





This Page is Intentionally Left Blank

Photo 1: Lake Lagunitas Forestry Project

Vegetation Management Report

Fiscal Year 2022

TABLE OF CONTENTS

Table of Contents

Executive Summary	1
1 Coordination to Reduce Wildfire Risk	1-1
1.1 Red Flag Warnings.....	1-2
1.2 Coordination with PG&E	1-2
1.3 Coordination with Lessees	1-3
1.4 Wildfire Coordination.....	1-4
2 Planning, Monitoring and Environmental Compliance	2-6
2.1 Biodiversity, Fire and Fuels Integrated Plan.....	2-7
2.2 Non-Native Invasive Species Mapping.....	2-8
2.3 Rare Plant Complinance	2-8
2.4 Seeps & Springs Inventory	2-9
2.5 Spotted Owl, Osprey, Wildlife and Migratory Bird Surveys	2-10
2.6 Resilient Forest Monitoring & Forest Restoration Planning	2-10
2.7 Foothill Yellow Legged Frog Monitoring	2-11
2.8 Prescribed Burning Report	2-12
2.9 Forest Pests & Pathogens.....	2-13
3 Vegetation Management	3-15
3.1 Cyclical Maintenance of Fuelbreaks.....	3-16
3.2 New Fuelbreak Construction-MA 21.....	3-20
3.3 Early Detection Rapid Response (EDRR)-MA 22	3-20
3.4 Initial Forest Fuel Reduction-MA 23.....	3-21
3.5 Improve Grassland and Oak Woodlands-MA 23.....	3-23
4 Compliance Verification and Monitoring in FY2022	4-29
4.1 Requirements Implemented by Management Action	4-29
4.2 Notable Compliance and Monitoring Considerations and Findings	4-32
5 BFFIP Review & Work Plan	5-1
5.1 Review of BFFIP Management Actions	5-1
5.2 Work Plan for FY2023.....	5-3
6 Appendices	6-4

TABLE OF CONTENTS

This page is intentionally left blank.

Executive Summary

Each year, the Marin Municipal Water District (district) plans, monitors, and performs actions to reduce the risk of wildfire and improve the resiliency and biodiversity of its lands. Vegetation management activities are tracked and monitored so the district may adapt its actions and adjust to new information. This report is part of that adaptive management cycle. The Biodiversity, Fire, and Fuels Integrated Plan (BFFIP) is being implemented under an adaptive management framework. Per the BFFIP and Environmental Impact Report “The district will evaluate the effectiveness of annual management actions based on the findings from monitoring results. An annual board report will include the findings from monitoring and any recommendations made by District staff for modifications to methods and/or the schedule of preservations and restoration actions”.

The first section covers coordination and planning to reduce wildfire risk, such as watershed closures during Red Flag Warnings; working with PG&E, lessees, and neighbors on defensible space; and coordinating with County Fire. The second section details planning, inventorying, monitoring and compliance work to support vegetation management. The third section shows the results of on-the-ground actions taken for fuel reduction and biodiversity and habitat enhancement. The fourth section describes the district’s verification and monitoring of compliance with mitigation measure requirements. The fifth section lays out the work planning and recommendations for fiscal year (FY) 2023. Table 1 below provides a summary of the district activities that occurred in FY 2022. Map 1 (Page ES-5) provides a summary showing the locations of vegetation management activities in FY 2022, while Map 2 (Page ES-6) provides a summary of vegetation work for the past three fiscal years.

EXECUTIVE SUMMARY

Table 1 Overview of Vegetation Management Activities

Completed Work	Outcome	Approximate Cost ^a	Description
Community Coordination for Fire Risk Reduction		\$1,700	
Red Flag Warnings	Watershed Closures	N/A	<ul style="list-style-type: none"> • Closed Watershed for 12 days due to Red Flag Warnings.
Coordination with PG&E	108 Acres	\$850	<ul style="list-style-type: none"> • Coordinating to ensure cyclical vegetation maintenance around and under transmission lines. • PG&E cleared vegetation along 11.0 miles of power lines across the watershed. • PG&E repaired/replaced 3 guy lines & anchors, 3 poles, & multiple hardware repairs along the Ignacio-Bolinas Transmission Line, and multiple Distribution lines across the watershed. • Working with PG&E to develop comprehensive plan on Mt. Tam to create better fire safety around all power lines on watershed lands.
Coordination with Lessees and Neighbors on Defensible Space	7 Acres	\$850	<ul style="list-style-type: none"> • Coordinating under existing lease agreement to prioritize maintenance funding for vegetation maintenance around infrastructure.
County Fire Coordination	County and Watershed Wide	\$ NA	<ul style="list-style-type: none"> • Provided direction and support for development of Marin’s Community Wildfire Protection Plan in collaboration with Marin County Fire and FIRESafe Marin. • Attended monthly FIRESafe Marin Meetings. • Submitted two cross jurisdictional grant applications to California Coastal Conservancy and Cal Fire for fuels and vegetation management work.
Planning, Compliance and Monitoring		\$410,393	
Biodiversity, Fire, and Fuels Integrated Plan (BFFIP)65943		N/A	<ul style="list-style-type: none"> • Implemented BFFIP Year 3 Targets.
Non-Native Invasive Species Mapping	Updated Records	N/A	<ul style="list-style-type: none"> • 638 invasive plant records updated.

EXECUTIVE SUMMARY

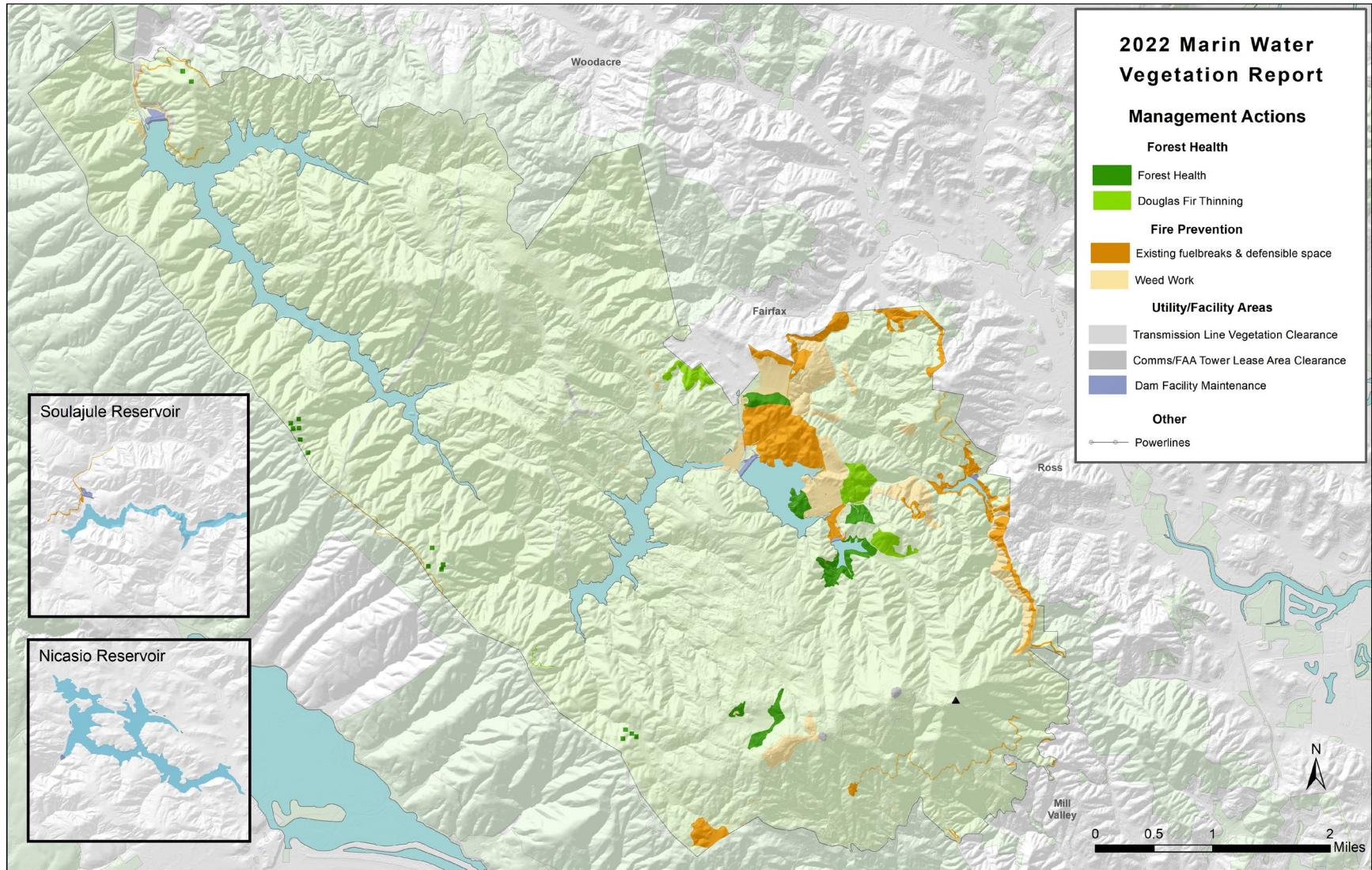
Expanded EDRR	Expanded Survey Area	\$19,898	<ul style="list-style-type: none"> • 300 Acres of Expanded EDRR in areas disturbed by vegetation work in the past 3 years. • 638 patches of Invasive weeds identified, of which 304 were new in FY22 alone.
Rare Plant Surveys	Rare plant compliance surveyed	\$144,525	<ul style="list-style-type: none"> • 1,283 acres surveyed for Rare plants ahead of vegetation management projects.
Seeps and Springs Monitoring	Seeps and Springs	\$3,556	<ul style="list-style-type: none"> • Continued hydrologic monitoring near Potrero Meadows.
Northern Spotted Owl Surveys	Nesting compliance	\$65,943	<ul style="list-style-type: none"> • Completed environmental compliance survey work for northern spotted owl to support watershed vegetation and construction related projects.
Bat Surveys	Roosting bat habitat surveys	\$2,520	<ul style="list-style-type: none"> • Completed environmental compliance survey work for roosting bat habitat prior to Doug Fir Thinning work.
Bird Surveys	Nesting Birds	\$95,917	<ul style="list-style-type: none"> • Completed environmental compliance survey work for nesting birds to support vegetation management work.
Tri-Annual Land Bird Survey	Nesting Birds	\$24,147	<ul style="list-style-type: none"> • Completed tri-annual nesting bird monitoring on the watershed.
Osprey Monitoring	Annual Monitoring	\$4,250	<ul style="list-style-type: none"> • Completed annual Osprey monitoring at Kent Lake.
Forest Restoration Monitoring and Mapping	Maintenance of Existing Areas	NA	<ul style="list-style-type: none"> • Routine Maintenance of 16 acres of Forest Habitat in the Resilient Forest Project Area.
Foothill Yellow Legged Frog	Annual Monitoring	\$23,516	<ul style="list-style-type: none"> • Completed annual monitoring of foothill yellow legged frogs at select watershed locations.
Prescribed Burning Report	Prescribed Burning Plan	\$6,655	<ul style="list-style-type: none"> • Developed reports for 6 burn plans across the watershed.
Watershed Fuel Modeling	Initial Field Work / Study	\$5,718	<ul style="list-style-type: none"> • Prepared GIS data to Tukman & Rice. Field work initiated.
Cultural Resource Study	Prep for Rx Burn	\$9,990	<ul style="list-style-type: none"> • Coordinated survey of Cultural Resources with FIGR and SSU in Rock Springs & Cataract Trail areas in preparation for an Rx Burn
Compliance Supplies	Supplies	\$3,760	<ul style="list-style-type: none"> • Fencing, flagging, etc. Supplies used for multiple compliance projects listed above.
Vegetation Management	Acres	\$2,728,114	
Cyclical Maintenance of Fuelbreaks	560 acres	\$715,592	<ul style="list-style-type: none"> • All fuelbreaks maintained at appropriate intervals

EXECUTIVE SUMMARY

	184 acres	\$472,902	<ul style="list-style-type: none"> Fuelbreak maintenance and cutting of woody vegetation.
	43 acres	\$36,680	<ul style="list-style-type: none"> Mowed fine fuels around structures, roadsides and parking areas.
	258 acres	\$69,310	<ul style="list-style-type: none"> Pulled/mowed broom from fuelbreaks.
	38 acres	\$107,961	<ul style="list-style-type: none"> Mowed non-fuelbreak roadsides.
	38 acres	\$28,740	<ul style="list-style-type: none"> Managed vegetation on dams and spillways.
New Fuelbreak Construction	10 acres	\$58,580	<ul style="list-style-type: none"> Contractors expanded defensible space at Fern Canyon Fuelbreak
Forest Restoration and Fuel Management	112 acres	\$602,056	<ul style="list-style-type: none"> Forest and woodland thinning to promote resilience
	64 acres	\$505,163	<ul style="list-style-type: none"> Initial forest fuel reduction.
	48 acres	\$96,893	<ul style="list-style-type: none"> Maintenance of forest restoration sites.
Priority Habitat Restoration & Fuel Reduction	795 acres	\$1,310,208	<ul style="list-style-type: none"> Removal of target invasive and weeds within forest and woodlands
	139 acres	\$623,722	<ul style="list-style-type: none"> Douglas fir thinning in oak woodlands and grasslands (OW&G).
	230 acres	\$457,683	<ul style="list-style-type: none"> Broom removal in OW&G.
	182 acres	\$91,490	<ul style="list-style-type: none"> Broom maintenance in OW&G.
	9 acres	\$36,680	<ul style="list-style-type: none"> Goatgrass reduction in OW&G.
	148 acres	\$36,159	<ul style="list-style-type: none"> Yellow Starthistle management in OW&G.
	87 acres	\$64,473	<ul style="list-style-type: none"> Control of other priority weeds in OW&G.
Early Detection Rapid Response	N/A	One Tam Contribution	<ul style="list-style-type: none"> 65 miles of roads and trails surveyed. 259 patches of invasive weeds treated in FY22.
Experiment with New Invasive Species Control Methods	N/A	\$39,978	<ul style="list-style-type: none"> Implemented Goat Grazing Projects at Deer Park Rd and Shaver Grade.

