

Chapter 2 – Alternatives

This page intentionally left blank.

2.1 Overview of Alternatives

NEPA requires project proponents to identify a range of reasonable alternatives within an EIS. Reasonable alternatives must be economically and technically feasible and demonstrate common sense. Alternatives must meet stated goals and objectives for taking action to a large degree, and must be within identified constraints. The No Action alternative must be analyzed under NEPA requirements. For this FEIS, the No Action alternative represents no substantial change in fire management actions as they have been implemented over the last several years and as they were described and analyzed in the 1993 FMP and its EA.

The following are summaries of the three alternatives developed for GGNRA's FMP FEIS:

Alternative A (No Action) – 1993 FMP, No Action

This alternative would be an update to the 1993 FMP only to reflect changes to the park's boundary (e.g., addition of new lands since 1993) and current national fire management policies. The focus of the 1993 FMP program is on vegetation management through the application of prescribed fire to perpetuate fire-dependent natural systems. In recent practice, many fire management actions have been mechanical fuel reduction projects (e.g., mowing, cutting to remove nonnative shrubs and trees, and selective thinning in forested stands) as a result of the establishment of the Wildland Urban Interface Initiative. A combination of staff shortages, the requirement to develop a new FMP, and a year-long moratorium on prescribed burning has resulted in limited prescribed burning over the past five years. This alternative would rely on the continued implementation of the 1993 FMP and recent emphasis on mechanical fuel reduction along with prescribed fire, and suppression of all wildfires. The fire management approach for Muir Woods National Monument would be the same for the No Action alternative and the two action alternatives (Alternatives B and C) and would include the use of prescribed fire as well as mechanical fuel reduction. Current research projects would continue and would focus on the role of fire to enhance natural resources and the effects of fire on key natural resources to determine the effectiveness of various fuel treatments.

Alternative B – Hazard Reduction and Restricted Fire Use for Research and Resource Enhancement

Under Alternative B, fire management actions would emphasize the use of mechanical methods to reduce fire hazards and fuel loads in areas with the highest risks. Compared to Alternative A, Alternative B would increase the number of acres mechanically treated each year, with a focus on the reduction of high fuel loads in the wildland urban interface area. The suppression strategy for wildfires and the approach used in the Muir Woods fire management unit (FMU) would be the same as under Alternative A. Limited use of prescribed fire could occur for research purposes within the park interior. Research projects would examine the role of fire to enhance natural resources and the effects of fire on key natural resources to determine the effectiveness of various fuel treatments. Natural and cultural resource goals and objectives would be integrated into the design and implementation of fuel reduction projects.

Chapter 2 – Alternatives, Overview of Alternatives

Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Multiple Treatments

This alternative would allow for the greatest number of acres to be treated on an annual basis to achieve fire management and resource objectives through the use of a broad range of fire management strategies. Mechanical treatment and prescribed burning would be used as a means to reduce fuel loading near developed areas and achieve resource enhancement goals. Mechanical treatments, complemented by prescribed fire, would be employed to assist with restoration and maintenance of the park’s natural and cultural resources. The suppression strategy for wildfires and the approach used in the Muir Woods FMU would be the same as under Alternative A. Research projects would examine the role of fire to enhance natural resources and the effects of fire on key natural resources to determine the effectiveness of various fuel treatments; they would also be used to adaptively guide the fire management program and help to maximize the benefits to park resources. Natural and cultural resource goals and objectives would be integrated into the design and implementation of fuel reduction projects.

The three alternatives analyzed meet the park’s goals and objectives to an acceptably large degree, and are within constraints imposed by regulations and policies, by risks associated with the wildland urban interface, and by technical and funding limitations. All three alternatives involve different combinations of prescribed burning and mechanical treatments. In each alternative, an upper limit has been set on the number of acres that would be burned or mechanically treated in any one year (see Table 2-1). These numbers are based upon an understanding of the park’s resources, staffing and funding, hazard risk assessment, and technical feasibility.

Table 2-1: Summary of Alternatives by Annual Acres Treated and Treatment Type

Treatment Type	County	Alternative A ¹	Alternative B	Alternative C
Mechanical Treatment ² (acres/year)	Marin	75	180	225
	San Francisco	5	10	10
	San Mateo	20	40	40
	TOTAL	100	230	275
Prescribed Burning (acres/year)	Marin	100	120	285
	San Francisco	<1	<1	<1
	San Mateo	10	0	35
	TOTAL	110	120	320

Source: GGNRA Fire Management Office Data 2004.

¹ Estimated based upon current practice, since 1993 FMP did not specify number of acres per year for treatments.

² Mechanical treatment refers to fuel reduction through methods such as mowing, cutting, short-term grazing, and selective thinning.

2.2 Alternatives Formulation Process

The formulation of alternatives for the GGNRA FMP FEIS was based upon guidelines for fire management and NEPA implementation, as expressed in Director's Order 18 and Director's Order 12, respectively. Initially, several alternatives were considered during the development of this FEIS, of which three are fully analyzed in this document. The others were considered carefully but rejected because they would not adequately meet the fire program's objectives. These alternatives are briefly discussed in Section 2.6, Alternatives Considered but Rejected.

An interdisciplinary team of NPS staff developed a set of alternatives based upon the purpose and goals contained in this FEIS (see Chapter 1), with input from other park staff, the general public, and public safety agencies. The interdisciplinary team was composed of staff with expertise in fire management, fire ecology, natural resource management, cultural resources, planning, public safety, interpretation, and public affairs.

The planning team began the process by conducting a review of the existing 1993 FMP and looking specifically at the manner in which it has been carried out in actual park operations over the last 12 years. In particular, the team reviewed the usefulness of the existing FMP with an eye to how effective its guidance has been in regard to recent fire management operations. Other pertinent data, such as maps of parklands, vegetation types, and resource locations, were assembled in order to provide information necessary to stimulate informed discussion at a series of scoping sessions. The park held a series of internal scoping sessions that included fire management personnel; subject-matter experts from a wide range of disciplines, including archeology, hydrology, Geographic Information Systems (GIS), and vegetation and wildlife management; park management; and park personnel at large. These internal sessions were followed by a series of scoping meetings in Marin, San Francisco, and San Mateo counties with local firefighting agencies, public safety organizations, and the interested public. As part of this scoping process, draft FMP goals were presented for public comment.

Reference to the goals of the FMP, area topography and hydrology, settlement patterns, and types of resources in the park informed staff about the development of Fire Management Units (FMUs). An FMU is any land management area that can be defined by management goals and constraints, topographic features, access corridors, values at risk or values to be protected, political boundaries, fuel types, or major fire regime groups that set it apart from management characteristics of an adjacent unit. As an example, FMUs may have dominant management goals, such as wildland urban interface protection issues. (See Fire Management Units section below.) The existing FMUs from the 1993 FMP are based upon vegetation communities. Park staff felt that more factors needed to be considered for defining FMUs and concluded that the action alternatives would have different FMUs from the 1993 FMP. The new FMUs are one consisting of areas adjacent to relatively dense suburban neighborhoods bordering the park (Wildland Urban Interface FMU); a larger, more open and undeveloped unit of parklands away from builtup areas (Park Interior FMU); and the special unit of Muir Woods National Monument (Muir Woods FMU), reflecting the important natural resources combined with high visitor use.

These new, proposed FMUs allowed a range of preliminary alternatives to be drafted, based upon an assessment of parklands within each FMU and public input from scoping with regard to appropriate fire

Chapter 2 – Alternatives, Alternatives Formulation Process

management techniques, FMP objectives, and risk assessment involving life safety, property protection, and resources at risk. These preliminary alternatives were checked against the purpose and goals, relevant constraints, and potential impacts; compared to see that they provided real options; and reviewed to ensure that they were based on environmental differences. They were refined in comparison to the Marin County Fire Department’s risk assessment model, and modified as necessary in regard to detailed fuel type data, park visitor and employee use patterns, watershed, topography, vegetation and wildlife patterns – especially those for rare and endangered species – and knowledge of archeological, cultural landscape, and historic values as appropriate. In addition, a GGNRA Fire Hazard Model (see Appendix E) was developed to provide further analysis within the park managed lands and provide additional input into the alternatives and FMU formulation. This model defines fire hazard as areas where steep slopes, south-facing aspects, and high-danger fuels exist in close proximity to values at risk and was created in GIS using several factors that could lead to a dangerous and costly wildland fire. Fuel type, topography, and the wildland urban interface were spatially analyzed to identify the areas of the park with the highest potential for destructive fire.

During this refinement phase, the FMUs were further subdivided into smaller, logical geographic project areas, allowing for an informed discussion of treatment strategies and management goals tailored to each project area, and, ultimately, a better definition of the individual alternatives. The sum total of the scoping effort, filtered through the specific expertise of the park interdisciplinary team, informed by recent experience with the 1993 FMP, checked against the purpose and goals of this planning effort and knowledge of park resources, property and use patterns, were the ingredients that resulted in the formulation of the alternatives presented in this FEIS.

Fire Management Units

FMUs provide the framework for development of a wildland fire program. As directed by NPS Reference Manual-18: Wildland Fire (RM-18) (NPS 1999a), each FMU should be unique as evidenced by management strategies, objectives, and attributes; should be consistent with management goals and objectives found in land and resource management planning documents; and should avoid redundancy. In addition, the number of units should be kept to a minimum. Two sets of FMUs are used in this FEIS – the existing six FMUs from the 1993 FMP are used in Alternative A, and three proposed FMUs are used in Alternatives B and C.

The No Action alternative retains the 1993 plan’s FMUs, which are defined by plant communities found within GGNRA. These are:

1. Grassland and Coastal Scrub. The grassland community at GGNRA extends from sea level to nearly 2,600 feet. It forms a mosaic with the coastal scrub community and mixed evergreen forests. The grasslands have had the greatest disturbance of any natural habitat in Marin County. The four main factors that have contributed to this disturbance are an increase in grazing pressures, the introduction of highly competitive nonnatives, cultivation, and the elimination of fire.

