

V. VEGETATION MANAGEMENT PROGRAM

This chapter sets forth a Vegetation Management Program) that: identifies and describes the various vegetation types within the Study Area and their associated fuel characteristics; outlines fire hazard reduction and resource management goals; identifies potential fuel treatment methods; and provides recommended treatment performance guidelines and standards and resource protection guidelines for each vegetation type. Coupled with the fuel treatment methods presented in Chapter IV. Fuel Reduction Methods, this Vegetation Management Program provides the fuel reduction and resource management standards and guidelines for each vegetation type that the District will incorporate into specific fuel reduction projects and annual fuels treatment that will be prepared to implement this Plan and achieve the District's goals and objectives over time.

Effective vegetation management practices are critical to maintaining the health of the area's diverse ecosystems while at the same time reducing potential hazards from wildfires in the region. As noted previously, three key factors contribute to wildfire risk—fuels, weather, and topography—and only fuels are readily within human control. The state of the art in reducing wildfire risk includes creating fire-resistant communities, defensible spaces, and a pattern of strategic fuel reduction zones that can compartmentalize and dampen fire progression patterns, reduce heavy fuel loads and restore native vegetation to fire-prone areas.¹ The vegetation management program (VMP) set forth in this chapter was created with these ideas at the forefront to focus efforts on reducing fuel loads within the Study Area.

Information from the following documents informed and provided the basis for this VMP:

- Vegetation Management Almanac for the East Bay Hills, published by the Hills Emergency Forum; Danielsen Consulting, Inc.; EBRPD; Ernest Orlando Lawrence Berkeley National Laboratory; and Wildland Resource Management, Inc., 2005;
- Final Environmental Assessment for the East Bay Regional Park District, Vegetation Management Projects Alameda and Contra Costa Counties, California, HMGP #919-515024, prepared by URS Corporation, April 2003;
- Fire Hazard Mitigation Program and Fuel Management Plan for the East Bay Hills, prepared for the East Bay Hills Vegetation Management Consortium by Amphion Environmental, Inc., 1995 (1995 Plan); and

¹ National Academy of Public Administration, 2004. *Containing Wildland Fire Costs: Enhancing Hazard Mitigation Capacity*. January.

- Individual land use and development master plans prepared by the District for parks within the Study Area.

The purpose of this VMP is to direct vegetation management in EBRPD's treatment areas; it is not intended to be used as a technical manual for habitat restoration, but rather as basic guidelines for improving habitat and restoring native vegetation while reducing wildfire hazards. This VMP is designed to work in coordination with the EBRPD Master Plan and in concert with the plans of other public agencies whose jurisdictions are adjacent to EBRPD lands to reduce wildland-urban interface fire risks in the Study Area. The EBRPD Master Plan defines the vision and mission of EBRPD and provides policies and guidelines for achieving the highest standards of service in recreation resource conservation, management, interpretation, and public access. This VMP also provides the guidelines for implementation of the 1995 Fire Hazard Mitigation Program and Fuel Management Plan which seeks to reduce common dangers of fire by mitigating hazards in the wildland-urban interface and includes a series of tools and methods regarding how to reduce these hazards.

A. OVERVIEW OF VEGETATION AND FUEL CHARACTERISTICS

The vegetation management methods and performance standards included in this Vegetation Management Program are set forth to provide guidelines for the management of fuels on EBRPD lands. The scientific community has been slow in showing interest in applied research documenting the effects and impacts of fuel management on specific vegetation communities; as a result most of the standards and special considerations established here are based on the experiences of land managers who have been working on fuel modification; available research to address known environmental considerations; and the professional knowledge and judgment of EBRPD staff and the consulting team. This Vegetation Management Program is where the fire science and fuel reduction goals and the resource management considerations for natural communities come together in a comprehensive program to guide future EBRPD vegetation management projects.

The information provided in this VMP for each identified vegetation type in the Study Area is meant to be comprehensive and informative for the various conditions that may confront the District in the future in regards to the variability of vegetation, fuel characteristics, slope and soil conditions, available methods, staffing and budgeting considerations. The EBRPD's commitment to adaptive management practices and reporting of results and ongoing monitoring of treatment outcomes will result in information becoming available regarding techniques that are proven to be effective, economical, and have the fewest potential adverse environmental impacts. As this VMP is implemented and treatment prescriptions are developed for specific areas, it is anticipated that the information contained in this Plan

will be refined and updated to incorporate greater detail and refined treatment methods and performance standards.

In this VMP, potential treatments to reduce fire hazard severity are organized by vegetation type rather than only by fuel type for several reasons. Even though vegetation types may combine several fuel types, treatments are most often aimed at changing fuel conditions (e.g., fuel volume, continuity, proportion of dead material) without changing the vegetation type. In addition, the potential beneficial or adverse effects of treatments are more directly associated with vegetation types as they are linked to special-status species, wildlife habitat, and other resource concerns.

1. Vegetation Management Program Vegetation Types

This vegetation management program (VMP) identifies and evaluates 16 vegetation types for management and fuel reduction under the following three major classifications: Grasslands and Herbaceous Vegetation, Scrub Vegetation, and Woodlands and Forest Plantations. Certain vegetation types found in EBRPD parks, such as freshwater and saltwater marshes, have been excluded from this analysis because they do not present a wildfire hazard due to their constant high moisture levels. The generalized vegetation types in the Study Area are shown in Figures V-1.a through V-1.d.

The vegetation types identified in this VMP for treatment were aggregated from approximately 300 vegetation types identified and mapped by EBRPD in 2006. These vegetation types were translated (or “crosswalked”) and organized by their fuel characteristics for the purposes of running the fire behavior prediction software (called FlamMap) to assess wildfire hazards as part of the Plan process. The various vegetative fuel characteristics that were considered and field checked included: tree heights, canopy cover, height to the lowest branches of the tree crown, volume, structure, height of the surface fuels, proportion of dead material on the ground and in the stand, and the size class distribution of biomass in the stand. The Wildfire Hazard Assessment report, included in Appendix C, provides additional information and details concerning the wildfire hazard assessment including fuel modeling, the vegetation crosswalk, and the identification of recommended treatment areas.

In addition to aggregating the EBRPD vegetation types into categories with similar fuel characteristics, the consultant team also organized them based on various plant classification systems² and their professional judgment. As discussed in Chapter III. Implementation, specific fuel treatment prescriptions will be based on field assessments and

² Holland, R.F. 1986. *Preliminary Descriptions of the Terrestrial Natural Communities of California*. California Department of Fish and Game, Sacramento, CA. and Sawyer-Keeler-Wolf, 1995. *Manual of California Vegetation*.

more detailed mapping conducted prior to project implementation to ensure that actual vegetation types and fuel conditions are characterized correctly.

2. Fuel Characteristics of Vegetation Types

Plant communities differ in the way they burn. Species with oily resins, such as eucalyptus and Monterey pines, are far more ignitable than those that lack such characteristics. Not only does the vegetation type itself influence the spread of fire, but managing the vegetation to reduce its heat output is a vital element in planning for fire-resistant landscapes, especially along the wildland-urban interface. The Wildfire Hazard Assessment report (Appendix C) contains a detailed discussion of the fuel characteristics of each vegetation type considered in this section.

Other measures of the comparative flammability and ease of ignition of the vegetation types that are described in this VMP are: the fire hazard rating, fire behavior fuel models, and ignition potential, as described below.

Fire Hazard Rating

Fire hazard ratings describe the variables that determine the potential of different vegetation types to burn, the potential flame length from these vegetation types, and their anticipated heat output when burning. Fire hazard is categorized as Low, Moderate, High, or Extreme. Table V-1 shows the fire hazard rating for each of the vegetation types considered in this VMP.

Wildfire Fuel Models

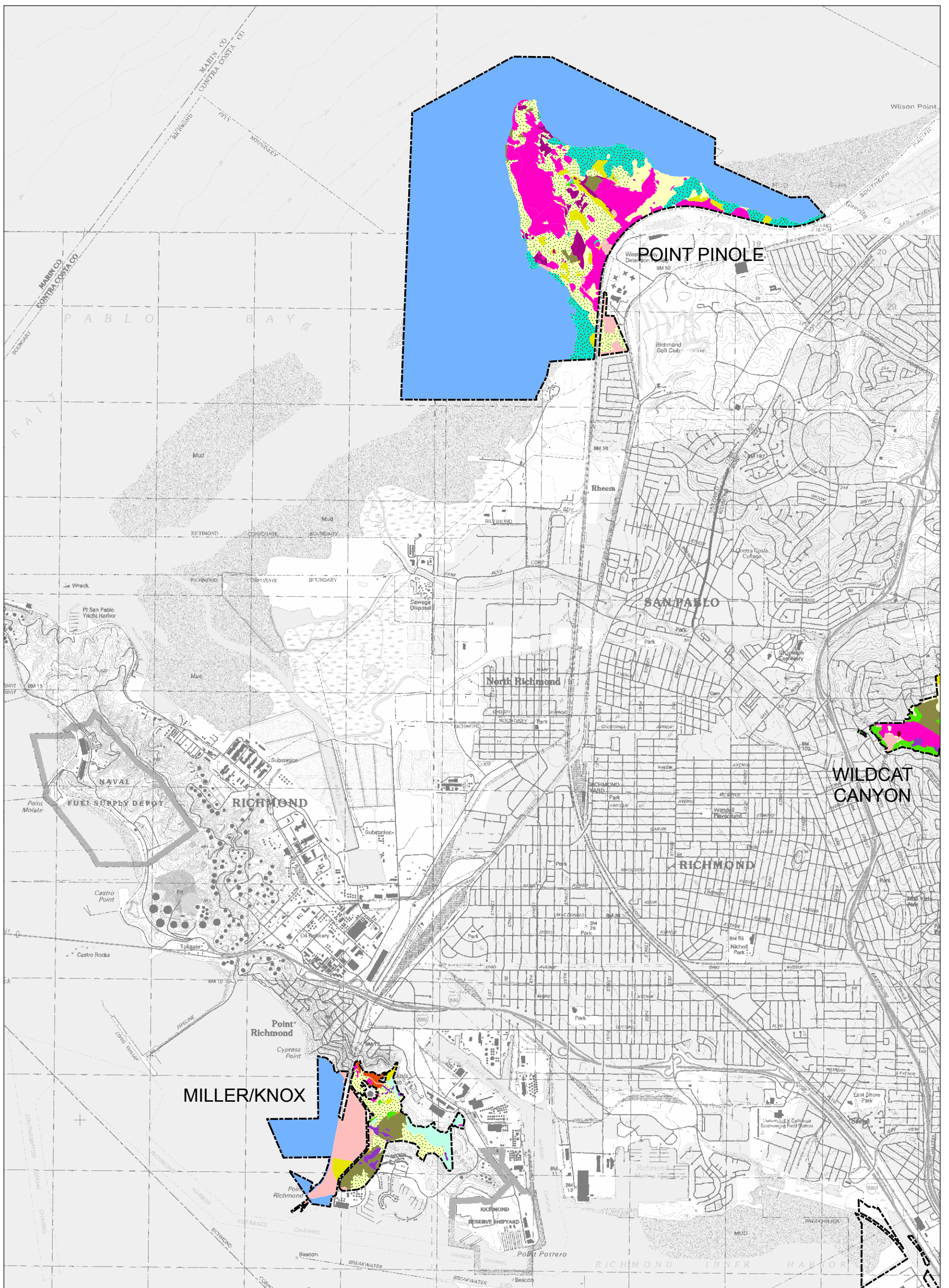
Fire scientists and professionals use Fuel Models, which are numbered based on the Fire Behavior Prediction System (FBPS), to provide a system to describe the general fire behavior that is expected when similar classes of vegetation types (or “fuel models”) burn. For the purposes of this Plan, the fire behavior fuel models used are derived from Richard Rothermel’s report *How to Predict the Spread and Intensity of Forest and Range Fires (General Technical Report INT-143)*.³

Table V-1: Fire Hazard Rating for Fuel Types

| Vegetation Type | Hazard Rating |
|---|------------------|
| Grasslands and Herbaceous Vegetation | |
| Coastal Prairie | Moderate |
| Serpentine Bunchgrass Grasslands | Low |
| California Annual Grasslands | Moderate |
| Ruderal Vegetation | Moderate |
| Scrub Vegetation | |
| Maritime Chaparral | Extreme |
| North Coastal Scrub - Xeric | Extreme |
| North Coastal Scrub - Mesic | High |
| Coyote Brush Scrub | High |
| Non-native Scrub | High |
| Woodlands and Forest Plantations | |
| Mature Eucalyptus Forest | High |
| Young Eucalyptus Forest | High |
| Mature Monterey Pine Forest | Moderate to High |
| Young Monterey Pine Forest | High |
| Oak-Bay Woodland | Low |
| Redwood Forest | Low |
| Riparian Woodland | Low |

Source: Amphion, Inc., 1995. Vegetation Management Consortium.

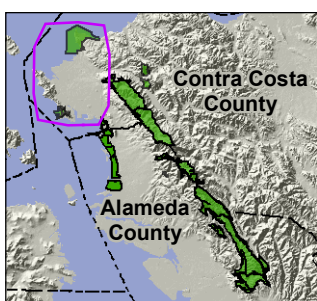
³ Rothermel, Richard C., 1983. *How to Predict the Spread and Intensity of Forest and Range Fires*. USDA Forest Service Intermountain Forest and Range Experiment Station, General Technical Report INT-143.



LSA



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FEET

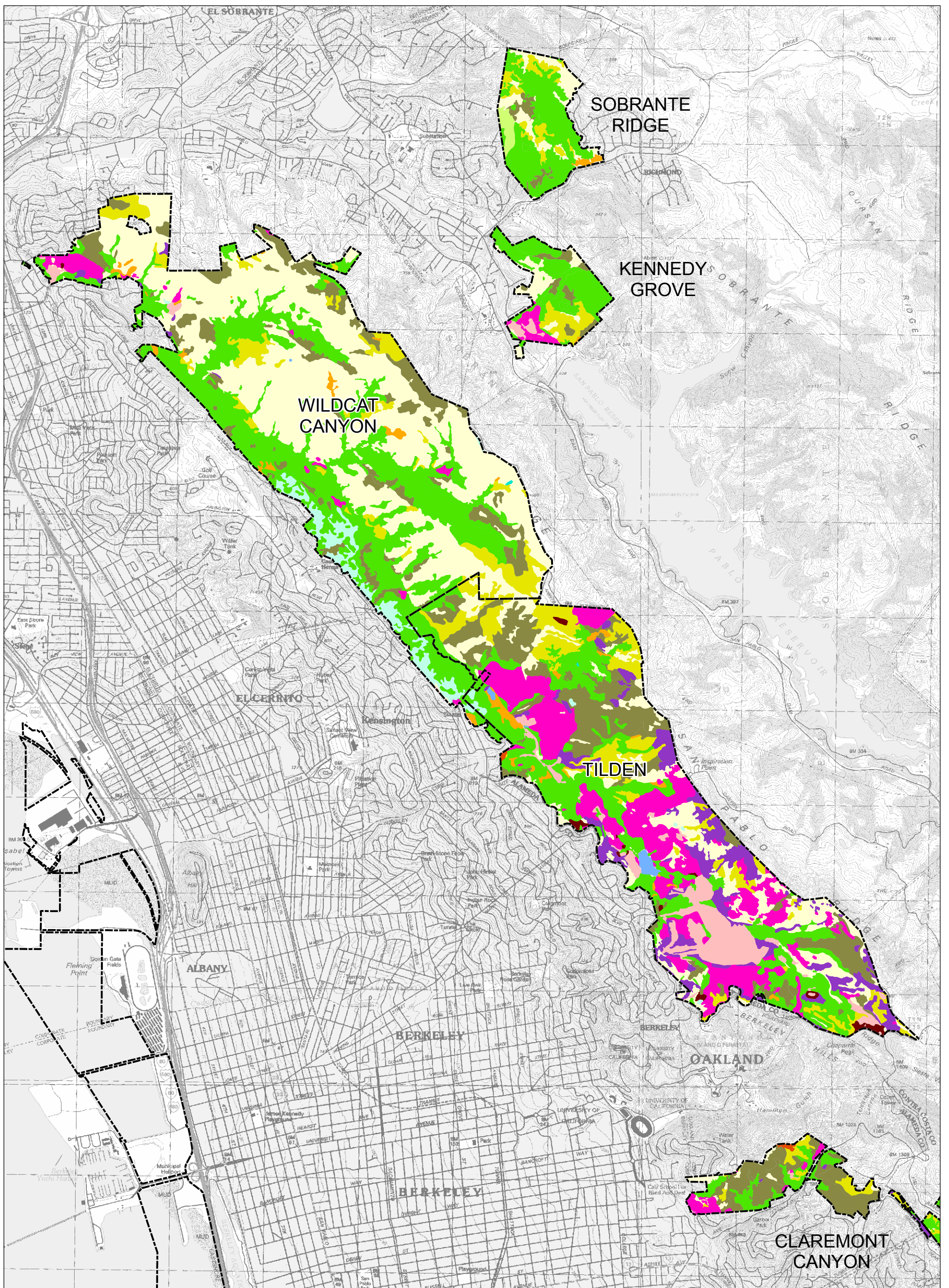


- | | | | |
|--|-----------------------|--|--------------------------------|
| | COYOTE BRUSH SCRUB | | CALIFORNIA ANNUAL GRASSLAND |
| | COASTAL SCRUB (MESIC) | | COASTAL PRAIRIE |
| | COASTAL SCRUB (XERIC) | | MARITIME CHAPARRAL |
| | REDWOOD FOREST | | OAK-BAY WOODLAND/FOREST |
| | RIPARIAN WOODLAND | | CONIFEROUS FOREST/PLANTATION |
| | FRESHWATER MARSH | | EUCALYPTUS FOREST/PLANTATION |
| | SALT MARSH | | RUDERAL VEGETATION |
| | AQUATIC/OPEN WATER | | DEVELOPED/DISTURBED/LANDSCAPED |
| | NON-NATIVE SCRUB | | PROJECT AREA |