EXECUTIVE SUMMARY

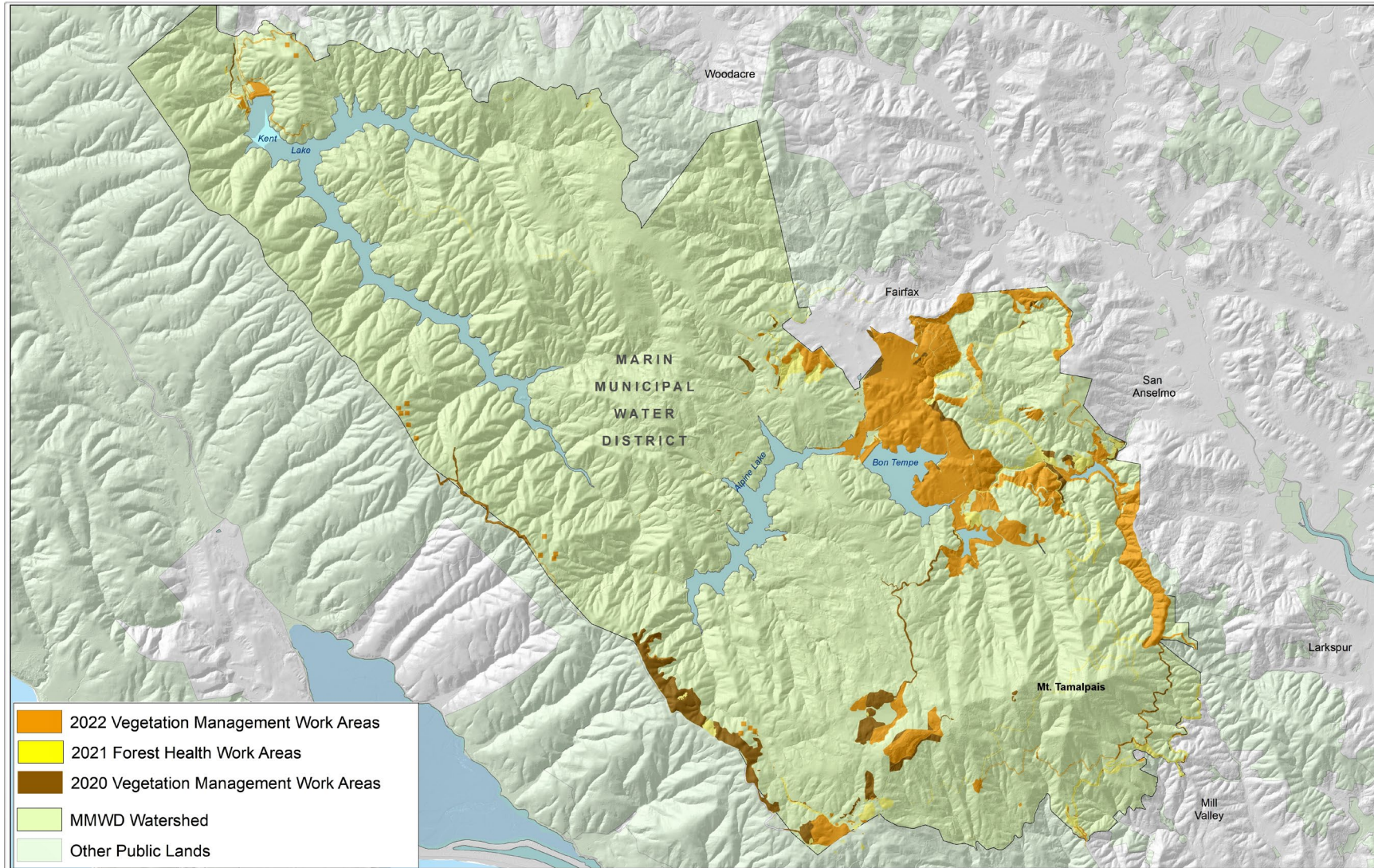
Map 1: Veg Work in FY22.



* FY22 map shows some limited fuelbreak & Forest Health Work in the Sky Oaks Area that carried over from projects that started in FY21 but didn't finish until FY22.

EXECUTIVE SUMMARY

Map 2: Vegetation work for the first three years of BFFIP implementation.



1 Coordination to Reduce Wildfire Risk

The district is responsible for managing its watershed lands, which includes minimizing the risk of wildfires. Over 25,000 structures housing approximately 45,000 residents are within two miles of district lands along a WUI that has a CalFire Fire Hazard rating of “High” to “Very High”. Wildfire also poses a threat to water quality and distribution, and to the ecosystem functions and values provided by watershed lands. Climate change, forest diseases, and the proliferation of weeds increase the potential for large wildfires.

This section details approaches to reduce the potential for fire ignitions and hazards through coordination with other agencies and landowners, as well as continuing best management practices to minimize ignition potential particularly during high-risk events. Adjacent to the watershed there are approximately 300 private properties, the remainder of the district’s lands are surrounded by State, Federal and other local agencies lands. Vegetation management actions are summarized in Section 3 Vegetation Management.

Work	Outcome	Approximate Cost	Description
Community Coordination for Fire Risk Reduction		\$1,700	<ul style="list-style-type: none"> Wildfire risk mitigation
Red Flag Warnings		N/A	<ul style="list-style-type: none"> Closed watershed for 12 days. Installed high fire danger signs on major gate entrances.
Coordination with PG&E	108 acres/11.0 miles	\$850	<ul style="list-style-type: none"> Coordinating to ensure cyclical vegetation maintenance around and under transmission & distribution lines. Monitored PG&E Contractors and Maintenance Crews on 108 Acres of land under and 11.0 miles of power lines. Worked with PG&E to ensure that pre-project environmental surveys are completed before vegetation management work is conducted.
Coordination with Lessees and Neighbors on Defensible Space	7 acres	\$850	<ul style="list-style-type: none"> Coordinating under existing lease agreement to prioritize maintenance funding for vegetation maintenance around infrastructure. Conducted assessments of fuelbreak infrastructure and defensible space to inform annual maintenance activities.
County Fire Coordination	NA	NA	<ul style="list-style-type: none"> Provided direction and support for development of Marin’s Community Wildfire Protection Plan in collaboration with Marin County Fire and FIRESafe Marin. Collaborated on Watershed Perscribed Fire Report Attended monthly FIRESafe Marin Meetings. Submitted two cross jurisdictional grant applications to California Coastal Conservancy and Cal Fire for fuels and vegetation management work.

1.1 Red Flag Warnings

Small fire events have occurred on district lands between 2006 and 2022. To reduce the potential for ignition during severe weather events the district coordinates with County Fire, and California State Parks to close sections of the watershed to automotive traffic during red-flag warnings. It is, therefore, imperative that the district be prepared to respond to fire events that occur on district lands. As such the district maintains operational readiness for initial attack and wildfire support services. The district currently has twelve trained wildland fire fighters with two additional seasonal staff trained. Ranger and Watershed Maintenance staff conduct monthly trainings.

The target is to regularly (annually or more frequently, as needed) train staff in Red-Flag Day protocols, ignition prevention BMPs, wildland firefighting techniques, and firefighting equipment maintenance.

- Participated in County wide red-flag sign coordination.
- Installed high fire danger signs at major watershed entrances.

Outcome	Total Closures
Watershed Closures	12



Photo 2: Fire Danger Signs at Main Entrance.



Photo 3: Fire Danger Signs posted in picnic areas.

1.2 Coordination with PG&E

PG&E-owned transmission lines and transformers are located within district lands. PG&E is responsible for maintaining clearance around transmission lines to minimize the potential for wildfires. The district will facilitate PG&E access for the purpose of vegetation management associated with their distribution and transmission lines and transformers. The target is to coordinate annually (or more frequently, as needed) with PG&E to ensure cyclical and emergency vegetation management occurs as needed under power lines and transformers.

Coordinated vegetation management treatments along 11.0 miles within 108 Acres of land under and adjacent to power lines.

Outcome	Approximate Cost
Coordinated vegetation management within 108 acres along 11.0 miles of distribution and transmission lines, and 3 wooden poles replaced with metal fire resistant poles.	\$850



Photo 4: PG&E Coordination under line on Eldridge Grade.



Photo 5: PG&E Veg Maintenance Coordination on Access Road leading to Pole Structure.

1.3 Coordination with Lessees

The district has entered into leases or easements with other parties that own facilities that are located within district lands. It is the responsibility of these other parties to conduct vegetation management activities around those facilities. The district performs annual inspections of leased areas and works with lessees to ensure vegetation management work is completed. The target is to coordinate annually (or more frequently as needed) with other parties that have entered into a lease or easement with the district, to ensure cyclical maintenance of fuelbreaks and other vegetation management activities occur around these facilities on district lands.

- Middle Peak / American Towers Facility – Coordinated 4 acres of defensible space maintenance.
- West Peak Building 402 – Coordinated 3 acres of defensible space maintenance.

Outcome	Approximate Cost
7 acres	\$850



Photo 6: American Towers Lease at Middle Peak of Mt. Tam.

1.4 Wildfire Coordination

The district is located adjacent to lands that are managed by other agencies, including private, county, state, and federal agencies. The district partners with these agencies and local fire departments to encourage the adequate management of fuels along common borders. District personnel attend monthly FIRESafe Marin meetings and participate in countywide Community Wildfire Protection Plan annual work plans and plan updates. Through the year district staff coordinate with local fire departments to improve community education regarding defensible space, ongoing vegetation maintenance, and ongoing emergency response. Additionally, the District’s Ranger staff and Watershed Maintenance staff carry out regular trainings relating to wildfire preparedness.

The District regularly discusses fuels management locations and techniques with Marin Wildfire Prevention Authority (MWPA) agency and committee representatives. This coordination is helping facilitate cross jurisdictional planning and management. In an effort to scale vegetation management effort the district is also working with the One Tam collaborative and County Fire to leverage the County Wide Vegetation Map to create an updated fuels profile for vegetated lands across Marin County, which will help to inform and prioritize fuel reduction efforts. Current coordinated grant applications with One

Tam and Marin County Parks total \$4.5 million. The district is also participating in One Tam Forest Health Strategy to develop multi-benefit forest restoration priorities.

Ongoing wildfire coordination efforts:

- Marin Wildfire Prevention Authority (MWPA)- Participating in Technical Advisory Committee.
- Continuing work on CalFIRE grant \$3.5 million.
- Continuing work on CA Coastal Conservancy grant \$1 million.
- Prescribed fire planning with MCF and NPS.
- MMWD/MCF Mutual Aid Agreement.
- Fire Safe Marin Board .
- Ongoing wildland fire trainings with MCF.
- Conducting wide fuels modeling.
- Working to Complete One Tam Forest Health Strategy.
- Working with OneTam partners to coordinate Resource Advisor readiness and standards for post-wildfire rehabilitation.



Photo 7: Marin County Fire Sawyer Training near W. Ridgecrest Blvd.



Photo 8: Marin Water Staff Wildfire Training.

2 Planning, Monitoring and Environmental Compliance

Another charge of the district is to protect important biological resources and ecosystem functions on the district's lands. Enhancing ecosystem resiliency is a key strategy for the district to pursue. Resiliency is defined as an ecosystem's ability to absorb shocks or perturbations and still retain desirable ecological functions, such as the ability to provide breeding and foraging habitat for wildlife; the ability to support significant biological resources such as rare, threatened, or endangered species; the ability to regenerate desired plant communities following a disturbance such as wildfire; the ability to cycle nutrients; and the ability to protect water quality. As part of the district's vegetation management actions environmental compliance surveys are completed to ensure the district's work doesn't impact sensitive resources.

The work in this section focuses on planning for vegetation management actions, inventorying and monitoring key natural resources, and performing actions related to environmental compliance.

Completed Work	Outcome	Approximate Cost	Description
Planning and Monitoring		\$410,393	
BFFIP Implementation		NA	<ul style="list-style-type: none"> Implemented BFFIP Year 3 Targets.
Non-Native Invasive Plant Species Mapping	Updated Records	N/A	<ul style="list-style-type: none"> Updated 638 Invasive Plant observations this FY.
Expanded EDRR	Expanded Survey Area	\$19,898	<ul style="list-style-type: none"> 300 Acres of Expanded EDRR in areas treated by MMWD or PG&E over the past 3 years. 254 Patches of invasive weeds maintained.
Rare Plant Compliance	1,283 Acres Surveyed	\$144,525	<ul style="list-style-type: none"> MMWD Contractors & Staff conducted 1,283 acres of rare plant surveys in potential project areas.
Seeps and Springs Inventory	Ongoing	\$3,556	<ul style="list-style-type: none"> Continued hydrologic monitoring near Potrero Meadows.
Northern Spotted Owl Surveys	Compliance	\$65,943	<ul style="list-style-type: none"> Completed environmental compliance survey work for northern spotted owl to support watershed vegetation and construction related projects.
Bat Surveys	Roosting bat habitat surveys	\$2,520	<ul style="list-style-type: none"> Completed environmental compliance survey work for roosting bat habitat prior to Doug Fir Thinning.

Bird Surveys	Nesting Birds	\$95,917	<ul style="list-style-type: none"> Completed environmental compliance survey work for nesting birds to support vegetation management work.
Tri-Annual Land Bird Survey	Nesting Birds	\$24,147	<ul style="list-style-type: none"> Completed triennial bird surveys to support trend monitoring in light of vegetation management work.
Osprey Monitoring	Annual Monitoring	\$4,250	<ul style="list-style-type: none"> Annual Osprey monitoring at Kent Lake.
Forest Restoration Monitoring and Mapping	Maintenance of Existing Areas	N/A	<ul style="list-style-type: none"> Routine Maintenance of 16 acres of Forest Habitat in the Forest Project Area.
Foothill Yellow Legged Frog	Annual Monitoring	\$23,516	<ul style="list-style-type: none"> Annual monitoring of foothill yellow legged frog at select watershed locations.
Perscribed Burn Report	Perscribed Burn Plan	\$6,655	<ul style="list-style-type: none"> Received reports for 6 burn plans across the watershed. See Appendix B.
Watershed Fuel Modeling	Initial Field Work / Study	\$5,718	<ul style="list-style-type: none"> Delivered GIS data to Ruceman & Rice. Field work initiated.
Cultural Resource Study	Prep for Rx Burn	\$9,990	<ul style="list-style-type: none"> Coordinated survey of Cultural Resources with FIGR and SSU in Rock Springs & Cataract Trail areas in preparation for an Rx Burn. Appendix C.
Compliance Supplies	N/A	\$3,760	<ul style="list-style-type: none"> Flagging, fencing, etc. Supplies used by multiple projects above.

2.1 Biodiversity, Fire and Fuels Integrated Plan

In an effort to expand vegetation management work to reduce fuel loads and wildfire hazards on watershed lands the district has developed the Biodiversity, Fire and Fuels Integrated Plan (BFFIP). The BFFIP supersedes the 1995 Vegetation Management Plan (VMP), which the District operates under from 1995-2019. The BFFIP was approved by the District’s Board of Directors and as such, is considered a discretionary action and subject to the California Environmental Quality Act (CEQA). As part of the CEQA process the district held a public meeting to inform the community and circulated the Draft Environmental Impact Report for public review from March 21, 2019 through June 19, 2019. The Plan and EIR were adopted on October 16, 2019.

- BFFIP adopted in October of 2019
- Updated Plant Pathogen BMP’s

Outcome	Approximate Cost
Plant Pathogen BMP Updates	NA

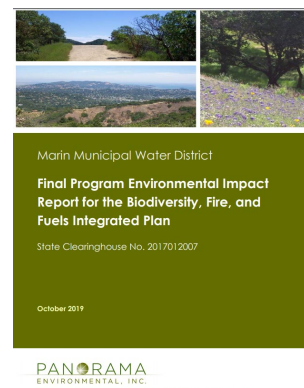


Figure 1: BFFIP EIR adopted in October of 2019.

2.2 Non-Native Invasive Species Mapping

To support the vegetation management actions that will be conducted by the district, the district needs to properly understand the location of invasive species and the extent that invasive species have spread on district lands. The district will continue to regularly update invasive species map. The target is to annually update the maps of invasive species. This information helps to inform vegetation management priorities and annual work plans.

The District completed a French Broom mapping update in FY 2018/2019 and is continuing with watershed wide Early Detection Rapid Response surveying as well as management of priority weeds.

Outcome	Approximate Cost
638 Records Updated	One Tam Contribution

2.3 Early Detection & Rapid Response (EDRR) Expansion

In FY22 Marin Water contracted with an experienced EDRR team at Golden Gate National Parks Conservancy to conduct surveys of 300 acres of land that had received some level of disturbance from recent vegetation or construction projects on the watershed. Vegetation management and construction projects have the potential to introduce, spread, or create conditions for the spread of invasive plant species. Experience has shown that proactive efforts to catch these plant infestations early are key to protecting the integrity of the habitat. This has already yielded benefits as we immediately treated several of the incipient infestations associated with the Ross Reservoir project and 2 other engineering projects on the watershed.

Outcome	Approximate Cost
300 Acres & 254 Patches of Invasive Weeds Maintained	\$19,898

2.4 Rare Plant Complince

To support the district's goal to preserve existing significant biological resources, including rare plants and sensitive natural communities, the district collects field data and updates watershed data on an ongoing basis. The objective is to ensure that all management actions taken on the Watershed have no significant negative impact on rare plants or sensitive natural communities. This information also helps the district track long-term trends and changes on the watershed and guides restoration planning efforts.

In FY 2019 the District completed a Rare Plant Inventory which is identified as a Monitoring Management Action in the BFFIP for year one. In FY21 & FY22, the district focused on rare plant compliance surveys to facilitate vegetation management and other watershed projects over the next 5 years.