2. Chaparral. Chaparral is not in abundance at GGNRA. Small communities exist in Muir Woods National Monument, the Marin Headlands, and at Sweeney Ridge and Milagra Ridge in San Mateo County. There are several types of chaparral in GGNRA.
3. Broadleaf Evergreen Forest. This community extends from 200 to 2,500 feet in elevation and is dominated by oak and/or tanbark oak. Along the mesic boundary of this mixed evergreen forest is the redwood/Douglas-fir community and along the xeric boundary is the coastal scrub and grasslands community.
4. Old-Growth Redwood. This community mainly consists of the redwood forest at Muir Woods National Monument. Many species contribute to this ecosystem. Major overstory and understory trees include coastal redwood, Douglas-fir, California bay laurel, tanbark oak, California hazel, and madrone.
5. Second-Growth Redwood and Douglas-Fir. Douglas-fir communities are found on Bolinas Ridge and within Muir Woods National Monument. The communities on Bolinas Ridge have been logged. Douglas-fir in Muir Woods National Monument sites have a brush understory and a significant component of dead fuel. Fuel loadings are increasing and need reduction in this community.
6. Eucalyptus/Other Nonnatives. Many vegetative species have been introduced into GGNRA park lands as ornamentals, wind breaks, or shade, or for pasture. Many of these have escaped cultivation and are invading native communities. Several stands of blue gum are found throughout GGNRA and typically occur near former ranchlands and along park boundaries, usually planted as windbreaks.

Table 2-2 lists total acreage in each FMU for the No Action alternative (Alternative A).

Table 2-2: Alternative A – Acreage by Fire Management Unit (FMU) and by County

FMU	Marin	San Francisco	San Mateo	Total Acres
Grassland/Coastal Scrub	8,252	446	1,907	10,605
Chaparral	147	0	53	200
Broadleaf Evergreen Forest	865	8	558	1,431
Old-Growth Redwood	471	0	0	471
Second-Growth Redwood/Fir	565	0	556	1,121
Eucalyptus/Other Nonnative/Developed	686	469	170	1,325
Total Acres	10,986	923	3,244	15,153

Source: GGNRA Fire Management Office Data 2004.

For the action alternatives, the park’s landscape has been divided into three FMUs, and 17 project areas (subunits of the FMUs). The FMUs for the action alternatives are largely based upon geography, proximity to developed areas, fuel hazards, and values at risk. Each FMU has its own set of management strategies, objectives, and attributes. Dividing the park into three FMUs allows park management to set broad strategies for each unit, with a set of allowable fire management actions under each. The strategies for each FMU vary by alternative, and the types of management actions that would occur in each are addressed in the discussions of the alternatives in this FEIS.

Chapter 2 – Alternatives, Alternatives Formulation Process

The proposed FMUs for the action alternatives are:

Unit 1, Wildland Urban Interface (WUI). This FMU includes those lands that border developed or “interface” zones. The basic WUI zone was defined as any land within 1,200 feet of an urban/developed area. Where it made practical sense, the WUI FMU boundary was extended to fire roads, trails, and jurisdictional boundaries. Lands within this FMU are characterized by a close proximity to values at risk (i.e., houses, infrastructure, etc.); have high hazard fuels/slopes and dry, easterly wind exposure; and receive high visitation (increased chance of ignitions).

Unit 2, Park Interior. This FMU is the largest and is characterized by a lower probability of fire threatening structures and the potential to use prescribed fires to achieve some resource management goals. The park interior lands include larger expanses of natural areas and cultural landscapes, inclusive of ranching and farming lands, and contain relatively intact native plant communities and contiguous areas and corridors of wildlife habitat.

Unit 3, Muir Woods National Monument. The designation of Muir Woods National Monument as an FMU is based on the area’s unique values at risk (first-growth redwoods), the area’s high visitation (ignition potential), and an ongoing fire management program for this area.

Table 2-3 lists total acreage in each FMU for the action alternatives (Alternatives B and C).

Table 2-3: Alternatives B and C – Acreage by Fire Management Unit (FMU) and by County

FMU	Marin	San Francisco	San Mateo	Total Acres
Wildland Urban Interface	2,524	923	1,479	4,926
Park Interior	7,910	NA	1,765	9,675
Muir Woods	552	NA	NA	552
Total Acres	10,986	923	3,244	15,153

Source: GGNRA Fire Management Office Data 2004.

NA = not applicable

Figures 2-1 and 2-2 illustrate the FMUs for the No Action alternative (Alternative A), and Figures 2-3 and 2-4 illustrate the FMUs for the action alternatives (Alternatives B and C).

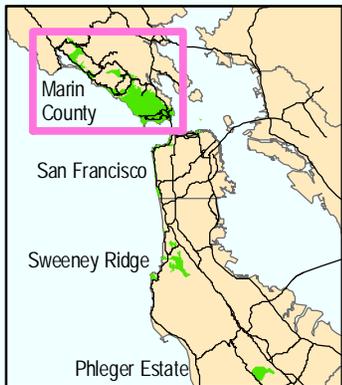
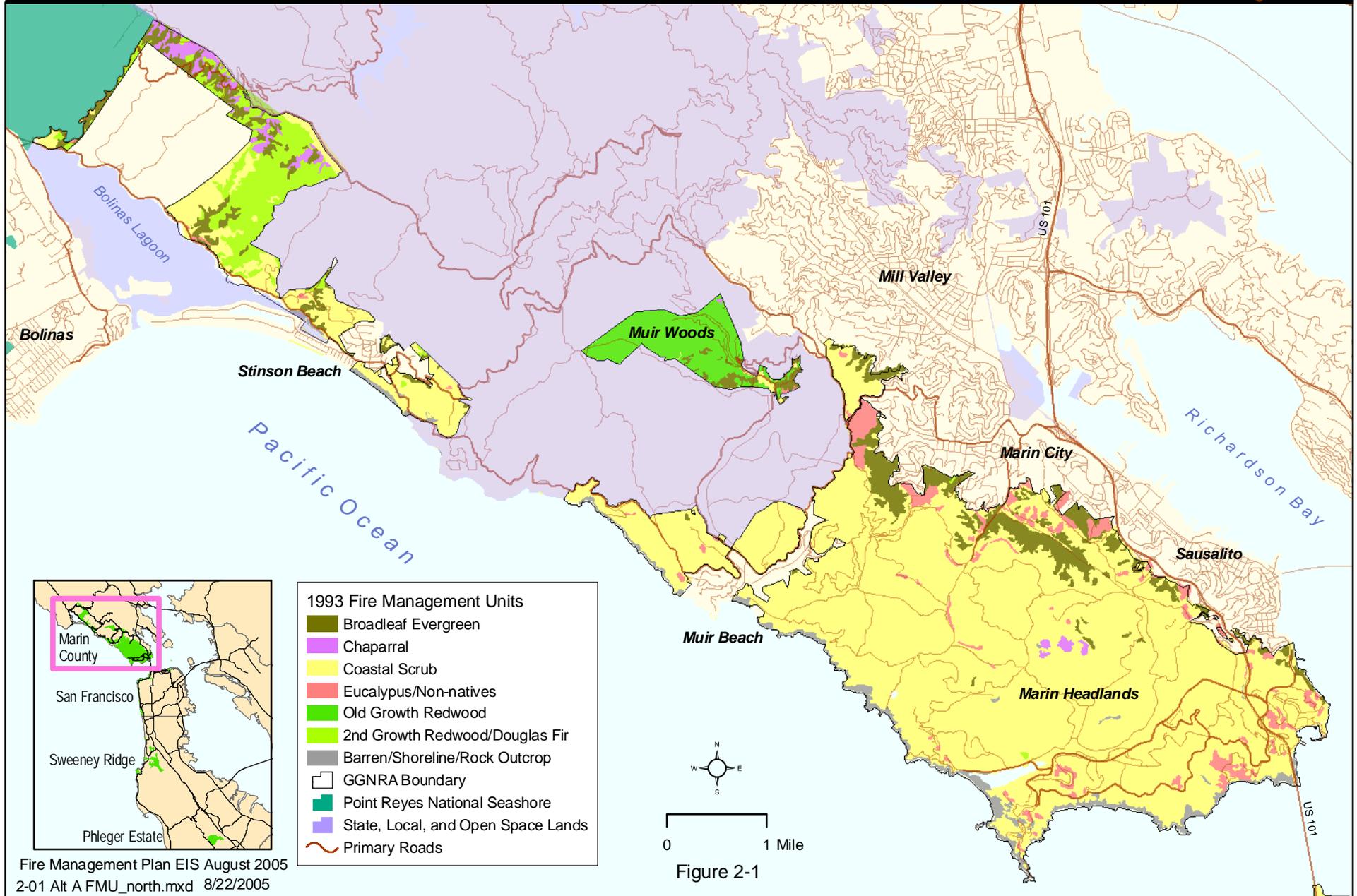
Project Areas

The three FMUs proposed for the action alternatives are further broken down into a total of 17 project areas, allowing for a finer level of understanding of existing resource values, vegetation and fire management conditions, treatment options, and management objectives specific to the resources contained within that area. It is anticipated that project areas would form the framework for planning the five-year implementation program for the selected alternative. Project areas were delineated using practical and geographically logical boundaries such as roads and trails, watersheds, park boundary, and buffers from urban development. Figures 2-5 and 2-6 show the fire management project area boundaries for the planning area. See Table 3-10 for acreages and vegetation classification by project area. The project areas are organized by county and are as follows:

Alternative "A" Fire Management Units

Marin County

National Park Service
Department of the Interior
Golden Gate National Recreation Area



