The burden of pre-fire actions to protect assets from wildfires rests with the residents or private landowners.

Midpen enters into lease and easement agreements with communication and utility companies that have facilities on Midpen land such as Pacific Gas and Electric Company (PG&E) that have infrastructure (e.g. powerlines or water tanks) on Midpen land. Easements are typically managed by the easement holder, with Midpen having limited input on the location, timing, and intensity of vegetation management pursued under that easement by the easement holder. For leases, the responsibility of vegetation management to help protect private assets lie with the leaseholder, and the requirement for vegetation management and defensible space are written into the lease or lease renewal. In all cases, the leaseholder's vegetation management activities must be reviewed and approved by Midpen to ensure that they meet standards for fuel reduction, natural resource protection, and other policies.

Many fuelbreaks along the perimeter of OSPs span ownership boundaries and are jointly managed by adjacent public and/or private landowners, or private entities. For example: Midpen would manage one side of the road while the adjoining landowner(s) manages the other side, even though the property line may not exactly follow the road. Midpen and its adjoining land owners would continue to rely on existing relationships and communication to maintain effective management of these areas.

4.5 Prioritization and Annual Planning

4.5.1 Priorities and 5-Year Plan

Midpen's objective is to create and maintain up to 1,000 acres of fuels management areas annually, depending on funding sources and availability of work crews. The work is discretionary, and projects can be chosen dependent on available funding based on the Plan priorities.

The initial 5 years of target work is identified in Chapter 8: Five Year Target Plan. Projects identified in the Five-Year Target Plan include maintenance of existing fuelbreaks and vegetation management areas and new, critical or high priority vegetation management work, based on wildland fire risk, proximity to the WUI, and efficient use of resources/accessibility (e.g. roadside clearance). Priority projects are summarized in the table below. It should be noted that new land is added to Midpen's landholdings periodically. Vegetation management areas may need to be added as new lands are acquired, following the guidelines presented in Section 4.3.3.

Table 5 Priorities for New Vegetation Management Areas

Preserve Name	Treatment Category	Limited (Acres)	Minor (Acres)	Moderate (Acres)	High (Acres)	Critical (Acres)	Total Acres

4.5.2 Annual Reporting

Annual reporting will occur: 1) to confirm the projects identified in the upcoming Five-Year Target Plan and 2) to make modifications as needed using adaptive management strategies. See Chapter 7 for more information on the monitoring and annual planning efforts.

The Annual Vegetation Management Report will describe the vegetation management activities undertaken the previous year. The draft Annual Vegetation Management Report will be prepared by the appropriate Vegetation Management or staff Coordinator. The final report will be presented to the General Manager for approval. The report will then be forwarded to the Board of Directors for review.

At a minimum, the Annual Vegetation Management Report will include the following basic information:

- A summary of the areas treated for the year by vegetation treatment category, including habitat type, acreages, and methods used by type of control (mowing, brushcutting, pulling, flaming, herbicide, etc.). A cost per acre will be provided for major treatment types.
- A qualitative assessment of effectiveness of Midpen's Vegetation Management Program, and suggestions for increasing future effectiveness. This assessment will

be based in part on follow up discussions with staff, contractors, and stakeholders involved in the overall vegetation treatment process

- A summary of pesticide use (e.g., herbicide application within a fuelbreak, insecticide use within an FMA), active ingredient (e.g., glyphosate, imazapyr) or pesticide formulation (e.g., Roundup ProMax™) used. This information would also be presented in the annual IPM report.
- A brief summary of public notifications, inquiries and responses about vegetation management on Midpen lands;
- Assessment of compliance with the Vegetation Management Plan including:
  - An evaluation of the effectiveness of any changes in practices that were implemented in the past 12 months.
  - A description of any experimental vegetation management projects (test studies) and the results, including a cost/benefit analysis.
  - Suggested changes to the program or the vegetation management practices proposed for adoption within the next 12 months, including:
    - Any changes in acreages, focus habitats, or areas to be treated to adapt to changing conditions; and
    - Any changes in methods or funding.

Vegetation Management Methods

4.5.3 Vegetation Management Toolbox

Manual, mechanical, grazing, and chemical approaches will be used to manage vegetation. Table 6 identifies the treatment actions and estimates for vegetation management, including creation and maintenance of vegetation management areas. Midpen will also employ a series of BMPs for each management activity undertaken. Each application will be once per year. Pesticides allowed are only those identified in the IPM EIR (Ascent Environmental, 2014), or subsequently approved by Midpen through an addendum process. Additional pesticides that are approved through this process could also be used under this plan in the future to assist with vegetation management area creation and/or maintenance.

Table 6 Vegetation Management Area Treatment Actions and Estimates

Treatment Type	Treatment Method	Method of Application	Purpose	Annual Application	Timing of Work
Manual and Mechanical	Mowing & Cutting	Tractors, brushcutters, chainsaws, chippers, masticators, jawz implement, pole pruner	Removal of vegetation for defensible space and fuelbreak creation		April through November, (may continue into fall, weather and resource dependent)

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	Discing & Cutting	Tractor-pulled Instrument, pole pruner	Discline creation	April through July
Mechanical	Flaming	--	Invasive species treatment in fuelbreaks	--
	Mowing	Tractors, mowers, or brushcutters	Invasive species treatment in fuelbreaks	--
Chemical	Glyphosate Round-up Promax	Cut-stump	Removal of native stumps for defensible space, fuelbreaks, and discline creation; Invasive species or SOD removal	April through June
		Spot spray	Creation of defensible space	April through June
	Clethodim	Spot spray	Invasive plant control in vegetation management areas	Spring/summer
	Aminopyralid	Spot spray	Invasive plant control in vegetation management areas	Spring/summer
	Clopyralid	Spot spray	Invasive plant control in vegetation management areas	Spring/summer
	Imazapyr	Spot spray	Invasive plant control in vegetation management areas	Spring/summer