FIGURE V-1.A

EBRPD Wildfire Hazard Reduction
and Resource Management Plan

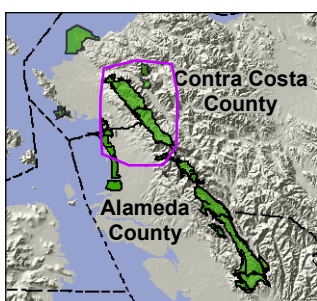
Vegetation Types



LSA



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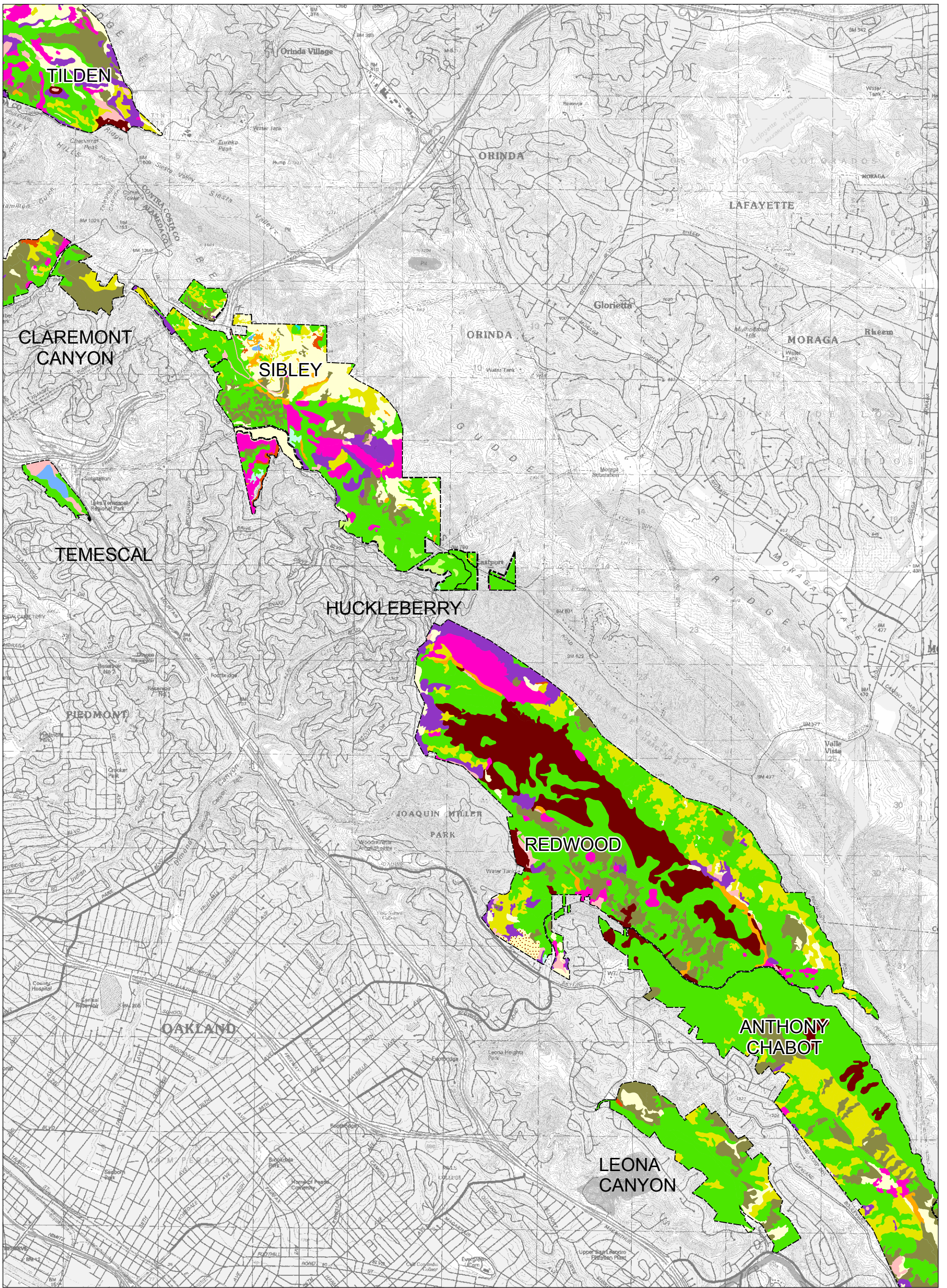


- | | | | |
|--|-----------------------|--|--|
| | COYOTE BRUSH SCRUB | | CALIFORNIA ANNUAL GRASSLAND (INCLUDES COASTAL PRAIRIE WITHIN WILDCAT) |
| | COASTAL SCRUB (MESIC) | | MARITIME CHAPARRAL |
| | COASTAL SCRUB (XERIC) | | OAK-BAY WOODLAND/FOREST |
| | REDWOOD FOREST | | CONIFEROUS FOREST/PLANTATION |
| | RIPARIAN WOODLAND | | EUCALYPTUS FOREST/PLANTATION |
| | FRESHWATER MARSH | | RUDERAL VEGETATION |
| | AQUATIC/OPEN WATER | | DEVELOPED/DISTURBED/LANDSCAPED |
| | NON-NATIVE SCRUB | | PROJECT AREA |

FIGURE V-1.B

EBRPD Wildfire Hazard Reduction
and Resource Management Plan

Vegetation Types



LSA



0 1,600 3,200
FEET

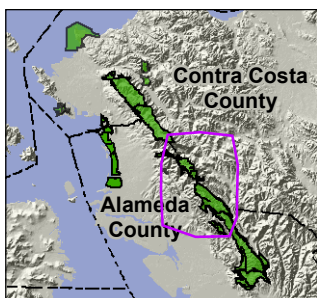
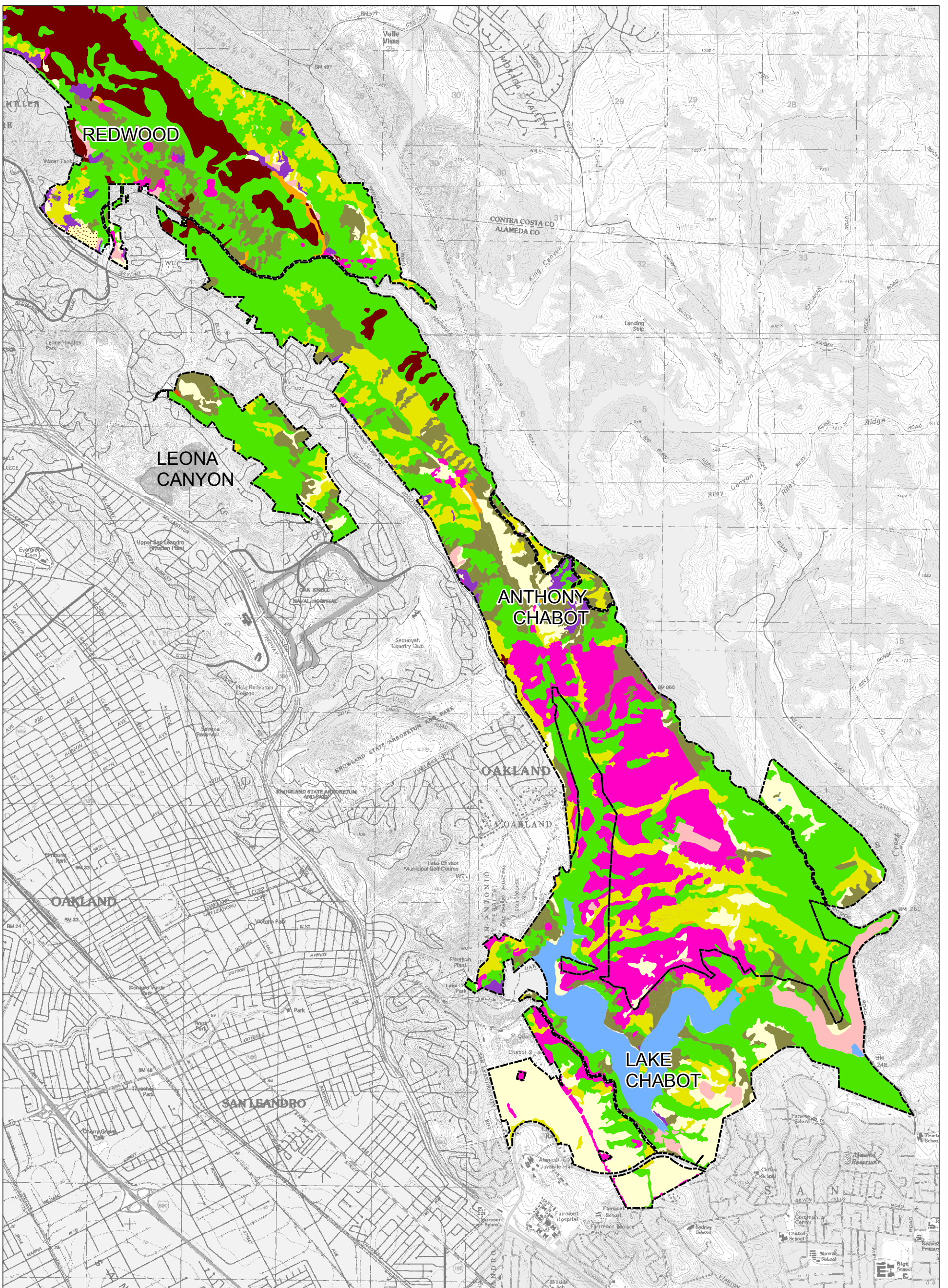


FIGURE V-1.C

EBRPD Wildfire Hazard Reduction
and Resource Management Plan

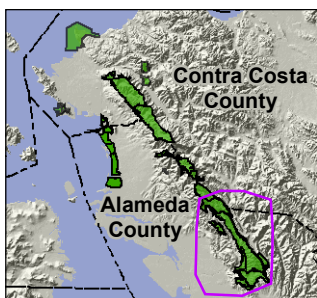
Vegetation Types



LSA



0 1,600 3,200
FEET



- | | | | |
|--|-----------------------|--|---------------------------------|
| | COYOTE BRUSH SCRUB | | CALIFORNIA ANNUAL GRASSLAND |
| | COASTAL SCRUB (MESIC) | | SERPENTINE BUNCHGRASS GRASSLAND |
| | COASTAL SCRUB (XERIC) | | MARITIME CHAPARRAL |
| | REDWOOD FOREST | | OAK-BAY WOODLAND/FOREST |
| | RIPARIAN WOODLAND | | CONIFEROUS FOREST/PLANTATION |
| | FRESHWATER MARSH | | EUCALYPTUS FOREST/PLANTATION |
| | AQUATIC/OPEN WATER | | RUDERAL VEGETATION |
| | NON-NATIVE SCRUB | | DEVELOPED/DISTURBED/LANDSCAPED |
| | | | PROJECT AREA |

FIGURE V-1.D

EBRPD Wildfire Hazard Reduction
and Resource Management Plan

Vegetation Types

Fuel models identified for the Study Area include Rothermel’s report *How to Predict the Spread and Intensity of Forest and Range Fires (General Technical Report INT-143)*.⁴ Fuel models identified for the Study Area include Models 1, 2, 4, 5, 6, 8, 9, and 10, as described throughout this chapter.⁵ Further information on fuel models and the characteristics included for each can be found in the Wildfire Hazard Assessment report included as Appendix C.

When determining the appropriate fuel model to apply to a GIS mapped vegetation type, the District and consultant team undertook extensive reconnaissance surveys to field check the actual fuel on the ground that will carry a fire. For example, a sparse stand of oaks or an individual oak with a grass understory may be characterized and mapped as a “Grassland” vegetation type in this Plan whose fire behavior can best be described using Fuel Model #1 because the oak leaves and branches may not contribute significantly to the fire behavior due to a minor amount of leaf drop, or because the height at which the branches start is comparatively high. The structure or arrangement of the vegetation is equally as important in determining an area’s fuel model as the kinds of plants that grow in the area. During implementation of the VMP and preparation of fuel modification prescriptions for specific recommended treatment areas, the District will review and determine the fuel model classification to be applied to each area prior to treatment.

Ignition Potential

The ignition potential for each vegetation type describes the ease with which a firebrand that lands within the vegetation type will start a fire. Fine fuels with large surface areas and an elevated ratio of oxygen to biomass tend to ignite easily (e.g., grasslands or pine forests). By contrast, ignition is more difficult in vegetation types that have a compact, low fuel bed composed primarily of leaf litter (e.g., oak-bay woodland), or where the fuel is suspended above in the crown (e.g., chaparral).

An ignition index for the East Bay was developed by a consensus of resource managers as members of the Hills Emergency Forum during the development of the 1995 Plan. Ignition potential is categorized on a relative scale

Table V-2: Ignition Potential for Fuel Types

| Vegetation Type | Ignition Potential |
|---|--------------------|
| Grasslands and Herbaceous Vegetation | |
| Coastal Prairie | 2 |
| Serpentine Bunchgrass Grasslands | 2 |
| California Annual Grasslands | 1 |
| Ruderal Vegetation | 3 |
| Scrub Vegetation | |
| Maritime Chaparral | 6 |
| North Coastal Scrub - Xeric | 4 |
| North Coastal Scrub - Mesic | 8 |
| Coyote Brush Scrub | 4 |
| Non-Native Scrub | 6 |
| Woodlands and Forest Plantations | |
| Mature Eucalyptus Forest | 1 |
| Young Eucalyptus Forest | 2 |
| Mature Monterey Pine Forest | 2 |
| Young Monterey Pine Forest | 2 |
| Oak-Bay Woodland | 6 to 8 |
| Redwood Forest | 8 |
| Riparian Woodland | 8 |

Source: Amphion, Inc., 1995. Vegetation Management Consortium.

⁴ Rothermel, Richard C., 1983. *How to Predict the Spread and Intensity of Forest and Range Fires*. USDA Forest Service Intermountain Forest and Range Experiment Station, General Technical Report INT-143.

⁵ Following initial treatments, fuel models 11 and 12 may be used for areas with predominantly post-treatment slash or to model fuel accumulations in eucalyptus groves.

of 1 to 10, with a 10 given to vegetation types most difficult to ignite. Table V-2 shows the ignition potential index for each vegetation type considered in this VMP.

B. INVASIVE PLANTS

One of the greatest challenges facing the District is the threat of invasive plants such as French broom, yellow star thistle, fennel, and oblong spurge. Invasive plants are harmful, non-native plants that are introduced into an environment in which they did not evolve. "Invasives" often have no natural enemies in these environments, allowing them to out-compete native plants. The spread of invasive plants is profound and rapid, negatively changing the landscape and environment. In many cases, invasives are highly flammable, and, because of their rapid proliferation, add to the fuel load and fire hazard. Issues concerning Invasive plants are mentioned in this chapter because when modifying vegetation types to achieve fuel reduction objectives (such as removing scrub and trees or undertaking a prescribed burn), the District can inadvertently create conditions (bare and disturbed soil) that allow invasive plants to flourish. An understanding of the biology and ecology of the targeted invasive species is necessary for long-term management. Appendix G provides detailed prescriptions for the control of invasive plant species and noxious weeds common to the Study Area.

The goal of this Plan is to work toward an ecosystem that is in equilibrium with a diverse mosaic of vegetation types that are sustainable for given site parameters. In keeping with the Plan's goals, the following are three objectives for reducing the invasive and noxious weeds that the District should seek to address when undertaking specific fuel reduction actions:

1. Control weeds.
2. Identify and achieve resource management objectives such as wildland fuel reduction, wildlife habitat maintenance, ecosystem preservation, forage production, or recreational land management.
3. Prevent reinvasion of the targeted weed or invasion of other noxious species.

Funding limitations may require prioritizing areas of greatest concern for the reduction of invasive weeds. At a minimum, the budget for weed control activities should consider:

- Direct costs (such as labor, equipment, and follow-up management activities)
- Indirect costs (such as the risk of treatment failure, non-use of target areas during establishment periods)
- Potential benefits from treatment actions
- Potential risks from treatment actions

- Staff training in the safe application of herbicides
- Public outreach information on vegetation management projects
- Written pest control recommendations.

Annual monitoring and evaluation should be conducted to determine the adequacy of the treatment techniques and management approach to suppression of invasive plants. Long-term commitment of three or more years is typically necessary to ensure treatment success. Follow-up treatments are usually necessary to prevent re-infestation or the occurrence of substitute invasive species. The Plan's management strategies must be implemented in compliance with the EBRPD Pest Management Policies and Practices Resolution and integrated pest management (IPM) policies, which require that the use of herbicides is minimized wherever possible.

To control weeds the District must carefully match treatment timing and type to the growth stage of the plant to maximize the effect of the treatment (see also Tables IV-2 and IV-3 in Chapter IV, Fuel Treatment Methods). For example, mowing, burning or grazing after yellow starthistle has bolted but before seed set is effective in reducing the present year's population along with reducing available seed for the next year's potential population. In this chapter, control of invasive species associated with wildfire reduction actions is primarily addressed in the sections concerning ruderal (weedy herbaceous) vegetation, non-native scrub (essentially French broom), and eucalyptus.

C. VEGETATION MANAGEMENT PROGRAM

The following sections describe general fuel modification treatments for the three major vegetation/fuel types considered in this Vegetation Management Plan: (1) Grasslands and Herbaceous Vegetation, (2) Scrub Vegetation, and (3) Woodlands and Forest Plantations, as outlined below:

- Grasslands and Herbaceous Vegetation
 - Coastal Prairie (Native Perennial Grassland)
 - Serpentine Bunchgrass Grassland (Native Perennial Grassland)
 - California Annual Grassland (Non-native Annual Grassland)
 - Ruderal Vegetation (Weedy Herbaceous)
- Scrub Vegetation
 - Maritime Chaparral
 - North Coastal Scrub (Xeric and Mesic)
 - Coyote Brush Scrub

- Non-Native Scrub
- Woodlands and Forest Plantations
 - Mature Eucalyptus Forest
 - Young (small-diameter) Eucalyptus Forest
 - Mature Monterey Pine Forest
 - Young (small-diameter) Monterey Pine Forest
 - Oak-Bay Mixed Woodland
 - Redwood Forest
 - Riparian Woodland.

For each of the vegetation types in this VMP, the primary resource values and fuel characteristics are identified as well as fuel reduction and resource management goals, and special considerations associated with each vegetation/fuel type. Potential treatment methods also are recommended, and each method's limitations are identified. "Before and after" treatment photos of high and low hazard fuel conditions for the highest hazard vegetation types are also provided in the following sections. This information is organized under the following headings:

- Vegetation Type Description
- Fuel Characteristics
- Fire Hazard Reduction and Resource Management Goals
- Potential Fuel Treatment Methods and Limitations
- Treatment Considerations and Guidelines

1. Grasslands and Herbaceous Vegetation

Fuel characteristics, resource management goals, and guidelines are described in this section for grasslands which are generally composed of the following four grassland and herbaceous vegetation types: Coastal Prairie (Native Perennial Grassland), Serpentine Bunchgrass Grassland (Native Perennial Grassland), California Annual Grassland (Non-native Annual Grassland), and Ruderal Vegetation (Weedy Herbaceous). Grasslands are dominated by herbaceous plant materials and annual grasses. Grasslands may include



California Annual Grassland (Spring)

widely spaced trees such as native oaks and some brush species, but, by definition, woody vegetation would generally comprise less than 30 percent of the overall cover.

a. Fuel Characteristics

The overall fire hazard of grasslands is rated as Moderate, with the exception of serpentine bunchgrass which is rated Low (high ratio of live to dead material). Annual grasses usually cure within a short period in the spring, responding to soil drying patterns, and die back each summer forming a fuel type comprised of small-diameter, fine dead fuels. A late spring rain may cause another crop of annual grasses to grow, prolonging the season of green fuel, and possibly causing a need for repeated treatment. The total volume of fuel in a coastal prairie vegetation type may exceed that of annual grasslands; however, the clumpy, discontinuous nature of the fuels inhibits fire spread and overall intensity. Like coastal prairie, serpentine bunchgrass is generally clumpy and discontinuous. In addition, serpentine bunchgrass is low in fuel volume.

Grasslands are easy to ignite in the summer; however, typical morning fog and fog drip may suppress ignition in the Bay Area. Grasslands carry fires into other fuel types in the summer, but may serve as a damper to fire spread when live and green in the winter and spring. Fire spreads rapidly in grasslands and responds seemingly instantaneously to changes in wind direction. The total heat output of grassland fires is relatively low, but flame lengths can exceed 10 feet in height. Grassland fuels respond quickly to changes in temperature and relative humidity as they dry out or hydrate rapidly. Grasslands are adapted to natural fire cycles, and most native perennial species sprout easily, rejuvenate quickly or require fire to trigger germination. Fire may enhance native grassland regeneration by reducing competition from non-native annual grasses, as annual grasses do not sprout but germinate from seeds with slight amounts of moisture.

Ignition Potential. Annual grasslands are easily ignited after they cure (dry), and have an ignition potential of 1. Coastal prairie and serpentine grasslands usually contain more living material and therefore are slightly less ignitable, receiving an ignition rating of 2. The ignition index for ruderal vegetation is 3 (less than annual grasslands) because the vegetation tends to stay green longer than annual grass, and the fuels are usually elevated from the surface until they are knocked down. Later in the year (generally by August) ruderal vegetation is easier to ignite.

Fire Behavior and Responsiveness to Suppression. The critical fire behavior considerations for grasslands are the rate of spread and ease of ignition as grasslands act as a “vector” to ignite other vegetation types. Under wildfire conditions, grasslands are one of the most dangerous vegetation types for firefighter safety due to the rapid frontal spread of fire that can catch suppression personnel off guard.