In FY22 1,283 acres were surveyed for Rare plant compliance across the following locations:

- Potrero Meadow Expansion
- Rock Spring Expansion
- Remote Tank Sites (Multiple)
- San Geronimo Ridge
- New Pumpkin Ridge
- Culvert Replacement Sites (Multiple)
- Below & Above Bon Tempe Filter Plant
- Upper Cataract
- Indian Crown Fuelbreak Expansion
- W. Ridgecrest
- Worn Springs to Deer Park (WODE)
- West Meadow Club
- Gertrude Ord
- Yolanda Trail to Worn Springs (YOWO)

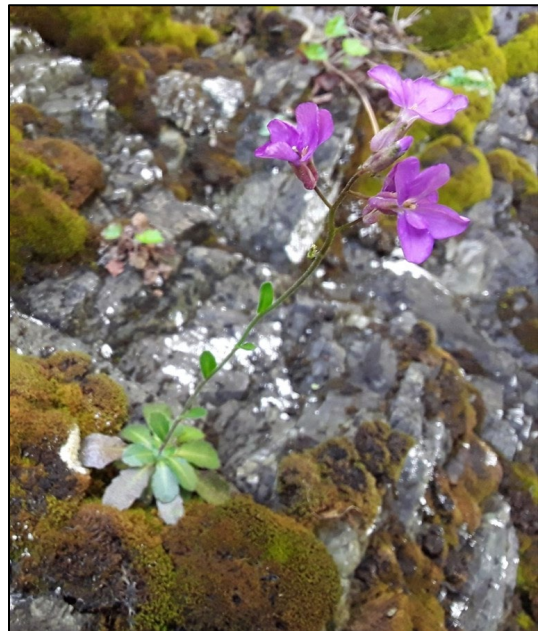


Photo 9: Coast Rock Cress (*Arabis blepharophylla*).

Outcome	Approximate Cost
1,283 Acres	\$144,525

2.5 Seeps & Springs Inventory

To support the district’s goal to preserve existing significant biological resources, including wetlands, seeps, and riparian habitat, the district will first need to properly understand the location of wetlands, seeps, and riparian habitat within district lands. The district is working to complete an inventory and GIS database of wetlands, seeps, and riparian habitat. The information will help the district identify projects to preserve and restore wetlands, seeps, and riparian habitat on watershed lands.

The target is to update the map data for wetlands, seeps, and riparian habitat; revise classifications; and complete a list of preservation and restoration projects. Data collection and verification work is ongoing by district staff and consultants. In FY 2021/22, the district monitored seeps and springs in the vicinity of Potrero Meadows in coordination with the prior year’s forest restoration work.

Seeps and springs mapped:

- Ongoing data collection near Potrero Meadows

Outcome	Approximate Cost
Ongoing seeps and springs inventories	\$3,556

2.6 Spotted Owl, Osprey, Wildlife and Migratory Bird Surveys

To facilitate vegetation management activities on the watershed the district carries out a number of pre-project biological surveys to minimize potential impacts. The survey results determine the mitigation or avoidance measures the district applies while carrying out vegetation management work. It's also a good way for the district to collect valuable biological data to monitor the long-term trends associated with biological resources on watershed lands. Surveys and monitoring work ensures that the district is complying with the regulations lined out in the Endangered Species Act and the Migratory Bird Treaty Act.

- Comprehensive district-wide northern spotted owl nesting surveys conducted.
- Nesting bird project surveys conducted in advance of all new vegetation work.
- Completed annual monitoring of Osprey at Kent Lake.
- Roosting bat compliance surveys conducted.



Photo 10: Compliance Photo showing location of Dark Eyed Junco Nest. Mark McCausland, Kleinfelder, 2022.

Outcome	Approximate Cost
Compliance surveys	\$188,527

2.7 Resilient Forest Monitoring & Forest Health Strategy

The District is collaborating with with the U.S. Forest Services, Cal Poly, and UC Davis to monitor greenhouse gas balance and water yield in Forest Restoraiton sites through pre-treatment and post-treatment data collection within a pilot treatment area.

The District is also working with One Tam Partners to develop a regional Forest Health Strategy through leveraging data from the recently complete County Wide Vegetaiton Map to identify opportunities for future forest restoration efforts. Staff are working with outside consultants and agency staff to finalize the planning effort. The District worked with One Tam partners to submit two grant applications in FY 2021/22 to support future Forest Restoraiton Projects.

- Utilized the One Tam on Forest Health Strategy to map out future multi-benefit forestry restoration work on the Mt. Tamalpais Watershed.

- Working with One Tam Partners to develop long-term grant funding proposal for implementation of Forest Health Strategy.

Outcome	Approximate Cost
One Tam Forest Health Strategy	NA
Submitted two Forest Restoration and Fuel Reduction Grants	NA

2.8 Foothill Yellow Legged Frog Monitoring

Since 2004, MMWD has conducted annual population monitoring of foothill yellow legged frogs (FYLF) on the Mt. Tamalpais Watershed. The FYLF is designated as a Federal and Species of Concern. The California Department of Fish and Wildlife also designates the FYLF as a California Species of Special Concern. Monitoring sites for FYLF are conducted at two known breeding sites within the Mt. Tamalpais Watershed, Little Carson Creek and Big Carson Creek, both of which flow into Kent Lake.

The annual monitoring of FYLF populations informs district vegetation work within their known habitats.

Outcome	Approximate Cost
Annual Monitoring	\$23,516



Photo 11: Foothill Yellow-legged Frog at different life stages

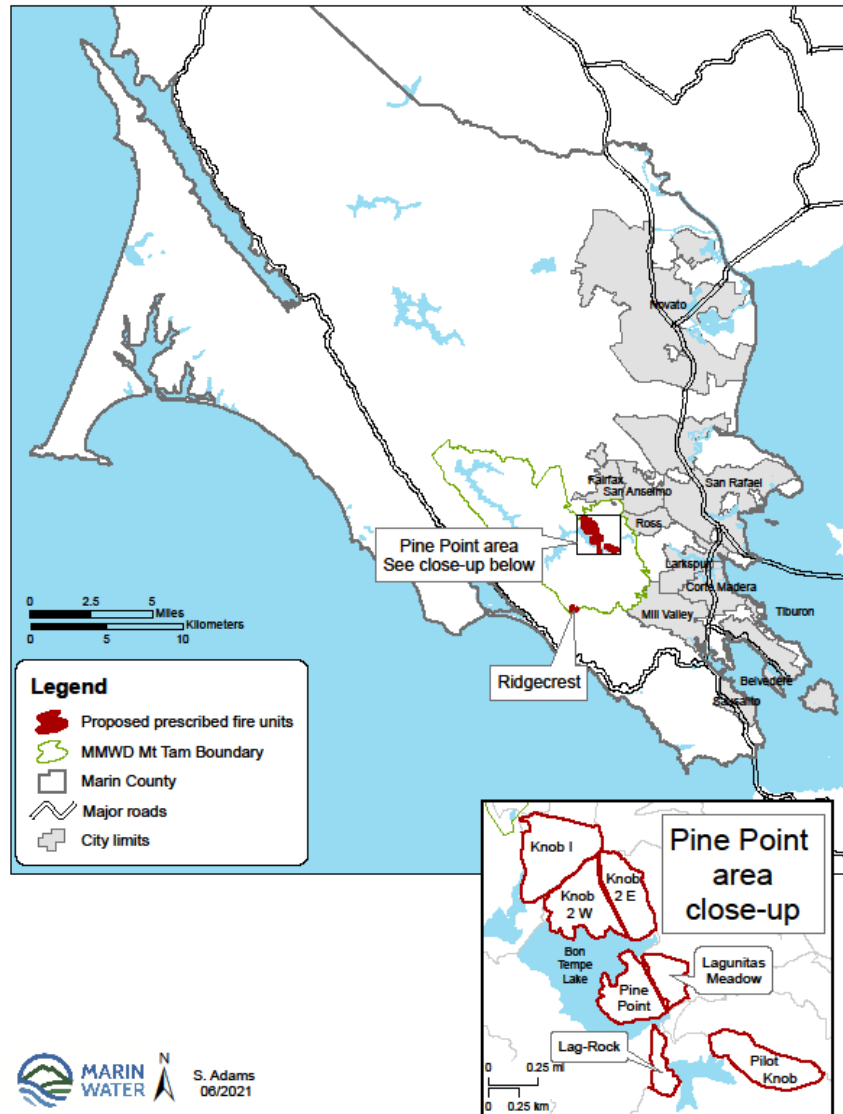


Photo 12: Foothill Yellow-legged Frog

2.9 Prescribed Burning Report

In FY 2021/2022 the district worked with Prescribed Fire Specialist Ben Jacobs to develop additional prescribed burn plans for the watershed. Staff also prioritized fuels reduction and forest restoration work to prepare future burn areas.

Map 3: locations reviewed as possible prescribed fire locations. A subset was selected as most suitable.



Prescribed burning:

- Due to ongoing compliance work and need to coordinate with Marin County Fire on needed resources, no prescribed burns were conducted this year.
- Prescribed Burn Plans were drafted for six forested units.
- Newest report received during FY22 attached as Appendix B.

Outcome	Approximate Cost
Six Burn Plans	\$6,655

2.10 Watershed Fuel Modeling

Marin Water contracted with Tukemean Geospatial to perform watershed-wide fuel modeling to evaluate the efficacy of existing and proposed fuel treatments. This wildland fire behavior modeling will be used to inform effective methods and locations for watershed fuel treatments needed to protect critical infrastructure and communities, as well as reduce severity and improve suppression response efforts.

Outcome	Approximate Cost
Initial Field Work / Study	\$5,718

Examples of the previous Fuel Modeling from Tukeman & Rice are shown below for the fuels work at Potrero Meadow (2020).

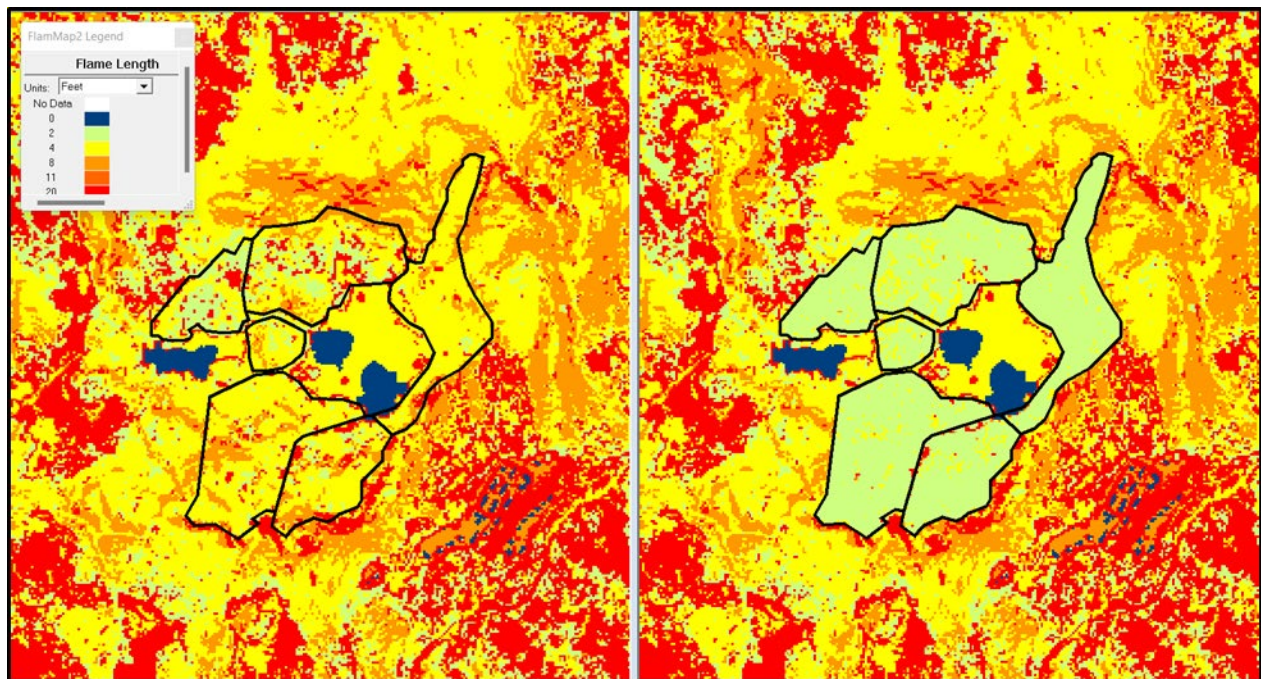


Figure 2: Pre-treatment (on left) and post-treatment (on right) flame length fire behavior prediction. Work areas shown with black outline.

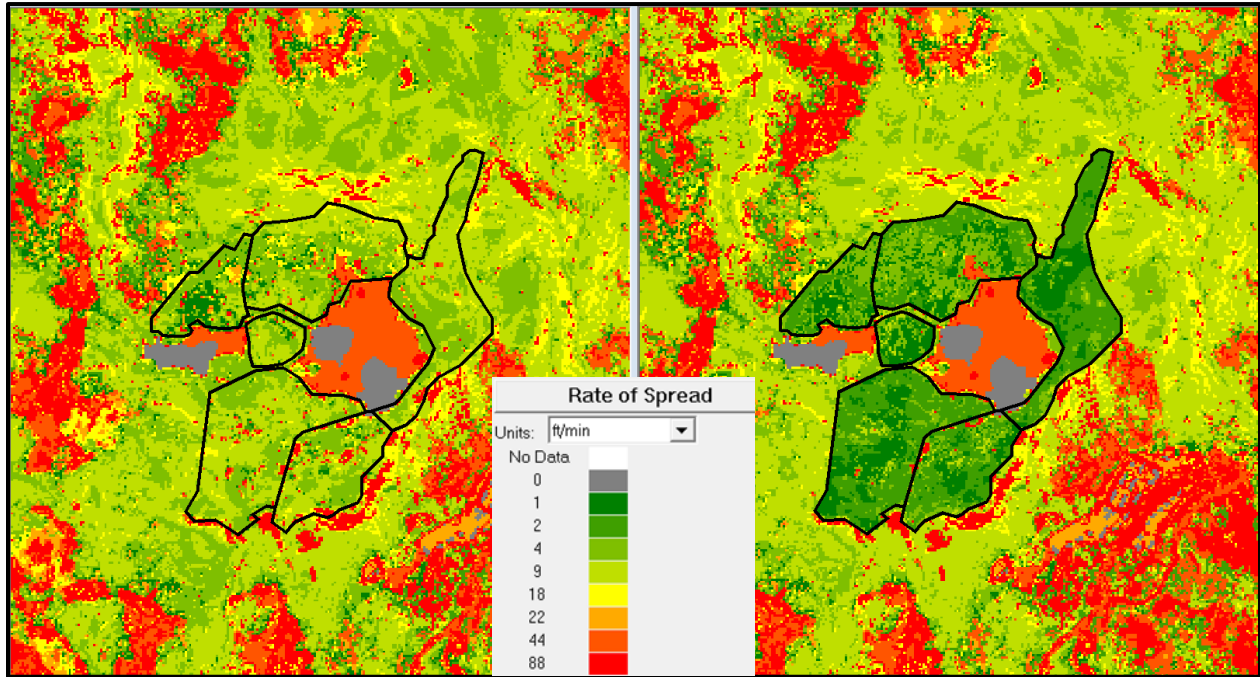


Figure 3: Pre-treatment (on left) and post-treatment (on right) rate of spread fire behavior prediction. Work areas shown with black outline.

2.11 Forest Pests & Pathogens

To limit the spread of forest pathogens as described in MA-14, Marin Water continues to implement Best Management Practices, as previously drafted by Phytosphere Research.

No additional forest pest and pathogen studies were conducted this year.

Outcome	Approximate Cost
Implement Forest Pest & Pathogen BMPs	N/A

2.12 Cultural Resources Study

Marin Water contracted with Sonoma State University, in consultation with the Federated Indians of Granton Rancheria, to conduct a cultural resources study for proposed prescribed burns in the vicinity of Rock Spring. See Appendix C.