	Imazapyr	Cut-stump	Invasive plant control/SOD in vegetation management areas	Spring/summer
	Phosphite	Spraying or injecting	SOD in vegetation management areas	Spring/summer
	Triclopyr BEE/TEA	Spot spray	Invasive plant control	Spring/summer

4.5.4 Treatment Types and Methods

Manual

Manual methods using power and non-powered hand tools to implement the VMP will be consistent with those described in Midpen's IPMP and focused on vegetation management system creation and maintenance. Non-powered hand tools used for cutting are most commonly loppers, hand pruners, hand saws, and hatchets, and may also include pulaskis, machetes, brush hooks, and brush axes. Common powered hand tools include chainsaws and brush cutters. Vegetation management tasks include lopping, pruning, and girdling trees or large single-stem shrubs. Push mowers, leaf blowers, and weed-whips are also used.

Tasks where manual treatments are implemented include lopping and pruning. Hand tools are used in virtually all management areas to perform fine-scale tasks and finish work following use of heavy equipment. Invasive species may be encountered during creation of the vegetation management system. Handling of invasive species is covered under this plan, and methods will be consistent with the IPMP. For herbaceous weeds, without viable seed heads, or woody weeds with small diameter twigs, the slash is scattered on-site. Larger diameter woody material or very large volume of seedless herbaceous material may be piled for burning. State-regulated noxious weeds with viable seeds, including goatgrass and starthistles, are bagged and either solarized on-site or landfilled off-site. Vining weeds, such as periwinkle and cape ivy, may be bagged and landfilled off-site or piled between tarps and solarized to prevent re-rooting while the vegetation decomposes.

Mechanical

Mowing and brushcutting are the primary categories covered under mechanical removal. Motorized heavy machinery is mounted with various mowing, mulching, chipping, and masticating heads for larger scale vegetation removal projects and cyclical maintenance tasks. Grass is typically mowed with tractors. Heavy, diesel-powered equipment includes excavators, backhoes, skid-steers, and tracked chippers, and tractors. Powered hand tools are also used, including brushcutters (metal blade), string trimmers (monofilament plastic line), and chainsaws, and 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. Ground crews of 3 to 15 persons with brushcutters and chainsaws work where heavy equipment cannot reach, generally more than 30 feet from a road edge and on slopes exceeding 30 percent. Chainsaws are used to limb or remove individual trees or shrubs. Brush-cutters are used where stem diameters are less than 5 inches at cut level or the vegetation is predominately herbaceous. Cutting of herbaceous vegetation, including grasses and very young seedlings, is done with string trimmers.

Motorized heavy machinery are mounted with various mowing, mulching, and masticating heads for larger scale vegetation removal projects and cyclical maintenance tasks. Heavy, diesel-powered equipment used by Midpen includes excavators, backhoes, skid-steers, and tracked chippers. Equipment operates both on-road and off-road. Any equipment used off-road is track-mounted to minimize soil disturbance and compaction. The mowing or grinding heads and chippers reduce material to a size that does not require pile burning. Articulating arms are used to extend reach both outward and up so equipment can primarily stay on existing roads. A backhoe or excavator may push or pull down individual small trees (less than 10 inches diameter at breast height or DBH) either with the arm or with a cable or chain attached to the arm.

Heavy equipment is typically transported to an access point along an existing service road. Use of heavy equipment is generally restricted to sites with 30 percent slopes or less and to unsaturated soils. To maintain public safety, road guards, signage, and temporary closures are used when equipment operates in close proximity to recreational roads and trails.

A masticator is a high-rotation drum with fixed teeth mounted on the hydraulic arm of an excavator that pulverizes vegetation. A masticator is used primarily for fuelbreaks, but also sometimes for brushing around structures, roads, parking lots and brush removal in grasslands. The masticator cuts vegetation ranging from grass to 6-inch diameter trees and can reach up to 22 feet horizontally. Masticators leave behind mulch and pieces of shattered wood up to approximately 12 inches long and can require, depending on vegetation, follow-up use of chainsaws by field staff. Use of a masticator is limited by terrain and soil moisture (i.e. soft ground).

Mulch material includes on-site brush, tree limbs, or imported material. It is accomplished with masticating heads attached to excavators or skid steers and with tracked chippers fed by the material generated by hand crews as they thin dead or diseased vegetation. Mulching involves the spreading of ground-up woody material—generally wood chips, but sometimes shredded bark or compost—over an area to reduce weed prevalence, suppress resprouting woody species, and increase soil moisture.

Chipping is another method of biomass disposal that uses a chipper to reduce branches and other woody material to chips (usually 1 to 2 inches long and less than an inch thick). 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. Chipping differs from mulching in two ways: chips are generally larger in size than mulch and are dispersed widely and shallowly with no intent to smother or suppress vegetation. Chips generally should not be piled more than 4 inches deep in most instances, and should not be placed in drainages, grasslands, or against tree trunks. Chips may also be hauled offsite and utilized as ground cover or erosion control in other areas.

Flaming is also used during vegetation management area creation to address broom and other invasive species seedlings. Consistent with the IPM methods, specially designed small, hand-held propane torches are used in small areas to kill dense and newly emerged green seedlings. Flaming is usually conducted during light rains or on wet days when forest litter or grassland thatch is not likely to catch fire and additional precautions are implemented at the time of use including, bringing truck-mounted or backpack water tanks, and operating with more than one person onsite.