Fire Management Plan EIS August 2005
2-01 Alt A FMU_north.mxd 8/22/2005

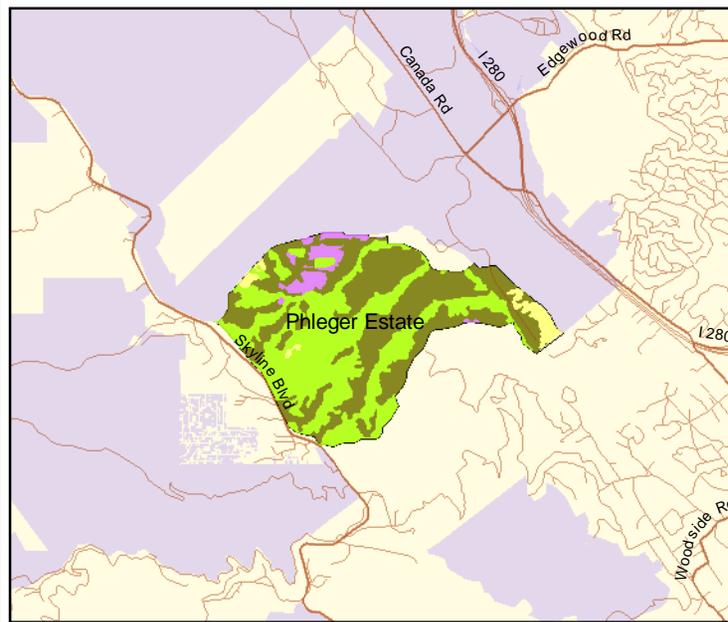
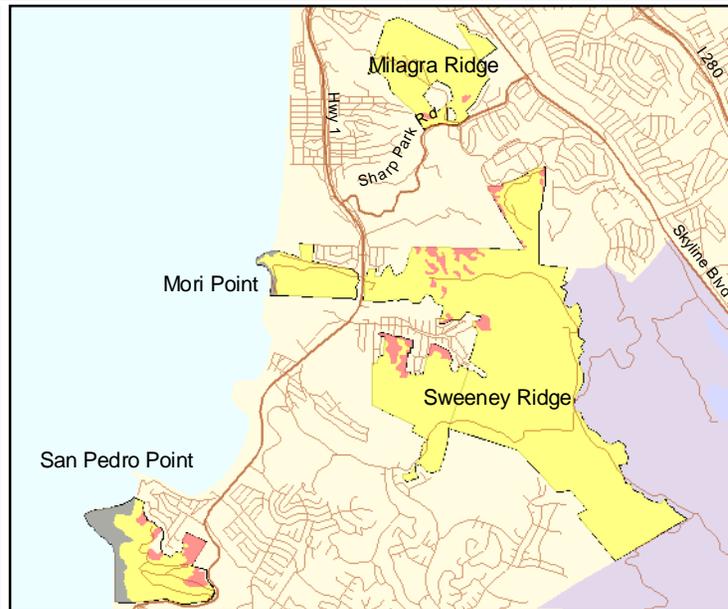
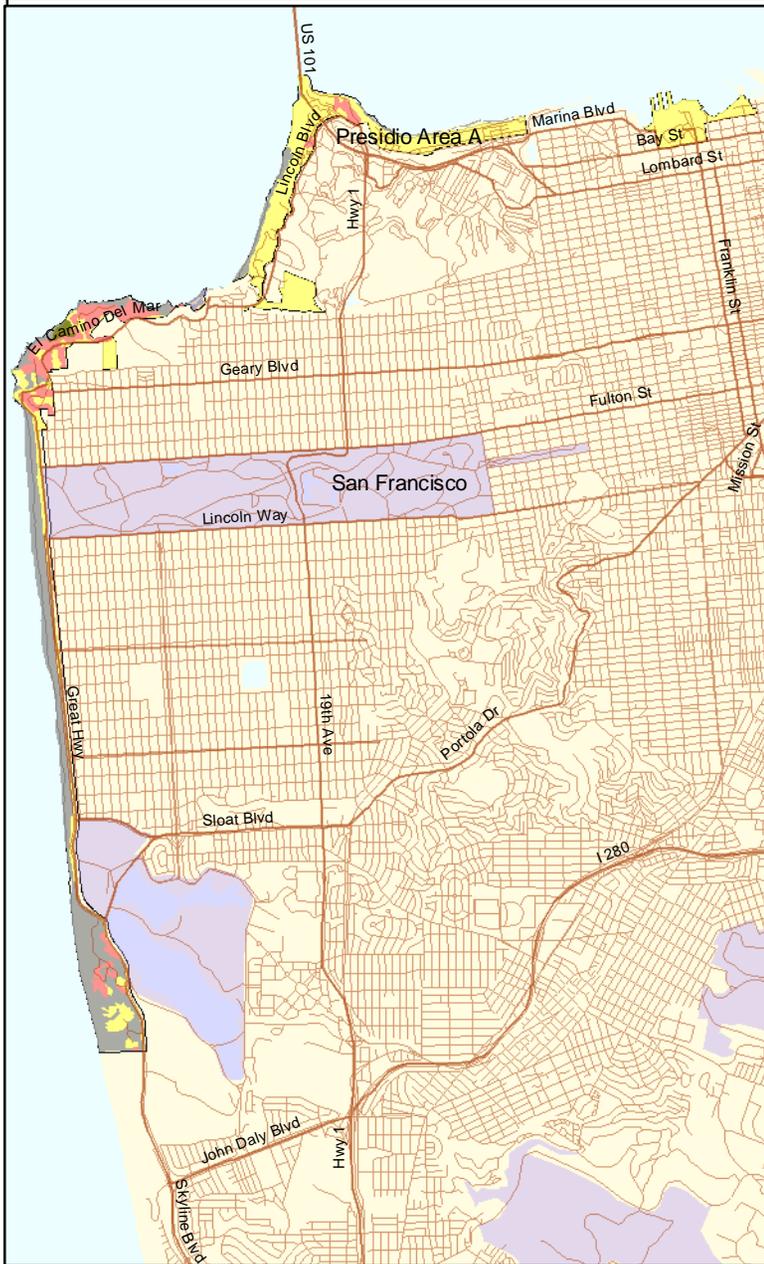
Chapter 2 – Alternatives, Alternatives Formulation Process

This page intentionally left blank.

Alternative "A" Fire Management Units

San Francisco and San Mateo County

National Park Service
 U.S. Department of the Interior
 Golden Gate National Recreation Area



- 1993 Fire Management Units**
- Broadleaf Evergreen
 - Chaparral
 - Coastal Scrub
 - Eucalypus/Non-natives
 - Old Growth Redwood
 - 2nd Growth Redwood/Douglas Fir
 - Barren/Shoreline/Rock Outcrop
 - GGNRA Boundary
 - State, Local, and Open Space Lands
 - Roads



0 1 Miles

Figure 2-2

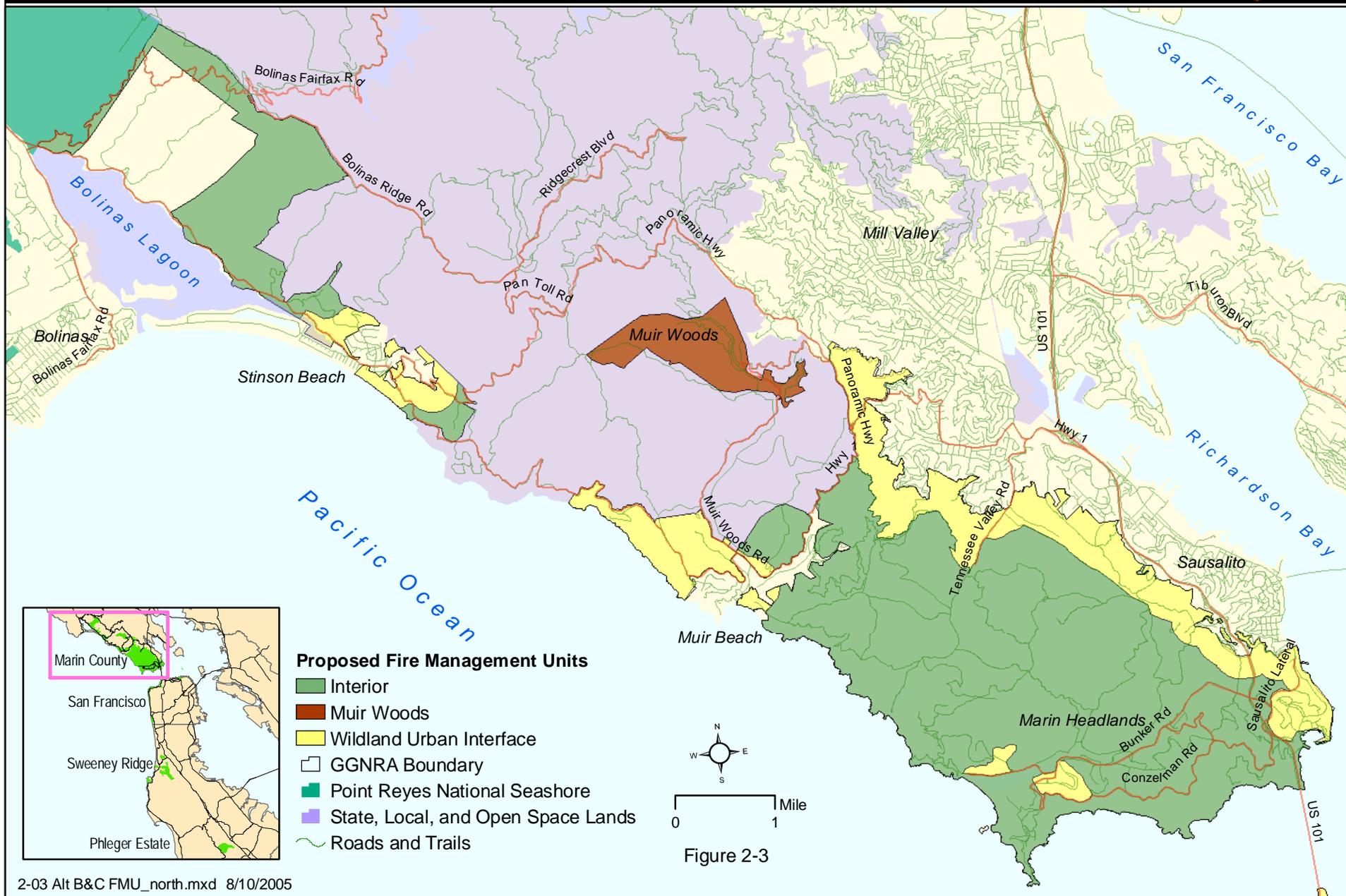
Chapter 2 – Alternatives, Alternatives Formulation Process

This page intentionally left blank.

Alternative "B" and "C" Fire Management Units

Marin County

National Park Service
 U.S. Department of the Interior
 Golden Gate National Recreation Area



Chapter 2 – Alternatives, Alternatives Formulation Process

This page intentionally left blank.