Outcome	Approximate Cost
Rock Spring Cultural Resources Report	\$9,990

3 Vegetation Management

The district has been proactively managing vegetation to reduce wildfire hazards and preserve and enhance significant biological resources by implementing measures that were recommended in the 1995 VMP, as well as actions suggested by research and monitoring over the past decades. This section details actions undertaken to reduce wildfire risk, improve forest health, increase ecosystem resiliency and the status and function of other key natural systems and species. These actions primarily involve fuelbreak maintenance and construction, resilient forest projects, invasive plant management and restoration of native plant communities through reducing woody species encroachment.

Completed Work	Outcome	Approximate Cost	Description
Vegetation Management	1,476 acres	\$2,728,114	
Cyclical Maintenance of Fuelbreaks	560 acres	\$715,592	<ul style="list-style-type: none"> All fuelbreaks maintained at appropriate intervals. Cut woody vegetation in established fuelbreaks. Mowed fine fuels around structures, along roadsides and parking areas. Pulled broom from fuelbreaks. Mowed non-fuelbreak roadsides. Managed vegetation on dams and spillways.
New Fuelbreak Construction	10 acres	\$56,880	<ul style="list-style-type: none"> Contractors and staff expanded defensible near Sky Oaks Headquarters.
Early Detection Rapid Response	65 Miles & 259 Patches Treated.	One Tam Contribution	<ul style="list-style-type: none"> 65 miles of roads and trails surveyed. 259 patches of invasive weeds treated in FY22. (See Compliance Section 2 Above)
Forest Fuel Management	64 acres	\$505,163	<ul style="list-style-type: none"> Completed 64 acres of initial forest fuel reduction treatments at Lake Lagunitas and Pilot Knob sites.
	48 acres	\$96,893	<ul style="list-style-type: none"> Retreated 48 acres of fuels at Potrero Meadow and the Resilient Forest Sites.
Priority Habitat Restoration and Fuel Reduction	795 acres	\$1,310,208	<ul style="list-style-type: none"> Improved grassland and oak woodland in the ecosystem restoration zones through Douglas fir thinning, broom removal, and management of other priority non-natives.
Experiment with New Invasive Species Control Methods	Goat Grazing	\$39,978	<ul style="list-style-type: none"> Implemented Goat Grazing Projects at Deer Park Fire Rd, and Shaver Grade Fuelbreak.

3.1 Cyclical Maintenance of Fuelbreaks

Fuelbreak Maintenance & Cutting of Woody Vegetation

A fuelbreak is a built asset requiring periodic maintenance to operate as intended. Fuelbreaks are strategically located blocks or strips of land where vegetation has been altered so that it has a low fuel volume and/or reduced flammability. Maintenance work is intended to maintain reduced fuel loads and stand structure that will slow fire spread and reduce flame lengths. Fuel reduction areas are maintained by re-cutting vegetation as warranted.

The target is for each fuelbreak to be re-treated on a cyclical basis, as needed to maintain desired fuel characteristics; each fuelbreak will be re-treated at least once every five years. Fuelbreaks remain effective only if they are continually maintained.

Fuelbreaks maintained in FY22 include:

- Meerna
- Ross Reservoir
- Bon Tempe Treatment Plant
- Fawn Ridge
- Scott TankW
- Sky Oaks Road Corridor
- Rock Springs Rx Burn Unit & Tank
- Bill Williams
- Phoenix Lake Shore
- Lower RR Grade
- Bull Frog Creek Corridor



Photo 13: Routine Fuelbreak Maintenance at Meerna Fuelbreak.

Outcome	Approximate Cost
184 acres	\$472,902



Photo 14: Rock Springs Rx Burn Prep.



Photo 15: Phoenix Lake Shore Fuelbreak Maintenance.

Fine Fuel Reduction

Managing vegetation in the most risk-prone area, including parking lots, picnic areas, and defensible space around structure is a top priority. These areas, which are most risk-prone, are maintained by re-cutting vegetation, as warranted to keep grasses at 4 inches or less in height. The work is performed primarily with power tools such as string cutters, the district also uses heavy equipment with mowers. The vegetation is shredded and scattered on site as part of the cutting process with no additional treatment required. Soils are not disturbed.

All annual grass (fine fuel) defensible space maintained around Watershed facilities.

- Completed fine fuel reduction around all watershed facilities.

Outcome	Approximate Cost
43 acres	\$36,680



Photo 16: Nicasio Reservoir Before



Photo 17: Nicasio Reservoir After

Broom Removal in Fuelbreaks

On-going management and elimination of broom within fuelbreaks significantly reduces the amount of cyclical maintenance needed, which frees up resources to implement other vegetation management actions. The elimination of broom, however, is difficult to achieve in fuelbreaks that are characterized by the presence of large and persistent broom populations and thus are classified as Compromised Fuelbreaks. Implementation of this management action is restricted to fuelbreaks that are not bounded by extensive broom stands. The fuelbreaks that meet this criterion are Optimized Fuelbreaks and Transitional Fuelbreaks. Annual broom management within fuelbreaks is informed by ongoing invasive plant mapping and surveys.

The ultimate intent is to eliminate broom in the Optimized Fuelbreaks and Transitional Fuelbreaks. To do this, broom plants must be removed annually before any are mature enough to produce seed pods and replenish the seedbank (i.e., reproductive broom).

Broom was manually removed and/or cut within existing fuel breaks:

- Knob 1 & 2

- Indian/Crown Road
- Blithedale Ridge
- Lagunitas Meadow
- Lower Meerna

Outcome	Approximate Cost
258 acres	\$69,310



Photo 18: Broom Maintenance at Indian Crown Fuelbreak

Roadside Mowing (Non-Fuelbreak)

Vegetation management around roadsides is necessary to ensure the integrity of the infrastructure. The district continues to conduct roadside mowing on an as-needed basis to maintain unobstructed access for district vehicles and a clear line of sight for both district staff and recreationists. The work is performed with a combination of heavy equipment with cutting or masticating heads mounted on articulating arms and with power tools including chainsaws and brushcutters.

Roadside mowing sites:

- Soulajule
- Peters Dam
- Old Railroad Grade (Middle)
- Hoo-Koo-E-Koo Fire Rd.
- San Geronimo Ridge Rd.

Outcome	Approximate Cost
38 acres	\$107,961



Photo 19: Roadside Mowing at Old RR Grade Before



Photo 20: Roadside Mowing at Old RR Grade After.

Dam Maintenance

Per CA Department of Water Resources – Division of Safety of Dams (DSOD), all woody vegetation was removed from district earthen dams. Cutting and disposing of any woody shrubs or trees on earthen dams protects the structural integrity, facilitates annual DSOD inspections and compliance with State regulations.

Dam maintenance sites:

- Phoenix Dam
- Lagunitas Dam
- Bon Tempe Dam
- Peters Dam
- Nicasio Dam
- Soulajule Dam

Outcome	Approximate Cost
38 acres	\$28,740



Photo 21: Dam vegetation maintenance at Soulajule.

3.2 New Fuelbreak Construction-MA 21

To facilitate firefighter access in the event of an ignition, the district has removed dead material, thinned canopies, and cleared brush along areas designated as fuelbreaks. Fuelbreaks infrastructure has been strategically designed based on detailed analyses of existing vegetation, fuel loads, slopes, slope aspect, and local climate data. The vast majority of proposed future construction is the widening or expansion of existing fuelbreaks to maximize their utility. Fuelbreak widening will be performed as crews are in the area performing cyclical maintenance in the existing system.

For FY22 most of the new Fuelbreak construction took place in the Taylor Trail Fuelbreak, just north of the Sky Oaks Office. Additionally roughly ½ acre of defensible space was constructed to expand the Fern Canyon Fuelbreak specifically adjacent to a personal residence bordering the Watershed.

Outcome	Approximate Cost
10 acres	\$58,580



Photo 22: 10 Fern Canyon fuelbreak expansion.



Photo 23: Taylor Trail Fuelbreak Construction.

3.2 Early Detection Rapid Response (EDRR)-MA 22

Eliminating new colonies of weeds is the most effective action aside from prevention that the district can take to preserve biodiversity (as well as reduce fuelbreak maintenance). EDRR includes regular surveys of parts of the watershed where weed invasion is most likely, and periodic surveys in remote areas where new weed invasions are likely to be less frequent. EDRR staff pull, cut, or dig out newly discovered invasions that area less than 100 square meters (0.02) in size; larger populations are flagged for later treatment by the district using watershed aides or contractors.

This fiscal year 65 miles of Roads & Trails were surveyed and 259 patches were managed by the EDRR team which is led by our One Tam Partners.

Additionally, In FY22 Marin Water contracted with an experienced EDRR team at Golden Gate National Parks to to conduct surveys of 300 acres of land that had received some level of disturbance from recent vegetation or construction projects on the watershed. See Section 2 for a full description.

Outcome	Approximate Cost
259 Patches & 65 Miles	One Tam Contribution

3.3 Initial Forest Fuel Reduction-MA 23

Reduce Accumulated Fuels and Brush Density

The district will reduce accumulated fuels and brush density in conifer and mixed hardwood forest to reduce wildfire risk and improve overall forest function. Thinning brush is an established means of promoting the growth of retained native trees by reducing the competition for light, nutrients, and water. The district is carrying out this work because over 10,000 acres of forests on district lands have been impacted by Sudden Oak Death (SOD) this has increased the fuel loads within the forest. Tanoak-dominated forest types have been the most heavily impacted: as the disease progresses, tanoaks drop out of the canopy resulting in fuel load build up, large openings in the canopy and an overall simplification in forest diversity and structures.

Forestry Fuel Reduction Sites:

- Pilot Knob
- Lake Lagunitas

Outcome	Approximate Cost
63.5 acres	\$505,163



Photo 25: Lake Lagunitas Forestry Project After



Photo 26: Lake Lagunitas Forestry Project Before



Photo 27: Lake Lagunitas Forestry Project After

Forest Fuel Maintenance

Ongoing maintenance of areas where fuels and brush density were reduced and where trees were planted is necessary to improve overall forest stand structure. Maintenance of existing Resilient Forest sites promotes long-term ecosystem resilience and function.

Forest Fuel Maintenance:

- Potrero Meadow
- Resilient Forest Sites

Outcome	Approximate Cost
48 acres	\$96,893



Photo 28: Potrero Meadow Project Maintenance.

3.4 Improve Grassland and Oak Woodlands-MA 23

Reduce Encroachment in Oak Woodlands & Grasslands

In the absence of wildland fires, native Douglas fir trees invade oak woodland and grassland habitat on Mt. Tamalpais. On the watershed, both woodland and grassland habitats have significantly declined in area due to the encroachment of Douglas fir trees. Using a combination of hand crews and heavy equipment to remove young fir trees growing within grasslands and mixed hardwoods slows the rate that these plant communities are lost and retains the unique habitat and biodiversity that each provides.

Oak woodland and grassland preservation:

- Sky Oaks
- Azalea Hill / Meadow Club Units (AMC)
- New Pumpkin Ridge
- Pilot Knob

Outcome	Approximate Cost
138 Acres	\$623,722



Photo 29: Doug Fir Thinning Near Sky Oaks Ranger Station.



Photo 30: Lakeview Meadow Before



Photo 31: Lakeview Meadow After

Prescribed Burn in Grasslands & Oak Woodlands

The district is evaluating options for broadcast burning in mixed conifer, grasslands and oak woodland communities. Prescribed burning will help improve grassland and oak woodland by minimizing the spread of Douglas-fir, coyote brush, and other woody species. Additionally, prescribed fire can reduce the fuel

loading at these sites, so that future wildfires will burn at a lower intensity and result in lower tree mortality. To facilitate future prescribed burning projects the district is contracting with County Fire to assist with the development of prescribed burn plans. Additionally, County Fire is assisting with pre-project vegetation management and would participate in future prescribed burning operations.

Prescribed burning:

- No prescribed burns conducted.
- Drafted burn plans for forested six units (See Planning Section).

Outcome	Approximate Cost
Six Burn Plans	\$6,655 (See Compliance Table)

Broom Removal in Oak Woodlands & Grasslands

The district takes a site-based approach when eliminating broom. Broom removal projects may be done simultaneously with fuelbreak maintenance in a specific area or as part of a restoration project. Broom removal requires the complete uprooting of the plant. Because soil disturbance stimulates germination of broom seeds lying dormant in the soil, initial clearing usually leads to a flush of new broom plants and the need to perform repeat clearing annual at a level of effort commensurate with the initial clearing. The period of high frequency, high intensity pulling typically lasts between 5 and 7 years. Eventually, the level of effort needed to prevent seed production decreases exponentially, and there is a corresponding decrease in soil disturbance. Broom sites are considered in a long-term maintenance phase when there is a zero seed set for seven consecutive years and when the effort needed to maintain zero seed set is reduced by 90 percent from the point of initial clearing. Site-based broom management is informed by the districts mapping and monitoring of areas with broom.

French broom manually removed from Oak woodland and grasslands:

- Below Filter Plant
- Indian Crown Expansion
- Pint Point
- Pilot Knob
- Sky Oaks Broom

Outcome	Approximate Cost
230 acres	\$457,683



Photo 32: Pine Point Before Broom Removal



Photo 33: Pine Point After Broom Removal

Broom Maintenance in Oak Woodlands & Grasslands

The District tracks maintenance of broom in Oak Woodlands & Grasslands separately from initial removal. Areas maintained by cutting are treated on an annual basis, while areas maintained by pulling are treated every two years. Additionally the District has found that Broom populations require an elevated level of maintenance for roughly six years after an initial pulling treatment before stabilization at a minimal level of maintenance. Areas such as the original Indian Crown Fuelbreak and Sky Oaks Meadow are examples that require minimal broom maintenance. The District acknowledges that the initial pulling work in FY22 will initially require a significant effort to maintain every two years.

Outcome	Approximate Cost
182 acres	\$91,490



Photo 34: Sky Oaks Meadow After Many Years of Broom Maintenance.

Goatgrass Reduction

This species is targeted because of its ability to invade serpentine habitat – one of the least-invaded and rare plant-rich habitats on the Watershed. At present, barbed goatgrass is restricted to three known locations, and though one is large, it remains discrete enough to fully manage. Extirpating these populations benefits watershed biodiversity and reduces future management costs. The goatgrass infestation on district lands is centered on the intersection of Bolinas-Fairfax Road and Pine Mountain Road, though two additional populations were found within the last five years: one near Bullfrog Quarry and the other on San Geronimo Ridge. The target is to treat all infestation annually with a long-term target of extirpation of this species from the watershed.

Our One Tam partners received an outside grant to conduct goat grass surveys and treatment. They surveyed 25 acres of grassland adjacent to known infestations, and conducted early season flaming treatments which reduces the manual treatment needed later in the season.

Goat grass manually removed at priority sites:

- Azalea Hill
- Pine Mt. Fire Rd.
- Bullfrog Rd.

Outcome	Approximate Cost
9 acres	\$36,680



Photo 35: Barbed goat grass (*Aegilops triuncialis*) at Pine Mt. Fire Rd.



Photo 36: Yellow starthistle (*Centaurea solstitialis*) at West Ridgecrest.

Yellow Starthistle Reduction

Yellow starthistle is second only to broom in the amount of the watershed that it has invaded. Eliminating this weed before it spreads further will benefit biodiversity and reduce future management costs. The district treats infested areas multiple times each year to achieve 25 percent

reduction in percent cover at existing infested sites and the district will initiate treatment of incipient populations as detected. The target is to achieve containment at the 2015 extent of yellow starthistle and a 10% reduction in the level of effort needed to prevent seed set.

Yellow star thistle removed at priority sites:

- Deer Park
- Sky Oaks Meadow,
- Ridgecrest Blvd
- MVAFB
- Peters Dam
- Fawn Ridge
- Cataract Trail

Outcome	Approximate Cost
148 Acres	\$36,159

Control of Other Priority Weeds

Invasions of other high priority weeds are limited and generally are scattered throughout the watersheds. The species targeted are known or suspected to negatively impact rare plants or sensitive natural communities.