Other methods to get rid of biomass cleared using mechanical methods is through pile burning. Pile burning is a method of biomass disposal which uses fire to eliminate piles of dried plant material. Piles vary in size from 5 to 10 feet in diameter and 4 to 8 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 at a later date. The composition of piles varies with vegetation type. Piles could consist of chaparral species, broom, as well as hardwoods, conifer limbs, and tanoak resprouts. The total volume of material burned in a year will not exceed 50 tons. Pile burning occurs between November and May under the direction of Midpen staff on days when weather conditions meet the specifications of the BAAQMD permit. Multiple piles may be burned on a single day. Drip torches or other approved ignition devices are used to start pile ignitions.

Chemical

Limited chemical control (pesticide) is used in vegetation treatment for stump and spot spray treatment, during vegetation management system creation and maintenance. Chemical treatment methods used within vegetation management areas include any method approved under the IPMP (including, but not limited to stump spray and/or spot spray). Chemical controls are not used within 5 feet of trails, roads, or human occupied facilities. Chemical control methods and requirements will follow the IPMP EIR requirements; however, the acreage and amounts of herbicides needed specifically for vegetation system maintenance are covered under this Plan.

Use of herbicide in a cut-stump method is used to maintain treatment areas that contain decadent woody vegetation. Trees or large shrubs that require removal within the inner 30 feet of defensible space are likely to be treated by cut-stump method with pesticide to permanently remove them from this high hazard zone. Although brush encroaching into disc lines and fuelbreaks will be primarily removed with chainsaws, more stubborn woody plants may require treatment with pesticide by cut-stump method. Spot treatments of vegetation within vegetation management areas with other pesticides, as identified in Table 6, may also be used to the limits specified.

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

Grazing

Livestock grazing, with sheep, goats, or cattle, or potentially even horses can be used to achieve vegetation management objectives including, fuel load reduction, weed suppression, and habitat enhancement. Midpen has employed both sheep and goats on a small-scale experimental basis for weed control purposes with limited success. Midpen currently utilizes cattle grazing across approximately 11,000 acres with much higher success at reducing fuel loads. Grazing may require the installation of temporary electrified fencing and temporary or permanent water facilities and other infrastructure (tanks, corrals, fences etc.) as well as the deployment of guard animals and/or a shepherd.

4.5.5 Vegetation Management Strategies for Construction and Maintenance

Grasslands

Fire fuels treatment (grass mowing) will be used to reduce potential fire spread and increase suppression efficiency in grasslands. Grasses in vegetation management areas will be reduced in height to less than 4-6 inches but not cleared to mineral soil to minimize soil erosion. Non-native and/or non-local shrubs and trees, decadent native trees and shrubs (i.e. old plants with a substantial number of dead limbs and twigs), and conifers under 10 inches DBH (diameter at breast height) 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 (parking lots and picnic areas) will typically be performed annually; elsewhere grasses will not be mowed.

Removal of encroaching woody material will typically occur once every 3 to 5 years in fuelbreaks and, if needed, 5 to 10 years in FRAs, depending on the rate of regrowth. The maintenance of fuelbreaks will be based on site level assessments and implemented when vegetation no longer meets desired conditions. The work will be accomplished by top-cutting with power tools, such as string trimmers and brushcutters, with the 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 or piled and burned on-site after curing for a minimum of 60 days. In some instances, limited dead and or downed material may be left in place as habitat features if it poses little overall fire risk. Herbaceous vegetation is not mowed during the creation of FRAs.

Shrublands (Coastal Scrub, Chaparral)

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). Along property boundaries, shrubs may be completely removed to a width that reduces direct flame contact from adjacent developed properties, to a maximum of 100 feet. In order 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 or single snags or logs). Rare native species may be pruned, but not removed in their entirety. Removal 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; this uprooting will be minimized on steep slopes. Disposal of the cut material will be done by chipping, pile burning or lopping and scattering. Cyclical maintenance in shrublands will typically be performed once every 3 to 4 years (once every 5 to 10 years in FRAs), though high densities of weeds may necessitate annual maintenance. The maintenance of fuelbreaks will be based on site level assessments and implemented when vegetation no longer meets desired conditions.

Oak Woodlands and Mixed Hardwood Forests

Understory shrubs, target weeds, and 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, as described below. 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 1/3 of the tree's total live foliage will 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 poses a fall hazard or are judged to 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 or chipped or removed if feasible. Cyclical maintenance in woodlands or forests will typically be performed once every 3 to 5 years (5 to 10 years or more in FRAs, if needed), though high densities of weeds may necessitate annual maintenance.

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.

Coniferous Forests

In some coniferous areas, mainly in dense Douglas-fir and mixed hardwood forests, reducing the fuel load may require thinning of smaller, mid-canopy trees where densities are high. In these cases, the trees will be felled and their branches removed for chipping, hauling, or pile burning. The trunks, if small enough, will be chipped, hauled, or pile burned as well. If trunks cannot be chipped or hauled, they may be left standing and pruned with leaving on the ground a last resort. The number of trees to be removed will depend upon that particular location and site characteristics. Canopy-level tree removal will be limited to those trees that pose a hazard to infrastructure or workers.

Agricultural Landscapes

Mowing and brush thinning will occur along agricultural service roads that could provide ignition sources for adjacent natural areas. Conservation grazing may able be used to reduce fuel loads.

Hazard Tree Removal

Individual tree removal may be considered in specific locations to reduce production of firebrands and spotting during wildland fires, and reduce risks to public safety The IPMP allows for 50 to 100 hazard trees to be removed per year, specifically for recreational safety. This plan would allow additional hazard tree removal for fire hazard reduction. For example, scattered live trees (<10 inches DBH) or SOD-killed trees may be removed at ridgetop locations that are vegetated mainly by grass or chaparral. In addition, larger diameter trees (>10 inches in diameter) may be removed on a case by case basis where they are within their falling height of established trails, roads, structures, parking areas, or other places likely to be frequented by visitors and staff. The removal and disposal of these trees would be conducted as previously described. In some instances, hazard trees may be left in place as a habitat feature until use by a species is complete (e.g. wait to fall a hazard tree with a known raptor nest until fledglings have left the nest). The Vegetation Management Plan for Public safety would allow for up to 100 additional hazard trees to be mitigated or removed per year.