California Annual Grassland (Summer/Fall)

Grasslands are represented best by Shortgrass (Fuel Model #1). Airborne embers are not carried significant distances ahead of the flame front due to the rapid rate of spread (the surface fire spread catches up to the embers that are distributed a short distance ahead of the flaming front). Grasslands themselves do not have the potential for carrying fire to the crowns of trees because trees are not typically located in grassland areas. However, any tree with low branches in an untreated grassland area could torch, spreading embers considerable distances to the west under a Diablo wind condition. Treated grasslands typically do not produce long enough flame lengths to ignite the crowns of trees that have been pruned to a height of 8 feet from the ground. Fire behavior typically remains within the range that suppression forces can successfully control by attacking the fire’s edges, with flame lengths between 2 and 10 feet. Relatively narrow strips of treated grassland 30 to 100 feet wide with a maximum height of 4 to 6 inches will reduce flame lengths within a short distance of the treatment area boundary, although spotting or preheating can ignite untreated fuels downwind of the strip of mowed grass.

b. Fire Hazard Reduction and Resource Management Goals

The following are fire hazard reduction goals for grasslands:

- Shorten height of grasses to remove ladder fuels, thereby minimizing torching and ember production and distribution.
- Shorten height of grasses to reduce overall fuel quantity and flame length.
- Reduce fuels in and around high use recreation sites (e.g., roadsides, picnic areas, overlooks.)
- Encourage native perennial grasses. Reduce brush encroachment into grasslands to optimize fuel volume, restrict fire duration, and minimize the potential for changing the area into a shrub-dominated fuel type with associated longer flame lengths.

The following are resource management goals for fuel reduction activities in grasslands:

- Maintain a sustainable natural landscape with grasslands as the major component.

- Maintain and enhance grassland habitat values for a diverse assemblage of native plants and wildlife, including invertebrates.
- Where environmentally- and economically-feasible, incorporate fuel reduction activities that encourage a shift in species composition from non-native annual grasses to native perennial grasses to favor the maintenance and expansion of coastal prairie and sustainability of serpentine bunchgrass habitat.
- Control infestations of invasive non-native (ruderal) species.
- Maintain and enhance habitat for special-status plants and animals.

c. **Potential Fuel Treatment Methods and Limitations**

The following discussion identifies potential fuel reduction treatment methods for grasslands and their limitations.

Hand Labor (Weed Whipping). Cutting grasslands changes their structure by “laying down” the fuel. The cut materials tend to blow away or decompose over time. Due to costs, hand labor is recommended only for small areas requiring treatment. Weed whipping must be done every year to reduce fuel, and may need to be repeated during the year when targeting selected removal of dry grass and invasive exotics in perennial grass stands in order to keep the proportion of dead to live material below 30 percent. When the percentage of live material is kept above 70 percent, fires are more difficult to ignite due to the higher moisture content of living foliage.⁶

Mechanical Treatment (Mowing). Mechanical treatments are generally a good method for treating roadsides and open fields. There are certain equipment limitations on slopes greater than 30 percent, areas of limited access, or areas with multiple obstacles such as stumps and/or large rocks. Mechanical treatments are similar to hand labor in that they do not explicitly remove fuel, but instead change its structure by “laying down” the cut materials. Disking should be avoided because it promotes invasive plant propagation and surface soil erosion.

Chemical Treatment. Post-emergent herbicides, such as Glyphosate, are selectively and economically used to treat grasslands along roadsides. When using herbicides, care must always be taken to protect special-status plants and native species; it should never be applied near aquatic habitats, but can be used on erosive sites if applied by hand to specifically target non-native or invasive species. Timing is critical relative to appropriate growth stage and rainfall for chemical treatments to be effective. Broadleaf-selective

⁶ Deeming, J.E., R.E. Burgan and J.D. Cohen, 1977. *The National Fire-Danger Rating System – 1978*. USDA Forest Service Gem Tech. Report INT-39.

herbicides can also be used, such as Transline or Milestone, to target invasive broad leaf weeds while leaving grasses and other monocots.

Prescribed Burning. Broadcast burns in the summer or early fall are known to favor native plants. Prescribed burns can also be conducted in foggy periods using fine grassy fuels to carry the fire (however, results are tied to fuel moisture and composition). Burning often can be made more acceptable if alternated in a cycle with other methods. Sowing native plant seed into the ash or during the following fall season can further advance restoration of native species.

Grazing (Cattle, Horses, Sheep and Goats). When using grazing, animal selection should be monitored with respect to seasonal grassland production, stocking rate, and quantity and quality of the vegetation left. Vegetation and wildlife responses vary greatly based on which grazing practices are utilized. Adverse grazing effects may include increased surface erosion, expansion of weed populations, depletion of sensitive herbaceous species, and breakdown of stream banks. Goats may deplete oak seedlings if not protected. Where grazing is desired in a strip pattern and fencing is not cost-effective, molasses can be spread in the area where grazing is to be concentrated.

Treatment Considerations and Guidelines

Fuel Reduction. The following section describes recommended fuel reduction treatment guidelines for grasslands that should be incorporated, as appropriate, according to site-specific conditions:

- On slopes less than 20 percent the minimum treatment area width should be 30 feet. Increase width to 100 feet or more on slopes greater than 20 percent (additional width may be required depending on topography and proximity of values at risk).
- For grassland along roadways, treated areas should be between 10 and 20 feet in width to minimize ignition potential and provide for evacuation and emergency response vehicle access.
- Maximum standing height of dead non-native grasses should be maintained at 4 to 6 inches. In native grass stands that have a mixture of dead and live material and in areas with grasses higher than 4 to 6 inches, maintain a maximum of 30 percent dead material by volume.
- Native grasses should be mowed to a height no shorter than 4 inches and may be mowed later in the year to accommodate seed ripening and dispersal. Early mowing in the spring (generally March through May, depending on the species) may also be desirable in some cases to remove non-native plant seedheads prior to ripening, thus

minimizing non-native seed germination. Mowing may need to be repeated to maintain fuel management standards.

- Reduce brush intrusion to a maximum of 30 percent brush crown cover. Reduce brush crown cover in treatment areas to 20 percent maximum for slopes greater than 20 percent.⁷

- Remove trees from grasslands or

prune lower tree branches to a height of 8 feet or 1/3 the tree height for trees less than 24 feet tall to reduce ladder fuels, as shown in Figure V-2. Mow grasses to a maximum standing height of 4 to 6 inches under tree crowns.

- To minimize impacts and maximize benefits on biological resources, grazing leases and management plans should incorporate performance standards that address:
 - Management goals
 - Range improvements (e.g., existing/proposed fences and water sources)
 - Kind and class of livestock
 - Livestock carrying capacity and stocking rate
 - Grass height and RDM related to slope
 - Season of use
 - Special management pastures and limitations (e.g., desirable plants, riparian corridors, wetlands)
 - Invasive plant control programs
 - Monitoring program and frequency
 - Supplemental feeding standards, including locations with regard to streams and ponds, that will reduce undesirable livestock concentrations in sensitive areas.

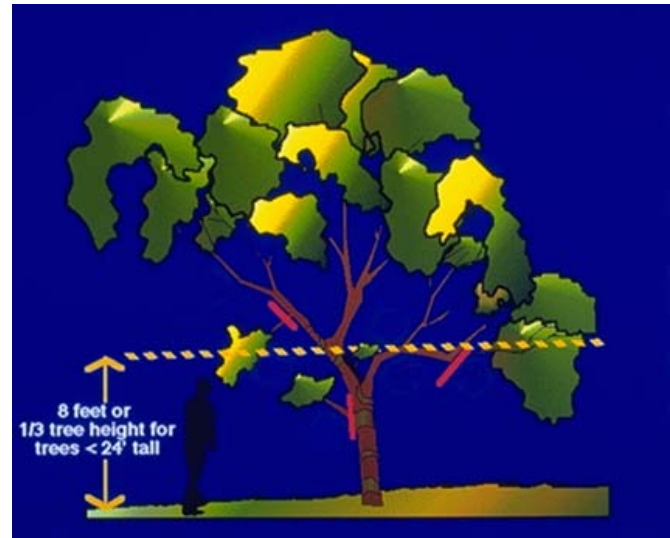


Figure V-2: Pruning Tree Limbs
Prune branches to a height of 8 ft above the ground in grasslands. For young trees, prune branches on the lower one-third of the tree. Do not disturb or thin the tree canopy.

Source: Wildland Resource Management, Inc.

⁷ Moritz, Ray, 2002. *Fire Resistant Trees & Shrubs*. California Forest Stewardship Program. California Department of Forestry and Fire Protection, Sacramento, CA.

- For grazing programs, special considerations to reduce re-introduction of non-native invasive plant species may include equipment cleaning, feed restrictions, and seasonal use restrictions.
- Treatment of areas with a high ignition potential (e.g., adjacent to roadsides or turnouts) may include conversion to low fuel volume landscaping material that maintains a high moisture content.
- Grasslands will need to be treated every year in areas near structures; however treatment may be as infrequent as 3 to 5 years if a primary goal is to reduce or slow shrub encroachment.

Resource Considerations. There are three grassland types in the Study Area that merit special consideration because of their high resource values and preponderance of native species: coastal prairie, serpentine grassland, and localized areas of high non-native perennial grass cover. The following guidelines shall be taken into account when identifying fuel reduction treatments for grassland habitats:

- Prior to conducting fuel reduction treatments, use the GIS database and a site reconnaissance to locate potential habitat for special-status plants and animals and nesting birds, and identify and include pre-treatment protection measures in the Action Plan for fuel reduction.
- Coastal prairie and non-native grasslands in the Study Area are known to support several plant species of special concern such as bent-flowered fiddleneck, big-scale balsamroot, Oregon meconella, Diablo helianthella, and fragrant fritillary. Grasslands with the potential to support these species should be surveyed prior to treatment during appropriate blooming periods. Occurrences of these plant species should be flagged and avoided, if possible, especially during treatment methods with high potential for ground disturbance. Avoidance may not be necessary during treatments that do not disturb surface soils, such as prescribed burning, mowing, or some grazing regimens if they are carefully managed to minimize impacts and maximize resource benefits for a particular species.
- The Skyline Serpentine Prairie in Redwood Regional Park supports a native perennial grassland with a diversity of species including many special-status plants (such as the federal- and State-listed endangered *Presidio clarkia*). EBRPD will perform fuel reduction treatments in accordance with the Serpentine Prairie Restoration Plan prepared by EBRPD in 2008.
- Both early and late season mowing and grazing can be beneficial for native perennial grasses. Early (March-April) mowing and grazing can be timed to defoliate immature (unripe) seed heads of non-native annual grasses, reducing competition with native

perennial grasses (see Tables IV-2 and -3). Fuel reduction activities should take advantage of different seeding and curing rates between annual and perennial grasses. However, occasional late mowing or grazing in the early summer after native seeds have set can help minimize adverse impacts and maximize benefits in areas supporting native grasses. Defoliation later in the season allows the native perennial grasses to grow and store root reserves, and to set and disperse seed. The timing of treatments will need to be determined on a case by case basis as part of the pre-treatment considerations.

- Mowing heights for grasslands should not be lower than 4 inches to prevent “scalping” of native perennial bunchgrasses and desirable forbs. Mowing heights may need to be adjusted on a site-specific basis but generally should range from 4 to 6 inches above ground level to favor native plants while removing non-native annual seedheads.



Coastal Prairie

- Ruderal herbaceous communities are less likely to support special-status species and native grasses, but pre-treatment surveys should be conducted to confirm this. Mowing ruderal areas should be timed to defoliate invasive plant species prior to seed ripening. Equipment should be cleaned of mud and accumulated material that could carry weed seeds prior to moving to a non-invaded site, and debris should be contained in a method that prevents spread of ripe seed of invasive plants into other areas.
- Nesting surveys should be conducted within 15 days prior to mowing if performed during the nesting season (February-July) to locate and avoid destruction of native bird ground nests if deemed necessary by the pre-treatment survey in compliance with the Federal Migratory Bird Treaty Act and State Fish and Game Code. There are currently no known special-status ground-nesting birds in the vicinity of the recommended treatment areas.
- The timing of treatment will need to be determined on a case-by-case basis to balance seed set and breeding concerns with mowing of annual grasses to reduce fire ignitions and invasive plant encroachment.
- Individual trees within grasslands likely hold some measure of aesthetic and/or wildlife habitat value, but these widely-spaced trees will not cause an active crown fire because of the discontinuity of tree crowns. They could, however, provide a seed source for invasion of grassland habitats by woodland species and should be considered for removal to maintain desirable and declining grassland habitat. Removal would more likely be required for eucalyptus or pines near ridgelines or homes. If not removed, the lower limbs of trees in grassland habitat may need to be pruned and/or grass under the tree canopy mowed to prevent torching.

- Treatment start dates should be based on field and weather conditions in the year that treatment will be undertaken. Mowing too early in a season with late rains may require additional treatment after non-native grasses re-grow then fully cure, and may be detrimental to desirable native species.
- Follow-up monitoring of treatments should be conducted.

2. Scrub Vegetation

Fuel characteristics and special considerations for the following four scrub vegetation types are described in this section: Maritime Chaparral, North Coastal Scrub (Mesic and Xeric), Coyote Brush Scrub, and Non-native Scrub. Differences in vegetation types and associated treatments will be noted in the text for each type of scrub vegetation. In general, scrub vegetation types are dominated by shrubs with some grassland or woodland species present but shrubs comprise over 30 percent cover, by definition.

a. Maritime Chaparral

Considered a type of “hard” chaparral, maritime chaparral (manzanita-chinquapin) is dominated by shrubs that vary in height from 2 to 12 feet with emergent overstory tree cover. Dominant plant species include: chinquapin, huckleberry, madrone, hazelnut, ceanothus, brittle-leaf manzanita, mountain mahogany, and poison oak. This vegetation type is very limited in extent in the Study Area, and is sensitive because it provides the only suitable habitat for the federally-listed Threatened pallid manzanita and also supports the CNPS-listed leatherwood and Shreve’s oak. Maritime Chaparral occurs on chert and shale soils that are very low in moisture holding capacity and support limited amounts of other vegetation. This vegetation type and the manzanita it supports are also fire dependent. Without disturbance by fire the manzanita does not reproduce, becomes decadent, and is replaced by shade tolerant species.



Manzanita-Chinquapin Chaparral

Fuel Characteristics

The overall hazard rating of maritime chaparral is Extreme. The natural structure (or form) of maritime chaparral shrub is dense small leaves, twigs and litter that supports fire. These fine fuels are the first to ignite, with fire then moving into the larger woody branches. Fire passes from shrub to shrub in the thick impenetrable stands with high continuity. The stand structure also limits human travel and direct fire suppression activities. Many species have oils, resins or other volatile chemicals that make them burn faster and hotter. The natural life

cycle of chaparral includes build up of dead materials within the shrub structure that fuels a fire. Mature stands often have a high ratio of dead to live material. Live foliage responds slowly to changes in temperature and weather; foliage becomes drier during the summer and remains dry until new growth appears in the spring. New growth remains higher in moisture than old longer into the fire season.

Once ignited, Maritime chaparral burns rapidly in dry weather, and it will burn after grass has sprouted following the first fall rains. Maritime chaparral carries fires from grasses into other larger-sized fuels, and has a moderate to very high heat output. This scrub type is adapted to natural fire cycle, and most species resprout easily after fire or require fire to trigger germination.

Ignition Potential. Maritime chaparral has an ignition potential of 6. This vegetation is more difficult to ignite than grasslands and north coastal scrub due to the limited understory grass and herbaceous materials.

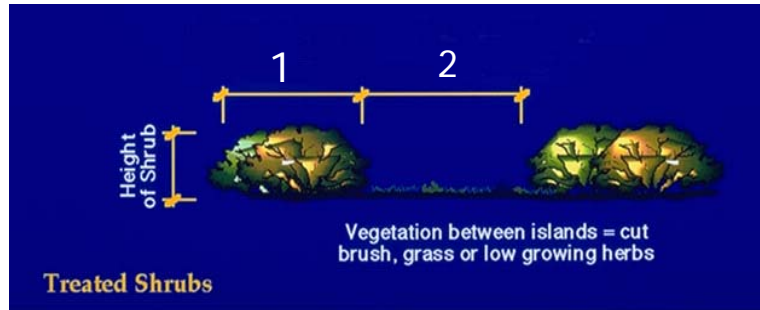
Fire Behavior and Responsiveness to Suppression. Fire behavior in this fuel type is best modeled as Chaparral (Fuel Model #4). Flame lengths range from 24 to 69 feet depending upon the percentage of dead material in the stand, total volume and slope. The heat output of this fuel type precludes direct attack and limits fire suppression effectiveness and can cause ignition of nearby structures. This fire behavior is similar to north coastal scrub in overall characteristics, but chaparral's is generally considered more hazardous due to its dense stands and high accumulation of leaf litter. Chaparral produces greater heat and dramatic spread rates once ignited. Embers produced by high-intensity wildfires in chaparral are distributed in a short range, usually less than 1,000 feet.

Fire Hazard Reduction and Resource Management Goals

The following are fire hazard reduction goals for maritime chaparral:

- Reduce dead materials and litter.
- Remove individual specimens to reduce the overall plant density, horizontal continuity, and fuel quantity.
- Minimize ladder fuels.
- Create clumps of chaparral groups (through mosaic or "patch regeneration" thinning, see Figure V-3) to break up large expanses of brush and slow rapid fire spread.

- Alternatively, shorten chaparral height to reduce fuel volume and flame length.
- Encourage a higher proportion of new foliar growth.



The following are the resource management goals for fuel reduction activities in maritime chaparral:

Figure V-3: Treated Shrubland

Design groups of plants small enough to provide horizontal separation between groups to allow proper maintenance and helps slow the spread of fire. Each shrub or group of plants should measure no wider than two times its height, or less than 120 square feet (or 6 feet x 20 feet). The space between groups should be greater than two times the height of the shrubs, or at least 6 feet.

Source: Wildland Resource Management, Inc., 2008

- Protect and enhance maritime chaparral habitat by providing for reproduction of dominant species.
- Protect and enhance pallid manzanita populations and other fire dependent native species by providing for reproduction of native shrubs.
- Maintain and enhance chaparral habitat values for a diverse assemblage of native plants and wildlife species (including invertebrates).
- Control infestations of invasive non-native species.
- Inhibit the replacement of manzanita by shade-tolerant species.

Potential Fuel Treatment Methods and Limitations

The following describes treatment methods and limitations for maritime chaparral.

Hand Labor. This treatment method minimizes soil disturbance and targets only specified plants. Hand labor treatments may be the only viable treatments in pallid manzanita or other special-status species, and should include removing dead materials and pruning lower branches of individual shrubs to resemble a short tree stand. Removed materials needs to be mulched, disposed of off-site or pile burned to reduce fuel loading. Desirable trees in chaparral stands need to be isolated by pruning lower tree branches and removing shrubs under and adjacent to the trees to prevent torching. When selecting trees for retention, give preference to pallid manzanita. Trees can also be removed to allow better growing conditions for pallid manzanita.

Mechanical Treatment. Steep slopes, often associated with chaparral, would preclude use of mechanical treatments. Heavy equipment is not recommended because of its unacceptable impacts to sensitive vegetation.

Chemical Treatment. Herbicides are not recommended for widespread use in this plant community due to the potential for adverse environmental impacts to desirable plant species. Direct manual application of herbicides may be used if eucalyptus or invasive, non-native species are present to eliminate seedlings or resprouts after cutting.

Prescribed Burning. Because of the high fuel loads in maritime chaparral and the relative proximity of houses and other structures, broadcast burning would entail a high level of risk and may require high-impact mechanical treatments to prepare for future burns. Pile burns following careful hand labor treatments would be an acceptable treatment and could enhance reproduction of pallid manzanita and other desirable obligate seeders. If pile burns are used, the treatment action should consider letting fire creep between piles in treated areas so that low-intensity fire may further promote native plant regeneration. Stationary fires may be fed from piles too large to qualify for pile burns. Burning chaparral after nearby/adjacent grass has grown to at least a 2-inch height will help ease concern about fire control as the adjacent green grasslands is not likely to ignite. In order to sustain desired native populations, suitable conditions must be present for seedling germination and establishment. Creating these suitable conditions without fire use may require clearing to bare mineral soil for some species, exposing the seeds at some depth in the soil to heat, or other similar treatments that mimic a fire occurrence.

Grazing (Goats). This treatment method is not recommended because it is non-selective and would result in unacceptable impacts to special-status species.

Treatment Considerations and Guidelines

Fuel Reduction. Recommended treatment guidelines for Maritime Chaparral are provided below.