Priority weeds manually removed at:

- Yolanda Trail
- West Peak / Mill Valley Air Force Base
- Peters Dam
- Ridgecrest
- Rock Springs
- Cataract Trail

Outcome	Approximate Cost
87 acres	\$64,473



Photo 37: Cape Ivy (*Delawarea odorata*) near Pine Mt. Tunnel Rd.



Photo 38: Cheat Grass (*Bromus tectorum*) near Yolanda Trail.

Experimental Weed Treatment

The District implemented two new weed grazing trials in FY22 near Deer Park Fire Rd and Shaver Grade. The focus in FY22 was to determine effectiveness of grazing at removal of mature stands of French Broom. Results were mixed with some areas showing a decline of live mature broom, but most of each of the 10 acre work areas retained healthy stands of broom and impact on the Broom populations from grazing was minimal. The District acknowledges there were some benefits from reduction of fine fuels in the grazing units, and an increase in positive comments and engagement from visiting community members.

Outcome	Approximate Cost
Goat Grazing Trial	\$39,978



Photo 39: Grazing Trial Along Deer Park Fire Rd.

4 Compliance Verification and Monitoring in FY2022

The district developed the BFFIP to plan the management of district lands to minimize fire hazards and maximize ecological health. The district prepared a Program EIR for the BFFIP in accordance with CEQA, which requires the implementation of mitigation measures to avoid or lessen the significant environmental impacts of the district's vegetation management activities. The Final Program EIR for the BFFIP was adopted in October of 2019. This section summarizes the district's fiscal year 2022 verification and monitoring activities conducted in compliance with the BFFIP EIR mitigation measure.

4.1 Requirements Implemented by Management Action

Mitigation compliance is tracked on a project-by-project basis. Projects fall within several Management Actions or MAs. The MAs with environmental compliance components include:

- MA-20: Perform cyclical maintenance throughout the infrastructure zone with sufficient frequency to maintain design standards.
- MA-21: Construct the remainder of the fuelbreak system
- MA-22: Expand EDRR to identify, report, and treat new populations of invasive species
- MA-23: Improve conifer and mixed hardwood forest stand structure and function in the ecosystem restoration zone
- MA-24: Improve grasslands and oak woodlands in the ecosystem restoration zone
- MA-25: Reintroduce or enhance historic populations of special-status plant species
- MA-26: Develop and implement 10-year restoration plans for Potrero Meadow, Sky Oaks Meadow, and Nicasio Island
- MA-27: Conduct experiments and trials to identify suitable methods for control of invasive species

The projects that were implemented under each management action and the mitigation measures that were implemented in fiscal year 2022 are summarized in Table 2.

Table 2 Management Actions, Projects, and Mitigation Measure Compliance

Management Action	Projects Completed under Management Action	Mitigation Measures Implemented	
All MAs with environmental compliance components		See Appendix A	
MA-20 Perform cyclical maintenance throughout the infrastructure zone with sufficient frequency to maintain design standards	<ul style="list-style-type: none"> • Fuelbreak maintenance and cutting of woody vegetation • Fine fuel mowing • Broom removal in fuelbreaks • Roadside mowing • Dam maintenance 	<ul style="list-style-type: none"> • MM Air-3 • MM Air-4 • BMP-1 	<ul style="list-style-type: none"> • MM Hazards-3 • MM Hydrology-1 • MM Noise-1
MA-21 Construct the remainder of the fuelbreak system	<ul style="list-style-type: none"> • New fuelbreak construction 	<ul style="list-style-type: none"> • MM Air-3 • MM Air-4 • BMP-1 • BMP-5 • MM Biology-2 • MM Biology-11 • MM Biology-12 • MM Cultural-3 	<ul style="list-style-type: none"> • MM Cultural-4 • MM Hazards-1 • MM Hazards-2 • MM Hazards-7 • MM Hydrology-1 • MM Noise-1 • MM Recreation-1 • MM Transportation-1
MA-22 Expand EDRR to identify, report, and treat new populations of invasive species	<ul style="list-style-type: none"> • Road, disturbed areas, and trail surveys • Control of small weed patches 	<ul style="list-style-type: none"> • BMP-7 • MM Biology-2 • MM Biology-11 • MM Biology-12 • MM Biology-17 • MM Cultural-1 • MM Hazards-1 	<ul style="list-style-type: none"> • MM Hazards-6 • MM Hazards-7 • MM Hydrology-1 • MM Noise-1 • MM Recreation-1 • MM Transportation-1

<p>MA-23 Improve conifer and mixed hardwood forest stand structure and function in the ecosystem restoration zone</p>	<ul style="list-style-type: none"> • Initial forest fuel reduction • Forest fuel maintenance 	<ul style="list-style-type: none"> • MM Air-1 • MM Air-3 • MM Air-4 • BMP-1 • BMP-4 • BMP-5 • BMP-6 • BMP-7 • MM Biology-2 • MM Biology-17 • MM Cultural-1 • MM Cultural-3 	<ul style="list-style-type: none"> • MM Cultural-4 • MM Geology-2 • MM Hazards-1 • MM Hazards-2 • MM Hazards-3 • MM Hazards-4 • MM Hazards-5 • MM Hazards-7 • MM Hydrology-1 • MM Noise-1 • MM Recreation-1 • MM Transportation-1
<p>MA-24 Improve oak woodlands and grasslands (OW&G) in the ecosystem restoration zone</p>	<ul style="list-style-type: none"> • Douglas fir thinning in OW&G • Maintenance of Douglas fir • Broom removal in OW&G • Broom maintenance in OW&G • Goatgrass reduction in OW&G • Yellow star thistle management in OW&G • Control of other priority weeds in OW&G 	<ul style="list-style-type: none"> • MM Air-1 • MM Air-3 • MM Air-4 • BMP-1 • BMP-4 • BMP-5 • BMP-6 • BMP-7 • MM Biology-2 • MM Biology-11 • MM Biology-12 • MM Biology-17 • MM Cultural-1 	<ul style="list-style-type: none"> • MM Cultural-3 • MM Cultural-4 • MM Geology-2 • MM Hazards-1 • MM Hazards-2 • MM Hazards-3 • MM Hazards-4 • MM Hazards-5 • MM Hazards-7 • MM Hydrology-1 • MM Noise-1 • MM Recreation-1 • MM Transportation-1

4.2 Compliance and Monitoring Considerations and Findings

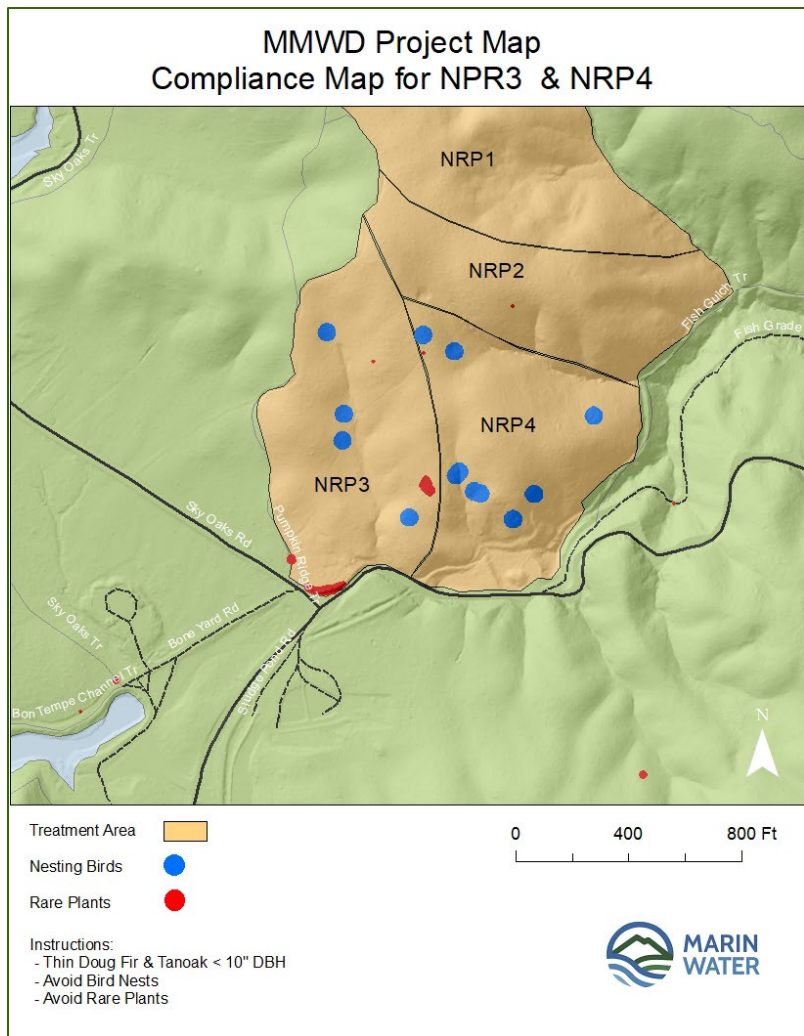
The district was able to effectively carry out the BFFIP mitigation measures for all Management Actions completed through the use of technical staff, partner agencies and professional environmental consultants. The district integrated new mapping technologies to help identify avoidance zones within project sites which helped guide field activities. This was especially effective for the district’s forestry restoration work in the vicinity of Pine Point, the Meadow Club and Rock Springs, which allowed district staff and contractors to use gps enabled devices to avoid sensitive resources within the work areas. The Pine Point Compliance Map shown below was used to avoid disturbance to Rare Plants and Bird Nest Locations.

The overall level of effort to carry out BFFIP compliance is significant and requires professionals with specific technical expertise. As the district scales up implementation of vegetation management under the BFFIP compliance costs will increase due to the need for additional compliance surveys. The compliance work is critical to ensuring that the district can effectively avoid sensitive resources and protects the biodiversity of the district’s watershed lands while reducing wildfire hazards. The number of total hours spent completing pre project surveys will increase during FY 2023/24 as the acres of implementation increase.

The district carries out compliance trainings with contractors working on the watershed before work is initiated.

On June 16th, 2022 the 2 acre ‘Lake Fire’ started by a smoking fisherman, occurred along the grasslopes above the Sunnyside trail near Bon Tempe Reservoir.

Marin Water and Marin County Fire staff immediately responded to and contained the incident. Fire weather conditions were moderate. No facilities were damaged. The Lake Fire started in an area previously treated by Marin Water contractors as part of the preparation outlined in a recently drafted prescribed Burn Plan. As expected, fire behavior was low due to the early treatments and mild weather.



Map 4: Compliance Map for NPR 3 & NPR4

5 BFFIP Review & Work Plan

5.1 Review of BFFIP Management Actions

As part of implementing the BFFIP the district conducts an annual review of project activities. As the district continues to scale up work to reduce the risk of wildfire, preserve and enhance important biological resources and ecosystem functions, the district will review and revise its work in response to changing conditions.

The below table compares BFFIP Year 3 Targets to actual completed work for FY 2022, and outlines BFFIP Targets for Year 4.

Management Actions	Year 3 Targets	Year 3 Completed	Year 4 Targets
MA-20.1 Maintain existing fuel breaks	180 acres	184 Acres	190 acres
MA-20.2 Mow fine fuels	30 acres	43 Acres	40 acres
MA-20.3 Broom removal in fuelbreaks	260 acres	258 Acres	260 acres
MA-20.4 Roadside mowing	40 acres	38 Acres	50 acres
MA-20.5 Dam maintenance	40 acres	38 Acres	45 acres
MA-21 New fuelbreak construction	10 acres	10 Acres	10 acres
MA 22.1 EDRR surveys	150 miles	65 Miles	150 miles
MA 22.2 EDRR weed treatments	100 patches	259 Patches	100 patches
MA 23.1 Forest fuel reductions	60 acres	64 Acres	60 acres
MA 23.2 Forest maintenance	48 acres	48 Acres	70 acres
MA 23.3 Forest Rx burn	1 Rx units	0 Units	1 Rx unit
MA24.1 Douglas fir thinning	140 acres	139 Acres	150 acres
MA24.2 Oak & grassland Rx burn	3 units	0 Units	3 units
MA24.3 Initial broom removal	225 Acres	230 Acres	260
MA 24.4 Broom maintenance	205 Acres	182 Acres	205
MA 24.5 Goatgrass removal	35 Acres	9 Acres	35
MA 24.6 Yellow star removal	110 Acres	148 Acres	120
MA 24.7 Priority weeds	-- acres	87 acres	-- acres
MA 25.1 Planting	2 projects	1 project	2 projects
MA 25.2 Habitat restoration	2 projects	0 projects	2 projects
MA 27 Weed control trials	2 project	2 projects	3 projects

For FY 2022 the district met the majority of BFFIP year three acre targets. The district was minimally under total acres of Broom Maintenance in Oak Woodlands & Grasslands, primarily due to contracting and mobilization of a existing vegetation contractor, who had been delayed with some emergency clean up work on the East Coast. The addition of a new contractor to Marin Water’s line up has proven to be very

effective and efficient and has greatly helped the district scale up vegetation management on the watershed.

The District now has multiple Rx Burn Plans in place, providing the exact prescribed conditions for weather fuel moisture, staffing, resources and compliance that need to be in place in order to conduct Rx Burns in accordance with BFFIP guidelines. The District did not conduct any Rx Burns in FY22 because the above factors did not align in a way to allow for a safe and effective burn. Any burn on the watershed would need to be lead by Marin County Fire and conducted in coordination with Marin Water staff and in accordance with the developed Rx Burn Plans.

The actual treated acres of goatgrass will vary from year to year based on the efficacy of ongoing treatments. Annual variations in Yellow Starthistle treatments MA 24.6 are directly related to seasonality of the plant and whether the treatment window falls in June or July (i.e. Prior vs Current FY) of each season.

In FY 2022 the district treated 1,476 acres for \$2,728,114 for an average cost of \$1,848/acre. Including \$410K in Compliance costs, the total cost increases to \$3,138,507, with a per acre cost of \$2,126/acre. As a percentage of total costs, compliance costs were 13% of the total. Costs referenced in this report reflect direct costs for vegetation work only, and do not include administrative support, planning, contract negotiation, etc. FY 2022 Total BFFIP expenses were funded with \$1,567,551 in grants provided by the California Coastal Conservancy, and the Cal Fire Forest Health Project. This funding represents 50% of the total FY 2022 expense.

The below table summaries cost per acre for vegetation management activities completed during FY 2022.

Cost per Acre by Management Action		
Management Action	Description	Cost/Acre
MA-8	Coordination with PG&E	\$8
MA-9	Coordination with Lessees	\$120
MA-20.1	Maintain fuelbreaks	\$2,567
MA-20.2	Mow fine fuels	\$861
MA-20.3	Remove broom from fuelbreaks	\$269
MA-20.4	Roadside mowing (non-break)	\$2,876
MA-20.5	Dam maintenance	\$766
MA-21	Construct new fuelbreak	\$5,748
MA-23.1	Initial Forest Fuel Reduction	\$7,954
MA-23.2	Maintenance of forest fuels	\$2,019
MA-24.1	Reduce fir encroachment in grasslands and oak woodlands	\$4,504
MA-24.3	Remove broom in grasslands and oak woodlands*	\$2,167
MA-24.4	Broom maintenance in grasslands and oak woodlands	\$502
MA-24.5	Reduce goatgrass	\$4,092
MA-24.6	Reduce yellow starthistle	\$244
MA-24.7	Control Other Priority Weeds	\$742
MA-27	Experimental Weed Treatment (Grazing)*	\$2,115

Total Vegetation Treatment Costs / Acre		\$1,848
Total Compliance Costs		\$410,395
Combined Veg & Compliance Cost / Acre		\$2,126

* Experimental Weed Treatment is typically measured based on number of projects for BFFIP compliance rather than acres, but for comparison purposes in the table above we counted the full 18.9 Acre treatment site in Experimental Weed Treatment rather than Initial Broom Removal in Grasslands & Oak Woodlands.