4.5.6 Equipment

The following table lists the types of equipment used to implement vegetation management actions.

Table 7Equipment Table for Vegetation Management Activities

Vehicle/Equipment Type	Fuel Type
Light duty automobile (car/light truck)	gasoline
Heavy truck	gasoline
Water truck	biodiesel
Van/medium truck	gasoline
Type III fire engine	biodiesel
Type IV fire engine	biodiesel
ATV	gasoline
Chainsaw/brushcutter	gasoline (25:1 or 50:1 with 2-stroke oil) or electric
Leaf blower	gasoline or electric

Chipper	biodiesel
Skid steer loader [a]	biodiesel
Backhoe [a]	biodiesel
Excavator [a]	biodiesel
Generator	biodiesel
Driptorch	gasoline and diesel or biodiesel mix (1:4)
Propane torch	propane

Notes:
[a] May be used with masticator or mower head.

4.5.7 Access

Access will be entirely from existing roads and trails. No new access roads are included as part of this plan. In some cases, access to work sites will not be accessible directly from maintained trails and roads and will be achieved by creating skid trails, which include foot trails or former trails that have grown over and can be cleared for access. Sensitive habitats, creeks, and wetlands will be avoided. Clearing of skid trails will not occur when soils are wet. The skid trails will not be graded or scraped. Skid trails will be rehabilitated following use, which involve de-compacting of soils, removing skid lines, distributing surrounding litter/duff back on-site, and obscuring entrance points with brush.

4.5.8 Personnel

Personnel needed to conduct various vegetation management actions depends upon the project and the year of implementation. The target person hours per project type are summarized in Table 8, as well as the maximum crew size on any given project for each management action. Work will be accomplished through crews of in-house staff as well as contractors. The number of workers on any given project will depend upon the activity. Crews of up to 20 people may be required for some project types. Up to 60 workers may be conducting vegetation management activities in a single day, but generally, only a few crews will be operating simultaneously. The amount of vegetation management work that can be completed each year will depend on annual staff capacity, funding, and other resource availability and will need to be balanced with other Midpen priorities that further the mission, annual Board-approved Strategic Goals and Objectives, and Vision Plan.

Table 8 Summary of Person Hours to Implement Vegetation Management Projects in 5 Year Implementation Plan

Project	Maximum Size Crew	Person Hours per Project
Table Text	Table Text	Table Text
Table Text	Table Text	Table Text
Table Text	Table Text	Table Text

4.5.9 Schedule and Timing for Implementation

Work generally occurs during daylight hours, typically from 7:00 am to 7:00 pm. Vegetation management activities will occur year-round but certain tools and techniques will be confined to specific months due to limitations such as the wet season, species protection requirements, permitting restrictions, and official fire season, determined by CAL FIRE. Scheduling and timing will be dependent on annual staff capacity, funding, and other resource availability and will need to be balanced with other Midpen priorities that further the mission, annual Board-approved Strategic Goals and Objectives, and Vision Plan.

4.6 Permits and Approvals

The following table identifies the potential permits and approvals needed for implementation of the Vegetation Management Plan.

Table 4.7-1 Potentially Required Permits or Approvals for the Proposed Plan

Agency	Approval or Permit
Federal	
U.S. Army Corps of Engineers (USACE)	Clean Water Act, Section 404, Nationwide Permit 14
U.S. Fish and Wildlife Service (USFWS)	Section 7 consultation for impacts to Federally Threatened or Endangered animal species
State	
California Department of Fish and Wildlife (CDFW)	Responsible and Trustee agency for CEQA review 1602 Streambed Alteration Agreement
Caltrans	Encroachment permits
Regional	
Bay Area Air Quality Management District (BAAQMD)	Prescribed burn permitting
San Francisco Regional Water Quality Control Board (SFRWQCB)	Section 401 Water Quality Certification

Local	
San Mateo County, Santa Clara County, Santa Cruz County	-Encroachment permit for work requiring traffic control on County roads and Coastal Development Permits for work in the Coastal Zone -Local tree protection and brush removal ordinances for various counties and cities.

4.7 Best Management Practices Incorporated into the Plan

Per 2014 IPMP CEQA and 2019 Addendum

Attachment 5

ATTACHMENT 2

PLANNING AND NATURAL RESOURCES COMMITTEE

R-19-127
September 24, 2019

AGENDA ITEM 2

AGENDA ITEM

Wildland Fire Resiliency Program – Public Meetings and Resource Management Policy Update

GENERAL MANAGER'S RECOMMENDATIONS

1. Receive updates on the development of the Wildland Fire Resiliency Program.

2. Review public feedback on the development of the Wildland Fire Resiliency Program.

3. Forward the recommended updates to the Resource Management Policies, as they relate to Wildland Fire, to the full Board of Directors for consideration.