- The following are recommended treatment performance standards for maritime chaparral stand structures where mosaic thinning is used for fuel modification (as shown in Figure V-3):
 - *Height:* Thin or selectively remove exotic species and shrubs to break up vertical and horizontal continuity.
 - *Clump Size:* Create clumps that are natural in appearance including specimens of variable age classes.
 - *Spacing:* Distance between clumps should be greater than approximately twice the height of tallest shrub crown.
 - *Crown Cover:* Retain approximately 25 to 50 percent shrub crown cover as determined by shrub height and island distribution.

- *Dead to Live Ratio:* The dead to live fuel ratio should be less than 20 percent in shrub canopy.^{8,9}
- *Preferential Removal of Species:* Preferentially cut back to the burl the most flammable sprouting species first, such as chamise. Keep less flammable sprouting species such as oak, coffeeberry, snowberry, rose, iris, and salal. Remove or thin huckleberries where they are likely to shade out pallid manzanita. The removal of brush should be based on the following criteria which are listed in approximate descending order of importance to fuel management objectives:
 - Listed species – retain all healthy and vigorous individual specimens of pallid manzanita.
 - Sprouting capability – remove species with sprouting capacity first.
 - Plant vigor – remove shrubs of low vigor, and all dying or dead shrubs, including pallid manzanita.
 - Effects of plant species on soils – i.e., retain ceanothus and other shrubs with slope-holding capacity that increase soil nutrients.
 - Value for wildlife food and cover.
 - Aesthetic values.
 - Diversity of species.
 - Encourage and protect obligate “seeders” (such as some species of manzanita and ceanothus).
 - Remove exotic species.
 - Favor chaparral community by removing oak, bay, madrone, buckeye, and other trees under 8 inches diameter at breast height (dbh) that are encroaching upon the maritime chaparral.
 - Consider the conversion of shrubs to lighter fuel types, e.g., grass, especially in maintained fuel reduction zone areas.
 - Chipping/mulch depth should be between approximately 2 and 5 inches following treatment. Use caution when allowing chips to be spread on the ground, as this could lead to suppression of desirable species and favor weeds.

⁸ There is no nationally-recognized standard for dead-to-live ratio in maritime chaparral. However, with a higher ratio of dead material in the shrub canopy these areas are more likely to experience a fire traveling through the full complex. A larger proportion of live material will hamper fire spread because a higher amount of moisture will need to be driven out of the fuel particles before ignition can occur.

⁹ *Fire Protection Training Procedures Handbook 4300 – Vegetation Fires*. California Department of Forestry and Fire Protection, Sacramento, CA.

- Set the following standards for areas where chaparral plants are cut or pruned:
 - Cut to a maximum height of 1.5 feet; allow maximum growth to 4 feet (total plant height) before re-treatment
 - Remove shrubs surrounding trees to the dripline; prune trees of lower branches
 - Debris to remain in place as mulch below shrub.
- Anticipate a 5 to 7 year treatment cycle to manage treated areas to standards of Chaparral (Fuel Model #4) with young brush, short mature brush, or patchy islands.

Resource Considerations. The following are resource considerations and treatment guidelines for maritime chaparral:

- Maritime chaparral is a sensitive plant community in the Study Area. It also supports pallid manzanita (a State- and federally-endangered species), leatherwood (CNPS List 1B), and Shreve's oak (CNPS List 3). Low impact, site-specific treatments such as hand cutting and pile burning are warranted in maritime chaparral, although pile burning would require additional measures to ensure seeds and seedlings would not be consumed. Goat grazing and mechanical treatments are not appropriate for this plant community, as these treatments are not selective and would result in unacceptable levels of damage to special-status and listed species.
- Many of the dominant shrubs (including pallid manzanita) in this plant community are obligate seeders that reproduce only by seed and will not stump sprout. These species (primarily ceanothus and pallid manzanita) need protection during treatments in their areas. In order to sustain populations, suitable conditions must be present for seedling germination and establishment. Suitable conditions may mean clearing to bare mineral soil for some species, or the selective removal of eucalyptus stands that choke out pallid manzanita.
- Bird nesting surveys should be conducted within 15 days prior to cutting shrubs if treatments are to be conducted during the nesting season (February to July) to locate and avoid nesting birds if deemed necessary by pre-treatment surveys. Treatment after approximately July 15 of any year will reduce the potential for disturbance of songbird nesting activities.
- Treatment after seed set (typically April or May) will reduce disruption to seed production of native obligate seeder shrubs, including pallid manzanita.
- Conduct follow-up monitoring of treatments. Monitoring the response to management practices needs to consider chaparral structure and composition, as well as fuel loading.

- There is a potential for fuel reduction treatments to spread a pathogen fungus, *Phytophthora cinnamoni*, which can kill pallid manzanita and other desirable native shrubs. The following procedures¹⁰ shall be implemented when conducting treatments in maritime chaparral:
 - Trim lower branches of shrubs that have died to provide sunlight, and remove smaller flammable fuels.
 - If dead or severely diseased shrubs are removed, avoid hauling material off of the site. If this is not possible, move it directly upslope without lateral movement and avoid any contact with maritime chaparral offsite. Clean equipment, vehicles and shoes that could spread infected soil when entering or leaving a maritime chaparral treatment area.
 - Conduct treatments when the soil is dry if possible.
 - If seed is collected for replanting, collect seed from high up on the shrub and ensure that it does not touch the soil. The disease is not spread by seed, but could be spread by soil attached to the seed.

b. North Coastal Scrub (Xeric and Mesic)

The north coastal scrub vegetation type, often called soft chaparral, is dominated by shrubs that vary in height from 2 to 8 feet. There are two types of north coastal scrub in the Study Area: xeric or dry coastal scrub (on dry, south-facing slopes) and mesic or wet coastal scrub (on moist, north-facing slopes).

Dominant plant species include: blackberry, poison oak, coyote brush, California sagebrush, ceanothus, and black sage. This plant community is dominated by native plants and animals, and the

dry phase is potentially the best habitat for Alameda whipsnake (a federal and State listed species), which may occur even in small pockets of north coastal scrub.



Mesic North Coastal Scrub

Fuel Characteristics

Xeric north coastal scrub has a fire hazard rating of Extreme with flame lengths ranging from 14 to 69 feet depending upon the percentage of dead material in the stand, total volume, and slope. The heat output of this fuel precludes direct attack and limits fire suppression

¹⁰ Danielsen, Charli. 2008. Personal communication with EBRPD Stewardship staff

effectiveness and can cause ignition of nearby structures. Dry north coastal scrub was modeled as either Fuel Model 4 (Chaparral) or Fuel Model 5 (Brush).

The overall fire hazard rating for mesic north coastal scrub is High because high persistent foliar moisture in this plant community makes flame fronts difficult to

sustain in these areas. It was modeled as Fuel Model 5 (Brush), with flame lengths ranging from 14 to 32 feet depending on the percentage of dead material in the stand, total volume, and slope. Mesic north coastal scrub typically has a higher proportion of small-diameter material in the stand than xeric north coastal scrub or chaparral.



Mesic Scrub (foreground) and Xeric North Coastal Scrub (background)

Ignition Potential. Dry north coastal scrub has a moderate ignition potential rating with an ignition index of 4. The wet north coastal scrub is rated with an ignition index of 8 as it is typically more difficult to ignite than the dry north coastal scrub due to the general moisture level and typically-reduced amounts of dead fuels.

Fire Behavior and Responsiveness to Suppression. Both xeric and mesic north coastal scrub are difficult to ignite, but once ignited both burn rapidly in dry weather due to the preponderance of small diameter material that can dry in a shorter period of time and burn more easily by spreading fires. This plant community responds more slowly to changes in temperature and moisture than grasslands, but faster than maritime chaparral. North coastal scrub carries fires from grasses into other larger-sized fuel types, and trees in the stand will torch from adjacent fuels, producing embers and distributing them widely. It has a moderate to very high heat output, and the long flame lengths limit suppression effectiveness and prevent direct attack. North coastal scrub produces small firebrands that are distributed to areas less than 1,000 feet away. This plant community is adapted to natural fire cycles, and most species found within this plant community resprout easily to rejuvenate individual specimens after fire, or require fire to trigger germination. Special-status species such as western leatherwood are found in this vegetation type. The natural life cycle of north coastal scrub includes buildup of dead materials in the inside of the shrub that fuels a fire. Mature stands often have a high ratio of dead to live material which can fuel a fire during dry weather. Foliage responds slowly to changes in temperature and weather and foliage becomes drier during the summer and remains dry until new growth appears in the spring. New growth remains higher in moisture than old growth longer into the fire season. North coastal scrub is a highly aerated fuel when moderately old, sometimes with a vertically discontinuous fuel structure that slows fire spread.

Fire Hazard Reduction and Resource Management Goals

Figure V-4 provides photos of north coastal scrub showing before treatment high hazard fuel conditions and low hazard fuel conditions. The following are fire hazard reduction goals for north coastal scrub:

- Create clumps of north coastal scrub (through mosaic thinning or patch-retention thinning) to break up large expanses and slow rapid fire spread.
- Alternatively, shorten height of shrubs to reduce fuel volume and flame length.
- Remove dead materials.
- Encourage higher proportion of new foliar growth.
- Remove ladder fuels.

The following are resource management goals for north coastal scrub:

- Maintain a sustainable diverse natural landscape of north coastal scrub in a mosaic of natural communities and successional stages.
- Maintain and enhance scrub habitat values for a diverse assemblage of native plant and wildlife species, including invertebrates.
- Shift species composition towards native scrub species or consider conversion to grasslands, where appropriate on historic grassland sites, or oak-bay woodland in steep drainages and north- or east-facing slopes.
- Control infestations of invasive species.
- Maintain and enhance habitat for special-status plants and animals including Alameda whipsnake.

Potential Fuel Treatment Methods and Limitations

The following potential fuel treatment methods could be applied to north coastal scrub areas, with the noted limitations:

Hand Labor. Hand labor treatments minimize soil disturbance and target only specified plants, making them effective for selective pruning and development of desired spacing, but may not be cost-effective over large treatment areas. Removed fuels will need to be mulched, scattered on-site, disposed off-site, or pile burned to reduce fuel loading.

Mechanical Treatment. Mechanical treatments should only be used to knock down shrubs or cut off tops, not to remove entire plants or disturb root balls. Mechanical treatments should also only be utilized on slopes under 30 percent to avoid soil disturbances



High Fire Hazard: North Coastal Scrub (Mesic)



Low Fire Hazard: North Coastal Scrub (Mesic)

LSA

FIGURE V-4

*EBRPD Wildfire Hazard Reduction
and Resource Management Plan*
Photo Comparison of High and Low Hazard
North Coastal Scrub (Mesic)

Back of V-4

from heavy equipment use. Operations should be done after approximately July 1 to minimize potential adverse impacts to breeding animals and obligate seeding plant species.

Chemical Treatment. Direct application or foliar spraying of herbicides may be used if eucalyptus or invasive, non-native species are present to eliminate seedlings or resprouts after cutting. Direct application may also be needed to control resprouting of cut shrubs or reduce the density of shrub cover.

Prescribed Burning. Fire intensity of untreated scrub during dry season may require use of initial hand labor or mechanical treatments in areas with high fuel loads to prepare for future burns. Burning scrub when adjacent grass is green and at least two inches tall reduces fire intensity and helps control the fire's spread. Pile burns may be an alternative treatment to broadcast burns as an initial management technique in conjunction with other treatments. If pile burns are used, actions should consider letting fire creep between piles within treatment areas so that low-intensity fire may promote native plant regeneration.

Grazing (Goats). Using goat grazing as a treatment method can retain the appearance of the natural community if conducted appropriately, but may create unwanted changes in structure and frequencies of plant species over time due to browsing. If grazing is used, protective actions will be needed to restrict desirable species from extensive browsing by grazing animals, which can result in bare soil. With any grazing treatment, a minimum amount of ground cover should remain. Treatment actions should avoid grazing during seed production of non-target species, especially obligate seeders. Timing, duration and stocking rates of grazing relate to palatability and potential impacts on targeted species.

Treatment Considerations and Guidelines

Fuel Reduction. The following guidelines are recommended for treatment actions in north coastal scrub to create clumps of scrub in grasslands, uniformly shorten shrubs, or convert treatment areas to grasslands:

- Monitor and report the effects of treatments in north coastal scrub. Monitoring species responses to management practices should consider shrubland structure and composition, animal abundance, and fuel loading and measurement of residue.
- Create north coastal scrub islands two times as wide as the height of tallest shrub through mosaic thinning or patch retention thinning. Clumps should be natural in appearance and include specimens of variable age classes.
- Within 100 feet of structures, grass between shrub islands should be mowed or grazed when cured.
- Retain approximately 30 to 50 percent of brush areas in brush crown cover.

- Prioritizing plant species for removal will change according to local conditions, such as the relative abundance of each species. (For example, where coffeeberry is not abundant, it may be prioritized highly for retention.) Species which are generally a high priority for removal are: coyote bush; poison oak; and Himalayan blackberry. Attempts should be made to maintain a diversity of species.
- Brush removal should be based on the following criteria, which are listed in approximate order of importance to fuel management objectives:
 - Relative flammability - remove the most flammable species first. Maintain less than 20 percent dead material in the shrub canopy.
 - Plant vigor - remove shrubs of low vigor, dying or dead shrubs.
 - Sprouting capability – cut sprouting species first and treat resprouts with herbicide, as necessary.
 - Effects of plant species on soils - Retain shrubs with slope-holding capacity, or those that increase soil nutrients (e.g., ceanothus).
 - Value for wildlife food and cover.
 - Aesthetic values.
- The following standards for debris to remain in place should be used:
 - Chipping/mulch depth should be between approximately 2 and 5 inches.
 - Standing stems should be no higher than 18 inches for those species that are cut (shrubs that readily resprout and have many stems at the base of plants).
- The following standards for areas where shrubs are shortened should be used:
 - Plants should be cut to maximum height of 18 inches; growth to 4 feet (total plant height) before re-treatment occurs.
 - Debris can remain as unchipped mulch.
- The following standards for pile burning should be used:
 - Stationary fires may be fed from piles too large to qualify for pile burns.
 - Let fire spread between piles.
 - Locate burn piles at a sufficient distance from retained vegetation to prevent scorching damage. Radiant heat can damage and even kill thin-barked trees.
- Initial treatment is the most time-, resource-, and cost-intensive operation. Follow-up maintenance is likely to include annual treatment.

- Repeated treatments occurring every two to three years are generally more effective than single treatments.

Resource Considerations. The following are resource considerations and guidelines for north coastal scrub:

- The north coastal scrub community is dominated by native plants and animals, and the dry phase is potentially the best habitat for the Alameda whipsnake, which may occur even in small pockets of scrub.
- The following measures are proposed to avoid and minimize any potential direct effects on the Alameda whipsnake:
 - Prior to treatment implementation, the locations of potential Alameda whipsnake habitat to be retained or managed, as mapped by the District, would be clearly indicated on treatment plans.
 - Vegetation clearing activities should be scheduled, insofar as possible, to avoid the breeding period for the Alameda whipsnake. (March 15 through June 15).
 - A qualified biological monitor would monitor all activities that involve vegetation removal and ground disturbance, or other activities that may result in the take of the Alameda whipsnake. The biological monitor would have the authority to stop any work that could result in the unauthorized take of an Alameda whipsnake or any other listed species. The monitor would be allowed sufficient time to move the animals from the site before work activities begin or resume, if necessary. The individuals would be relocated to the closest suitable habitat that would not be affected by treatment activities. Only individuals of listed species that are at risk of injury or death by treatment activities would be moved by the biologist; any others would be left undisturbed.
 - The biological monitor would be on site to monitor the initial vegetation removal and/or ground-disturbing activities. The monitor would perform a clearance survey for listed species immediately prior to the initial ground disturbance. Safety permitting, the biological monitor would also investigate areas of disturbed soil for signs of listed species within 30 minutes following the initial disturbance. The monitor would inspect the treatment area for Alameda whipsnake before activities begin each day by checking under standing equipment before it is moved and checking any debris piles.
 - If the biological monitor observes whipsnake in the work area, he/she would stop work, move the individual to the closest suitable habitat that would not be affected by treatment activities or, if possible, the Alameda whipsnake would be allowed to disperse on its own.

- Prior to treatment implementation, all contractors, their employees, and agency personnel involved in vegetation removal and earth-disturbing activities would complete a 30-minute employee education program on the Alameda whipsnake. The presentation would be conducted by a qualified biologist and would include an explanation of endangered species issues, a description of the Alameda whipsnake habitat needs, an explanation of their status under the federal Endangered Species Act, associated consequences of noncompliance with the USFWS Biological Opinion, and a description of minimization and conservation measures being taken to reduce effects to these species during treatment implementation.
- If any on-site contractors find what they believe to be a listed species, work or activities that may result in injury, death, harm, harassment, or capture of the individual would immediately cease and the biological monitor would be immediately notified. The biological monitor would record the location of the species and would handle the situation as described above.
- Plastic monofilament netting (e.g., erosion-control matting) or similar material would not be used at treatment sites because Alameda whipsnakes may become entangled or trapped in it. Acceptable substitutes include coconut coir matting with a minimum mesh size of one inch square or tackified hydroseeding compounds.
- The biological monitor would be contacted regarding any employee or contractor who might inadvertently kill or injure an Alameda whipsnake; or anyone who finds a dead, injured, or entrapped individual. In the case of an injured or dead animal, the biological monitor will collect the animal and transfer it to an approved facility for rehabilitation or preservation. The biological monitor will be responsible for reporting the take to the USFWS and CDFG within 24 hours of the discovery.
- Sensitive habitat areas, other than those identified as recommended treatment areas in this Plan, that require protection from potential project impacts would be identified and delineated with high visibility, temporary, orange-colored fence at least 4 feet in height, flagging, or another type of barrier. Such fencing would be inspected by the biological monitor and maintained daily until completion of the treatment. The fencing would be removed only when all construction equipment is removed from the site. No treatment activities would occur inside the delineated sensitive habitat. Where necessary, a snake-proof fence may be erected to prevent Alameda whipsnakes from entering the project zone. This fence would be at least 18 inches high, staked vertically and buried underground to a minimum depth of two inches.
- Native understory plant species would be protected to the extent practical.
- The District would identify and limit to the maximum extent possible all access roads and skid trails. Outside of the recommended treatment areas, these access roads

- and skid trails would avoid scrub habitat, primary constituent elements for the critical habitat of the Alameda whipsnake, and stream and riparian habitats.
- All material stockpiling and staging areas would be located within designated disturbed/ developed areas that are outside of sensitive habitat areas as determined by the biological monitor, CDFG, and/or the USFWS.
 - Vehicle and equipment refueling and lubrication would only be permitted in areas where accidental spills can be immediately contained. All equipment would be regularly maintained to avoid fluid leaks (e.g., gasoline, diesel fuel, hydraulic fluid). All leaking fluid would be stopped or captured in a container until such time that the equipment can be immediately moved off site and repaired. Storage of hazardous materials and refueling of equipment would not occur within 50 feet of any pond or active creek drainage. The District and/or its contractors would prepare a plan for immediate containment and cleanup of hazardous material spills within or adjacent to each project site.
 - To avoid or minimize attracting predators of the Alameda whipsnake, all food-related trash items, such as wrappers, cans, bottles, and food scraps, would be disposed of in a securely covered container.
 - North coastal scrub in the Study Area is known to support several plant species of special concern such as Oakland star tulip, Franciscan thistle, western leatherwood, fragrant fritillary, and Diablo helianthella. Shrublands with the potential to support these species should be surveyed prior to treatment during appropriate blooming periods. Occurrences should be flagged and avoided, if possible, or treatments devised to minimize impacts and maximize benefits.
 - Nest surveys should be conducted within 15 days prior to mechanical treatment (typically mowing) if performed during the nesting season (February through July) to locate and avoid special-status nesting birds if deemed necessary by the pre-treatment survey.
 - The timing of treatment will need to be determined on a case-by-case basis to balance seed set (July-August for most desirable native shrubs) and wildlife breeding concerns. Treatment start dates should be based on the field and weather conditions of any given year. Treatment after July 1 will generally reduce disturbance to seed set of plants and nesting song birds, although nesting could continue until August and pre-treatment nest surveys may be appropriate. Greater limitations to treatments may be required if species of special concern are found to occur in treatment areas.
 - Maintain species diversity. The order of priority for species retention will change according to local conditions such as the relative abundance of each species. For example, where coffeeberry is not abundant, it may be placed high in priority to retain.