5.2 Work Plan for FY2023

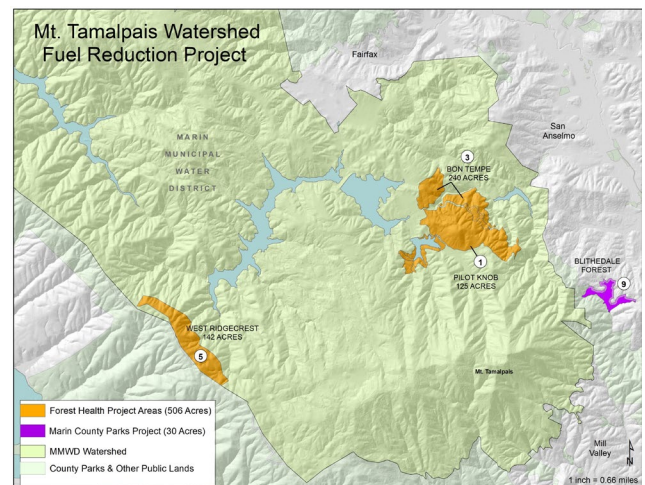
The district conducts year-end reviews of BFFIP activities to inform project planning for the following year. For year four of BFFIP implementation the district will continue to rely on grant funds received from California Coastal Conservancy Wildfire Resiliency Program, and Cal Fire Forest Health grant. These funds have been allocated over 2-3 years to help meet the BFFIP targets and goals of reducing wildfire fuels while enhancing biodiversity and ecosystem function. Below is a brief summary of BFFIP priorities for year four.

Planning and Monitoring

- Complete One Tam Forest Health Strategy and Wildfire Fuels Modeling to inform future BFFIP work.
- Collaborate with One Tam to secure long-term grant funding to continue to scale up BFFIP.
- Continue mapping and treating of non-native invasive plants.
- Participate in Marin Wildfire Prevention Authorities Technical Advisory Committee.
- Update Marin Water's Shared Resources Agreement with County Fire.

Vegetation Management

- Complete BFFIP Year 4 vegetation management plan.
- Continue fuelbreak expansion at Sky Oaks / Taylor Trail areas.
- Implement forest restoration work around the Bon Tempe Treatment Plant.
- Focus Broom work in the Ross Reservoir Fuelbreak and surrounding areas.
- Implement prescribed burns with County Fire.
- Scale up forestry restoration work in accordance with BFFIP.
- Continue removal of invasive weeds.
- Amend BFFIP to support ongoing grant applications and One Tam Forest Health Strategy Implementation.



Map 5: Planned forestry and fuel reduction work areas being funded by California Coastal Conservancy between 2021-2025.

6 Appendices

Appendix A – Mitigation Measures List

The following mitigation measures were implemented for all Management Actions (MAs) with environmental compliance components (MA-20 to MA-27):

MM Air-2 (Asbestos)	MM Biology-8 (Northern Spotted Owl; nesting season)
MM Air-3 (Air Pollutants)	MM Biology-9 (Western Pond Turtles)
MM Air-4 (Smoke)	MM Biology-10 (CA Red-Legged Frog)
BMP-1 (Operations)	MM Biology-12 (Foot-Hill Yellow Legged Frog)
BMP-2 (Pre-work Assessment/Planning)	MM Biology-13 (Mollusks)
BMP-3 (Import fills, rock & plants)	MM Biology-14 (Northern Spotted Owl, avoidance buffer)
MM Hazards-1 (Spills)	MM Biology-15 (Wetlands)
MM Hazards-3 (Fire Risk)	MM Biology-16 (Native Grasslands)
MM Hazards-4 (Prescribed Burn Plan)	MM Cultural-2 (Cultural Resources)
MM Hazards-7 (Fire Ignition)	MM Geology-1 (Erosion Control)
MM Hydrology-1 (Water Quality)	
MM Noise-1 (Noise Reduction)	
MM Recreation-1 (Roads & Trails)	
MM Transportation-1 (Emergency Access)	
MM Biology-1 (Worker Training)	
MM Biology-2 (Special-Status Plants)	
MM Biology-3 (Invasive Species)	
MM Biology-4 (Forest Diseases)	
MM Biology-5 (Roosting Bats)	
MM Biology-6 (Badgers)	
MM Biology-7 (Nesting Birds)	

Appendix B – Rx Burn Report

MARIN MUNICIPAL WATER DISTRICT – PRESCRIBED FIRE PLANNING REPORT #2

Prepared by Ben Jacobs, Contractor

The following proposed burn units were scouted by the contractor and District staff on March 15-18, 2022. A total of nine units consisting of 489 acres were evaluated. Note that the acres listed below are taken directly from the initial maps and should be considered planning areas. Final acreages may vary if the burn unit boundaries are adjusted during their actual lay out.

BURN UNIT NAME	ACRES	REPORT PAGE NUMBERS
Sky Oaks	45	5-7
Azalea North Face	169	7-9
BT Dam South	17	9-10
Mountain Theater	8	11-12
RS-2.5	1	12
RS-6	11	13-14
Worn Springs Upper and Lower	151	14-16
Air Force Base Upper and Lower*	70	16
Fawn Ridge	17	17-18

* These units were found to be not feasible for prescribed burning.

To meet the deliverables requested by the District, the following five items were evaluated for each individual unit:

1. Suggestions on how to modify the unit boundary and size.
2. Possibilities, benefits, and drawbacks to different options for what time of year the burn is conducted.
3. Evaluating defensibility and proposed mitigations.
4. Recommendations for pre-burn vegetation site prep work.
5. Helping MMWD plan and select units that have the best chances of taking place, not escaping, and meeting agency objectives.

Prior to the evaluation of each burn unit, there is a general discussion of each individual deliverable which are common to all the burn units

It should be noted that this site visit was limited to a preliminary evaluation of each proposed burn unit. Further analysis and planning will need occur by a qualified Burn Boss with District staff input to create a unit specific burn plan prior to any execution. All burn plans will need to reviewed and approved by appropriate District personnel before actual ignition can commence.

In discussions with District staff, the MMWD overall goals and objectives for its fuels treatment program are primarily based on strong ecological components. The intent of treatments is to not necessarily prevent fires, save structures, or even stop a wildfire. The strategy is to change fire behavior in treated areas by reducing future intensity and flames lengths. Additionally, the focus is

to increase ecosystem resiliency, watershed health, provide defensible space, and create possible anchor points. In this way fire safety becomes a tangential benefit.

The predominant species found throughout the units consist of coast live oak, canyon live oak, black oak, Oregon white oak, Douglas fir, coast redwood, madrone, tanoak, California bay laurel, huckleberry, coyote brush, poison oak, coffee berry, monkey flower, chamise, California buckeye, various ferns, and native and non-native grasses. There are also pockets of French broom among other invasive species and large areas where sudden oak death has adversely impacted the vegetation.

It is also important to note, attaining desired future conditions in these fuel types is a multi-treatment, multi-year process. It is impossible to burn an area just once and then walk away. All the burn units analyzed in this report will require continuous maintenance treatments into the indefinite future. This is true of nearly every fire prone vegetation type in California.

Suggestions on Modifying Unit Boundary and Size

All recommendations on burn unit modifications are suggestions only. Ultimately final unit boundaries will be the responsibility of District staff working with a Burn Boss to make the determinations where the final perimeters should be located. It should be expected that some burn unit boundaries and acreages will be slightly adjusted.

Possibilities, Benefits, and Drawbacks of Burn Timing

Local fire history will most likely indicate that pre-settlement burning occurred during the drier summer months. The District should mimic this process to the greatest extent possible in conjunction with management goals and objectives. Burning in mid-summer may not always be feasible due to external factors outside the District's control, including obtaining permits, local and regional wildfire activity, resource availability, political pressure, etc.

Late spring/early summer burning before the onset of fire season has the advantage of more resource availability and not being as prone to foehn-type wind events. If there is a substantial grass component, burning can usually begin soon after the grasses have cured. The disadvantage of burning early and into the drier months is that heavier fuels may not be dry enough as well as greater mop-up and longer term patrols being required in the burn permit. As fuels dry out, burn down in heavier may last for weeks in the absence of rain or mop-up. This could lead to significant political pressure, smoke concerns, or other factors that would necessitate extensive mop-up. This type of mop-up may cause excessive resource impacts throughout the burn interiors. Additionally nesting bird limited operating periods must be considered. This can sometimes be mitigated through bird surveys and establishing buffer zones if feasible around known nests.

Fuels should be dry enough to meet objectives in the fall, but recent years have shown a great number of wind events and a large amount of wildfire activity across the state. The ideal burn window for many units would be after some initial fall moisture followed by adequate drying. The timing of burns could be 'threading the needle' in between rain and wind events. Burning in the fall

a few days ahead of precipitation will have the advantage of lessening risk and reducing the amount of mop-up and patrol.

Given the difficulty in finding windows during the traditional drier months, the District should also consider burning throughout the winter if conditions are appropriate. This should be done in accordance with meeting management goals and objectives and avoiding unforeseen adverse ecological impacts. Diligent fire effects monitoring will help inform and validate this decision. Other factors to consider are high visitation periods and the amount of trail/road management and/or necessary closures. No matter what time of year burning occurs, all perimeters must be secured to minimize the chance of an escape.

Because burning at different times of year will have advantages, disadvantages, and different ecological effects, the District's land management objectives should serve as the foundation for deciding when to burn any unit. If there are operational advantages to burn a particular unit at a certain time of year, they are listed under that individual unit.

Evaluating Defensibility and Proposed Mitigations

The entire perimeter of every burn should be surveyed for hazards (snags, hung up trees, widow makers, etc) which should be identified and mitigated whenever possible. This can be done either prior to or concurrently with prepping the units. A broad description of hazards should be included in a unit specific prescribed burn plan.

For all units it is assumed the desired wind direction will have a westerly component. Burning under an east wind is usually not acceptable due to elevated fire danger. With this in mind, recommended minimum specifications for all handlines in forested areas are a 10 foot saw cut and a two foot scrape down to mineral soil. In grasslands, the recommended minimum specifications are a six foot mow line and a two foot scrape to mineral soil on the side of the mow line farthest from the burn. (Note – the official State standard of mineral soil fireline width used by Cal Fire is four feet. This may be required as part of a burn permit. If not required, a two foot minimum scrape should be adequate in most places and will reduce resource impacts.) There is also the option of burning in grass with wet lines versus a mineral soil line. Wet lines have less resource impact and do not disturb soil. However, wet lines always require a hoselay and necessitate more skill, coordination, and firefighter experience.

The 10 foot minimum saw cut should be done in the spirit of a shaded fuel break versus full canopy clearance. This will include thinning smaller trees, limbing larger trees, removing shrubs, bucking up and removing dead and down fuels, etc. The saw cut should focus primarily on the burn side and as needed on the 'green side' (opposite of the burn side). Cut fuels can be scattered deeper within the unit or moved to the outside, whichever is easiest or makes the most sense. Saw cuts should be completed around the entire the perimeter where determined to be necessary, including along roadways. Snags should be evaluated for safety and control issues and may need to be fallen or rung with a mineral soil scrape. Burn units requiring a saw cut greater than 10 feet are noted in their individual write ups.

When burn units are bordered by lakes or are immediately adjacent to one another and share a common holding boundary, prep work can be reduced accordingly. In some cases prep work may be done only on one side depending on the sequence of burning or the amount of time in between burns. In some cases prep may be determined to be necessary on both sides or not at all. This should be clarified in a unit specific burn plan.

Whether or not hoselays are deployed along perimeters will be at the discretion of the Burn Boss or may be required on a burn permit. (Hoselays are usually not deployed along roads where engine access is good.)

All handlines and road prep should adhere to Minimum Impact Suppression Techniques (MIST) whenever possible.

Pre-Burn Vegetation Site Prep Work

Scouting for pre-burn vegetation site prep work was mostly confined to unit perimeters, although some burn interiors were looked at. Interior pre-burn prep work can create large volumes of material in need of disposal. Pile burning is one of the most common ways of debris disposal and comes with its own set of challenges. This includes finding the right burn windows, having the right amount personnel, the potential for escape, high costs, etc. Pile burning is usually completed as a preliminary phase prior to broadcast prescribed burning.

Scattering the material and disposing of it in a broadcast burn is another option. This is a cheaper treatment, can be done quicker with less labor, and can help provide adequate fuel loading to carry fire in areas of lighter fuels. However, scattering fuels may increase fire hazard if the unit is not burned in a timely manner (1-2 years).

A third option is chipping. This disposal method is usually confined to near roadways and may be limited by the diameter of the vegetation. It is best if the material is chipped into a vehicle and hauled away. Chipping onsite can create problematic fuel beds due to long term smoldering and incomplete consumption when burning.

The biggest determinants for debris disposal will usually be management objectives with cost efficiency factored in. More intensive treatments typically require more labor, and are consequently more expensive.

Where terrain and fuel loading has allowed, the District has already masticated the timbered interiors of some units. This treatment will create an open stand and reduce fire intensity. The benefits of mastication should be considered with the ecological alteration to the forest floor.

Smoke Management

This short section is included because managing smoke is one of the biggest limiting factors to successful prescribed burning in the Bay Area. District personnel must build their own relationship with the Bay Area Air Quality Management District to work to ease current restrictions. To effect positive change on the landscape and significantly reduce fire risk, prescribed burners cannot be

limited to arbitrary burn cut off times, 100% mop-up requirements, no option to burn at night, or implementing only small burns containing mostly grass fuels which immediately burn down.

District staff should collaborate with local partners such as Marin County Fire Department, National Park Service, California State Parks, and private landowners to ensure that onerous restrictions are minimized and reasonable burn windows are given when the weather is conducive to good smoke dispersal.

There are smoke sensitive targets in nearly all directions surrounding the District. These smoke targets must also be thought of as wildfire targets. Thus the District has a responsibility to try to appropriately manage their land so ultimately those surrounding communities are able to live with wildfire and not be destroyed by it.

SKY OAKS

The Sky Oaks burn unit is potentially challenging due to steep slopes, thick vegetation, and the required amount of prep work, particularly on the west flank. Going clockwise from the District headquarters, the initial map unit has the northern (upper) west flank bounded by a portion of the Taylor Trail and a small draw down to Concrete Pipe Road which makes up the north, east, and south flanks. The southern (lower) west flank runs up a steep slope through thick vegetation back to the headquarters.

Suggestions on Modifying Unit Boundary and Size

The small draw on upper west flank is not a particularly good location for a burn unit boundary. It is therefore recommended to use the Taylor Trail as the boundary along the upper west and the north flanks. The trail is underslung and will require a hoselay and prep (see below). At the northeast corner there are options to construct a short handline to connect the trail down to Concrete Pipe Road. A faint spur ridge heading north/northeast down to a wooden/metal fence is one possibility. The terrain is steep and road cut banks should be avoided. Using the trail would decrease the size of the unit by approximately five acres.

The Concrete Pipe Road is drivable and defensible and should be used as the east and south flanks from northeast corner past the Canyon Trail to an unnamed tributary of San Anselmo Creek. Before the creek there are different options to tie the burn back to the headquarters along the lower west flank, all of them involving fireline construction. This portion of the perimeter is complicated by steep slopes, a large patch of chamise, and an abundance of French broom, some which has been previously cut. Taking the shortest route towards the headquarters, the line will use a broad ridge east of the creek tributary and cross two spur tributary draws. The lower draw is steep and topographically challenging; the upper draw is gentler and slightly less so. The chamise opens up to more of a grassland higher on the slope before reaching the headquarters.

It may be possible at the bottom of the lower draw to take the perimeter west and pick up a more open ridge towards the headquarters. This would increase the unit size but would lessen the length of fireline directly in the chamise. A third option would be to exclude as much of the chamise as possible by using a broad ridge along the oak canopy edge from Concrete Pipe Road connecting to

the end of Girl Scout Road. This would reduce the burn size down another ten or so acres. None of these options are perfect and all will have the previously stated challenges. The exact line location will need to be determined when writing the actual burn plan.