SUMMARY

The Midpeninsula Regional Open Space District (District) is developing a Wildland Fire Resiliency Program (Program) to address the Board of Director's (Board) Fiscal Year (FY) 2019-20 Strategic Goals and Objectives that include working with fire agencies and surrounding communities to strengthen the prevention of, preparation for, and response to wildland fires. To engage the public and receive early feedback in the process of developing the Program, the District held three public open houses. Consultants (working closely with District staff, partners, and stakeholders) have reviewed, identified gaps, and recommended several changes to the District's Resource Management Policies (RMP) that address the changing reality of California's wildland fires and reflect the latest science of ecosystem resiliency

BACKGROUND

The Board approved the FY2019-20 Strategic Goals and Objectives that include working with fire agencies and surrounding communities to strengthen the prevention of, preparation for, and response to wildland fires. In response, District staff began developing a robust, strategic, and comprehensive fire management program. The District entered into contract with two consultants, Spatial Informatics Group, Inc., (SIG) and Panorama Environmental, Inc., (Panorama) to assist in the development of a Prescribed Fire Program in the summer of 2018, which then expanded to the development of a more comprehensive Wildland Fire Resiliency Program (Program) (R-19-52; R-19-69). The Program will address four main components of the District's Wildland Fire Management activities:

1) Wildland fire risk reduction through non-fire fuel reduction activities;
2) Monitoring of District lands;
3) Preparation of pre-fire plans with Resource Advisor maps; and

4) Use of prescribed fire to manage wildland fire fuels, reintroduce fire as a natural and cultural process, and provide staff and local fire agency fire training opportunities.

DISCUSSION

Public Open Houses
During the week of August 19, 2019, the District held public open houses in Half Moon Bay, Los Gatos, and Woodside with assistance from SIG, Panorama, local fire agencies, CAL FIRE, and firesafe councils. The objective of these meetings was to communicate the District's Program components and invite early public comment on the development of program elements. Outreach and notices prior to the events included 1,441 postcards to preserve neighbors, posting on the District's August eNews, sending an Interested Parties e-blast, event posting on Facebook and through Evite, updates to the project webpage on the District's website, and personal invites to fire agency partners (e.g. CAL FIRE, Woodside Fire, Santa Clara County Fire, Firesafe Councils).

The format of the event was a 45-minute presentation to describe fire ecology and history within the San Francisco Bay Area, explain what the District currently does for fire preparedness, outline the framework of the new developing Program, and inform how the public can get further involved. This presentation is currently on the District website for public viewing. After the presentations, the public was invited to review and comment at four workshop-style stations: 1) non-fire fuels management, 2) protection and monitoring of the environment, 3) pre-fire and resource advisor maps, and 4) an informational station about actions the public can do to protect themselves from fire.

Overall, the feedback from the public was overwhelmingly positive with appreciation expressed to the District for engaging the public early in the process of developing the Program. Multiple people expressed concern for fuel reduction locations or escape routes next to local communities (e.g. Grandview/Espinosa Community, Heather Heights, Redwood Estates, Blackberry Hill Community). Support was expressed about the intentional objectivity through the use of science for prioritizing fuel breaks as many people were unaware of the decision-making process. Some requested that work be conducted prior to completing the full Project analysis. Attachment 1 highlights and summarizes comments and feedback received at each station. This information will be used to further develop Program components as well as guide public outreach and education on wildland fire.

Board of Forestry and Fire Protection – California Vegetation Treatment Program (CalVTP)
On June 24, 2019, the California State Board of Forestry and Fire Protection released the CalVTP Draft PEIR for a 45-day public review and comment period, ending on August 9, 2019. The CalVTP identifies, among other treatment actions, prescribed burning (i.e. pile burning and broadcast burning). Staff from the Natural Resources and Planning Departments reviewed and commented on the proposed program. Comments included general support for the CalVTP and a request for two modifications to the Program: expansion of the geographic scope and the inclusion of an Invasive Species Biologist during project planning.

Of particular interest, the District may be able to tier off the Cal VTP and associated PEIR for future prescribed fire burns in conjunction with CAL FIRE, potentially affecting Program and CEQA work currently contracted with SIG and Panorama to complete. District staff is deferring some aspects of the prescribed fire portion of the Program until the CalVTP Final PEIR has been certified and adopted (anticipated in early 2020 if SB 632 (Galgiani) is signed by Governor Newsom, which specifies a February 1, 2020 deadline). Once the PEIR has been certificated and adopted, the District will analyze the current scope of work with SIG and Panorama to determine if the CAL FIRE program provides a full analysis and what, if any, additional environmental evaluation by the District is warranted.

Resource Management Policies (RMP) and Goals
The RMPs document defines the policies and practices used by the District to protect and manage resources on District lands. The word "resources", as used in this document, includes plants, animals, water, soil, terrain, geologic formations, historic, scenic, and cultural features. The RMPs comprise a "living" document that grows and changes regularly, based on new experience and information. It is reviewed and updated every five to ten years and chapters amended as needed to respond to ever-changing resource conditions (e.g. insect or disease out-breaks, large cataclysmic events, climate change etc.). A review of the RMPs by SIG and Panorama determined that the goals and components of the District's Program are generally supported by the RMPs.

SIG and Panorama also performed a detailed review of other relevant documents and policies, including external agency documents (e.g. CALFIRE) in collaboration with stakeholder organizations (e.g. Sierra Club, Amah Mutsun Tribal Band) to further inform the District's Program development. SIG and Panorama prepared a report, *Wildland Fire Resiliency Program-Resource Management Policies Analysis and Recommendations* (Attachment 2) which presents the methods and results (including a gap analysis) of the District's RMP review and provides recommendations for revised and additional policies that will support the overarching objectives and goals of the District Wildland Fire Resiliency Program. The primary recommended additions or modifications to the existing RMP policies and implementation measures that will support the new Program are:

- Create or augment existing policy to define and support programmatic planning efforts for wildland fire resiliency activities and the removal of regulatory barriers.
- Create or augment existing policy to acknowledge consideration of the adopted Community Wildfire Protection Plans for San Mateo and Santa Clara Counties, and the implementation of actions that are consistent with District practices.
- Add ecosystem resiliency to the Wildfire Management policies and a recommendation to identify acceptable levels of change to the environment that allow for establishment and maintenance of resiliency at the landscape level.
- Augment existing policies to incorporate the definition and importance of adaptive management and decision-making flexibility that responds to ecological feedback.
- Expand the focus of non-fire fuel management actions as a strategy to reduce fire risk.
- Add existing policy and implementation methods to acknowledge the need for new technology and tools to effectively support management methods.
- Add existing policy to address post-fire restoration and response.
- Allow for acceptable levels of visual change at the landscape scale resulting from fuels management actions under Scenic and Aesthetic Resource policies to protect from catastrophic biodiversity and aesthetic impacts resulting from large fire events.