- Some shrubland communities can be converted to grass, especially where devoid of special-status species in fuel reduction zones or where soils and/or historic aerial photos indicate historical grassland.
- Where vegetation management actions focus on conserving brush habitat, tree and shrub removal should be conducted as necessary to restore Alameda whipsnake habitat and attain approximately 35 percent canopy closure.
- If goat grazing is used in predominantly native habitat, a program should be explored to consider goat quarantine prior to grazing for at least three days to prevent dispersal of invasive plant seeds from offsite. Goat grazing should be monitored by a District representative to ensure they are moved frequently to prevent overgrazing.

c. Coyote Brush Scrub

Coyote brush scrub represents an association of native shrub species that occupy former grasslands due to the exclusion of natural disturbances such as fires and grazing pressures. It is not necessarily considered a natural plant community because human actions (e.g., fire suppression) were necessary for it to invade grasslands. After the exclusion of livestock grazing in some parks such as Tilden Regional Park in the 1950s, coyote brush



Coyote Brush

began to accelerate its invasion of grasslands. Currently several areas within the Study Area support almost pure stands of coyote brush, including parts of the west-facing slopes of Wildcat Canyon, Tilden, Claremont Canyon, and Lake Chabot regional parks. The mix and proportion of shrubs and trees will depend on the stage of natural succession of any one brush stand. The extent of the tree component may vary, but will generally comprise less than 30 percent cover. Dominant plant species include annual grasses, blackberry, coyote brush, ceanothus, huckleberry, monkey flower, poison oak, sage, California bay, scrub oak, and live oak.

Fuel Characteristics

The overall hazard for coyote brush scrub is rated as High, with flame lengths ranging from 14 to 32 feet depending upon fuel type, fuel volume, and slope. It was modeled as either Chaparral (Fuel Model 4), Brush (Fuel Model 5), Timber – Grass (Fuel Model 2) or Closed Timber Litter (Fuel Model 8) based on structure, species composition, and presence of trees.

Ignition Potential. Coyote brush scrub has a Moderate ignition potential rating with an ignition index of 4. The preponderance of dead material that accumulates under the green foliage in coyote brush scrub, becomes moderately-easily ignited.

Fire Behavior and Responsiveness to Suppression. In comparison to mesic north coastal scrub or grasslands, coyote brush scrub has a greater fuel volume and a higher proportion of larger diameter material in the form of large branches within a vertically and horizontally continuous fuel bed. The intertwined shrub canopies prevent easy access and movement within stands, and that condition, along with high flame lengths, makes direct fire suppression nearly impossible. All trees in coyote brush scrub are predicted to torch. The taller profile of emerging trees promotes longer ember distribution, depending on wind direction and the position of the trees on the slope.

Coyote brush scrub has moderate to very high heat output. Overall it is slow to respond to changes in temperature and moisture due to vegetation structure and shading effects of tree canopies. Species present in coyote brush scrub often respond to fire more rapidly than chaparral species; coyote brush scrub is adapted to natural fire cycles. Most species resprout easily to rejuvenate individual specimens after fire, or require fire to trigger germination. The natural life cycle of coyote brush scrub includes build up of dead materials inside the shrub that fuels a fire. Mature stands often have a high ratio of dead to live material. Foliage becomes drier during the summer and remains dry until new growth appears in the spring. New growth remains higher in moisture than old growth longer into the fire season. As tree canopies shade out shrubs, the dead shrubs remain and increase dead fuel volume.

Fire Hazard Reduction and Resource Management Goals

Figure V-5 provides photos of coyote brush scrub showing before treatment high hazard fuel conditions and low hazard fuel conditions. The following are fire hazard reduction goals for coyote brush scrub:

- In most treatment areas, encourage conversion to grasslands by reseeding with native grasses, such as California brome, blue wildrye, meadow barley, slender hairgrass, and spikebent, after brush removal and control activities are completed.
- Remove dead materials to decrease the amount of available fuels, including the amount of fine dead fuels. The overall height of grasses and shrubs should be shortened to decrease the chance of carrying fire up into taller adjacent plant materials or structures, and to increase the proportion of live material.
- Remove individual specimens to reduce the overall number of plants and fuel quantity to provide 60 percent canopy cover.

- In more moist areas, such as north- and east-facing slopes or in steep drainages, encourage natural succession to woodlands by protecting emerging tree species and reducing fuel ladders formed by surrounding shrubs through drip-line pruning conducted on stands of trees.

The following resource management goals apply to coyote brush scrub:

- Control infestations of invasive species.
- Maintain and enhance habitat for special-status plants and animals.
- Consider conversion to native grassland or encourage succession to oak-bay woodland, where appropriate.

Potential Fuel Treatment Methods and Limitations

The following fuel treatment methods and their limitations are provided for coyote brush scrub. (See also the treatment methods and limitations for shrubs in maritime chaparral and north coastal scrub.)

Hand Labor. Hand labor treatments minimize soil disturbance and target only specified plants, making them effective for selective pruning and development of desired spacing, but may not be cost-effective over large treatment areas. Removed fuels will need to be mulched, disposed off-site, or pile burned to reduce fuel loading.

Mechanical Treatment. Mechanical treatment should knock down shrubs or cut off tops. Mechanical treatments should be utilized only on slopes under 30 percent to avoid soil disturbance due to heavy equipment use. Operations should generally be done after July 1 to minimize affects to breeding animals and obligate seeding plant species. Machinery is often impeded by the numerous small oaks that may be desirable to retain.

Prescribed Burning. Fire intensity of untreated scrub during dry season may require use of initial hand labor or mechanical treatments in areas with high fuel loads to prepare for future burns. Burning scrub when adjacent grass is green and at least two inches tall reduces fire intensity and helps control the fire's spread. Pile burns may be an alternative treatment to broadcast burns as an initial management technique in conjunction with other treatments. If pile burns are used, actions should consider letting fire creep between piles within treatment areas so that low-intensity fire may promote native plant regeneration.

Grazing (Goats). Goat grazing can be used to reduce total shrub cover in a treatment area and reduce overall fuel load, but may not be an effective long-term treatment because coyote brush scrub resprouts rapidly following defoliation.



High Fire Hazard: Coyote Brush Scrub



Low Fire Hazard: Coyote Brush Scrub

LSA

FIGURE V-5

*EBRPD Wildfire Hazard Reduction
and Resource Management Plan*
Photo Comparison of High and Low Hazard
Coyote Brush Scrub

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Treatment Considerations and Guidelines

Fuel Reduction. The following treatment guidelines are recommended for coyote brush scrub: (See also the treatment guidelines for maritime chaparral and oak-bay woodland.)

- Knock down or crush scrub to a maximum height of 18 inches.
- Follow prescriptions for north coastal scrub where trees do not exist.
- Convert to native grassland, where appropriate, by reseeding after brush control treatment actions are completed.

- If succession to oak-bay woodlands is the desired goal, protect individual trees and small groups of trees and encourage development for canopy closure. For trees over 8 feet tall, cut out shrubs below driplines and within 6 feet from the edges of canopies, as shown in Figure V-6. Protect oaks shorter than 6 feet in height, and prune up to a maximum of 1/3 the height of trees that are less than 24 feet tall.



Figure V-6: Dripline Thinning in Successional Scrub

Remove shrubs under short trees and within 6 feet from edge of canopy to protect trees from torching.

Source: Wildland Resource Management, Inc. 2005.

- Apply mulch or permit annual grasses to provide cover between tree islands. Grasses will need to meet grassland treatment standards. Avoid invasion by weed species with an aggressive monitoring and treatment program.
- Initial treatment will be the most time-, resource-, and cost-intensive operation, followed by annual mowing of grass between clumps. A treatment cycle of 5 to 7 years will be necessary to maintain shrub clumps in treeless areas, and 3 to 5 years to maintain areas surrounding emerging trees. As tree canopies touch (within 10 years in most cases), maintenance requirements will dramatically decline.

Resource Considerations. The following resource considerations and guidelines apply to coyote brush scrub:

- Because of the high density of coyote brush, little or no understory is present except along edges or in openings. There is little potential for occurrence of special-status plant species.
- Nesting surveys should be conducted within 15 days prior to mowing or cutting shrubs if performed during the nesting season (February to July) to locate and avoid nesting birds if deemed necessary by the pre-treatment survey. Treatment actions should be conducted in late summer to fall so that grass seeding is accomplished prior to the rainy season to promote germination and establishment. Treatment start dates should be based on the field and weather conditions of any given year.
- Follow the conservation measures identified for Alameda whipsnake potential, listed previously for north coastal scrubs.
- Fuel reduction decisions should be made on a site-by-site basis to either encourage succession of woodlands (on moist sites), convert to grassland and prevent additional coyote scrub encroachment, or maintain as a scrub community. To return the treatment area to grasslands and hold succession at that stage, vegetation treatments should include mowing, grazing, and/or broadcast burning.
- The following are recommended treatment performance standards for coyote brush scrub where mosaic thinning is used for fuel modification:
 - *Height:* Height of scrub should be variable, with taller clumps of brush interspersed with shorter stature vegetation and openings. Thin or selectively remove exotic species and shrubs that will stump sprout to achieve desired vertical and horizontal variability.
 - *Clump Size:* Create clumps that include specimens of variable age classes.
 - *Spacing:* Distance between clumps should be greater than approximately twice the height of tallest shrub crown.
 - *Crown Cover:* Retain approximately 25 to 50 percent shrub crown cover as determined by shrub height and island distribution.
 - *Dead to Live Ratio:* The dead to live fuel ratio should be less than 20 percent in shrub canopy.
 - *Preferential Removal of Species:* Keep less flammable sprouting species such as oak, coffeeberry, huckleberry, snowberry, rose, iris, and salal. The removal of brush should be based on the following criteria which are listed in approximate descending order of importance to fuel management objectives:
 - Listed species – retain all healthy and vigorous individual specimens of pallid manzanita.

- Sprouting capability – remove species with sprouting capacity first.
- Plant vigor – remove shrubs of low vigor, and all dying or dead shrubs, including pallid manzanita.
- Effects of plant species on soils – i.e., retain shrubs with slope-holding capacity that increase soil nutrients.
- Value for wildlife food and cover.
- Aesthetic values.
- Diversity of species.
- Encourage and protect obligate “seeders” (such as some species of manzanita and ceanothus).
- Remove exotic species.
- Consider the conversion of shrubs to lighter fuel types, e.g., grass, especially in maintained fuel reduction zones.
- Chipping/mulch depth should be between approximately 2 and 5 inches following treatment.
- o Set the following standards for areas where coyote brush-scrub plants are cut or pruned:
 - Cut to a maximum height of 1.5 feet; allow maximum growth to 4 feet (total plant height) before re-treatment
 - Remove shrubs surrounding trees to the dripline; prune trees of lower branches
 - Debris to remain in place as mulch below shrub.
- Protect individual native tree specimens from browsing and girdling during grazing treatments.
- Anticipate a 5 to 7 year treatment cycle to manage treated areas to standards of Coastal Scrub (Fuel Model #5) with young brush, short mature brush, or patchy islands.

d. Non-Native Scrub

Non-native scrub occurs throughout the East Bay Hills, especially where the native vegetation has



Broom Scrub (foreground) and Eucalyptus (background)

been removed and/or the soils have been disturbed. French broom is the most common of the three non-native broom species found in the Study Area, occurring in large stands along roads, trails, housing developments, and in areas that have been previously managed for fuel reduction. Because of its fast growth and high rate of reproduction, French broom may form monocultures that out-compete all native and other non-native species. Associated herbaceous species are mostly non-native and include poison hemlock (a very invasive weed in the East Bay Hills), Italian thistle, wild radish, and black mustard. Broom scrub is difficult to eradicate; it is also adapted to a natural fire cycle. Most species resprout easily to rejuvenate individual specimens after fire. Some broom species depend on fire to promote germination or clear sites of competitors and create ideal situations for their growth. Other shrubs, especially coyote brush, may be present at some sites.

Fuel Characteristics

Overall hazard for non-native scrub is rated as High with flame lengths of 15 to 18 feet depending on vegetation type, fuel volume, and slope. Generally this vegetation type was modeled as Brush (Fuel Model 5) as suggested by the structural attributes and fuel volumes of non-native scrub vegetation.

Ignition Potential. Non-native scrub has a moderate ignition potential with an ignition index of 6 because plants tend to stay green year-round or cure late in the season (August to October). The ignition potential can be greatly increased with the presence of other exotic species, such as pampas grass, that have a high proportion of fine fuels or dead materials.

Fire Behavior and Responsiveness to Suppression. Fire behavior is variable depending on volume and the structural characteristics of fuels. While this fuel type is only moderately easy to ignite, once ignited, fires can spread rapidly when these fuels are dry. Pampas grass and yellow star thistle increase the “fineness” or surface area of fuels, which adds to their ignitability. This vegetation type has moderate to very high heat output and responds more slowly to changes in temperature and moisture than similar fuel types with a greater proportion of dead material in the fuel bed. Some species have oils, resins, or other volatile chemicals that make them burn faster and hotter.

Fire Hazard Reduction and Resource Management Goals

Figure V-7 provides photos of non-native scrub showing before treatment high hazard fuel conditions and low hazard fuel conditions. The following goals relate to fire hazard reduction in non-native scrub areas:

- Convert areas dominated by invasive species to more fire-safe vegetation types, such as native grassland or oak-bay woodland (on moist sites).
- Remove or reduce total fuel volume.



High Fire Hazard: Non-Native Scrub



Low Fire Hazard: Non-Native Scrub

LSA

FIGURE V-7

*EBRPD Wildfire Hazard Reduction
and Resource Management Plan*
Photo Comparison of High and Low Hazard
Non-Native Scrub

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- Shorten the overall height of shrubs to decrease the opportunity for fire to carry up into taller adjacent plant materials or structures.
- Utilize techniques that minimize successful reproduction and establishment of broom scrub.
- Treat potential ignition sites, (e.g., along roadsides, picnic areas, and overlooks).

The following resource management goal should be considered for non-native scrub areas:

- Convert non-native scrub to a vegetation type with low fuel volumes and high species diversity, such as grassland or oak-bay woodland, as appropriate.

Potential Fuel Treatment Methods and Limitations

The following potential fuel treatment methods and their corollary limitations should be considered for non-native scrub areas within the Study Area:

All Methods. Preventing seed set of broom by defoliation after flowering (after May or June) but before seeds are ripe is generally considered the optimum strategy to reduce future spread of this invasive scrub species. Repeated treatments are necessary for successful conversion. Any disruption in the treatment cycle (i.e., skipping a growing season) usually results in the return to dominance of broom and other invasive scrub and may actually increase the size and density of population. The timing of treatments is as important as treatment selection; as a result, differential timing of re-seeding should be used to promote native species growth over that of invasive species. Mulching and/or seeding with native species after brush removal will also help reduce recurrent invasion and promote native species growth. Care should be taken to prevent the exposure of bare soil following treatment, which could lead to increased weed invasion in treated areas.

Hand Labor. Hand labor treatments are generally not effective unless plant roots are removed. For new small infestations, the root ball can be easily pulled up when soils are moist in the rainy season. Uprooting broom is largely ineffective, however, because soil disturbance encourages reseeding from broom and other invasive and non-native species. Mulching and re-seeding with rapidly-establishing grasses such as California brome can reduce invasion of non-native species.

Mechanical Treatment. Mechanical treatment methods can be used to cut broom prior to seed set (June-July), but procedures must be followed to prevent spreading seeds of

noxious species including cleaning equipment blades, tracks, and vehicle undercarriages prior to working new sites.¹¹

Chemical Treatment. Foliar application in the middle to late winter is generally the best chemical treatment method for controlling or reducing broom and other similar invasive scrub species, but care should be taken to avoid sensitive or non-target species within the treatment area.

Prescribed Burning. Prescribed burning is best used in conjunction with mechanical or hand labor treatments that cut down existing plants; doing so can reduce recurrent invasion of weed species by reducing their seed banks. After cutting in the late summer or fall, burning the following spring or early summer will remove litter and reduce re-establishment of broom and other invasive species. Where no overstory exists, cut plants should remain on-site to increase seed destruction by the prescribed burn. Cutting plants prior to prescribed burning is generally more effective than girdling plants.

Grazing (goats). Goat grazing does not appear to be effective in eliminating broom and, as such, should not be considered as a fuel reduction treatment option in non-native scrub areas.

Treatment Considerations and Guidelines

Fuel Reduction. The following treatment guideline is recommended for non-native scrub areas:

- Where non-native scrub is intermixed with other vegetation communities, see the recommended treatment performance standards for grassland, maritime chaparral, and oak-bay woodland provided elsewhere in this document and incorporate such standards, as necessary, to achieve the desired treatment performance for non-native scrub areas intermixed in these other plant communities.

The goal in non-native scrub areas is to eliminate broom and other exotic species; treatments should be conducted yearly or more frequently, where feasible, as each year that these species set seeds makes them more difficult to eradicate.

Resource Consideration. The following resource considerations and guidelines apply to non-native scrub areas:

- Because of low diversity and invasive qualities, non-native scrub provides low resource values.

¹¹ See <http://www.fs.fed.us/eng/t-d.php> for details on a portable vehicle washer suitable for cleaning equipment effectively to reduce the spread of invasive species.

- Removal of any and all of this vegetation is ecologically desirable provided it does not result in increased erosion or harm nearby vegetation during treatment.
- Native habitat restoration and follow-up treatments should occur to prevent recurrent invasion.
- The following special considerations should be included to reduce the re-introduction of invasive plants:
 - Leave mulch and/or seed with native grasses to reduce the amount of bare surface soils after any treatment.
 - Incorporate best management practices (BMPs) into fuel reduction methods to reduce the spread of invasive or non-native seeds, including equipment cleaning, feed restrictions for grazing animals, adequate residual dry matter, and seasonal restrictions on grazing.
- Time treatments to destroy and prevent distribution of the current seed crop, as noted above.

3. Woodlands and Forest Plantations

Fuel characteristics and special considerations for woodlands and forest plantation vegetation types will be discussed in general for seven woodland and forest types: mature eucalyptus forest, young (small-diameter) eucalyptus forest, mature Monterey pine forest, young (small-diameter) Monterey pine forest, oak-bay woodland, redwood forest, and riparian woodland. Differences in vegetation types and associated treatments will be noted in the text for each type of woodland vegetation.



Eucalyptus Forest/Plantation

a. Mature Eucalyptus Forest

Large stands of eucalyptus were planted on grasslands in the Study Area in the early 1900s and developed into dense plantations of approximately 1,000 stems per acre (trees spaced approximately 7 feet apart). Elsewhere, stands of eucalyptus have been damaged by cutting and years of the freeze/thaw cycle, but have grown into mature stands, fence rows, and strips of large eucalyptus trees. Treatment methods for plantation stands, other mature stands, and fence rows or strips will vary due to the density/spacing of trees in these areas and the surrounding vegetation. Dominant species are blue gum and, to a lesser extent, red gum. Understory plant diversity is generally mixed, ranging from a rich assembly of native shrubs and young oaks and bays, to a well-developed stand of French broom, to an

understory of young eucalyptus with annual grasses at edges of stands. Edges also are often mixed with other introduced species such as acacia and Monterey pine. Large plantation stands of eucalyptus are generally easier to identify and treat as a distinct unit; those eucalyptus surviving on their own or in a fence row-like strip may require different treatment methods and implementation plans entirely due to their unique site characteristics.