Alternative "B" and "C" Fire Management Units

San Francisco and San Mateo County

National Park Service
U.S. Department of the Interior
Golden Gate National Recreation Area

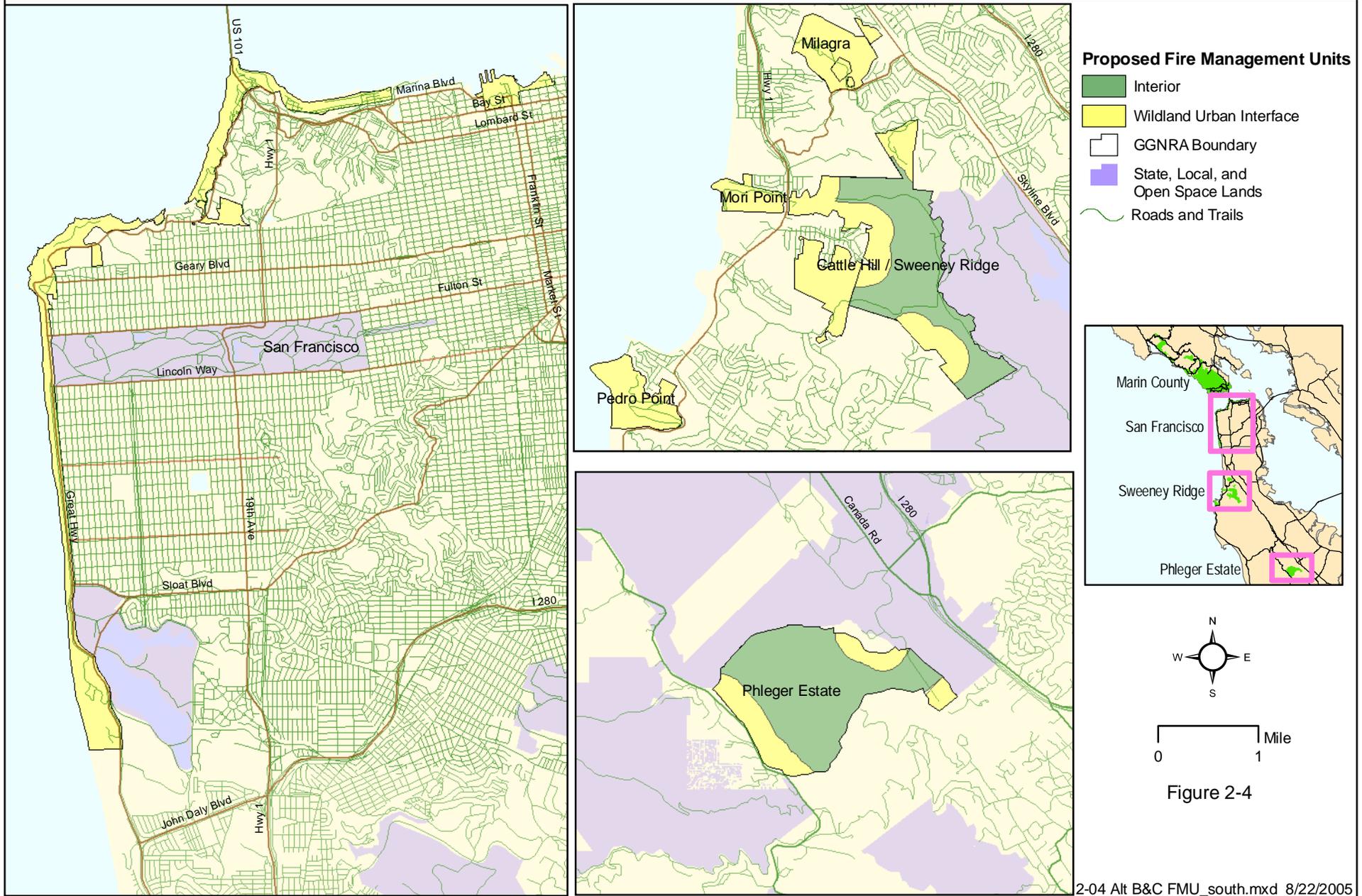


Figure 2-4

Chapter 2 – Alternatives, Alternatives Formulation Process

This page intentionally left blank.

Fire Management Project Areas

Marin County

National Park Service
 U.S. Department of the Interior
 Golden Gate National Recreation Area

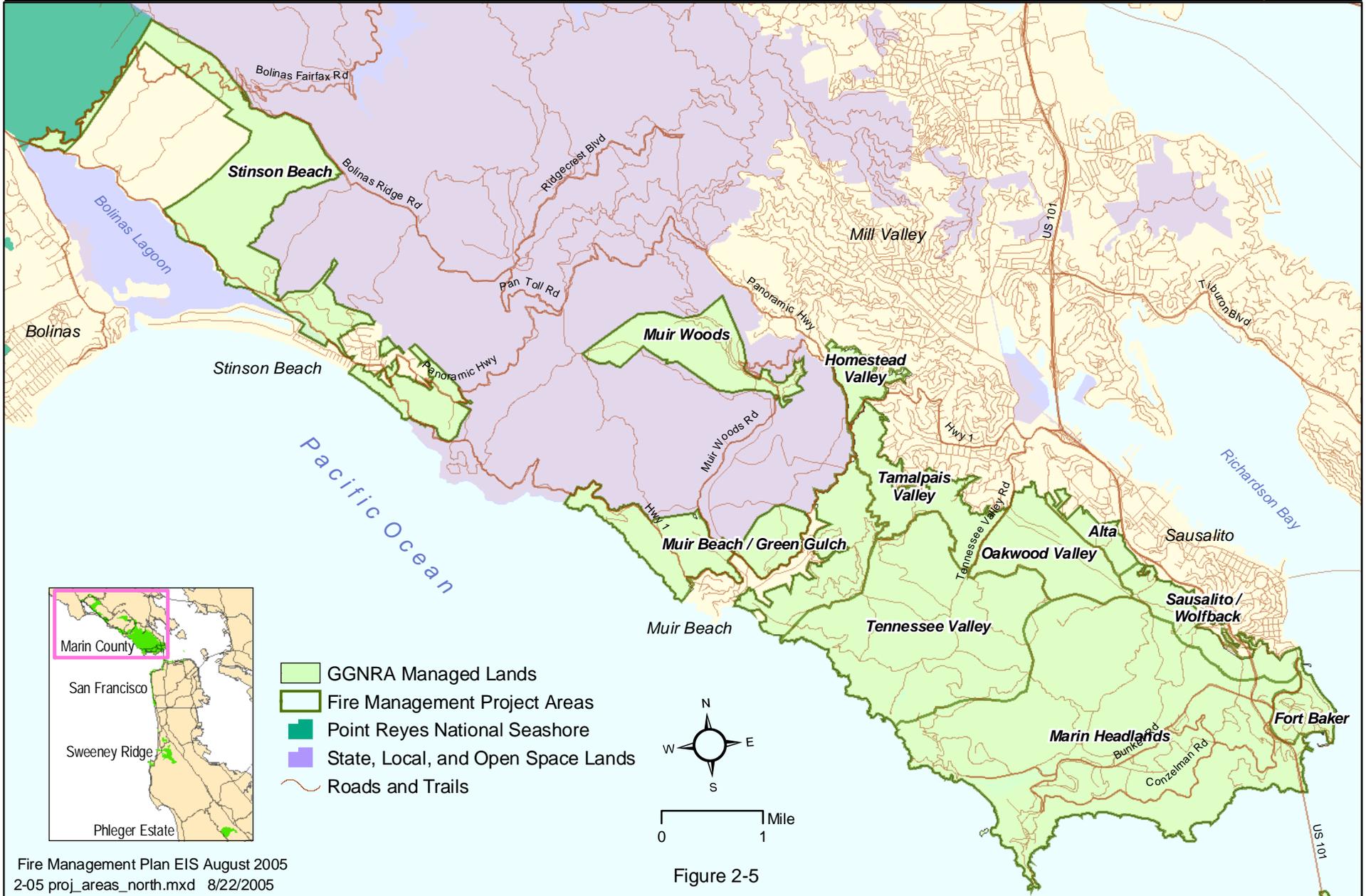


Figure 2-5

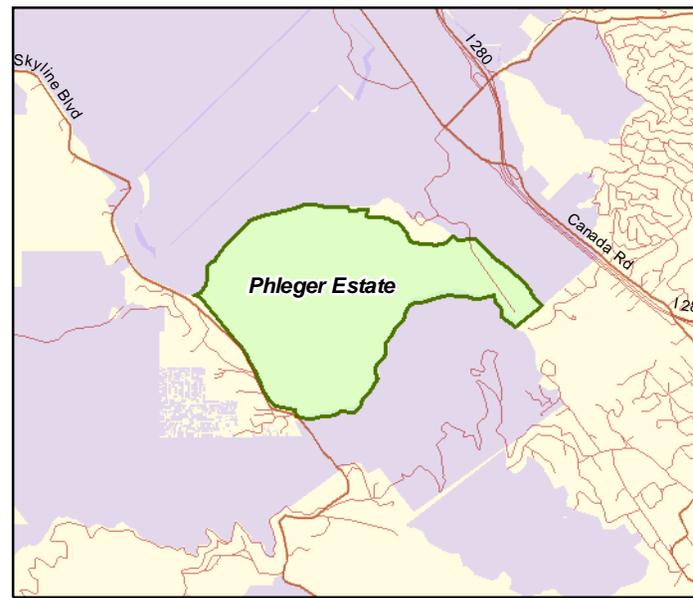
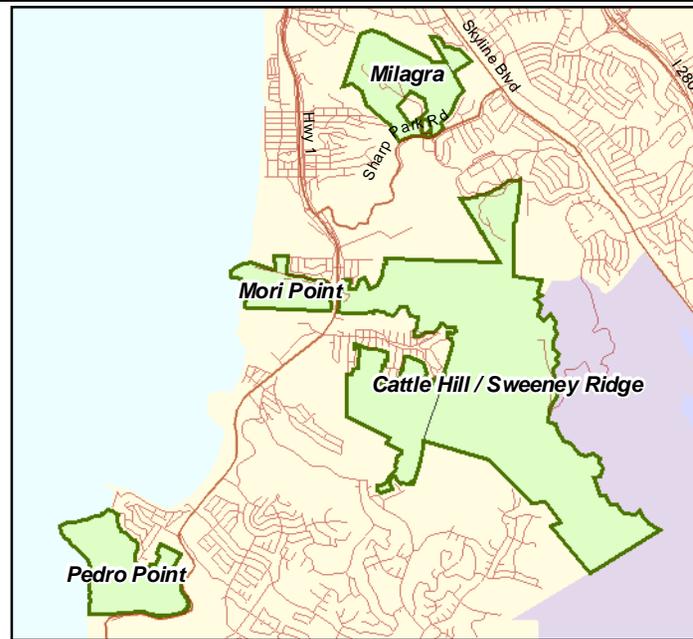
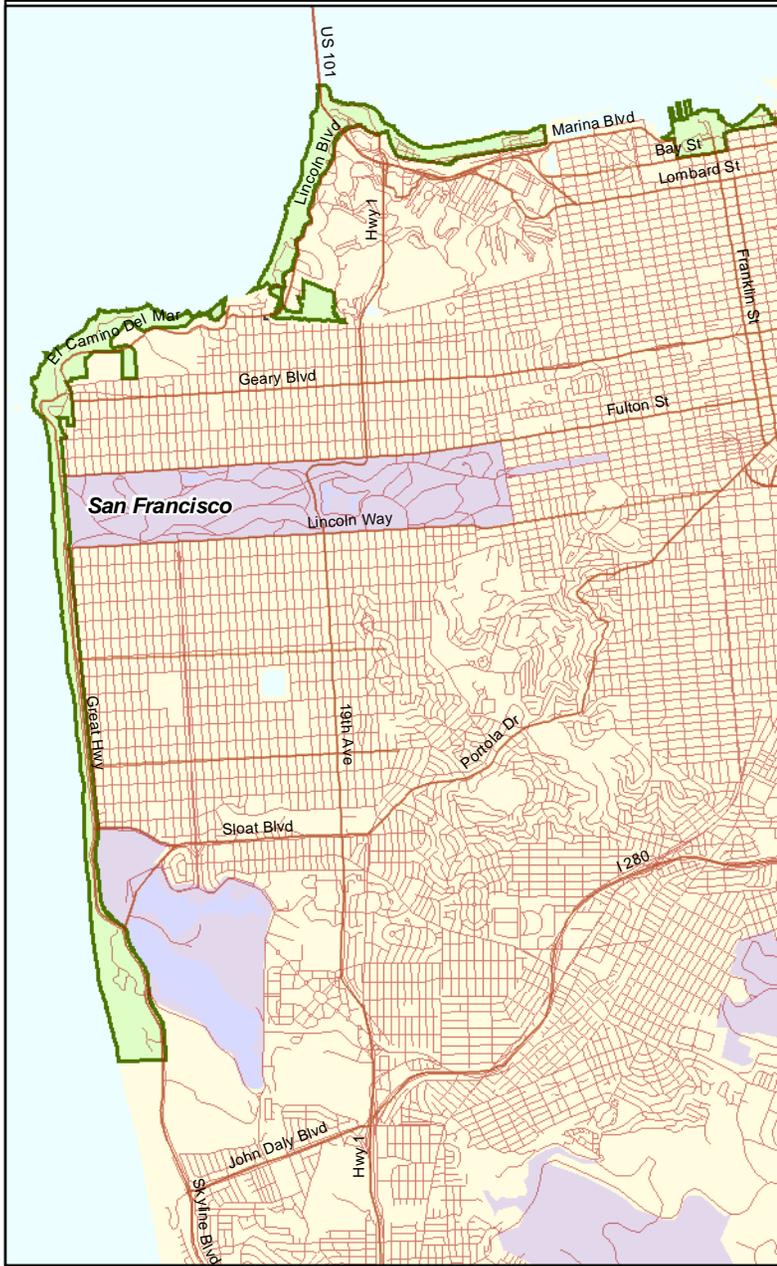
Chapter 2 – Alternatives, Alternatives Formulation Process