- Add and modify Climate Change policies to allow for trade-offs between some upfront carbon sequestration loss and greenhouse gas emissions in exchange for fuel reduction projects, prescribed burns, and development of ecological resiliency to prevent large scale, catastrophic fires that would result in greater overall greenhouse gas impacts.

FISCAL IMPACT

Review of the draft policy changes and summary of community response has no direct fiscal impact. An explanation of future implementation costs will be presented to the full Board when the final Wildland Fire Resiliency Program is brought before them for consideration.

BOARD COMMITTEE REVIEW

No prior Board Committee review has occurred for this item. The full Board was provided an informational update on the Prescribed Fire Program in February of 2019 in which changes to the Project scope were discussed, resulting in Board approval to proceed with a more comprehensive Wildland Fire Resiliency Program (R-19-03). The Board approved amending the contract with SIG at the April 24, 2019 Board meeting (R-19-52), to provide fire ecology services and a detailed project description for the Program. The Board approved amending the contract with Panorama, at the May 22, 2019 Board meeting (R-19-69), to provide environmental review services for the Program.

PUBLIC NOTICE

Public notice was provided as required by the Brown Act. Public notice was also sent to the Resource Management and Wildland Fire interested parties list by postal or electronic mail.

CEQA COMPLIANCE

The District's existing RMPs were adopted in 2011 and evaluated in an Initial Study/Mitigated Negative Declaration. Updates to the policies may require additional CEQA evaluation, depending on the guidance provided by the Planning and Natural Resources Committee and direction provided the Board. Any further CEQA evaluation would be presented to and considered by the Board when it considers adopting changes to the Policies.

NEXT STEPS

Comments received from the open houses will be incorporated, where appropriate, into Program components, as well as guide public outreach and education on wildland fire. If supported by the Planning and Natural Resources Committee, the draft recommended RMP changes will be forwarded to the full Board for consideration, anticipated in Quarter 3 of FY2020. If the CalVTP Draft PEIR is certified and adopted, staff would issue a FYI to the Board or return to the PNR Committee to discuss how it affects the District's proposed Program. Staff will return to PNR in October of 2019 to discuss the Non-Fire Fuels Management Plan.

Attachments:
1. Public Comment Summary Report
2. Resource Management Policies Analysis and Recommendations
3. Comment Letters Received

Responsible Department Heads:
Kirk Lenington, Natural Resources Manager
Korrine Skinner, Public Affairs Manager
Matthew Andersen, Chief Ranger and Visitor Services Manager
Michael Jurich, Land and Facilities Manager

Prepared by:
Coty Sifuentes-Winter, Senior Resource Management Specialist, Natural Resources

Criteria for Locations and Prioritization of New Vegetation Management Areas

PUBLIC SAFETY VMP

Methodology for Locating Vegetation Treatments for Public Safety

The locations for establishment of new fuel management areas was initiated by identifying Midpen lands within the areas below. Areas classified as "water" or "wetland" were excluded from treatment:

- Adjacent to or near existing or planned fuels treatment areas;
- Identified by Midpen or other fire management or vegetation management professional staff as important areas for fuels treatment;
- Up to 300 feet from vulnerable populations (school, hospital, nursing home);
- Up to 100 feet from existing occupied Midpen buildings;
- Up to 200 feet from emergency response infrastructure (communications tower, fire station, police station, medivac location, evacuation center, critical water infrastructure, such as storage tanks and pumps for fire suppression);
- Up to 200 feet from a designated expanded fire response/fire monitoring clearing zone (safety zone, parking area, staging area, helicopter landing zone, lookout);
- Within 200 feet of sensitive resources or other Midpen High Value Asset that would benefit from and/or respond favorably to treatment or at risk of loss in the event of a wildfire;
- Within 200 feet of a designated Midpen evacuation route;
- Within 10-25 feet (depending on flame length) of primary Midpen designated emergency access roads accessible by a Wildland Type 3 fire engine; and
- Areas that enhance the ability to efficiently conduct fire suppression by providing infrastructure (e.g., staging areas, disc lines) and ingress/egress of fire suppression equipment.

Methodology for Prioritizing Vegetation Management Areas for Public Safety

Prioritization is established by assigning points for each of the following factors. The areas with the most points (up to XX) receive the highest priority ranking. Prioritization of vegetation management areas that are currently in the Conservation Grazing Program will be reduced by 1 point recognizing the beneficial reduction of fuel loads that results from grazing activities.

- Within 300 feet of vulnerable populations (schools, hospitals, nursing homes);
- Within 300 feet of designated Midpen evacuation routes;
- Within 100 feet of designated occupied Midpen buildings;
- Within 300 feet of critical emergency response infrastructure (communications tower, fire station, police station, medivac location, pre-planned Incident Command Post, evacuation center);

- Within 300 feet of Midpen designated fire response/fire monitoring clear zones (safety zone, parking area, staging area, helicopter landing zones, Lookout);
- Vegetation treatments identified in the field by professional fire staff;
- Within 300 feet of sensitive resources that would benefit from and/or respond favorably to treatment;
- Within 500 feet or adjacent to current and planned fuel management treatments;
- Within high fire risk areas - CALFIRE Very High, Santa Cruz High C-Fire M-Fire;
- Within 1,000 feet or adjacent to current and planned fuel management treatments;
- Within 300 feet of other high value assets or potential treatment areas identified by Midpen staff (including strategic regional fuelbreaks and cooperative efforts with neighboring property owners); and
- Within 200 feet of sites designated as having SOD Midpen data.