Fuel Characteristics

The overall fire hazard rating for mature eucalyptus forest is High, with flame lengths ranging from 6 to 21 feet depending upon fuel volume, stand structure, treatment history, and slope. The wide variety of flame lengths primarily relates to the depth of litter below trees, amount of dead materials within and around trees, stand density, and density of the understory, but is also associated with the species' shreddy bark, volatile oils, and aerodynamic leaf structure. The mature eucalyptus forest was modeled as Closed Canopy Oak Woodland Understory (Fuel Model 10), Brush (Fuel Model 4), Hardwood Litter (Fuel Model 9) or Closed Canopy Oak Woodland (Fuel Model 8). Eucalyptus is well-known for its long distance ember distribution, casting viable firebrands miles from the flaming front to ignite spot fires in grass, brush, or roofs miles ahead of the main fire. Unmanaged stands also have a propensity to torch and carry crown fire.

The presence of volatile oils in the trees increases the speed of fire spread, total heat output, and overall ignitability. Ignited leaves and bark are easily lofted into the air by heavy winds and increase the potential for starting new fires long distances from a fire (i.e., spotting). The size of leaves and bark from mature eucalyptus trees are typically large enough to ensure that the ember is still burning (versus small particles that could be extinguished in flight) when it lands. Heat output from mature eucalyptus fires is high when sufficient fuel has accumulated in the area. Large limbs respond more slowly to changes in temperature and moisture, but a preponderance of fine fuels such as leaves, loose bark, and small twigs respond more rapidly to fire. Eucalyptus trees are susceptible to freeze damage and insect attacks, which further increase the volume of dead materials in eucalyptus stands.

Ignition Potential. Mature eucalyptus has a High hazard rating due to the presence of fine fuels, especially in areas with a deep build-up of litter and dead materials. As a result, these areas have an ignition index of 1. Mature eucalyptus will ignite year-round when weather is dry; however, fog-drip limits ignition on foggy summer and winter mornings.

Fire Behavior and Responsiveness to Suppression. The heat output of the eucalyptus fuelbed limits direct attack and fire suppression effectiveness; spotting characteristics can cause ignition of nearby structures and ignition can occur year-round. These trees are adapted to a natural fire cycle and have the ability to rejuvenate through

stump sprouting which makes eucalyptus difficult to remove. This vegetation type accumulates fuels more quickly than any other in the Study Area.

The position of a eucalyptus stand on a hillside, the hillside's slope, stand height in relation to nearby structures, and the stand's distance from structures each influence treatment options and can be triggers for removal (see Figure V-8). Previous management of eucalyptus groves also heavily influences treatment options:

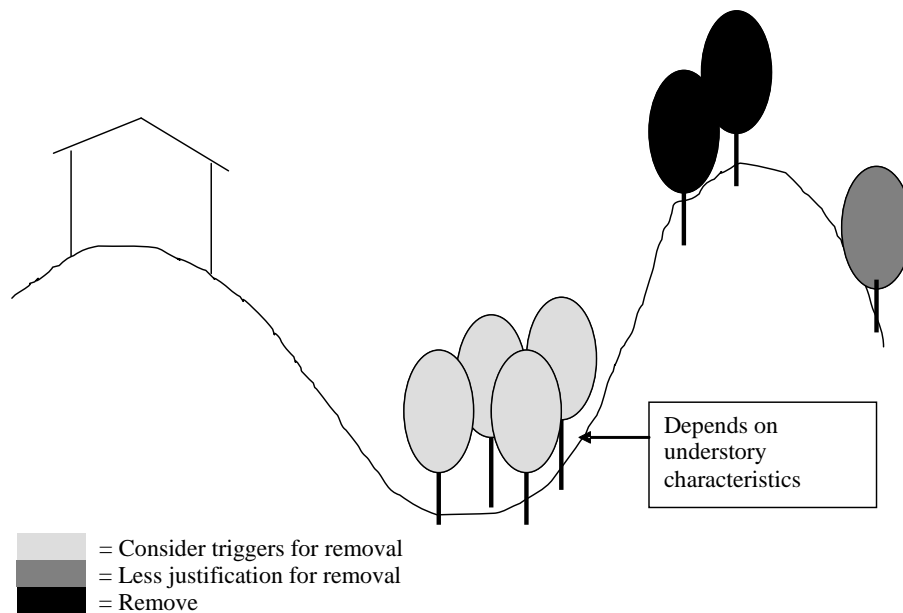


Figure V-8: Eucalyptus Tree Removal

Triggers for removal of eucalyptus: (1) trees located on ridges, (2) trees within 1,000 feet of structures, (3) Trees within 100 foot elevation of structures, (4) trees with a well-developed native understory (particularly oak/bay woodland).

Source: Wildland Resource Management, Inc. 2007.

- Eucalyptus situated in valleys and with a native understory should be thinned, and the overstory and understory managed to reduce flame lengths.
- Where understory removal has occurred, future treatments should focus on maintaining the separation of the surface-level fuels and crown fuels.
- Where no thinning has previously occurred and the understory is composed of non-native plants, understory removal is appropriate.

Fire Hazard Reduction and Resource Management Goals

Figure V-9.a and 9.b provide photos of mature eucalyptus forest showing before treatment high hazard fuel conditions and low hazard fuel conditions. The following fire hazard reduction goals apply to mature eucalyptus forest:

- Create vertical separation between the tree canopy and surface fuels below (including young trees).
- Remove dead materials and decrease duff layer.
- Remove loose bark.
- Create a large separation between groupings of trees to slow the rapid fire spread from crown to crown.
- Target eucalyptus trees on ridgelines for removal, as they are more prone to cast embers long distances. Remove trees on ridge tops or near the wildland-urban interface to reduce fire spread through spotting.
- Thin eucalyptus stands to reduce overall fuel production. Young eucalyptus should be thinned to a 10-15 feet spacing; mature trees to a spacing of 20-35 feet.
- Convert mature eucalyptus forests to a more fire-safe vegetation type. Avoid creating second growth eucalyptus forests by conducting successive treatments until fire hazards are sufficiently reduced or other desired plant communities are established.

The following resource management goals should be considered for mature eucalyptus forests:

- Replacement of eucalyptus by grassland or oak/bay woodland should be considered, where feasible, as eucalyptus are non-native to the East Bay Hills. Careful planning and implementation can minimize and shorten the potentially-adverse effects of converting these areas to grasslands or other desired vegetation types.
- Control invasive non-native species in the understory and encourage establishment of native grassland plants as part of the treatment prescription.
- Protect large native trees or shrubs.

Potential Treatment Methods and Limitations

The following potential treatment methods and limitations should be considered prior to implementing treatment actions in mature eucalyptus forests:

Hand Labor. Hand labor techniques are generally effective for the removal of litter below trees, removal of loose bark, and other treatment actions prior to treatment with prescribed burning. These treatment methods are also effective for removing lower branches, selectively thinning eucalyptus stands by removing smaller trees in well-established stands, and conducting treatment actions on sites too steep for equipment or those with other special considerations. Routes planned for removing cut trees must be coordinated to minimize any potential adverse impacts from hauling operations.



High Fire Hazard: Mature Eucalyptus Forest



Low Fire Hazard: Mature Eucalyptus Forest

LSA

FIGURE V-9.a

*EBRPD Wildfire Hazard Reduction
and Resource Management Plan*
Photo Comparison of High and Low Hazard
Mature Eucalyptus Forest



High Fire Hazard: Mature Eucalyptus Forest



Low Fire Hazard: Mature Eucalyptus Forest

LSA

FIGURE V-9.b

*EBRPD Wildfire Hazard Reduction
and Resource Management Plan*
Photo Comparison of High and Low Hazard
Mature Eucalyptus Forest

Mechanical Treatment. Mechanical treatment methods should be utilized on slopes under 30 percent to avoid adverse effects due to heavy equipment use. Routes planned for removing cut trees must be coordinated to minimize any potential adverse impacts from skidding or yarding operations. (see Chapter IV. Fuel Treatment Methods)

Chemical Treatment. Chemical treatments can be used as follow-up treatments to reduce resprouting following tree cutting. Monitoring of plant response and implementing additional treatments are critical to prevent stump sprouting. Chemical treatment effectiveness is dependent on the type of herbicide and application practices utilized. Refer to Chapter IV, Fuel Treatment Methods, for specific information regarding chemical application methods and timing.

Prescribed Burning. Prescribed burning can be effective for removing litter build-up and understory brush, but requires using other methods to prepare eucalyptus stands prior to burning to ensure the safe use of this technique and to prevent crowning. Intermixed oaks and bays and other desirable species should be protected from unacceptable crown damage during prescribed burns in mature eucalyptus forests. Burning in eucalyptus stands produces more seedlings and sproutings, however, and is therefore not a desirable treatment method where the intent is to convert the stand over time to an oak/bay woodland or grassland.

Treatment Considerations and Guidelines

Fuel Reduction. Additional options for managing mature eucalyptus stands, as well as recommended guidelines for these treatment methods, are provided below:

- Thin overstory and maintain as eucalyptus plantation.
 - Do not convert to another vegetation type. Maintain eucalyptus as a mature, even-aged single-species stand and maintain vertical separation of crown to soil surface.
 - Mulch forest floor to 2 inches maximum depth; do not use eucalyptus leaf litter.
 - Prevent sprouting of cut stumps.
 - Anticipate follow-up treatment in approximately 3 to 5 year cycles or as needed to maintain standards.
- Create shaded fuel reduction zones by thinning the overstory and minimizing the understory.
 - Thin eucalyptus trees to 20- to 35-foot spacing.
 - Control sprouting of cut stumps.
 - Provide 8 to 10 feet of vertical clearance between lowest branches and surface soil.

- Remove understory shrubs and small trees. Remove all trees smaller than 12 inches diameter at breast height. These are young, shorter trees that are located beneath the major canopy and create fuel ladders into mature trees.
- Remove or chip all materials less than 4 inches in diameter, unless logs are needed for erosion control.
- Anticipate follow-up treatment in approximately 3 to 5 year cycles or as needed to maintain standards.
- Manage surface fuels beneath the understory trees and shrubs and limb overstory eucalyptus.
 - Separate understory fuels from the overstory for 2 times the height of the fuel, including young trees, beneath mature eucalyptus. Prune mature eucalyptus to further achieve this desired separation.
 - Provide 8 to 10 feet of vertical clearance between the overstory's lowest branches and surface soils.
 - Maintain canopy closure to prevent shrub development.
 - Mulch forest floor to 2 inches maximum depth.
 - Remove loose bark.
 - Control and eliminate all suckering, including cut eucalyptus stumps.
 - Anticipate a 2 to 3 year cycle of treatment to maintain standards to create the equivalent of Fuel Model 8 in these areas.
- On treated areas susceptible to landslides, a geotechnical evaluation must be made on a case-by-case basis to determine the contribution of the root mass in deterring soil slippage or slumping and the potential impacts of vegetation type conversion on future landslide potential.

Resource Considerations. The following resource considerations and guidelines should be applied to mature eucalyptus forest:

- Raptors may use eucalyptus forest for nesting in the spring. If spring treatments are planned, pre-treatment surveys should be conducted to identify the presence of nesting pairs. Treatments such as prescribed burning, logging, or chemical treatments in the vicinity of known nesting pairs of any raptors should be postponed until the young have fledged or until it is determined by a qualified biologist that treatments are able to proceed without harming birds or nests. The width of the protected buffer zone around an active nest should be determined by a qualified biologist on a site-specific basis.

- Great blue herons are known to nest in the vicinity of eucalyptus forests near Lake Chabot. The area should be avoided during the breeding and nesting season, or until a qualified biologist confirms that treatment activities in this area can proceed without harm to birds or nests. Buffer zones should be implemented until the young have fledged.
- To protect the known monarch butterfly wintering area in the Point Pinole Shoreline Regional Park, treatments in or near this area should be prescribed and monitored in coordination with resource professionals to protect monarch roosting habitat.
- Fog drip from eucalyptus is a local phenomenon that can encourage the growth of both native and non-native understory species. Follow-up monitoring and treatment should be conducted to favor native revegetation and control non-native infestations.

b. Young Eucalyptus Forest

Young eucalyptus forests typically result from the re-growth of previously cut mature eucalyptus. This vegetation category includes relatively small young specimens from 1 year to 10 years of age. These stands are occasionally mixed with oaks, bays, and pines, as well as exotic shrubs or chaparral. Edges are also often mixed with other introduced species such as acacia and Monterey pine. The forest is dominated by trees with multiple trunks and a larger amount of leaves at the lower levels. This vegetation type is more hazardous than mature eucalyptus forest due to high tree density and the presence of multiple stems, which can suspend dead leaves and branches within these stems that act as an additional ladder fuel.

Fuel Characteristics

The overall fire hazard rating of young eucalyptus forest is High, with flame lengths ranging from 7 to 31 feet depending on fuel volume, stand structure, treatment history, and slope. The wide variety of flame lengths primarily relates to the amount of dead materials within each tree, stand density, and understory composition, creating a high heat output in these areas. There is a high proportion of living fuels in the form of young sprouts 2 to 20 feet tall. The multiple stems originating from a single trunk form a basket-type structure that catches, aerates, and suspends dead material, creating a dry, fluffy fuelbed that burns easily and intensely. The few large limbs respond more slowly to changes in temperature and moisture, but there is a preponderance of dead fine fuels (e.g., leaves, loose bark, and small twigs) which responds more rapidly. Fire can easily move up into the crown in young eucalyptus forests due to the dense understory and vertical continuity of fuels. Young eucalyptus trees are susceptible to freeze damage and insect attacks, which further increase the volume of dead to live fuels. When damage occurs, dead material often stays on stems for years,

creating elevated hazards. Emerging second growth or young eucalyptus forest was modeled as Fuel Model 7.¹²

Ignition Potential. This vegetation type has an ignition index of 2 because less litter is present than that found in mature stands due to the age of trees or recent management activities.

Fire Behavior and Responsiveness to Suppression. Litter depth is usually shallow because of recent management activity, but complete continuity of fuels – both vertically and horizontally – makes the fuel bed particularly hazardous because it burns as a uniform block. The high density of stems prevents easy access and further hinders effective fire suppression. The heat output of this fuelbed precludes direct attack, limits fire suppression effectiveness, and can cause ignition of nearby structures. Ember distribution is not as far as mature eucalyptus because the height of stands is generally shorter and materials cast aloft are not as large. The presence of volatile oils increases the rate of fire spread. Ignited leaves and bark are easily lofted, increasing the potential for spotting. The size of leaves and bark are typically large enough to ensure the ember is still viable (versus small particles that could be extinguished in flight); however, young sprouts do not typically have bark that exfoliates in strips. Eucalyptus are adapted to natural fire cycles, and its ability to rejuvenate through stump sprouting makes it difficult to permanently remove individual specimens.

Fire Hazard Reduction and Resource Management Goals

Figures V-10.a and 10.b provide photos of young eucalyptus forest showing before treatment high hazard fuel conditions and low hazard fuel conditions. The following fire hazard reduction goals pertain to young eucalyptus forest:

- Where feasible, eliminate this vegetation type and convert these areas to more fire safe vegetation types, such as grassland or oak-bay woodland. Remove young eucalyptus trees on ridge tops or near the wildland-urban interface to reduce fire spread through spotting.
- Where conversion is not possible:
 - Remove any loose bark.
 - Consider reducing the number of stems per tree.
 - Create separation between large groupings of trees to inhibit rapid fire spread from crown to crown.

¹² Rothermel (1983) states “Fire behavior model 7 – Fires burn through the surface and shrub strata with equal ease and can occur at higher dead fuel moisture contents because of the flammable nature of live foliage and other live material.” Young eucalyptus stands growing as a thicket would burn as a block, with surface and crown fuels burning at the same time. The high oil content in the eucalyptus and pine foliage is another common factor.



High Fire Hazard: Young Eucalyptus Forest



Low Fire Hazard: Young Eucalyptus Forest

LSA

FIGURE V-10.a

*EBRPD Wildfire Hazard Reduction
and Resource Management Plan*
Photo Comparison of High and Low Hazard
Young Eucalyptus Forest



High Fire Hazard: Young Eucalyptus Forest



Low Fire Hazard: Young Eucalyptus Forest

LSA

FIGURE V-10.b

*EBRPD Wildfire Hazard Reduction
and Resource Management Plan*
Photo Comparison of High and Low Hazard
Young Eucalyptus Forest

- Create vertical separation between the tree canopy and surface fuels below.
- Remove dead materials to 3 tons/acre and decrease duff layer to 2 inches.

The following resource management goal applies to young eucalyptus forest:

- Eucalyptus plantations are a non-native vegetation type; replacement of eucalyptus by hardwood forest or grassland is generally desirable. Careful planning can minimize and shorten potential adverse effects from conversion.

4. Potential Fuel Treatment Methods and Limitations

The following treatment methods and their corollary limitations should be considered for young eucalyptus forest:

Hand Labor. Hand labor treatments are effective for removing sprouts, lower branches, foliage, loose bark, and understory litter as well as for conducting other actions prior to follow-up chemical or prescribed burn treatments. Hand labor is also effective for selective thinning of stands by removing trees or stems on sites too steep for mechanical equipment or sites with other special considerations. Routes planned for removing cut trees must be coordinated to minimize potential adverse impacts on nearby water or biological resources from hauling operations.

Mechanical Treatment. Mechanical treatment techniques can chip or otherwise process sprouts and small branches quickly, but should only be used on slopes under 30 percent to avoid potential adverse effects that may result from heavy equipment use. Haul routes planned for removing cut trees must be coordinated to minimize potential adverse impacts from hauling operations. These treatment methods can also be used to remove or eliminate stumps of cut trees to facilitate further use of machinery to mow grass or brush.

Chemical Treatment. Herbicides should be used in follow-up treatments to reduce resprouting or stump sprouting after trees have been cut. Monitoring of plant response and additional follow-up treatments as required on a site-specific basis are critical to prevent stump sprouting.

Prescribed Burning. Prescribed burning is generally not recommended without prior implementation of other treatment methods to prepare eucalyptus stands for safe burning and to prevent crowning; prescribed burning is more difficult to use in young eucalyptus forest than in mature stands due to the increased presence of understory litter and the shorter distance between surface fuels and overstory canopies. Burning in eucalyptus also produces more seedlings and sprouting, and is therefore not a desirable treatment method.

Treatment Considerations and Guidelines

Fuel Reduction. The following treatment guidelines are recommended for young eucalyptus forest:

- Standards for conversion to lighter fuel types:
 - Thin eucalyptus to shaded fuel break or convert to a more fire-safe vegetation type (e.g., grassland or oak-bay woodland) that existed prior to introduction of eucalyptus.
 - Continue monitoring treated areas and conduct follow-up treatment actions as necessary to control and prevent regrowth.
 - On treated areas susceptible to landslides, a geotechnical evaluation must be made on a case-by-case basis to determine the contribution of the root mass in deterring soil slippage or slumping and the potential impacts of vegetation type conversion on future landslide potential.
- Standards for separation of fuel structure:
 - Stand density should be thinned by selecting one stem per stump to remain and removing all others, and removing stumps to 25-foot spacing. Give preference for removal to those stumps adjacent to native vegetation.
 - Prune lower branches to 10 feet to create vertical separation between the tree canopy and surface fuels below (including other species).
 - Remove any loose bark up to 10 feet from the ground.
 - Remove dead materials to a loading of 3 tons/acre and decrease the duff layer to 2 inches.
- Remove or chip all cut materials less than 4 inches in diameter unless logs are needed for erosion control.
- Anticipate an approximately 2 to 3 year treatment cycle or as needed to maintain fire hazard reduction standards.

Resource Considerations. The following resource considerations and guidelines apply to young eucalyptus forest:

- Young or small stature eucalyptus stands do not have the same special considerations as the mature specimens with respect to raptor nests, great blue heron rookeries, or monarch butterfly roosts.
- As eucalyptus mature, they offer shade and shelter from wind and can act as nurseries to foster native shrubs and trees. However, the potential benefit as nursery sites for native hardwood forests is diminished in young eucalyptus woodlands.