This page intentionally left blank.

Fire Management Project Areas

San Francisco and San Mateo County

National Park Service
U.S. Department of the Interior
Golden Gate National Recreation Area



- GGNRA Managed Lands
- Fire Management Project Areas
- State, Local and Open Space Lands
- Roads and Trails



Figure 2-6

Chapter 2 – Alternatives, Alternatives Formulation Process

This page intentionally left blank.

Marin County

1. Alta. This area is entirely within the Wildland Urban Interface FMU. The Alta project area is bordered by Marin City and Sausalito to the northeast, the Alta Trail to the southwest, and the Wolfback project area at the Rodeo off-ramp to the southeast. The project area is adjacent to the neighborhood represented by the Headlands Homeowners Association and Marin City. While the area was not mapped during the vegetation classification mapping effort, vegetation types include coastal scrub/chaparral, native hardwood forest, and nonnative evergreen forest (primarily eucalyptus). This area also contains mission blue butterfly habitat. The fire management issues are the extensive stands of nonnative evergreen forest in close proximity to developed and populated areas, and the need to reduce fuel conditions along access roads.
2. Fort Baker. This area is entirely within the Wildland Urban Interface FMU. The Fort Baker project area includes the Fort Baker cantonments as well as the Bay Area Discovery Museum, the future home of the Fort Baker conference center and institute, the U.S. Coast Guard structures located near the north anchorage of the Golden Gate Bridge, and the Vista Point viewing area by the Golden Gate Bridge. This project area has a moderate degree of park visitation. The project area is bordered by San Francisco Bay to the east and south, Sausalito to the north, and the Marin Headlands project area to the west. Portions of the areas closest to the bay are builtup or developed, with the remaining land area covered by a mix of coastal scrub, grassland, oak woodland, and nonnative forests. This project area contains important mission blue butterfly habitat. Fire management issues in this project area include (1) the need to manage the dense overgrowth of nonnative evergreen trees, which have expanded beyond the historic bounds and created fire hazards to nearby historic structures; (2) the need to reduce hazards along the Highway 101 and Alexander Avenue corridors; and (3) the need to improve the defensible space around buildings and below the High Vista neighborhood.
3. Homestead Valley. This area is entirely within the Wildland Urban Interface FMU. The Homestead Valley project area is bordered by Panoramic Highway to the west, Shoreline Highway to the south, and the Homestead Valley neighborhood to the north and east. The predominant vegetation types in this area are coastal scrub, grassland, native hardwood forest, and nonnative evergreen forests (eucalyptus and cypress). Spotted owls have been known to use the native forests in this area for habitat. A key fire management issue in this area is the buildup of hazardous fuels in close proximity to residential areas.
4. Marin Headlands. This area is predominantly within the Park Interior FMU with a small amount within the Wildland Urban Interface FMU. The Marin Headlands project area includes the Gerbode Valley and Rodeo Valley watersheds. It is bordered by the Fort Baker and Sausalito wildland urban interface buffer to the east, the Tennessee Valley watershed to the northwest, and the Pacific Ocean to the west and south. The Marin Headlands are dominated by coastal scrub and grasslands, with herbaceous wetlands and riparian scrub in the low-lying areas. Nonnative stands of eucalyptus and Monterey pine are present in some of the developed areas, and native hardwood forest is present in Gerbode Valley. A large portion of the land along the Pacific Ocean is unvegetated rocky slopes. There are several clusters of development from the past military occupation found in this area, including Fort Barry and Fort Cronkhite, a former Nike missile, historic coastal fortifications, and the

Marine Mammal Center area. This project area supports habitat for several significant plant and wildlife species, such as the federally listed threatened California red-legged frog and the endangered tidewater goby and mission blue butterfly. Examples of fire management issues in this area include buildup of hazardous fuels adjacent to historic structures, nearby residential areas, and popular visitor destinations where access is limited.

5. Muir Beach/Green Gulch. This area is within the Park Interior FMU and the Wildland Urban Interface FMU. The Muir Beach/Green Gulch project area is comprised of three parcels surrounding the Muir Beach community and the Green Gulch Zen Center, including the Banducci Ranch area. The area is bordered by Tennessee Valley to the south, the Tamalpais Valley area to the east, Mount Tamalpais State Park to the north, and the Pacific Ocean to the west. This project area contains habitat for coho salmon, steelhead, and the California red-legged frog. The vegetation in this project area includes mainly coastal scrub and grassland, with herbaceous wetlands and riparian forests in the drainages. The forested portions include native hardwood forest and nonnative eucalyptus. An additional eucalyptus stand is located outside the GGNRA boundaries and could encroach into the project area. Some developed land and unvegetated shoreline is also present in the project area. The dune scrub areas along Muir Beach are often ignited by beach fires. This area is a popular visitor destination. Fire management issues here include the overgrowth of nonnative evergreens and other fuel loads along critical access/egress routes and developed areas.
6. Muir Woods National Monument. This project area is entirely within the Muir Woods FMU. The area is defined by the boundaries of the Muir Woods National Monument and lies west of Mill Valley off Panoramic Highway. At the eastern end of the project area, Camino Del Canyon contains several residences and historic structures. The project area consists predominantly of native hardwood and evergreen forests, including Douglas-fir, old-growth and second-growth redwoods, bay laurel, tanoak, and madrone. The area near Camino Del Canyon includes riparian forest, grassland, and nonnative evergreen forests, and has been affected by many nonnative species. This project area contains habitat for the spotted owl, salmonids, and bats. This is one of the most popular visitor destinations within the entire GGNRA. The fire management concerns in this project area are to reduce the fuel loads and threats to key access/egress routes and surrounding communities, and to provide for visitor safety in case of a fire.
7. Oakwood Valley. This area encompasses lands within both the Park Interior FMU and the Wildland Urban Interface FMU. The Oakwood Valley project area is bordered by the Alta Fire Road to the northeast, Tennessee Valley Road to the northwest, and the Miwok Trail to the south. The Oakwood Valley and Marinview residential communities are adjacent to the project area. The vegetation consists mainly of native hardwood forests (oaks), coastal scrub, and some grassland. Riparian forests, as well as nonnative eucalyptus, are present in the drainages. The primary fire management concerns in this area are to maintain low fuel conditions and adequate fire road access/egress, particularly along the residential community interface.
8. Stinson Beach. This area predominantly encompasses acres within the Park Interior FMU and some acres within the Wildland Urban Interface FMU. The Stinson Beach project area is comprised of

three distinct regions that surround the Stinson Beach community. This area includes GGNRA lands north of Stinson Beach and south of the Bolinas/Fairfax Road as well as land south of Stinson Beach near Panoramic Highway. The vegetation types in this project area are coastal scrub, grasslands, Douglas-fir/coast redwood, and native hardwood forest. Smaller amounts of herbaceous wetlands, riparian forests, and nonnative evergreen forests are present, as are areas of unvegetated shoreline. Spotted owl habitat is present in Stinson Gulch, and several Bolinas Lagoon tributaries, including Easkoot Creek, contain coho salmon and steelhead. Stinson Beach is a popular visitor destination. Fire management issues in this area include the need to reduce fuel loads between the park and adjacent communities and developed areas, and to provide for safe fire road access and egress routes.