Possibilities, Benefits, and Drawbacks to Time of Year

In order to get fire to carry, the unit should be burned when the grass is cured. Burning in the late spring/early summer has the advantage of the chamise having higher live fuel moistures to moderate its potential intensities. However, early season burning may not meet objectives in the wetter forest types on the north facing slopes. Burning in the fall will better meet fuel reduction objectives throughout the unit, but must be balanced with controlling fire in the chamise. Burning in the fall after a rainfall, risks the north facing slopes remaining too wet to adequately achieve objectives. Overall, early summer (in coordination with any limited operating periods) may provide the best window to balance attaining objectives with controlling the burn. Due to the burn location, smoke will most likely be a nighttime impact to Fairfax regardless of when the unit is burned.

Evaluating Defensibility and Proposed Mitigations

The underslung north flank can be made defensible with a hoselay along Taylor Trail and by bucking and removing heavy fuels away from the trail at least 20 feet inside the burn unit. Where possible and acceptable, roll out potential should be reduced along the trail through trenching while minimizing (or rehabbing) disturbance to the trail tread. The short handline connecting the trail to the road can be prepped using the standard specifications above (10 foot saw cut, two foot scrape).

The lower west flank line is problematic for the reasons stated above. Accordingly, it is recommended that the saw cut be widened to at least 20 feet in the chamise and shrub types. This fireline will also need a hoselay. As much French broom as possible should be cut prior to burning, allowed to cure, and then burned in feeder piles during the following winter. All other piles in the burn unit, including those above the road on the steep southeast slopes, should ideally be burned prior to ignition.

The roadside will need the standard saw cut preparation to minimize scorch and spotting.

Recommendations for Pre-Burn Vegetation Site Prep Work

Old growth madrones and other mature trees identified by District staff should be prepped (ringed with a small mineral soil scrape) in the unit interior to minimize the fire impact. All water infrastructure, both inside and outside the unit, will need to be evaluated for protection or exclusion. This includes features in between the Girl Scout Road and Taylor Trail, along Concrete Pipe Road, and all the buildings and improvements associated with the District headquarters. There are wooden stairs on Taylor Trail which can be protected by the hoselay and/or scratch lines.

Additionally, there is an old CCC concrete septic facility located in the middle of the unit east of the lower west flank. This feature is surrounded by dense vegetation. The level of prep around the tank will need be determined by District staff in conjunction with the Burn Boss.

The District may want to consider either cutting or mechanically crushing the chamise beforehand. This would allow the material to cure and be burned during the winter prior to burning the rest of

the unit. The disadvantage is the cost and/or amount of labor required. Steep slopes may limit the area accessible to heavy equipment.

Chance of Implementation, Escape, and Meeting Agency Objectives

Prepping and implementing this burn has an enhanced level of complexity due to the brush types in and around the southwest corner, the closeness of improvements and infrastructure, and proximity to Fairfax with the incumbent smoke impacts. As the burn will be highly visible and impact visitor access within the general area, it is critical that the District does thorough public outreach prior to implementation. Public information will be key to ensure support of the project from local communities.

If the burn rolls out on the underslung north flank, the Concrete Pipe Road provides a defensible secondary line. If fire crosses the handline on the west flank, the Sky Oaks Road also provides a defensible secondary line. Fire crossing the lower west flank may necessitate going into structure protection mode as well as aggressively attacking fire outside the unit. Chance of escape can be reduced by thorough burn prep, choosing the right burn window, having an ample water supply for the hoses, and adequate resources to protect improvements while holding the burn.

Without some sort of intensive pre-burn preparation, there may be some reluctance from the local fire departments to support burning chamise in a broadcast burn. This may affect whether or not a burn permit is issued.

AZALEA NORTH FACE

The Azalea North Face burn unit is potentially challenging due its size, the presence of sensitive plants, and proximity to the Meadow Club golf course. The initial map uses the Bolinas Fairfax Road as the small north and entire west flanks, the Azalea Hill Trail as the south flank, a short handline as the east flank, and the Golf Club Service Road with some identified cutoffs as the northeast flank.

Suggestions on Modifying Unit Boundary and Size

To avoid the hairpin curve on the Bolinas Fairfax Road at the northern tip, it is recommended to move the perimeter south of the phone line corridor. Fuels are a relatively light grassland which could be connected with hand or mow line between Golf Course Service and Bolinas Fairfax Roads. The Bolinas Fairfax Road is viable as the west flank and much of the Azalea Hill Trail runs through a sparse grassland requiring minimal prep.

However, there are issues with the rest of the perimeter. The eastern section of the south flank is located in a serpentine area with Jepson's ceanothus and leather oak. This is sensitive habitat which is not the target burn vegetation and where any soil disturbance is undesirable. Holding in this area could only be done using a lot of water and skilled personnel. For this reason it is recommended that this entire area be excluded from the burn. A new southeast flank should be scouted from the Azalea Hill Trail west of the serpentine area, down a ridge line through the oak woodland to the Golf Course Service Road. This line should be located to reach the road northwest of the solar farm. Using this line has the advantage of excluding the serpentine area, the east flank powerline, the solar farm, and the entire maintenance area and boneyard.

The Golf Course Service is narrow, but paved and drivable. There is a section along the northeast flank where the road veers north into the golf course proper away from the burn unit boundary. In this area the burn would come right down to the golf course green which might be an issue. It is recommended that a hand or mow line be scouted to move the perimeter uphill and away from the green. Both this exclusion line and the southeast flank will need to be further scouted and adjusted prior to writing the burn plan.

Possibilities, Benefits, and Drawbacks to Time of Year

This unit can only be burned when the grass is cured. After curing, it can be burned whenever it is dry enough and within prescription. Timing should be coordinated to avoid impacting the golf course during special events or times of high use.

Evaluating Defensibility and Proposed Mitigations.

With the above boundary modifications, most of the unit is defensible with roads or light fuels. The exclusion lines by the north flank phone line and golf course green, Azalea Hill Trail, the new southeast flank may require hoselays as part of the burn permit. This will strengthen these flanks and reduce the need for soil disturbance along the trail. However, installing a hoselay all the way from the southwest corner to the Golf Course Road may not be feasible to the large amount of hose and the need for a large capacity snap tank(s), water tender, or equivalent at the southwest corner. For this reason, the southeast flank may require a wider scrape up to four feet in the event water is not available. Prepositioning backpack pumps at strategic locations along this line may be necessary.

Recommendations for Pre-Burn Vegetation Site Prep Work

As stated above, the unit will require preparation of three hand or mow lines. A mow line may be sufficient to exclude the phone line at the north flank due its short distance. Handlines are recommended along the southeast flank and around the golf course green cutoff. There should be minimal to no prep along the Azalea Hill Trail due to the presence of Marin dwarf flax. The District will need to clarify whether brush can be cut along the trail. The Bolinas Fairfax and Golf Course Service Roads should have vegetation cut back 20 feet on the burn side where necessary in the heavier fuels to minimize scorch and spotting. Prepping the service road may need to be done when the course is closed due to noise impacts.

Interior treatment should focus on cutting Douglas fir reproduction at the District's discretion. This material could be scattered or piled. Any piles created should be burned prior to the broadcast ignition. The District may also want to consider segmenting the unit using the main ridge running from near the southwest corner to the golf course green exclusion line. This may be necessary for air quality purposes and to divide the unit into two separate one day ignitions. This segment boundary would most likely need to be a handline versus mow line to eliminate the need to install a hoselay.

Chance of Implementation, Escape, and Meeting Agency Objectives

With the above recommended boundary modifications and proper prep, the overall unit is reasonably defensible and burning should maintain the oak woodland objective. The Pine Mountain Fire Road may serve as a secondary line on the west flank near the Azalea Hill trailhead, however the road veers westward going north and loses its secondary effectiveness. Alpine Lake is a secondary boundary to the south, but this is some distance from the Azalea Hill Trail. Bullfrog Road can serve as a secondary line to the east, however fire would have the potential impact the excluded infrastructure (solar farm, powerlines, maintenance yard) before reaching the road.

There are other issues that could limit implementation. The burn will be highly visible and will require the closure of the Azalea Hill Trail. The golf course has a 'high dollar cliental' who may not appreciate being impacted by smoke. Timing the burn on days the course is closed will be necessary to mitigate this concern. It is critical that the District does thorough public outreach prior to implementation. Public information will be key to ensure support of the project from local communities.

The Golf Course Service Road is off District property and may require a liability waiver and/or an agreement to allow fire apparatus access. The District will also need to confirm with the County Public Works whether a use permit is necessary to burn all the way to the service road. The Bolinas Fairfax Road will require traffic control. This will add complexity and will require coordination with the County Sheriffs and County Public Works. There is precedent of closing this road and there are gates to limit public access. Due to its large size, smoke can be expected to impact Fairfax, the golf course, and surrounding area. All of these issues will need to be resolved before the burn can go forward.

BT DAM SOUTH

The BT Dam South unit is relatively straight forward with the exception of the west flank. The initial map has the unit laid out down to Alpine Lake to the north and the Bon Tempe Dam and Lake to the east. The balance of the perimeter was drawn to include the native grassland habitat and not the actual unit boundary.

Suggestions on Modifying Unit Boundary and Size

Due to the powerlines in the northern portion of the proposed unit, it is recommended to move the boundary south from the lake to the Alpine-Bon Tempe Pump or Rocky Ridge Road to exclude them entirely. Both roads are underslung but defensible. If the Alpine-Bon Tempe Pump Road is used, a short, scoured out draw can be cleaned up and used to connect the two roads at the northwest corner. This piece will require a hoselay and will define the lower (northern) west flank.

The upper west flank above Rocky Ridge Road will need a handline constructed to the south/southwest away from the draw. This handline should follow the Douglas fir/oak woodland boundary as topography allows; the location is slightly overslung but defensible. As the slope gets steeper and more overslung, good prep will be essential before reaching an area of relatively lighter fuels. The line will eventually need to veer east and cross back over the draw through gentler terrain following the Douglas fir vegetation edge uphill to the next spur ridge. At this point the line can turn to the north/northeast and downhill underneath a Douglas fir, madrone, and California bay laurel overstory to define the south

flank. Terrain is favorable and fuels are generally light under the canopy. For the east flank, it is recommended to use the Shadyside Trail as the boundary instead of the lake for ease of access for holders.

This approximate unit boundary contains the bulk of the oak woodland and native bunch grasses and will need to be confirmed or adjusted when writing the actual burn plan. This proposed perimeter decreases the unit size substantially down to about half of the original map size.

Possibilities, Benefits, and Drawbacks to Time of Year

As with previous units, fuels must be dry enough with the native bunch grasses cured to carry fire. A late spring/early summer burn may provide the best window as adjacent fuels under the Douglas fir canopy may not yet support significant fire spread. Fall burning fall is also an option, but control problems may persist along the west flank.

Evaluating Defensibility and Proposed Mitigations.

The road and trail defining the north and east flanks respectively are defensible and require normal prep on the burn side where needed to minimize scorch and spotting. The first 200 feet above Rocky Ridge Road on the west flank is potentially challenging due to terrain. Both the saw cut and scrape can be widened as determined by a Burn Boss when laying out the unit. The west and south flanks will require a hoselay for which the Bon Tempe Lake can provide an excellent water source.

Recommendations for Pre-Burn Vegetation Site Prep Work

To help meet the oak woodland/native grass maintenance objective, Douglas fir reproduction can be cut and scattered throughout the unit interior and along the west flank. The cut material may assist with fire spread after it has dried. Material can also be piled and burned the following winter at the discretion of the District. As mentioned above, the fireline prep along the west flank may need to be widened where needed due to overslung terrain.

The stairs, wooden water bars, signs, and posts associated with the Shadyside Trail will need to be protected through either a hoselay, backpack pumps, and/or removing adjacent fuels away.

Chance of Implementation, Escape, and Meeting Agency Objectives

This is a small one day unit that has defensible boundaries around half its perimeter. There are secondary lines in the form of lakes or the Rocky Ridge Road on all flanks except the south. A control problem to the south will burn deeper into District and will be confined between a road and lake for some distance. It should be possible to eventually contain an escape in this location by tying into the two secondary boundaries with either direct or indirect attack.

The burn will require closure of the Shadyside Trail and either closure or delays on both the Alpine-Bon Tempe Pump and Rocky Ridge Roads. For this reason, it is critical that the District does thorough public outreach prior to implementation. Public information will be key to ensure support of the project from local communities. Due to its smaller size, smoke should pool within the immediate area at night and should not be a significant issue to the local communities.

MOUNTAIN THEATER

The Mountain Theater unit is surrounded by defensible boundaries around most of its perimeter. The initial map has the northwest flank defined by Ridgecrest Boulevard, the east flank by the Mountain Theater Trail, and the south flank by the Douglas fir/grassland vegetation edge.

Suggestions on Modifying Unit Boundary and Size

The northwest and east flanks should stay the same as the original map. It is recommended to expand the south flank south to the Mountain Theater Access Road for ease of holding. This would entail bringing the burn on to a small sliver of State Parks land. If this is not an option, a handline will need to be constructed along the District boundary through a Douglas fir, madrone, canyon live oak, and giant chinquapin forest.

Possibilities, Benefits, and Drawbacks to Time of Year

This unit is almost 100% forested with the objective of reducing ladder fuels and lowering future fire intensities. The interior has been masticated. For this reason, a fall burn window is recommended to ensure masticated fuels are dry enough for consumption and to kill the smaller trees. Burning in the fall also has the advantage of a quicker burn down time. However, areas outside the unit will possibly be more available as spotting receptacles. Fall burning can be challenging due to the higher elevation exposure to foehn-type wind events. Burning a few days ahead of precipitation will have the advantage of reducing the amount of mop-up and patrol. Fuels may be too wet if the unit is burned in the spring.

Evaluating Defensibility and Proposed Mitigations.

If the south flank can be moved to the Mountain Theater Access Road, the unit is highly defensible. The road will serve as a good secondary line if a handline must be constructed. The Mountain Theater Trail on the east flank may require a hoselay which will aid holders if burning in the fall. The rest of the perimeter is surrounded by a drivable paved road with good engine access. The trail and roadsides will need the standard saw cut preparation to minimize scorch and spotting.

Recommendations for Pre-Burn Vegetation Site Prep Work

As mentioned above, the unit interior has been masticated and will require no additional work. The balance of the perimeter will require normal prep work in areas of heavy or problematic fuels. There are numerous wooden features requiring prep and protection. They include fences along the trail, a historic power pole along the south flank, and fences and signs at the junction of Ridgecrest Boulevard and the Mountain Theater Access Road. The Cushing Memorial Amphitheater is southeast of the unit. While much of the amphitheater is non-combustible, the surrounding area should be evaluated for any pre-burn prep of wooden features in case there is spotting in that direction.

Chance of Implementation, Escape, and Meeting Agency Objectives

The unit has a high chance of implementation and success due to its defensibility. It will be a District personnel decision of how to proceed in case there is a substantial delay getting State Parks

to approve the boundary. Although potentially visible throughout the area, smoke is not anticipated to be a significant issue.

Fuels transition to grass west across Ridgecrest Boulevard which may experience higher rates of spread in the event of spotting. The Benstein and Simmons Trails can serve as secondary lines if needed if control problems are experienced across the boulevard. There are other trails that can serve as secondary lines in other directions. These include the Rock Spring Trail to the east and the Mountain Theater Fire Trail to the south.

A portion of the Mountain Theater Trail will need to be closed and Ridgecrest Boulevard and the Mountain Theater Access Road may be subject to delays. Therefore it is critical that the District does thorough public outreach prior to implementation.

RS-2.5

The RS-2.5 unit is a small, straight forward unit. The east flank is defined by Ridgecrest Boulevard and the rest of the unit is surrounded by grasslands.

Suggestions on Modifying Unit Boundary and Size

There are no suggestions for modifying the unit boundary or size. If it is not feasible to bring the unit boundary east all the way to Ridgecrest Boulevard on the State Parks right of way road corridor, the burn will probably not be worth doing due its already small size.

Possibilities, Benefits, and Drawbacks to Time of Year

Due to the similar fuel type and objectives, burning would ideally occur in the fall within a similar window to the Mountain Theater unit.

Evaluating Defensibility and Proposed Mitigations.