- There is little ecological reason to protect young eucalyptus stands. However, where the young eucalyptus are intermixed with oak-bay woodland, caution should be exercised to protect the native understory vegetation and encourage their success.
- Control invasive non-native species in the understory as part of the treatment prescription.

c. Mature Monterey Pine Forest

Monterey pines were widely introduced in large plantations in the San Francisco Bay Area in the early 1900s. The understory diversity in mature pine plantations is sometimes poorly developed, consisting mainly of young pines with annual grasses at edges of stands. More open stands may have a well-developed understory of oaks, bays, poison oak, and blackberry with an intermix of cypress. The edges of pine forests are also characterized by other introduced species such as acacia and French broom. Monterey pines do not resprout once cut. Monterey pines are susceptible to pine pitch canker and other diseases, which further contribute to the amount of dead material contributing to fuel loads in those areas where such diseases are present.



Monterey Pine Forest

Fuel Characteristics

The overall fire hazard of mature Monterey Pine plantations is rated as Moderate to High. Flame lengths can be 2 to 16 feet depending upon understory conditions, development stage, and site slope. Pine forests were modeled as Closed Canopy Oak Woodland Understory (Fuel Model #10), Hardwood Litter (Fuel Model #9), Timber Grass (Fuel Model #2) or Closed Canopy Oak Woodland (Fuel Model #8).

Ignition Potential. Mature Monterey pine plantations have an ignition index of 2 for both plantations and mature groves. The presence of needles, a high fire hazard understory, and fine dead wood on the ground and in the lower portions of trees increase the ignition potential.

Fire Behavior and Responsiveness to Suppression. Mature Monterey Pine plantations are relatively easy to ignite if tall grass groundcover or litter is built up (e.g., fallen needles and branches). If these fuels do not exist, it is more difficult to ignite the crowns of mature trees. Heat output and spread is linked to fuel build-up and the amount of understory litter. The presence of volatile resins in Monterey pines increases their heat production and rate of fire spread and there is a high heat output when fuel has

accumulated. Ignited needles and branches are easily carried aloft, increasing the potential for spotting. Large limbs respond more slowly to changes in temperature and moisture. When there is a preponderance of fine fuels such as needles and small twigs, Monterey pines respond more rapidly to ignition. The majority of pine plantations in the parks are aged and more susceptible to insect attacks which increase the volume of dead fuels. Monterey pine forests are a fast accumulator of fuels, and are adapted to frequent low-intensity fires.

Fire Hazard Reduction and Resource Management Goals

Figure V-11 provides photos of mature Monterey pine forest showing before treatment high hazard fuel conditions and low hazard fuel conditions. The following fire hazard reduction goals apply to mature Monterey pine forest:

- Create vertical separation between the tree canopy and surface fuels below (including shorter trees).
- Remove dead materials and decrease the underlying duff layer.
- Create a separation between groupings of trees to inhibit rapid fire spread from crown to crown.
- Remove specimens on ridge tops or near the wildland-urban interface to reduce fire spread through spotting.
- Thin stands to reduce overall rates of fuel production.

Encourage the conversion of Monterey pine forest to more native fire-safe vegetation types such as oak-bay woodland or redwoods.

The following resource management goals should be considered when directing vegetation management actions for mature Monterey pine forest:

- Removing Monterey pines and restoring native vegetation types, such as grassland or oak-bay woodland, is generally desirable. Careful planning can minimize and shorten potential adverse impacts that may result from such conversion, but some Monterey pines should be retained where appropriate to provide structural diversity and nesting habitat.
- Native understory vegetation should be encouraged to succeed after removal of Monterey pines.
- Invasive plants in the understory should be controlled as part of the treatment prescription.



High Fire Hazard: Mature Monterey Pine Forest



Low Fire Hazard: Mature Monterey Pine Forest

LSA

FIGURE V-11

*EBRPD Wildfire Hazard Reduction
and Resource Management Plan*
Photo Comparison of High and Low Hazard
Mature Monterey Pine Forest

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Potential Fuel Treatment Methods and Limitations

The following fuel treatments and their corollary limitations should be considered for mature Monterey pine forest:

Hand Labor. Hand labor techniques are effective for removing dead limbs and litter below trees, as well as for implementing other vegetation management actions prior to prescribed burning or other follow-up treatments. Hand labor can also be used to remove lower branches to create separation between the understory and the canopy, and for the selective thinning of stands on sites too steep for mechanical equipment or those sites with other special considerations. Haul routes planned for removing cut trees must be coordinated to minimize potential adverse impacts resulting from hauling operations.

Mechanical Treatment. Mechanical treatments should only be used on slopes under 30 percent to avoid potential adverse effects due to heavy equipment use. Haul routes planned for removing cut trees must be coordinated to minimize potential adverse impacts resulting from hauling operations.

Prescribed Burning. Prescribed burning requires hand labor or mechanical treatment actions prior to its implementation to prepare most tree stands and to prevent possible crowning. Pile or stationary burns are effective for removing dead limbs or other materials accumulated from hand labor or mechanical treatment actions. Low intensity broadcast burns are effective for removing litter build-up; Monterey pine litter is generally easy to burn and fire is unlikely to spread quickly when surrounding grasses are green.

Grazing (Goat). Any goat grazing of understory materials must include protection measures for selected native understory vegetation to prevent girdling or depletion of these trees.

Treatment Considerations and Guidelines

Fuel Reduction. The following treatment guidelines are recommended for vegetation management actions in mature Monterey pine forests:

- Remove all ladder fuels.
- Guidelines for the separation of fuel structure:
 - Create vertical clearance between live needles and understory fuel.
 - Remove all dead material.
 - Prune branches to increase vertical separation.

- On treated areas susceptible to landslides, a geotechnical evaluation must be made on a case-by-case basis to determine the contribution of the root mass in deterring soil slippage or slumping and the potential impacts of vegetation type conversion on future landslide potential.

Resource Considerations. The following resource considerations and guidelines apply to mature Monterey pine forest:

- Although Monterey pine forest is not native to the East Bay Hills, it has some environmental value in providing bird perching and nesting habitat, invertebrate and reptile habitat, and supporting associated native plant species.
- Open stands may support a native understory, including maritime chaparral and other vegetation types.
- Monterey pines could support raptor nests. If treatments are proposed during the nesting season, pre-treatment surveys should be conducted to detect active raptor nests. If an active nest is found, it should be protected with an adequate buffer zone until after the nestlings have fledged.
- Most areas of pine plantations should be cleared and restored to native vegetation types, but some Monterey pines should be left for wildlife habitat and aesthetic value.

d. Young Monterey Pine Forest

Young Monterey pine stands are the results of either management or disturbance that created conditions for germination and growth. This vegetation category includes relatively small young specimens from 1 to 20 years of age. Monterey pine stands are occasionally mixed with oaks and bays as well as exotic shrubs or chaparral. The young pine stands are more hazardous than the mature pine forest due to the high tree density and uniform arrangement of fuel both horizontally and vertically.

Fuel Characteristics

The overall fire hazard rating for young pine stands is High, with flame lengths ranging from 7 to 31 feet depending upon fuel volume, stand structure, treatment history, and slope.

There is a high proportion of living fuels in the form of young trees 2 to 20 feet tall. Young pine stands were modeled as Fuel Model 7.¹³

Ignition Potential. Young Monterey Pine forests are categorized with an ignition index of 2 due to the typically “fluffy” fuelbed of highly-ignitable pine needles; it is often easy for

¹³ Rothermel (1983) states “Fire behavior model 7 – Fires burn through the surface and shrub strata with equal ease and can occur at higher dead fuel moisture contents because of the flammable nature of live foliage and other live material.” Young pine stands growing as a thicket would burn as a block, with surface and crown fuels burning at the same time.

fire to move up into the crown in these areas due to their dense understory and the continuity of fuels that results from branches that do not self-prune and grow to the ground. Ember distribution from young Monterey pine forest is not as far as that for mature Monterey pine because the height of the stand is generally shorter and materials cast aloft are not as large.

Fire Behavior and Responsiveness to Suppression. Litter depth is usually shallow because of recent management activity, but complete continuity of fuels – both vertically and horizontally – makes the fuelbed particularly hazardous because it burns as a uniform block (sometimes flames reach a height of 40 feet). The high density of stems prevents easy access and further hinders effective fire suppression. The heat output of this fuelbed discourages direct attack, limits fire suppression effectiveness, and can ignite nearby structures. The presence of volatile oils in the fuel bed increases the rate of fire spread. Lower branches often die due to excessive shading from the dense overstory of Monterey pine stands, and the dead lower branches that are still attached to the trunk promote torching when fires occur in the understory. High stand density promotes crown fire spread once lower fires reach the overstory. Where Monterey pines grow in other vegetation types they are also prone to torching, even as scattered trees.

The overall height of Monterey pines promotes far-reaching ember distribution; ignited leaves and bark are easily carried aloft, increasing the potential for spotting. Pine needles create continuous, highly aerated surface fuels which ignite easily; needles are often wind-blown and accumulate in nooks and crannies of structures to create additional opportunities for ignition. Young pines also produce a high heat output, while large dead limbs respond more slowly to changes in temperature and moisture. When there is a preponderance of fine dead fuels around tree stands these trees respond more rapidly to ignition. Pines are adapted to natural fire cycles and are able to rejuvenate through prolific seed germination and vigorous growth.

Fire Hazard Reduction and Resource Management Goals

Figure V-12 provides photos of young Monterey pine forest showing before treatment high hazard fuel conditions and low hazard fuel conditions. The following goals pertain to fire hazard reduction in young Monterey pine forest:

- Thin stands to reduce the total number of 50 to 70 trees per acre. Young Monterey pines should be removed entirely and mature trees thinned to a 25-30 feet minimum spacing.
- Create horizontal separation between large groupings of trees to slow rapid fire spread from crown to crown.

- Remove specimens on ridge tops or near the wildland-urban interface to reduce fire spread through spotting.
- Create or increase the vertical separation between tree canopy and surface fuels below (including other species) to reduce the potential for torching and crown fires.
- Remove dead materials.

The following resource management goals should be considered when determining vegetation management actions for young Monterey pine forest:

- Removing Monterey pines and restoring native vegetation types (such as oak-bay woodland or grassland) is generally desirable. Careful planning for conversion to these vegetation types can minimize potential adverse effects on local species.
- Native understory vegetation (especially oak-bay saplings) should be protected and encouraged to succeed after removal of Monterey pines.
- Invasive plant species in the understory should be controlled as part of the treatment prescription.

Potential Fuel Treatment Methods and Limitations

The following are potential treatment methods that can be used for young Monterey pine forests; limitations to these treatment methods are included where applicable.

Hand Labor. Hand labor treatments are generally effective for removing trees smaller than 10 inches in diameter as well as litter below lower branches and foliage. These treatments are typically used prior to and in conjunction with prescribed burning. Hand labor treatments are also effective for selectively thinning Monterey pine stands by removing trees or stems on sites too steep for mechanical equipment or on sites with other special considerations. Hand labor treatment methods are most effective for removing occasional pines growing in other vegetation types. Careful planning of skid trails must be conducted, however, to minimize the potential adverse impacts to water features and biological resources that can result from transporting downed trees and slash.

Mechanical Treatment. The high density of trees in a young Monterey pine forest slows productivity when using mechanical treatments and limits travel and accessibility within stands. Cutting blades used in mechanical treatments can chip or otherwise process trees quickly, however, they are more effective in treating larger fuel loads once made accessible to mechanical equipment. Mechanical equipment should only be used at sites with slopes under 30 percent to avoid adverse effects due to heavy equipment use. Skid



High Fire Hazard: Young Monterey Pine Forest



Low Fire Hazard: Young Monterey Pine Forest

LSA

FIGURE V-12

*EBRPD Wildfire Hazard Reduction
and Resource Management Plan*
Photo Comparison of High and Low Hazard
Young Monterey Pine Forest

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trails planned for removing cut trees must be coordinated to minimize potential adverse impacts resulting from transport of removed materials.

Chemical Treatment. Chemical treatments are generally not needed or recommended for use in young Monterey pine forest.

Prescribed Burning. Prescribed burning is generally not recommended without other methods first being used to prepare stands prior to burning. Prepare sites for prescribed burns by increasing vertical separation between the understory and overstory, and removing excess fuels in the understory. Prescribed burns are generally more difficult to use in young stands than in mature stands due to the density and content of fuels and the deep understory fuel beds.

Treatment Considerations and Guidelines

Fuel Reduction. The following treatment guidelines should be included in vegetation management actions on young Monterey pine forest:

- Remove occasional pines on ridgetops:
 - Select pines within 50 feet (elevation) of the ridgetop when structures are within 1,000 feet of trees.
 - Removing all cut material is preferred, although materials smaller than 4 inches can be chipped and packed into depressions. Material larger than 4 inches in diameter should be removed and disposed of or used offsite.
- Young Monterey pine forest should be converted to native vegetation types (typically oak-bay woodland or grassland) where appropriate.
- Separate the fuel structure: reduce vertical and horizontal fuel continuity.
- Anticipate a 2 to 3 year treatment cycle to maintain or convert young Monterey pine forest to a more fire safe vegetation type.
- On treated areas susceptible to landslides, a geotechnical evaluation must be made on a case-by-case basis to determine the contribution of the root mass in deterring soil slippage or slumping and the potential impacts of vegetation type conversion on future landslide potential.

Resource Considerations. The following considerations and guidelines should be included when determining vegetation management actions for young Monterey pine forest:

- As Monterey pines mature they may offer nesting habitat, shade, and shelter from wind to foster native shrubs and trees. Where possible, individual trees should be maintained

for both their visual interest and their structural diversity as well as to promote native shrub and tree growth.

- Where young Monterey pines are intermixed with native shrubs and trees, caution should be exercised to protect selected native vegetation when removing pines.
- Open stands may support a native understory, but there are no records of species of special concern to suggest special management requirements in these areas.
- It is less likely that raptor nesting occurs in young Monterey pine stands, but pre-treatment surveys and the protection measures discussed above for mature Monterey pine forest should be implemented to eliminate the potential for adverse impacts to these species.

e. Oak-Bay Woodland

The canopy of oak-bay woodland communities is composed of coast live oak, California bay, and madrone trees, with these species typically reaching 30 to 50 feet in height. Oak-bay woodland has a 30 to 70 percent tree canopy cover by definition, but supports a shrub understory that usually includes a combination of elderberry, poison oak, and toyon. Non-native blackwood acacia shrubs have also invaded oak-bay woodland areas in scattered locations. Openings in the understory may support both non-native and native grasses (especially blue wildrye). Oak-bay woodland with a dense closed tree canopy (more than 70 percent canopy cover) typically supports little grass or shrub understory. Fuel characteristics are primarily dependent on the amount and structure of the understory and the relationship of the trees to underlying shrubs and groundcovers.



Emerging Coast Live Oak/California Bay Woodland

Oak-bay woodland is susceptible to sudden oak death (SOD) and other similar diseases, which can kill trees and therefore increase the overall fuel load within the area. Alameda and Contra Costa Counties are under quarantine restrictions for SOD and activities that could spread it are regulated by the County Agricultural Commissioners (CAG). This quarantine placed special rules regarding movement and use of susceptible plants, as well as

sanitation practices that must be followed to minimize spread of the pathogen. While the course of the disease is unpredictable and variable, death of the shrub or tree is almost certain. The pathogen is known to attack 17 species, 16 of them found in California including madrone, bay laurel, redwood, douglas fir and two species of native oaks. As a result, EBRPD must obtain necessary permits and approvals for treatments conducted in areas known to be infected with SOD to prevent its spread.

Fuel Characteristics

The hazard rating associated with oak-bay woodland is determined by its understory, but it is usually rated as a Low hazard due to the moderating effects of canopy cover. Expected flame lengths range from 1 to 34 feet depending upon the presence of understory, overall fuel volume, stand structure, treatment history, and slope. Where the understory is well-developed, the potential for crown fires exists as the shrubs will produce flames that are long enough to involve the tree crowns. Without understory vegetation, fire behavior is fairly benign. Woodlands with understory were modeled as Chaparral (Fuel Model #5) and Brush (Fuel Model #4); woodlands with no understory were modeled as Oak Savanna (Fuel Model #2) and Closed Canopy Oak Woodland (Fuel Model #8), depending on the density of the canopy cover. Oak forests were modeled as Closed Canopy Oak Woodland (Fuel Model #8) because of the dense canopy cover and the absence of understory. In all cases, vegetation modeled as Fuel Model #8 are not targeted for treatment because of their low fire hazard.

Ignition Potential. Ignition potential in oak-bay woodland depends on understory vegetation; the typical ignition index for oak-bay woodlands is 6 but may be reduced to 8 where the canopy has closed, the understory has few shrubs or litter buildup, and the understory is kept moist and cool by the tree canopy's shade.

Fire Behavior and Responsiveness to Suppression. Ignition in oak-bay woodland depends on available surface fuels, and fire behavior is dependent on volume and structure of these fuels (including low hanging branches) that can carry fire into the oak canopy. These woodlands are relatively easy to ignite if ground cover is untreated grass or if there is a build up of dead material in the underlying shrubs; if these fuels do not exist, oak-bay woodlands are difficult to ignite. Oak-bay woodlands are the most benign of any vegetation type if the canopy is closed and understory is absent, as the live leaves are relatively fire resistant. The possibility of torching or crown fire is quite low in these conditions and if live materials are pruned to maximize distance from the ground to the canopy. Embers from oak-bay woodlands and forests are typically not distributed long distances and, as such, carry a low potential for spotting. Oak-bay woodlands can have high heat output if the understory is well-developed, but will generally have a low heat output if understory fuels are composed of only a thin layer of leaf litter and occasional herbs. Oak-bay woodland responds more slowly to changes in temperature and moisture where grasses are absent, and are naturally

adapted to frequent low intensity fires (such as through understory grasses or through leaf litter). Acacia stands (an invasive species) associated with oak-bay woodland increase the potential for ignition and fuel volume. The presence of these acacia stands significantly increases the fire risk in oak-bay woodland. Some outer margins of oak-bay stands are overstocked with dense thickets of young oak and bay trees, which can increase the fire hazard.

Fire Hazard Reduction and Resource Management Goals

The following fire hazard reduction goals are provided for oak-bay woodland:

- Understory fuels should be reduced.
- Create vertical separation between the tree canopy and surface fuels.
- Remove dead materials in the understory and canopy, such as dead branches still attached to live trees, to reduce the available fuel load and increase vertical separation.
- Encourage a dense, healthy canopy to shade out more flammable and invasive understory species.
- Remove all blackwood acacia within oak-bay woodlands.
- Encourage the natural succession of woodland to forest (i.e., to Fuel Model #8).



Coast Live Oak Woodland/Forest With Moist Understory

The following resource management goal should be considered during vegetation management actions for oak-bay woodland:

- Treatment of oak-bay woodlands should be limited to understory thinning of scrub vegetation (see especially considerations for north coastal scrub), thinning dense stands of young native trees and saplings, removing invasive non-native vegetation, and replanting these areas with native vegetation.
- Bay trees have been discovered as a vector/host for Sudden Oak Death. Young bays that touch oaks should be selected for removal.

Potential Fuel Treatment Methods and Limitations

The following are potential treatment methods and their limitations, where applicable, for oak-bay woodlands:

Hand Labor. Hand labor treatments are generally effective for removing litter below trees, cutting and removing lower branches and dead limbs, and conducting other treatment actions prior to prescribed burning to remove debris. Hand labor treatments are also effective for selectively thinning stands of hazardous trees (i.e., dead trees or flammable species) on sites too steep for mechanical equipment use or at sites with other special considerations. Skid trails planned for removing cut trees must be coordinated to minimize potential adverse impacts resulting from transporting trees and slash.

Mechanical Treatment. Mechanical treatments are not commonly used because the numerous tree trunks in oak-bay woodlands make placement and maneuverability of equipment difficult, but mechanical treatments may be suitable to reduce brush encroachment depending on individual stand structure. Mechanical treatments should only be used on slopes under 30 percent to avoid adverse effects that could potentially result from heavy equipment use. Skid trails planned for removing cut trees must be coordinated to minimize potential adverse impacts resulting from transporting trees and slash.

Prescribed Burning. Prescribed pile or broadcast burns are generally effective for removing dead limbs or other materials accumulated through hand labor treatments. Prescribed burns may require pre-treatment through other methods (such as hand labor or mechanical treatment) to ready them for safe prescribed burning and to prevent any crowning.