ECOSYSTEM RESILIENCY VMP

Methodology for Locating Potential Fuel Reduction Areas for Ecosystem Resiliency

The location of new FRAs on Midpen lands are confined to native forests or woodland areas of at least 100 acres in size. Areas classified as “water” or “wetland” are excluded from treatment.

Methodology for Prioritizing Fuel Reduction Areas for Ecosystem Resiliency

Prioritization is established by assigning points for each of the following factors. The areas with the most points (up to X) receive the highest priority ranking.

- Within 300 feet of sensitive resources that would benefit from and/or respond favorably to treatment;
- Within high fire risk areas (Priority zones: CALFIRE Very High, Santa Cruz High C-Fire M-Fire);
- Within 500 feet of points designated as having mortality due to forest disease, such as SOD;
- Identified by Midpen or vegetation management professional staff as important areas for fuels treatment for ecosystem resiliency;
- Where past land use history has increased the number of trees per acre to unnatural conditions;
- Identified as an area for prescribed fire for natural resource benefits;
- Promotes late-seral habitat conditions; and
- Site is experiencing vegetation encroachment that is changing the fuel regime or converting the vegetation type.

Attachment 5

ATTACHMENT 4

From:	FD-David Pucci
To:	Coty Sifuentes-Winter
Subject:	FW: Request for Comments for Partners and Stakeholders - Vegetation Management Plan for Public Safety and Ecosystem Resiliency
Date:	Tuesday, October 22, 2019 9:14:42 AM
Attachments:	image001.png image003.png image004.png image006.png image007.png

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EXTERNAL

Fire Prevention staff feel that you have a good plan in place and they don't have any additional suggestions. Thanks for letting us review this!

DAVE PUCCI

Acting Fire Chief

Redwood City and San Carlos Fire Departments
City of Redwood City
755 Marshall Street
Redwood City, CA 94063
Phone: (650) 780-7452
E-mail: dpucci@redwoodcity.org
www.redwoodcity.org/fire/

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Midpeninsula Regional Open Space District

MIDPENINSULA REGIONAL OPEN SPACE DISTRICT
PLANNING AND NATURAL RESOURCES COMMITTEE

Historic Train Depot
110 Higgins Canyon Road
Half Moon Bay, CA 94019

Tuesday, October 22, 2019
1:30 PM

APPROVED MINUTES*

CALL TO ORDER

Director Cyr called the meeting of the Planning and Natural Resources Committee to order at to order at 1:30 p.m.

ROLL CALL

Members Present: Jed Cyr and Karen Holman

Members Absent: Yoriko Kishimoto

Staff Present: General Manager Ana Ruiz, General Counsel Hilary Stevenson, District Clerk/Assistant to the General Manager Jennifer Woodworth, Natural Resources Manager Kirk Lenington, Senior Resources Management Specialist Coty Sifuentes-Winter, Senior Resources Management Specialist Julie Andersen, Rangeland Ecologist/Botanist Lewis Reed, Resource Management Specialist I Matt Sharp Chaney, and Senior Property Management Specialist Elaina Cuzick

ORAL COMMUNICATIONS

No speakers present.

ADOPTION OF AGENDA

Motion: Director Holman moved, and Director Cyr seconded the motion to adopt the agenda.

VOTE: 2-0-0 (Director Kishimoto absent)

COMMITTEE BUSINESS

1. Approve the September 24, 2019 Planning and Natural Resources Committee Minutes

*Approved by the Planning and Natural Resources Committee on October 28, 2019

Motion: Director Holman moved, and Director Cyr seconded the motion to approve the minutes for the September 24, 2019 Planning and Natural Resources Committee meeting.

VOTE: 2-0-0 (Director Kishimoto absent)

2. Addendum to the Mindego Hill Ranch Grazing Management Plan to Expand Conservation Grazing into the South Pasture (R-19-140)

Rangeland Ecologist/Botanist Lewis Reed provided the staff report describing the purpose of the proposed addendum, including guidelines for ongoing resource management work, expansion of the grazing area, and additional infrastructure improvements.

Public comments opened at 1:42 p.m.

BJ Burns, San Mateo County Farm Bureau President, stated that based on the size of Mindego Ranch, more cattle could be grazed there than are currently allowed. Mr. Burns expressed concern regarding mountain lion and coyote predation and stated the District should increase the reimbursement to the grazing tenants if predation occurs.

Public comments closed at 1:45 p.m.

Motion: Director Cyr moved, and Director Holman seconded the motion to forward a recommendation to the Board of Directors to adopt an addendum to the Mindego Hill Ranch Grazing Management Plan as an amendment to the Russian Ridge Use and Management Plan that adds the south pasture as part of the conservation grazing area on the property.

VOTE: 2-0-0 (Director Kishimoto absent)

3. Amendments to the Grazing Management Policy (R-19-139)

General Manager Ana Ruiz recommended having the Committee hear the presentation and receive public comment and otherwise continuing the item to provide staff additional time to meet with stakeholders, including members of the conservation and agricultural communities, given very recent comments received and the level of interest from new stakeholders. This additional outreach and public input would help refine any final recommendations that the Committee would consider at a later date.