Ridgecrest Boulevard is a two-lane paved road and is highly defensible. It will need the standard saw cut preparation to minimize scorch and spotting. The balance of the unit will require burning off mow and wet lines in the grass. This will necessitate a higher skill level and close coordination between burners and holders. Constructing handline down to mineral soil in the grasslands would mitigate most holding problems, however, this may not be desirable from a resource impact standpoint.

Recommendations for Pre-Burn Vegetation Site Prep Work

A handline or standard width mow line around the south, west, and north flanks will need to be completed and a hoselay installed. There is no necessary interior work to be done as it will have been either thinned or masticated prior to ignition.

Chance of Implementation, Escape, and Meeting Agency Objectives

With proper coordination of burning off wet lines, there is very little chance of escape from this unit. Being a small, straight forward burn the chance of success is very high. As Ridgecrest Boulevard will be subject to delays, it is critical that the District does thorough public outreach prior to implementation. Although potentially visible, smoke is not anticipated to be a significant issue.

RS-6

The RS-6 unit is basically a larger version of RS-2.5. The initial map has the unit boundary defined by the Douglas fir forest/grassland edge around a portion of the north and east flanks. The Simmons Trail defines a portion of the south and west flanks. An unnamed creek and Douglas fir forest define the boundary around the southwest corner.

Suggestions on Modifying Unit Boundary and Size

The southwest corner should be moved east to the Simmons Trail to facilitate easier holding. The entire west flank should consist of the Simmons Trail which, moving north, becomes underslung and parallels the small, unnamed creek within 20 feet. There is a pocket of Douglas fir mortality along this flank. The boundary should cross the creek on a bridge (that will need to be protected) and veer to the right on the "Unnamed Trail 4-8-14 #6". This trail will require significant prep. Staying east of the creek, the boundary ties into an open grassland on the north flank. The grassland will require either a handline or a mow line uphill to the Benstein/Benstein Spur Trail junction. From this point the Benstein Spur Trail, which is overslung in grass, can be used until a long grassland can define the east flank with a hand or mow line. This flank will tie back to a hand or mow line at the southeast corner which in turn will form the south flank before tying back into the Simmons Trail.

The above paragraph should be followed only if it is the District's desire to burn RS-6 as a separate unit. However, in the name of cost efficiency, operational simplicity, and less prep, it is recommended that RS-6 be burned as one unit in combination with RS-2.5 and RS-5. In this case Ridgecrest Boulevard would define the entire east flank (with the attendant State Park issue). The south flank would be a hand or mow line with hoselay from the boulevard to the Simmons Trail. The west flank would remain the same. The north flank would continue from the Benstein/Benstein Spur Trail junction and use the spur trail, which is mostly overslung, all the way to Ridgecrest Boulevard to encompass RS-5. The RS-5 unit should be kept south of the trail and the northeast corner on the initial map should be made part of the Upper Lag Rock 2 & 4 unit. Burning these three units as one will add approximately 4-5 acres of additional grassland.

Possibilities, Benefits, and Drawbacks to Time of Year

Due to the similar fuel type and objectives, burning would ideally occur in the fall within a similar window to the Mountain Theater unit.

Evaluating Defensibility and Proposed Mitigations.

As with previous units, Ridgecrest Boulevard is a two-lane paved road and is highly defensible. The grasslands on the north and south flanks will need either a hand or mow line in conjunction with a hoselay. Advantages and disadvantages of burning off wet lines versus handlines has been discussed above. The west flank and portions of the other flanks where the line or trail is over or underslung will require diligent prep which may need to be wider than usual. The roadside will need the standard saw cut preparation to minimize scorch and spotting.

Recommendations for Pre-Burn Vegetation Site Prep Work

A handline or standard width mow line through the grasslands will need to be completed and a hoselay installed. During the prep work of the Simmons and Benstein Trails, all wooden features such as the bridge and water bars will need to be prepped and/or protected. Snags in the Douglas fir mortality pocket along the west flank should be evaluated for either felling, lining, or excluding. There is no necessary interior work to be done as it will have been either thinned or masticated prior to ignition.

Chance of Implementation, Escape, and Meeting Agency Objectives

With good unit preparation and proper coordination burning off wet lines, this unit has a high chance of success. Control problems will most likely be limited to along the west flank or the northwest corner. While some distance away, the Cataract and Mickey O'Brien Trails could serve as secondary lines to the west. To the north an escape should be hemmed in between the Simmons and Benstein Trails and connected through direct or indirect attack.

Portions of the Simmons, Benstein, and Benstein Spur Trails will need to be closed and Ridgecrest Boulevard may be subject to delays. Therefore it is critical that the District does thorough public outreach prior to implementation. Although potentially visible throughout the area, smoke is not anticipated to be a significant issue.

WORN SPRINGS UPPER & LOWER

The Worn Springs Upper and Lower units are ambitious and challenging primarily due the steep terrain, the presence of infrastructure, large amount of cutoffs, and an unclear north flank. The initial map used Shaver Grade Road to define the southwest flank, the Phoenix Lake Road to define the south flank, a grassland at the southeast corner and the winding Worn Springs Road to define the east flank, and some sort of combination handline or mow line to define the north flank. The midslope Yolanda Trail divides the unit into two the upper and lower segments.

Suggestions on Modifying Unit Boundary and Size

This is a fairly complex burn that will take additional scouting to accurately define the entire boundary. The Shaver Grade Road parallels Phoenix Creek and is a defensible boundary. However, there are powerlines within the unit at the southwest corner that will need to be prepped (using the standard hand or mow line specifications underneath or adjacent uphill to the actual corridor) if the area is too large to have them excluded. Along the south flank, the ranger residence will need to be excluded as well as possibly moving the boundary up to the powerline corridor above the Phoenix Lake Road in two locations. At the southeast corner it is recommended that the boundary be moved west and either use the powerline corridor or cutoff the switchback at the Phoenix Lake and Worn Spring Road junction and go straight uphill to tie back in with Worn Springs Road. There are 2-3 additional switchbacks on the Worn Springs Road that could be cutoff for a straighter east flank. This includes the area around the covered Ross Reservoir. There is a lot of French broom in this area.

After rounding the last broad curve along the Worn Springs Road at the northeast corner on the map, the unit should be extended along the road north to the Unnamed D17 Trail to form a northern tip. This

is an open grassland and fuels are sparse along the trail. The Unnamed D17 Trail should be used as much as possible as the upper north flank down to the Yolanda Trail to avoid rocky and bluffy terrain and areas of chamise.

There are a few open spur ridge options below the Yolanda Trail down to Shaver Grade Road to use as the lower north flank. This area will need additional scouting to determine which ridge is the most ideal. If possible the flank should be kept as straight as possible when transitioning below the trail. If fuels or terrain make this difficult, there could be a significant dog leg in the north flank. Note that the various spur ridges below the trail start out in relatively open grasslands, but become much more vegetated towards the bottom at Shaver Grade Road. This is especially true as the upper north flank starts out as sparse grass, but vegetation density increases going down slope.

Possibilities, Benefits, and Drawbacks to Time of Year

The unit has multiple aspects (although primarily west) and a lot of fuel variability ranging from grasslands, chamise patches, oak woodlands, and thicker riparian vegetation along the west flank. For this reason it is difficult to identify an optimal time of year for ignition. Burning in the spring has the advantage of lower intensities but the disadvantage of having a large unit needing patrol and mop-up into the summer months. Burning in the fall has the advantage of fuels being dry (or perhaps too dry) and burning into the cooler months. However, post-burn wind events could create significant control problems and possibly lead to an escape. Meeting the desired objectives and resource availability should be the primary factors to consider when targeting a specific time of year for ignition.

Evaluating Defensibility and Proposed Mitigations.

The numerous switchback cutoffs and the presence of substantial infrastructure such as powerlines, residences, reservoirs, etc. will all require a large amount of prep to avoid control problems or property damage. Shaver Grade Road, Phoenix Lake, and large grasslands make much of the unit defensible along the southwest, south, and upper northern flanks. Two other areas of concern are the switchbacks along the east flank of Worn Springs Road and the north flank below Yolanda Trail. Additionally Yolanda Trail is a narrow, midslope single track which is not a viable hard boundary to separate the upper and lower segments. The unit interior is very steep and roll out below the trail is inevitable in areas of heavier fuels.

The north flank will most likely require a hoselay. A large capacity snap tank(s), water tender, or equivalent will be needed for adequate water storage at the northern tip. This hoselay will have tremendous head pressure and will require gated wyes mostly closed to attempt to mitigate bursting hoses.

Recommendations for Pre-Burn Vegetation Site Prep Work

All cutoffs, exclusions, and north flank may need wider than normal firelines at the discretion of a Burn Boss. This will be necessary to minimize the risk of damaging any property or improvements. All roadsides will need the standard saw cut preparation to minimize scorch and spotting. If possible, the French broom should be cut, piled, and burned along the east flank prior to ignition. Prepping the interior Yolanda Trail is not recommended due to the low probability of success in preventing roll out.

Chance of Implementation, Escape, and Meeting Agency Objectives

It may be difficult for the District to obtain a burn permit for this unit due to its size and difficulty in holding the north flank. Much of the interior terrain in the upper segment is very rugged and rocky which presents a safety concern to burners. The District should consider using aerial ignition with either drones or a helicopter to mitigate some of the firefighter exposure. This will also allow for a much quicker ignition than hand firing the entire area. Aerial ignition could possibly keep the burn as a one day operation.

Due to the large amount of close proximity values at risk, slope steepness, and lack of a viable midslope segment break, the unit will require a large amount of engines and firefighters for proper staffing. It is highly likely that once the unit is ignited, it will burn through both segments all the way to the bottom whether or not that is desired. Once fire reaches the heavier lower vegetation along the Shaver Road, extended patrols and mop-up will be necessary in the absence of rain.

Segmenting the burn using interior ridges is a possibility, but this will also entail the same difficulty as holding the north flank. This includes water and hose logistics, more fireline prep, issues with the steep terrain, and having adequate resources to keep the burn within the desired segment boundary.

Secondary lines include the Concrete Pipe Road to the west and several trails to the north which could be connected through handlines. Any secondary lines to the east would be located within the wildland urban interface and will require structure protection. Phoenix Lake is a solid boundary to the south.

Lastly, the District should consider its nearby boundary to private land as to whether this is a feasible project. At approximately 151 acres this could be a multi-day ignition with a large volume of smoke produced close to an urban area. It is recommended that while the District should not cancel this burn, personnel should take a hard look at how much risk they are willing to take. If the decision is to go forward with the burn, it is critical that the District does thorough public outreach prior to implementation. Public information will be key to ensure support of the project from local communities.

AIR FORCE BASE UPPER & LOWER

The Air Force Upper and Lower units were found to be overall not feasible. This was primarily determined by the south flank of the upper unit which contains substantial historic infrastructure associated with the old air force base. While all the infrastructure is situated at the ridgetop, it would not be possible to adequately prep and protect all these features due to terrain and fuels.

With the upper unit not being feasible, the general topography rules out the lower unit as all potential boundaries going downslope to the north would be steep and overslung. The Bowling Alley Trail, which is a narrow social trail originally dividing the two units, was scouted as a possible boundary for the south flank of the lower unit. This trail was found to be non-viable due to the reasons stated above. There is no defensible terrain along the entire north facing slope which could be used as an upper boundary for the lower.

For these reasons, it is recommended to not attempt to burn either of the Air Force Base units.

FAWN RIDGE

The Fawn Ridge unit is challenging due to the Bolinas Fairfax Road, close proximity of Fairfax and horse corrals, steep terrain, and a potentially difficult south flank. The initial map used the Bolinas Fairfax and Fawn Ridge Tank Roads, and a handline to define the north/northwest flank, the horse stable area to define the east flank, and the Canyon Trail and small, narrow draw to define the south/southeast flank. The north and south flanks converge to form a western tip at the Concrete Pipe Road turnoff.

Suggestions on Modifying Unit Boundary and Size

From the water tank it should be possible to follow a broad ridge to the right of two large oak candles downhill towards the horse stables. The terrain is steep but defensible. There is a good gravel bed dry stream to serve as a barrier along the east flank adjacent to the stables. All vehicle access ends at the southeast corner where the gravel bed ties into the Canyon Trailhead. The Canyon Trail parallels a small creek along the south flank. There are several piles in this area, some can be excluded by using the creek as the boundary instead of the trail.

Approximately halfway along the south flank, the Canyon Trail turns south and the unit boundary becomes a small, narrow draw. This draw will be problematic as a holding boundary due to its narrowness, fuels, and steep terrain. The perimeter may need to be adjusted along this flank to one side of the draw or the other. Either option is not ideal. The draw gets steeper and narrower going west into a redwood forest with varying defensibility.

Instead of using this draw all the way to the western tip, it is recommended that a west flank be scouted up to the Bolinas Fairfax Road. The northwest corner along the road would need to be located at a turnout to facilitate a hoselay. Terrain is very steep through an oak woodland but this option could exclude the worst of the south flank draw as well as the powerlines near the western tip. This may be the only realistic option and would need to be further scouted during the burn plan development.

Possibilities, Benefits, and Drawbacks to Time of Year

In order to maximize the length of time and benefit of reduced fuels next to the urban wildland interface, it is recommended to burn this unit in the spring after the grass has cured.

Evaluating Defensibility and Proposed Mitigations.

The roads, gravel bed, and trail that define most of the north, east, and the eastern portion of the south flank respectively, are all defensible and will require only normal prep work. Due to the large amount of structures associated with the horse stables, an engine will most likely need to be positioned in that location throughout the entire burn.

As stated above, the draw making up the western portion of the south flank is only marginally defensible. If used, it will require enhanced prep or additional scouting to relocate the perimeter. There were no obvious alternative perimeter locations that could be seen either north or south of the draw. However, this unit was burned in the year 2000. If possible, burn records or retired District personnel should be consulted to learn what was done to address and mitigate the holding concerns along this flank.

Recommendations for Pre-Burn Vegetation Site Prep Work

There may be a need to brush back fuels along the Bolinas Fairfax Road as necessary to lower fire intensity and spotting potential. There are powerlines running parallel to the road so all poles and anchors will need to be prepped and protected. All wooden signs along the road should be scraped around. The water tank will require no specific protection and can serve as a water source. The standard prep specifications should be adequate for the handline between water tank and stables. This line will require a hoselay.

While the gravel bed requires minimal to no prep along the east flank, the adjacent horse stable structures should be evaluated for any potential issues. Any piles in this area, along the Canyon Trail, or in the creek should be either burned or scattered prior to ignition. There are two wooden bridges, one on the east flank and the other on the south flank that will need to be protected.

As mentioned above, the south flank draw will require substantial prep to make it defensible. A 20 foot saw cut may be necessary and a handline constructed on one side of the draw or the other. This section of line will require a hoselay.

If a new west flank is scouted, the standard fireline specifications can be used in the oak woodland. A hoselay will need to be deployed along the line as well. If the District decides to forego this handline and use the south draw all the way to Concrete Pipe Road, the powerlines cutting across the unit will probably not require any enhanced prep. Fuels are light underneath and the powerlines are located high above the ground.

Chance of Implementation, Escape, and Meeting Agency Objectives

There are several issues affecting the feasibility of implementing this burn unit. They include traffic control along the Bolinas Fairfax Road, the immediate proximity of the urban wildland interface, smoke impacts to Fairfax and the horse stables, and the closure of the Canyon Trail. Most of these issues can be mitigated with good burn prep, traffic management, and proper public outreach prior to implementation. Public information will be key to ensure support of the project from local communities and the horse stables. Fortunately the small size and relatively light fuels through much of the unit will help make the smoke impacts manageable.

If there are significant control problems, the Concrete Pipe, Boy Scout, and Deer Park Fire Roads can serve as secondary lines to the west, south, and east. San Anselmo Creek may serve as a secondary line to the north but it may have limited viability. Both San Anselmo Creek and Deer Park Road could involve fire being in the interface and may require structure protection.

The biggest problem will be resolving the south flank boundary. Given that this unit has been previously burned, this issue should not be insurmountable with additional scouting and/or consultation.