Grazing. Cattle may be used on open stands of oak-bay woodland, but goat grazing is typically preferred where shrubs are abundant. Goat grazing of understory materials must be carefully managed and monitored to protect trees, and prevent girdling and potential impacts to species of special concern.

Treatment Considerations and Guidelines

Fuel Reduction. The following treatment guidelines are recommended for oak-bay woodland:

- Reduce vertical continuity
- Standards for stand density:
 - Encourage and maintain canopy closure of emerging tree species.
 - Leave all trees bigger than 8 inches diameter.
 - Leave 1/3 of the trees under 8 inches in diameter to retain a range of size categories.
- Mulch site to a maximum depth of 2 inches to prevent invasion of noxious weeds.
- Standards for species diversity:

- Maintain and encourage a diversity of tree and shrub species.
- Manage woodlands to promote an understory of low herbaceous material below tree canopies.
- Selectively remove or thin species in the following order:
 - Exotic species in the understory (such as Acacia trees, Himalayan blackberry, pampas grass, and French broom).
 - Regionally common shrubs that readily resprout (such as coyote brush, monkey flower, poison oak and sage).
 - Only as a last measure to maintain overall species composition should other species favored for fuel characteristics be thinned or removed (such as ceanothus, oak, huckleberry, snowberry, rose, iris or salal).
 - Consider selecting young bay trees for removal, as bay trees tend to produce ladder fuels and are known for their oil content. This species also is known to be a vector for sudden oak death and may prevent oak regeneration.
- Protect individual native tree specimens from browsing and girdling during grazing treatments.
- A treatment cycle from 7 to 10 years in length is likely needed when emerging woodland is in early developmental stages.
- Anticipate a 3 to 5 year treatment cycle to manage treated areas to standards of Chaparral (Fuel Model #4) with young brush, short mature brush, or patchy islands among emerging oak-bay woodland. Treatment cycles will decrease as trees mature and canopy closes to an anticipated 7 to 10 year interval.
- Manage closed canopy to standards of Closed Canopy Oak Woodland (Fuel Model #8). Anticipate a 3 to 7 year cycle to maintain standards of Closed Canopy Oak Woodland (Fuel Model #8)¹⁴. Understories will need to be treated more frequently; pruning of lower branches will be required less frequently.

Resource Considerations. The following resource considerations and guidelines pertain to oak-bay woodland: (See also the resource considerations and guidelines for grasslands and brush and shrub vegetation types).

- A number of special-status plant species occur in the understory of oak-bay woodlands and forests, including western leatherwood. Other special-status plants occur at the edges bordering brush and grassland. Pre-treatment surveys to locate occurrences of

¹⁴ Descriptions of fire behavior fuel models are referenced in Appendix B of Appendix C: Wildlife Hazard Assessment and Treatment Areas.

special-status plant species should be conducted in woodland and forest areas prior to fuel management, especially prior to the initial treatment activities and follow-up seasonal surveys should be conducted, as necessary.

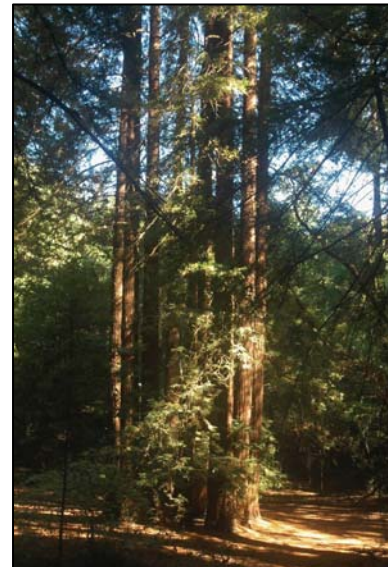
- Animal species of concern, such as the San Francisco dusky-footed woodrat, occur in oak-bay woodland and forest habitats. A wildlife biologist should conduct a pre-treatment survey to determine the potential impact on animal species of concern and provide recommendations for mitigation prior to implementation of any vegetation management actions.
- Nesting surveys should be conducted within 15 days prior to any treatment performed during the nesting season to locate and avoid special-status nesting birds and all nesting raptors. Treatment near active nests of special-status birds and raptors should be delayed until after the nestlings have fledged.
- Plan-related fuel reduction treatments activities in oak-bay woodland habitat could spread a pathogen fungus *Phytophthora ramorum* or sudden oak death (SOD) from treated areas to areas not yet infected. SOD can impact oaks and other desirable native trees and shrubs. Alameda County, Contra Costa County, and other Bay Area Counties are under quarantine restrictions for SOD. Oak and other host plant material (as defined by the statute cited) may not be moved outside of the quarantine region without specific written certification from the California Department of Agriculture or other authorized agricultural officials (e.g. County Agricultural Commissioners).¹⁵ The following measures shall be followed when working in oak-bay woodland to reduce the spread of SOD:
 - District staff shall consult with the appropriate County Agricultural Commissioners, and implement Best Management Practices (BMPs) for treatments in infected oak-bay woodlands to minimize the risk of spreading this fungus to uninfected areas.
 - District staff and subcontractors shall be informed of the presence of SOD and instructed to prevent unauthorized movement of host plant debris, soil, or mud and these resource guidelines concerning SOD.
 - If dead or diseased host plants are removed from a treatment area, infected plant material shall be contained and moved for disposal off-site within the quarantine region in an area where SOD would not contact uninfected woody vegetation as specified by a permit issued by the authorizing agricultural compliance officer.
 - No host plant material shall be moved outside of the quarantine region which includes Contra Costa and Alameda County.

¹⁵ California Department of Food and Agriculture. 2008. Plant Quarantine Manual Section 3700. Oak Mortality Disease Control. State Miscellaneous Ruling.

- If cut trees are to be left onsite for chipping or burning, they should be felled in a manner that minimizes subsequent transport, disturbance, and contact with adjacent oak-bay woodlands.
- Clean equipment, vehicles and shoes of host plant debris, soil or mud that could spread infected soil when entering or leaving an infected oak-bay woodland treatment area. Shoes should be cleaned with Lysol or bleach. Vehicles should be inspected to ensure they are clean prior to leaving an infected area.
- Conduct treatments when the soil is dry (June-October). Avoid treatments in wet weather when soils are saturated (November-May).

f. Redwood Forest

The redwood forest vegetation type is dominated by coast redwood (*Sequoia sempervirens*) which reaches heights of 75 to 150 feet and is usually located along a narrow zone adjacent to perennial creeks, drainage swales, canyons, or on north or east exposures where the moisture level is higher. The understory is usually sparse and consists largely of bay trees, ferns and oxalis. Redwood forest may be intermixed with riparian forest and can include planted cypress. In general, redwood forest represents a low fire concern and is considered a beneficial vegetation type.



Redwood Forest

Fuel Characteristics

The overall hazard for redwood forest is rated as Low, with flame lengths ranging from 7 to 31 feet depending upon fuel volume, stand structure, treatment history, and slope. Redwood forests were modeled as Hardwood Litter (Fuel Model #9) and Closed Canopy Oak Woodland (Fuel Model #8), depending on the volume and diameter of dead material on the forest floor. Dead and downed woody fuels include some larger (greater than 3 inches in diameter) fuels that pose occasional control and containment problems. Where redwood forests support significant fuel loads from tree deposition and understory vegetation, this fuel type has a high moisture content and so has rarely burned with intensity, even in extreme conditions. A diverse understory contributes to a higher probability of isolated torching of trees and crown-fire spread.

Ignition Potential. Redwood forest has a low ignition potential with an index of 8 because of the high moisture content typical of this vegetation type.

Fire Behavior and Responsiveness to Suppression. Ignition in redwood forests is dependent upon build-up of surface fuels. It is usually difficult to ignite the canopy; natural litter or duff is also only somewhat flammable and will smolder, creating a fire that is difficult to fully extinguish. Once large fuels ignite heat output is high, although the fire generally burns slowly.

Fire Hazard Reduction and Resource Management Goals

The following goals are recommended for fire hazard reduction in redwood forest:

- Encourage a dense, healthy canopy to shade out flammable understory plants and exotic species.
- Create vertical separation between the tree canopy and surface fuels below to reduce the potential for crowning.
- Remove dead materials from the understory.

The following resource management goals are recommended for consideration when determining appropriate treatment actions for redwood forest:

- Vegetation management actions should encourage and protect this vegetation type.
- Treatment actions should be avoided in healthy stands of redwood forest (i.e., those with a closed canopy and minimal understory shrubs) that meet the standards of Closed Canopy Oak Woodland (Fuel Model #8) or Hardwood Litter (Fuel Model #9).

Potential Fuel Treatment Methods and Limitations

Several potential treatment methods have been identified to address vegetation management in redwood forests. These treatment methods and their limitations, where applicable, are described below:

Hand Labor. Hand labor treatment methods are generally effective for removing litter from below trees, cutting dead limbs, and for other necessary actions prior to prescribed burning. Hand labor is also effective for selectively thinning stands by removing structurally hazardous trees or specimens on sites with other special considerations. Haul routes planned for removing cut trees must be coordinated to minimize potential adverse impacts resulting from hauling operations.

Mechanical Treatment. Mechanical treatments may be used selectively to clear encroaching brush at margins of redwood stands, but should only be used on slopes under 30 percent to avoid any potential adverse effects that may result from heavy equipment use. Haul routes planned for removing cut trees must be coordinated to minimize potential

adverse impacts resulting from hauling operations. Equipment should be kept at least 100 feet from the top of banks of intermittent or perennial streams to reduce potential damages to stream banks or an increase runoff.

Prescribed Burning. Pile or stationary burns are effective for removing dead limbs or other materials once gathered through hand labor or mechanical treatment methods. Low intensity broadcast burns are effective for removing litter build-up, especially in open redwood stands. Prescribed burning will require the use of other treatment methods prior to the burn to prepare the site for a safe prescribed burn and to reduce the potential for unwanted crowning of the fire.

Grazing. Grazing is not recommended as a vegetation management option in redwood forest except at the margins of forests. In open stands goat grazing can be used to clear understory materials, but protection of trees and desirable species is required to prevent girdling, trampling, and browsing on these species.

Treatment Considerations and Guidelines

Fuel Reduction. The following treatment guidelines are recommended for redwood forest:

- Reduce vertical continuity
- Standards for stand density:
 - Encourage a closed canopy where feasible.
 - Minimize understory competition by removing saplings.
 - Young redwood crown sprouts and sapling growth should be thinned, leaving 3 to 6 sprouts per stump, depending on the vigor of the original stump and the vigor and size of sprouts. For stumps up to 1 foot in diameter, leave 3 sprouts; for larger stumps, the number of sprouts left may be increased up to 6, depending on their vigor and size.
- Maintain and encourage redwood trees, and remove or control invasive or non-native species.
- Treatment cycles in redwood forests are generally between 10 to 15 years, as understories in these forests tend to develop slowly and large amounts of dead material are required to trigger required treatment. Redwood forest with closed canopy should be managed to Closed Canopy Oak Woodland (Fuel Model #8) standards.

Resource Considerations. The following resource considerations and guidelines pertain to redwood forest:

- While redwood forests are generally fire resistant and adapted to natural fire cycles, they can be damaged by intense fires. Light fires are beneficial in this vegetation type, however, with many of the associated species having adaptive attributes. No special-status plants have been identified in this vegetation type in the Study Area.
- Nesting surveys should be conducted within 15 days prior to treatment if performed during the nesting season to locate and avoid special-status nesting birds and all nesting raptors. Treatment near nests of special-status birds and raptors should be delayed until after the nestlings have fledged.

g. Riparian Woodland

Riparian forest is usually located in a narrow zone along perennial creeks and drainage swales where the year-round moisture level is high. These areas are dominated by a mixture of deciduous and evergreen trees, shrubs, and groundcovers, including: bay, maple, oak, redwood, and willow trees as well as ceanothus, ferns, honeysuckle, oxalis, and wild rose. This vegetation type generally represents the lowest fire concern, has high habitat values, and can be beneficial as a natural fuel reduction zone.



Willow Riparian Woodland/Forest

Fuel Characteristics

The overall hazard rating for riparian forest is Low, with flame lengths ranging from 2 to 5 feet depending upon fuel volume, stand structure, treatment history, and slope. Riparian forests were modeled as Hardwood Litter (Fuel Model #9), Closed Canopy Oak Woodland (Fuel Model #8), and Riparian Woodland (Fuel Model #6). Only in rare circumstances would riparian forest be identified for treatment; such circumstances may include the build-up of suspended dead material from high water flows or the development of dead stalks within the forest.

Ignition Potential. Riparian woodlands have an ignition index of 8 due to elevated moisture levels in these areas.

Fire Behavior and Responsiveness to Suppression. Riparian woodlands are difficult to ignite and respond very slowly to changes in temperature and moisture. Their natural structure forms a protective canopy and there is a relatively low ratio of dead to live materials in normal circumstances, although significant accumulations may result from high water flows. Riparian woodlands often lack a well-developed understory, making them even

less susceptible to fire hazards. However, in severe fire weather conditions high loadings of stressed live fuels and dead fuel accumulations can lead to high-intensity burning and virtual scouring of riparian areas.

Fire Hazard Reduction and Resource Management Goals

The following fire hazard reduction goals are recommended for riparian woodland:

- Encourage a dense, healthy canopy to shade out more flammable understory plants and invasive species.
- Minimize maintenance activities and conduct treatment actions only where significant understory accumulation occurs.
- Restrict vegetation management activities to along the edges of riparian woodlands, where feasible.
- Remove dead materials and reduce the build-up of flammable leaf litter as needed.
- Create or increase the separation between surface fuels (especially from adjacent areas) and taller trees or other aerial fuels by reducing the height of the underlying shrub layer and pruning smaller, lower branches.

The following resource management goals should be included for any vegetation management actions occurring in riparian woodland:

- Enhance and protect this vegetation type to minimize any potential adverse impacts resulting from treatment actions.
- Protect adjacent water bodies from sedimentation or pollution that may occur as a result of treatment actions or due to the use of mechanical treatment techniques.

Potential Fuel Treatment Methods and Limitations

The following potential treatment methods have been identified for riparian woodland; a description of these treatment types and any limitations is provided below:

Hand Labor. Hand labor treatment methods are effective in removing tree litter, exotic species, and dead limbs as well as to reduce excessive build-up of fuel in open canopy or previously disturbed riparian communities. These methods are also effective for selectively thinning stands by removing structurally hazardous trees or addressing vegetation management concerns at sites with other special considerations. Skid trails planned for removing cut trees must be coordinated to minimize potential adverse impacts resulting from transporting trees and slash.

Mechanical Treatment. Mechanical treatments are not recommended for vegetation management in riparian woodlands as the dense nature of riparian woodlands could inhibit equipment movement and effectiveness, and mechanical treatments carry a high risk of erosion, runoff pollution, and other adverse impacts to riparian areas. These treatment methods may be used selectively to clear encroaching brush at the margins of riparian woodlands if their use is determined not to present an unacceptable risk to riparian and aquatic areas. Mechanical treatments should only be used on slopes under 30 percent to avoid additional adverse effects due to heavy equipment use. Skid trails planned for removing cut trees must be coordinated to minimize potential adverse impacts resulting from transporting trees and slash. Equipment must be kept at least 100 feet from the top of banks of intermittent or perennial streams; equipment must also be routinely checked to ensure that fuel, oil, and other fluids and lubricants are not dripping from vehicles. Refueling should only be conducted offsite; if offsite-only fueling is infeasible, re-fueling areas must be properly contained and additional safety measures included to prevent local contamination from occurring. All spill prevention procedures must be followed. Refer to the Mechanical Treatment section of the Fuel Treatment Methods section of this Plan (Chapter IV, Section C) for more details.

Chemical Treatment. Chemical treatment methods should generally be avoided in riparian woodland areas to reduce potential adverse environmental impacts that may result from their use. Only chemicals registered by the State for use in aquatic environments should be considered for spot application in these areas.

Prescribed Burning. Prescribed burning is not recommended for riparian woodlands due to their high moisture content and relative inability to burn efficiently. Pile or stationary burns can be effective for removing dead limbs or other materials gathered by hand, but these materials will typically require a drying period prior to burning, and burn sites should be located at least 100 feet outside of the riparian zone. Prescribed broadcast burns may back into riparian areas to largely self-extinguish in the wetter fuels, where feasible, to obviate cutting a control fire line to contain the broadcast burn.

Grazing. Grazing is generally not recommended for riparian woodlands, and should only be used along the margins of these areas. If goat grazing is used to clear understory materials, trees and desirable species must be protected against girdling and browsing. Grazing should be confined to the dry season only, and buffer zones around aquatic habitats should be created to minimize potential impacts to these areas from grazing activities.

Treatment Considerations and Guidelines

Fuel Reduction. In open or previously disturbed riparian forest, the following treatment guidelines should be applied:

- Reduce the continuity of ladder fuels.
- Encourage a closed canopy in all riparian woodlands and minimize understory growth.
- Maintain canopy closure where it has already occurred.
- Maintain and encourage native species diversity within riparian woodlands.
- Protect individual native tree specimens and other desirable species from browse and girdling during grazing treatments.
- Anticipate a 10 to 15 year treatment cycle, although additional treatments may be required following storms or other events that create large amounts of dead material in riparian woodlands.

Resource Considerations. The following resource considerations and guidelines pertain to riparian woodland:

- Riparian forest is an important natural community valued for its productivity, as valuable wildlife habitat, as an important buffer and filter for aquatic and fish habitat, and for its intrinsic aesthetic value. As such, treatments should be avoided in healthy stands (i.e., those with closed canopy and minimal understory shrubs) that meet the standards of Closed Canopy Oak Woodland (Fuel Model #8) or Hardwood Litter (Fuel Model #9)¹⁶. Pre-treatment surveys should be conducted by resource professionals to ensure litter removal or other activities do not impact special-status species such as the San Francisco dusky-footed woodrat.
- Great care must be taken to avoid adverse impacts to this vegetation type as well as to any adjacent streams, wetlands or other water bodies. BMPs should be employed to avoid indirect impacts to aquatic habitat and associated special-status species (specifically steelhead salmon) from erosion, sedimentation, or other forms of pollution (see Chapter IV. Fuel Treatment Methods). These BMPs should include minimizing soil disturbance resulting from trampling, establishing a temporary protective buffer zone between treatment areas and aquatic habitat, installing erosion control barriers such as straw wattles, requiring spill prevention practices and measures for all equipment and vehicles, and confining activities to the driest periods to minimize potential impacts to surrounding areas.

¹⁶ Descriptions of fire behavior fuel models are referenced in Appendix B of Appendix C: Wildlife Hazard Assessment and Treatment Areas.

- The California red-legged frog is known to occur in the Study Area, therefore, ground applications of certain herbicides in designated critical habitat (limited in the Study Area to a one square mile section that includes a portion of Robert Sibley Volcanic Regional Preserve) and in areas where the California red-legged frog has been identified (Tilden Regional Park) will only be applied in compliance with the 2006 U.S. District Court Order.¹⁷ This order generally prohibits the use of 66 specified pesticides within varying distances of aquatic habitat, and restricts pesticide use, but not any other forms of habitat alteration that may otherwise occur. An exception to the injunction states that it does not apply to pesticide use if all of the following conditions are met:
 - a. The pesticide is applied for control of state-designated invasive species and noxious weeds under a program administered by a public agency;
 - b. The pesticide is not applied within 15 feet of aquatic breeding habitat, non-breeding aquatic critical habitat areas, or within 15 feet of aquatic features within non-critical habitat sections subject to the injunction;
 - c. Application is limited to localized spot treatments using hand-held devices;
 - d. Precipitation is not occurring or forecast to occur within 24 hours;
 - e. Application is conducted by a certified applicator or under the direct supervision of a certified applicator; and
 - f. Only the amine formulations of 2,4-D or triclopyr are used.

¹⁷ U.S. District Court, Northern District of California. 2006. Case No. 02-1580-JSW, *Center for Biological Diversity v. Johnson, et. al.* (<http://www.epa.gov/espp/litstatus/stipulated-injunction.pdf>)