9. Tamalpais Valley. This area is entirely within the Wildland Urban Interface FMU. The Tamalpais Valley project area is defined by the Miwok Trail to the south and west, Tennessee Valley Road to the southeast, and the park boundary to the northeast. The Homestead Valley project area lies to the north and the Tennessee Valley project area lies to the south. The vegetation in this area is dominated by coastal scrub, grassland, and native hardwood forest, with large stands of nonnative eucalyptus throughout the area. A small area of riparian forest is located along Tennessee Valley Road, and some developed areas are found along the northern boundary. Fire management issues in this area include the need to reduce fuel loads between the park and adjacent communities and to provide for safe fire road access and egress routes.
10. Tennessee Valley. This area is named for the watershed it encompasses and is entirely within the Park Interior FMU. It is bound by the Pacific Ocean to the southwest, Coyote Ridge to the northwest, the Miwok Trail to the northeast, and the Hill 88 ridge to the south. The majority of vegetation in Tennessee Valley is coastal scrub, with grasslands comprising nearly a fifth of the acreage. Herbaceous wetlands, riparian scrub, and nonnative evergreen forests are present in the drainages. Disturbed lands surround the Miwok riding stables and the old farmhouse, and much of the coastline is unvegetated rock outcrops. The area has frequently visited trails. Fire management issues here include the need to maintain adequate fire road access with reduced fuel loads.
11. Wolfback Ridge/Sausalito. This area is entirely within the Wildland Urban Interface WUI. The eastern boundary of the project area is defined by the park boundary adjacent to Highway 101 and Sausalito. Wolfback Ridge consists mainly of coastal scrub and grassland, and includes native hardwood forest, riparian forest, and nonnative evergreen forest (mostly eucalyptus) scattered throughout the area. The Wolfback Ridge neighborhood is bordered on the west and partially on the east by dense eucalyptus forest. Mission blue butterfly habitat is also located here. Fourteen acres of disturbed land are found along the borders of the project area. The primary fire management issue here is the need to create defensible space along the park boundary that adjoins the residential communities.

San Francisco County

12. San Francisco. The San Francisco project area includes all NPS-managed lands within San Francisco County and is entirely within the Wildland Urban Interface FMU. These include Fort Mason, Alcatraz, NPS-managed lands (Area A) of the Presidio of San Francisco including Fort Point National

Historic Site, and the area from Fort Miley to Fort Funston. The FMP does not include any fire management actions or priorities for the lands within the Presidio managed by the Presidio Trust (Area B). The vegetation types within the project area are the coastal dune communities, with areas of coastal scrub, native hardwood forest, and riparian scrub. Large stands of nonnative evergreen forest are located throughout the project area. The primary fire management issues in this project area are to create defensible space around buildings that adjoin wildland fuels, and to work closely with the Presidio Fire Department (which is responsible for structural fire suppression as well as fire management in Area B of the Presidio) in wildfire planning and management actions. In addition, small research burns could occur in conjunction with approved U.S. Fish and Wildlife Service recovery plans for federally listed threatened and endangered plant species.

San Mateo County

13. Milagra Ridge. This area is entirely within the Wildland Urban Interface FMU. The project area is defined by the park boundary on Milagra Ridge and lies just north of Sweeney Ridge and northeast of Pacifica. The site contains significant cultural and historical resources as well as important mission blue butterfly, California red-legged frog, and San Francisco garter snake habitat. The vegetation in the project area is dominated by coastal scrub, and includes areas of grassland and riparian forest. Nonnative evergreen forest is also present. The primary fire management issue here is the reduction of hazardous fuel loads in areas adjacent to developed communities.
14. Mori Point. This area is entirely within the Wildland Urban Interface FMU. The Mori Point project area stretches from the Pacific Ocean to Highway 1 west of the Vallemar section of Pacifica. Along its northeastern boundary it connects with the northwestern arm of the Sweeney Ridge project area, near Shelldance Nursery. The area is dominated by grassland interspersed with coastal scrub. The low-lying areas contain herbaceous wetlands and riparian scrub, which are home to the San Francisco garter snake and the California red-legged frog. The western edge of the area consists of unvegetated shoreline.
15. Phleger Estate. This area is mostly within the Park Interior FMU, with some acres within the Wildland Urban Interface FMU. The Phleger Estate boundary adjoins Huddart County Park and the town of Woodside to the southeast. Highway 35/Skyline Highway defines the boundary to the southwest. Lands to the north include Midpeninsula Regional Open Space District, San Francisco watershed, and California Department of Fish and Game holdings, as well as private estates. Vegetation in the area is dominated by Douglas-fir/coast redwood (second-growth) and native hardwood forests. Several acres of coastal scrub are located along the northern boundary, and a small amount of grassland is found along the eastern edge. The Phleger Estate is in the West Union/Francisquito Creek watershed, which contains steelhead. The fire management concern in this project area is the hazardous fuel load buildup with the potential for wildland fire in close proximity to developed areas.
16. Pedro Point. This area is entirely within the Wildland Urban Interface FMU. Pedro Point lies 2.5 kilometers southwest of Cattle Hill and is defined by Highway 1 and the Pacific coast. The Pedro Park area of Pacifica lies to the north, open space to the south and east, and the Pacific Ocean to the

west. The vegetation in this area is mostly coastal scrub, with nonnative evergreen forest encroaching from the northern boundary. The western portion of the area is nonvegetated coastal bluffs. The fire management issue here is the buildup of hazardous fuels adjacent to the Highway 1 corridor and other builtup areas.

17. Sweeney Ridge/Cattle Hill. This area is divided equally between the Park Interior FMU and the Wildland Urban Interface FMU. The Sweeney Ridge/Cattle Hill project area is defined by the boundaries that constitute these two GGNRA parcels. The project area lies just east of Pacifica and is bordered to the south by San Francisco watershed lands managed by the San Francisco Public Utility Commission (SFPUC). The majority of this area is coastal scrub, with large areas of grassland in the north and riparian scrub in several of the drainages. Stands of nonnative evergreen forest (mostly eucalyptus) encroach into the project area from outside the park boundary. The fire management needs in this project area are to reduce the fire hazards adjacent to the Vallemar neighborhood and to maintain adequate fire road access.

2.3 Fire Management Actions

Vegetation within NPS units is managed to achieve resource benefits and management goals such as restoring ecosystems, maintaining ecosystem health, maintaining or improving the condition of cultural landscapes, and reducing hazard fuels. Fuels management includes strategic planning and implementation of treatments ranging in scale from site-specific to landscape level. These treatments are designed to improve the park's ability to protect life and property and to maintain or restore the sustainability of healthy ecosystems, which is a fundamental legislative mandate (NPS 2003a).

Fuel reduction activities reduce the fire hazard of all fuel types when risk assessments demonstrate a reasonable chance for future wildland fire damage. The beneficial outcome is that firefighter and public safety is enhanced, real property as well as natural and cultural resources may be protected, and potential suppression and property damage costs may be significantly reduced. The goal of fuel reduction projects is to provide for increased protection of homes within and adjacent to parklands, and to protect sensitive species and their habitats and important cultural resources within the park.

The following sections review types of fire management activities that are further described and articulated in each of the alternatives.

Suppression

Wildfire suppression is the activity that most people associate with fire management. Suppression includes all actions taken to put out an active fire, and is defined as the restriction of the spread of a wildland fire and the elimination of all threats from that fire. All wildland fire suppression activities provide for firefighter and public safety as the highest consideration while minimizing loss of resource values, economic expenditures, and/or the use of firefighting resources (NPS 2003a). Fire suppression methods used should be those that cause minimum resource damage while accomplishing effective control. A flexible suppression strategy allows for the choice of using methods to confine, contain, or control a wildland fire, with input from the park, suppression forces, and adjacent landowners.

Mechanical Treatment

Mechanical treatment is a term used to describe the application of various tools and equipment to reduce fuels and achieve fire and resource management goals. The park often uses mechanical treatments, including mowing, short-term grazing, cutting, and selective thinning, to remove hazardous fuels around buildings, along travel corridors, and in a number of places within the park where wildland fuels grow directly against the urban interface (i.e., along the boundaries where there are houses and other built developments), and to reduce the long-term fuel hazard through vegetation type conversion. The most common method of mechanical fuel reduction is through the use of chain saws to thin or remove targeted vegetation, which is then piled to be burned at a later date, or chipped using a chipper. In other instances, such as for fire road maintenance, large mowers and brush-cutting attachments are used for controlling vegetation.

Mechanical treatment includes provisions such as the following:

- Fuel breaks – clearing corridors of vegetation;
- Shaded fuel breaks – reducing density of underbrush, removing tree limbs;
- Mosaics of cleared areas, areas with reduced vegetation density, and uncleared areas;
- Short-term use of animals (such as cows or goats) to reduce fuels;
- Removal of nonnative, nonhistoric trees and treatment of cut stumps with herbicide to prevent resprouting when necessary; and
- Revegetation, as appropriate, of treated areas to avoid erosion and retain natural and/or cultural resource values over the long term.

Prescribed Fire

Prescribed fire is the use of management-ignited fire to meet specific resource and fire management goals and objectives under predefined fuel and weather conditions. (A prescription will always factor in a set of conditions to address the safety of the public and fire staff, weather, and probability of meeting the burn objectives.) Prescribed fires are used to manage vegetation, reduce hazardous fuel loads near developed areas, manage cultural landscapes, and restore natural systems, and for research purposes. Before any prescribed fire is permitted, a smoke management plan approved by the Bay Area Air Quality Management District (BAAQMD) must be in place. Also, a burn plan, signed by the superintendent, is required.

Ecosystem restoration projects can use prescribed fire to control nonnative plants and restore degraded habitat. Information gained through the use and effect of prescribed fire on natural resources can be critical to sound, scientifically based management decisions for a particular resource and can aid in future management decisions. Similarly, cultural resource management goals can also be achieved through the judicious application of prescribed fire to, for instance, modify vegetation type and patterns in cultural landscapes, or provide opportunity to reveal previously unknown archeological resources in densely overgrown areas.

Pile Burning

Pile burning refers to the controlled burning of piles created during mechanical fuel reduction activities or general park maintenance operations. Pile burning is frequently used when chipping is not feasible or is done in conjunction with prescribed burning (in the first phase) to reduce fuel loads to a level that allows burning over the landscape. Pile locations are sited to minimize impacts from intensive soils heating. Piles are covered, allowed to dry, and then typically burned during wet conditions when the probability of fire extending beyond the piles is low. This can occur any time during the year, depending upon weather conditions. As pile burning contributes emissions to the Bay Area Air Basin, a smoke management plan

must be submitted to BAAQMD and approval received prior to burning. An approved burn plan must also be in place.

Monitoring and Research

Integral to any fire management plan are monitoring and research programs that allow the park to document basic information, to detect trends, and to ensure that the park meets its fire and resource management objectives. By studying trends, park staff can identify specific concerns, develop hypotheses, and identify specific research projects to develop solutions to problems. Using results from a high-quality monitoring program to evaluate a park's prescribed fire management program is important to successful adaptive management. These results can help managers determine whether objectives are being met and verify that the program is on track, or conversely, provide clues to what may not be working as planned so that appropriate changes can be made.