Resource Management Specialist I Matt Sharp Chaney provided the staff presentation reviewing the steps taken to develop the draft Grazing Management Policy, including stakeholder outreach workshops, meetings with the San Mateo County Farm Bureau Executive Committee, scientific literature review, Board committee review, and grazing tenant survey and interviews. Mr. Sharp Chaney described the District's Conservation Grazing Program, including program goals and size, current reimbursement practice, and livestock protection measures, and the three strikes program used in other areas of the state with regards to mountain lion predation.

Sheila Barry, Bay Area Livestock and Natural Resources Advisor with the University of California, provided additional information regarding the process used and information gathered at the stakeholder workshop meetings.

Mr. Chaney provided a summary of the responses received from the grazing tenant surveys and workshops held with partner agencies, agricultural producers, and wildlife advocacy stakeholders, and outreach to additional organizations and stakeholders. The four components of the draft Grazing Management Policy Amendment are economic factors, wildlife and livestock protection, research, and public connection. Mr. Sharp Chaney reviewed the various suggested edits to the draft policy, which are the result of feedback received from stakeholders and members of the public.

Senior Property Management Specialist Elaina Cuzick presented a case study, with information provided by District grazing tenant Ronnie Seever, to illustrate the impacts of predation on grazing economics.

Director Holman requested clarification regarding penning options for calves.

Mr. Chaney reported penning livestock would be difficult due to the landscape and large acre pastures where cattle are widely dispersed. However, the District can help identify pastures that are more easily protected, where animals could be sequestered for a short period of time after calving, which is when predation is most likely to occur.

Public comments opened at 2:38 p.m.

Kimberly Boester, program coordinator for Project Coyote, which seeks to promote coexistence between people and wildlife shared information regarding her organization's work with ranchers to reduce interactions between predators and wildlife using nonlethal tools. Ms. Boester thanked the District for its emphasis on nonlethal tools to prevent conflicts and stated Project Coyote would be happy to work with the District on this program.

Ron Sturgeon thanked the District for its work on the draft policy and spoke in opposition to the Marin County Livestock Protection Program. Mr. Sturgeon suggested the District's Animal Unit Month (AUM) rate should be cut in half in order to help support grazing operations. Mr. Sturgeon provided alternatives to the draft policy amendment language including a request that the District provide 100% economic relief for ranchers to sustain ranching and the natural resource benefits of grazing.

Lynn Cullens, Associate Director of the Mountain Lion Foundation, provided comments regarding the negative impact the loss of cattle has on grazing operations. Ms. Cullens expressed opposition to lethal measures to control predation on conservation preserves. Ms. Cullens said the reason for increased mountain lion predation is due an increase in lethal controls and a lack of a stable adult mountain lion population.

BJ Burns, San Mateo County Farm Bureau President, spoke in favor of strong consideration of the current predation situation for ranchers, stating the lion population will continue to increase.

Tiffany Yap with the Center for Biological Diversity spoke against lethal removal of mountain lions on conservation lands. Ms. Yap spoke regarding the contributions mountain lions have to the environment, including promoting biodiversity, supporting riparian areas, and helping sustain habitats for aquatic and terrestrial plants and animals.

Vince Fontana commented on the size of cattle that may be lost to predation, which can vary. Mr. Fontana expressed concern regarding the lack of deer in the area, which is leading to additional predation of livestock.

Doug Edwards commented regarding the number of mountain lions in San Mateo County and the lack of data related to the size of the lion population. Mr. Edwards spoke in favor of verifying the size of the San Mateo County mountain lion population.

BJ Burns provided comments regarding the dwindling number of ranchers in the area stating that the public are putting them out of business.

John Cozzolino invited District staff to visit his and other ranch properties to see evidence of mountain lions in the area. Mr. Cozzilino spoke in favor of game management for predators.

Ms. Cullens spoke regarding the mountain lion population in the area and spoke against killing mountain lions stating that working together with ranchers to share information can help find compromise and solutions.

Public comments closed at 3:14 p.m.

Director Cyr spoke in favor of District staff further working on the draft policy to incorporate public feedback and return to the Committee at a later date.

Director Holman suggested staff should hold a meeting with the various stakeholders to seek consensus.

Natural Resources Manager Kirk Lenington reported a similar meeting was planned, but due to low interest from the conservation community, the meeting was not held. Staff will work with the ranching and conservation communities to organize another meeting.

No Committee action taken.

ADJOURNMENT

Director Cyr adjourned the meeting of the Planning and Natural Resources Committee of Midpeninsula Regional Open Space District at 3:20 p.m.

Jennifer Woodworth, MMC
District Clerk

Public Comments received through March 30, 2020

From:	[redacted]
To:	Clerk; General Information
Subject:	Karen Holman - Ward 5 - Board Contact Form
Date:	Thursday, March 26, 2020 9:53:06 AM

EXTERNAL

Name *	Glenn Fisher
Select a Choice *	Karen Holman - Ward 5
Email *	[redacted]
Location: (i.e. City, Address or District Ward)	[redacted] Palo Alto

Comments: *

Ms. Holman,
I'm a frequent hiker in MidPen lands and very interested in fire management (I have a friend who's a fomer fire ranger for national parks). I've read the draft Wildland Fire Resiliency Program (Oct. 2019).

I'm strongly in favor of major effort to reduce the fire load in MidPen lands. Hiking in various parks, whether Purissima Creek or Windy Hill, Rancho San Antonio or Los Trancos, I'm amazed at the amount of downed wood, cuttings piled by the side of the trail, fallen trees, and other fuel. As climate change warms and dries California, this is a huge liability for our region.

I urge you to move quickly and strongly on an aggressive plan to reduce the fire load now.

I also request that you keep me informed of upcoming meetings regarding the Wildland Fire Program. I was not aware of the August 19, 2019 public meeting (and I was also in the Sierras hiking), even though I'm on the Board Meeting notification list (and was at that time).

Thank you,

Glenn Fisher
Palo Alto