The NPS uses a standardized fire effects monitoring program as a data collection procedure nationwide. The benefits of establishing standardized data collection procedures in a fire monitoring program include documenting basic information, detecting trends, identifying future research needs, and facilitating information exchange between resource protection staff and fire suppression agencies. Research projects, their methodology and objectives vary over the park landscape depending on the research questions and the researchers involved. Research projects developed in association with the fire management program will be managed in conjunction with the NPS Research and Collection Permit Program through the GGNRA Natural Resources Management and Science Division.

2.4 Actions Common to All Action Alternatives

Several actions that are currently part of the fire management program at GGNRA would continue under all of the alternatives analyzed in this EIS. These activities are described below.

Wildland-Urban Interface Initiative

In 2001, the NPS began implementing provisions of the federal Wildland-Urban Interface Initiative program. This program was designed to facilitate cooperative ventures with park neighbors – including other federal agencies, states, counties, private landowners, and local fire agencies – to reduce the potential for wildland fire to burn from federal lands to neighboring properties. This is accomplished through implementation of fuel reduction projects in communities adjacent to GGNRA. Through this program, the NPS also receives funding for fuel reduction projects on parklands near the interface with private property or lands managed by other agencies.

Defensible Space/Vegetation Clearing around Buildings

The protection of all buildings from wildfire within GGNRA would continue under all alternatives. NPS staff or private contractors would continue to clear vegetation around park structures. Individual structures would be assessed to determine the appropriate vegetation treatment based on fuel type and slope, building construction type, historic significance, and potential sources of ignition.

Priorities for hazardous fuels removal projects are set annually and the projects are performed throughout the year. The defensible space required at each structure is based on individual site topography and usually ranges from 30 to 100 feet around structures.¹ In some cases, a larger cleared area may be required to protect the structure from potential fire hazard due to prevailing winds or the presence of drainages or swales close to the structure. Fuel type and fuel loading are also factors considered in determining these types of projects. Large trees are pruned or removed if the tree poses a threat. Grasses are cut, and smaller trees are pruned or removed based on an individual assessment. Pruning and removal actions must be in conformance with approved cultural landscape preservation plans and historic preservation compliance stipulations when the landscape has been determined to be historic.

Roadside Fuel Reduction

The park maintains roads that provide routes for public safety, recreation, and access for park management uses. Front-country roads that are paved are generally open to public motor vehicle traffic. Unpaved, back-country roads are generally open only to NPS vehicles, but may also be open to foot, horse, and/or bicycle users. Some roads may serve as control lines during a prescribed fire or wildland fire suppression operation.

Upkeep of park roads is the responsibility of the GGNRA Maintenance and Engineering Division. The FMP alternatives do not propose changes to the status or management of park roads and trails. All fire roads would continue to be maintained to allow for safe and efficient access by emergency vehicles, and

¹ Parcels in Marin and San Mateo counties, mapped by the State Board of Forestry as State Responsibility Areas, must comply with PRC 4290-4291, which requires a minimum 100 feet of defensible space as of January 2005.

Chapter 2 – Alternatives, Actions Common to all Action Alternatives

at a minimum, to allow access by Type III fire engines. Maintenance standards for emergency vehicles access on back-country roads in Marin County would conform to those described in the Memorandum of Understanding (MOU) between the Marin Municipal Water District (MMWD) and the NPS. FMP actions may include grading of road surfaces, placement of erosion control measures, and vegetation thinning by mowing or cutting along the road corridor to a specified width based on fuel type, slope, and roadway composition. Larger trees along the sides of the roadways may be limbed up and smaller trees removed as needed to ensure emergency vehicle clearance is met. Grass that grows within the roadway may be cut or mowed. Debris would be cut up and broadcast in the immediate area, piled and burned, or chipped and hauled offsite.

In separate actions apart from the FMP, the park may evaluate on an ongoing basis the condition of park roads. Unnecessary roads may be eliminated or designated for non-vehicular use, in coordination with other park planning efforts such as the Trails Forever initiative. In some cases, existing roads may be reconfigured or rerouted to address erosion and/or maintenance concerns.

In Marin County, there are approximately 44 miles of fire roads, amounting to 52 acres requiring treatment each year to keep clear and open from debris. In San Mateo County, there are 10 miles of fire roads, amounting to 16 acres of mechanical treatment each year. San Francisco County roads, as well as paved roads in parklands in Marin and San Mateo counties, would be maintained on a regular basis under the park's maintenance operation and are not included as part of the fire road calculations.

Suppression

The current policy at GGNRA is to suppress all unplanned ignitions using minimum impact suppression tactics (MIST) whenever possible and feasible given the constraints along the urban interface.

Suppression of fires will be aggressive and will be conducted with the highest regard for human safety. Specifics of MIST tactics are included in Appendix G.

Wildland fire suppression would be conducted to suppress wildfire at minimum cost consistent with values at risk, while minimizing the impacts from suppression activities. A “confine,” “contain,” or “control” strategy would be used in the suppression of all wildfires, as follows, with the majority of wildfires suppressed using the control strategy.

- Confine – to restrict the wildfire within boundaries determined either before or during the fire. These identified boundaries will confine the fire, with no action being taken to put the fire out.
- Contain – to restrict a wildfire to a defined area using a combination of natural and constructed barriers that will stop the spread of the fire under the prevailing and forecasted weather conditions until the fire is out.
- Control – to fight a wildfire aggressively through the skillful use of personnel, equipment, and aircraft to establish fire lines around a fire to halt the spread and extinguish all hot spots until the fire is out. Control activities will use standard suppression practices.

Suppression will be accomplished through a combination of cooperative agreements with local fire agencies and qualified park fire personnel. Annual operating plans will identify individual suppression concerns in order to minimize suppression impacts. Furthermore, all control efforts will be evaluated for consideration of effects on resource values.

Fire suppression methods used should be those that cause minimum resource damage while accomplishing effective control. Suppression activities will attempt to avoid disturbance of all threatened and endangered (T&E) species and their habitats, as well as archeological and cultural sites, whenever reasonably possible, i.e., when these activities do not preclude life, safety, or private property considerations. A representative from the NPS will be present during extended attack suppression activities within or near GGNRA.

A Wildland Fire Situation Analysis (WFSA) and Delegation of Authority (DOA) will be prepared for the superintendent's approval each time a wildfire escapes initial attack or burns into a second burning period. It is also possible that, during an emergency situation in which an unplanned ignition has grown to a large and dangerous fire, the superintendent would authorize the use of heavy motorized equipment such as bulldozers to construct larger and longer fire lines. Other fire suppression activities require limited offroad vehicle use by trucks, fire engines, and lowboys for hauling heavy equipment.

Aircraft may drop retardant and water during suppression of unplanned ignitions. Since retardant (e.g., Phoschek) contains phosphorus, retardants will not be used in streams or wetlands when feasible. Helicopters may also be used to deliver water, foam, and/or retardant. Helicopters will need areas to land (helispots) within the park. All landing areas will meet the standards outlined in the Interagency Helicopter Operations Guide (IHOG). In addition, the GGNRA Aviation Management Plan identifies safe locations for landing in areas administered by the park. Temporary road and trail closures may occur during fire suppression events.

Treatment of Muir Woods FMU

Preservation of the pristine character of Muir Woods National Monument is a management priority stated in the 1993 FMP. Many species contribute to the ecosystem in and around Muir Woods National Monument and this diversity calls for a variety of prescription parameters. Fuel buildup currently presents a fire hazard to the resources of the monument and residential development to the east along Panoramic Highway and in Homestead Valley. The exclusion of fire from the monument perpetuates and increases the degree of hazard to these adjacent areas and increases the likelihood of higher-intensity fires within the redwood stands. Prescribed fire would be used in the redwood/Douglas-fir forest to restore the role of fire to this ecosystem. Prescribed burning may also be used for management of nonnative species in the monument, such as in the Conlin Avenue area near the maintenance yard.

A fire chronology based on fire scar examination was done for two redwood (*Sequoia sempervirens*) forest sites in Marin County (McBride and Jacobs 1978). Fire frequencies averaged 21.7 and 27.3 years. The difference between the two sites was attributed to the increased influence of fog (Jacobs et al. 1985). The short interval is thought to be an artifact of Native American burning. Natural fires would ignite and burn through sections of the forest, cleaning out undergrowth, dead and down material, and litter on the

Chapter 2 – Alternatives, Actions Common to all Action Alternatives

forest floor. The beneficial effects of this process were numerous in that nutrients were released into the soil, forest density was regulated, fire-dependent species were provided with a favorable environment for reproduction, and wildlife was provided with more favorable habitat. Redwoods themselves require bare mineral soil to reproduce successfully from seed after the passing of a fire. Conversely, pests and pathogens find conditions generally less favorable.

The interruption of this ecological cycle through 150 years of fire suppression has produced visible deleterious effects. The buildup of dead and down material on the forest floor and the density of undergrowth create conditions favorable to catastrophic fire. Increased amounts of fuel produce fires that burn faster, hotter, and with greater intensity. Control becomes more difficult and the likelihood of adverse ecological effects such as mortality in mature trees is increased.

The existing fire hazard can be illustrated by the Ben J. Fire of June 13, 2001, which may have been started by an illegal campfire. The fire burned on the slopes west of Redwood Creek and the Hillside Trail and south of the Ben Johnson Trail. NPS staff responded quickly and were able to contain the fire. If this fire had occurred in late summer/early fall, during the height of the fire season, it would have been much hotter and spread faster, posing a significant threat to the first-growth redwood groves.

The NPS reintroduced fire into the ecology of Muir Woods National Monument during the second half of the 1990s under the 1993 FMP. Three burns were conducted in the redwood/Douglas-fir forest. In 1996, the nine-acre Upper Deer Park Burn between Deer Park Fire Road and the Dipsea Trail was conducted to serve as an anchor point for future suppression efforts and as a starting point for future burns. In 1997, the Deer Park 2 Prescribed Fire (52.5 acres) was completed, and in the following year (1998) the Johnson Prescribed Fire (35 acres) was conducted on neighboring forested units. Two Conlon Prescribed Burns at the lower end of Camino Del Canyon were completed in 1997 and 1999 (20 acres each) to reduce nonnative broom species in grassland areas. Several other burns were planned but not executed for many reasons. In addition to burns on NPS lands, the California Department of Parks and Recreation has conducted several burns around Muir Woods National Monument in order to create fuel breaks and to manage nonnative plant species.

Under the FMP FEIS alternatives, the strategy for Muir Woods National Monument is the same under each of the three alternatives and therefore is addressed as an element common to all alternatives. The objectives for the fire management strategy in Muir Woods are to:

- Restore the role of fire in the relevant vegetation communities;
- Reduce fuel loading and the threat of catastrophic wildfire; and
- Further study fire effects in old-growth coast redwood forest.

The proposed fire management strategy for Muir Woods National Monument is similar to that of the 1993 FMP and includes a mix of prescribed fire and mechanical fuel reduction. Prescribed burning would be used to reduce fuel loading and to benefit from the reintroduction of fire into the diverse plant communities in the monument. Small-scale mechanical fuel reduction projects, such as construction of shaded fuel breaks and understory thinning, would be implemented as elements of an overall strategy to

reduce the hazard of a high-intensity fire. Mechanical fuel reduction would be used to treat approximately five acres annually. In woodlands hard hit by Sudden Oak Death (SOD), thinning could be used to reduce standing snags and ladder fuels and to remove smaller-diameter trees. Nonnative species may be controlled by either applying prescribed fire or mowing first, leaving the brush to cure in place followed by prescribed fire. Research in the monument could also employ prescribed burning to investigate the relationship between fire and SOD and the use of prescribed burning in limiting or controlling French broom in the Conlin Avenue area.

Established trails, roads, and natural features would be used to the extent possible as fire control lines to avoid disturbance to ground cover, soils, and possible subsurface cultural resources. In keeping with NPS standards, all burn preparations and operations would be designed to produce the lightest impact possible to the monument. Post-burn rehabilitation of burn units would be an important aspect of the program. Prescribed burns would range in size from 0.5 to 50 acres for approximately 50 acres annually. The total acreage would include one or more research burns conducted on smaller plots. A total of five acres of mechanical clearance would be conducted annually at the monument, including clearing defensible space around park structures and treating areas of nonnative plants.

Use of prescribed fire for both fuel reduction and resource enhancement has proven effective throughout the range of coast redwood forests, and will continue within Muir Woods National Monument. Expansion of the current public education program will be necessary in order to carry out further prescribed burning. Interpretive and educational opportunities that are currently available or in process include fire ecology provisions in school and public programs, a self-guided walk featuring fire ecology in Muir Woods National Monument, a public display on fire ecology and control burning, a fire wayside exhibit, and placement of the fire weather station in an area visible to the public with an interpretive explanation. Use of prescribed fire in Muir Woods National Monument is a sensitive issue requiring availability of staff to inform and educate the public, neighboring agencies, and other interested parties about the benefits and role of fire in coast redwood forests.

Treatment of San Francisco County Project Area

The lands managed by GGNRA within the City and County of San Francisco are heavily used and are comprised primarily of coastal scrub, nonnative grassland, landscaped grounds, nonnative shrubs and trees, or beach sand and bluff with little burnable vegetation. In a few areas, very dense, nonnative evergreen forest does pose a high fire hazard to the public and firefighters. For example, an area of overly mature cypress trees on the southern end of Sutro Heights and a dense stand of blackwood acacia near the Lobos Creek channel in the southwestern edge of Area A of the Presidio adjoin residential properties and would benefit from mechanical fuel treatment. Clearing dense vegetation from historic structures throughout the San Francisco parklands would benefit public safety and help preserve the structures in case of a wildfire or structural fire in the area. The fuel reduction strategy for the San Francisco lands – to maintain defensible space around buildings adjacent to wildland fuels and to provide some mechanical removal of nonnative evergreen trees – would improve firefighter safety and reduce the risk of a fire spreading from federal lands to the adjacent dense residential neighborhoods.

No prescribed burning is proposed for the San Francisco County project area, including Alcatraz Island, except in conjunction with implementation of approved U.S. Fish and Wildlife Service recovery plan objectives for federally listed threatened and endangered plant species, which could entail research burns. The areas with the highest existing fire hazard contain nonnative and highly flammable trees or dense nonnative shrubs that could most effectively be treated by mechanical fuel reduction and follow-up maintenance. Neither fire management staff nor resources staff has identified areas of Alcatraz Island or the majority of the San Francisco project area that would benefit from prescribed burning. Given the brief window for permissible burning each season in the Bay Area, fire management staff prefer to concentrate their efforts in areas where they can be most effective in reducing fire hazards and producing resource benefits in relation to the amount of investment of time and budget required.

Public Information and Fire Education Programs

The NPS manages an active fire information and education program within the park that also serves local communities. This program assists in educating NPS employees, volunteers, park partners, other agencies, park visitors, and the general public about fire management goals and policies. The education program currently produces flyers for nearly all fire management projects within the park for distribution to the public, posting at the project site, and posting on the park's fire management web pages. The fire management office has arranged for, conducted, or presented at a wide range of public meetings in communities close to WUI program projects.

A comprehensive public information and education program would be included as part of all of the alternatives. GGNRA has shared a full-time fire education, prevention, and information specialist with Point Reyes National Seashore since 2001. The fire information and education program is in the developmental stages at both local and national levels. This program is adding to what has been traditionally provided through GGNRA's Office of Public Affairs and the Division of Interpretation and Education. This fire information and education program includes fire safety and prevention, fuels management, the role of fire in GGNRA's ecosystems, GGNRA's fire history and the cultural use of fire on the landscape, and fire research programs and opportunities. The fire information and education program is directed at neighbors, visitors, partners, NPS employees, and the news media.

The proposed program could include the following:

- Site bulletins and temporary exhibits/bulletin boards about prescribed burns;
- Fire ecology and wildfire wayside exhibits at key visitor locations;
- Public Information Officer (PIO) on wildfires;
- Site bulletins and temporary exhibits/bulletin boards about mechanical fuels treatment projects;
- "Burning Issues" teacher workshop;
- Fire education ranger-led or self-guided walk at Muir Woods National Monument;
- Fire news reporting/ParkNet;
- Enhanced fire management web pages;

- Fire education internship program;
- Increased press releases, media briefings, and tours;
- Defensible space home evaluation program;
- Community notification electronic mailing lists integrated with fire and fuels management planning;
- Two community mailings per year; and/or
- Short fire and fuels management video presentations at some visitor centers.

Notification of fire and fuels management activities would be done prior to project commencement and could be achieved by using road and trail signs as well as postings at visitor centers, entrance stations, post offices, and other areas of high visitor use. The fire management office will develop and implement an education and communication plan for all site-specific fire management implementation projects. For large-scale fuel reduction projects (more than one acre) that could affect mid- to close-range viewsheds for residents on the park boundary, park staff will arrange a meeting with the community to present the scope of work and provide an opportunity for public comment. Communication plans for projects may require information such as the project scope, schedule, and alternative trail routes, where needed, to be posted in the project vicinity.

Communication with adjacent land management agencies (e.g., State Department of Parks and Recreation, Marin County, and Marin Municipal Water District) would always be conducted when projects occur at or near their boundaries. These agencies also would be notified if a project on GGNRA lands has potential to affect lands under their jurisdiction.

When prescribed fires or unplanned ignitions are visible from scenic overlooks or popular visitor use areas, park interpreters or the fire education specialist would be present, if possible, to alleviate public concern and to teach visitors about the objectives and benefits of prescribed burning. The Public or Fire Information Officer (P/FIO, respectively) would notify adjacent communities by press release, as requested, before implementing prescribed fires.

GGNRA staff would follow the standard operating procedures for implementing a Fire Step-up Plan during fire season. For example, when red-flag warnings are issued by the National Weather Service for the local area, fire managers may post high fire danger signs within the park.

In the event of wildland fire, the P/FIO would work closely with visiting FIOs who may be part of Incident Management Teams to ensure that the park message is delivered accurately and effectively. Wildland fire will also be reported to BAAQMD as soon as possible. Media and public queries would receive prompt replies that would contain information about the fire, the fire management plan, and ecosystem restoration as appropriate.

Community mailings would reinforce prevention measures and inform the public of fire and fuels management activities. A defensible space homeowner education program would provide an opportunity for homeowners to learn about ways to minimize loss of property.

Fire Cache

Fire cache facilities are used to store the equipment and supplies necessary to support all fire operations within GGNRA, as well as two national park units in the East Bay – John Muir and Eugene O’Neill. Currently, fire vehicles and equipment are stored in several facilities in the Marin Headlands and Fort Baker. Building 1068 at Fort Cronkhite houses the main fire management offices; Building 1069 at Fort Cronkhite houses the engine crew along with the power tool cache, hand tool cache, personal protection equipment, and line gear for additional personnel. The Regional Training Center at GGNRA has been reactivated and personnel are often outfitted from the GGNRA Fire Cache. Building 1069 also contains hose and hardware for the two Type 6 and two slip-on wildland fire engines assigned to the park. A separate building, T1111 at Fort Cronkhite, contains surplus gear and equipment not used on a daily basis. Finally, the two Type 6 wildland fire engines are housed in Building 407 at Fort Baker.

Storage of fire equipment and vehicles in a central location would decrease response time to major park assets and facilitate communication among park staff members responsible for fire management. Ideally, the fire cache will be housed in a single location at some time in the near future. Such a facility would need to be strategically located and have engine bays for at least two wildland fire engines, including one Type 3 engine. Sufficient office space would be required in addition to area for crew members and equipment. This cache/wildland station could potentially be an interagency facility in conjunction with the Marin County Fire Department or one of the city fire organizations. In the past, GGNRA has operated a regional mobilization center. As this program could possibly be reactivated, it should be given some consideration in planning for future cache needs.

The park will conduct a facilities assessment for the fire cache to refine the program and storage needs and study options for relocation and consolidation. This assessment will be done in coordination with other interested agencies, and appropriate environmental review will be conducted for implementation.

Fire Effects Monitoring

Fire effects monitoring is essential to determining the effects of the fire program on GGNRA ecosystems and to providing guidance to the fire program for adaptive management. The effects of prescribed fire have been monitored in GGNRA since 1991. In accordance with the NPS Fire Monitoring Handbook (FMH), vegetation and/or fuels data are collected both before and one, two, five and ten years after prescribed burns in order to assess whether or not the burn has met stated objectives (NPS 2003b). Existing FMH plots at GGNRA are located at Bolinas Ridge, Stinson Beach, Muir Woods National Monument, Tennessee Valley, Rodeo Valley, Milagra Ridge, and Sweeney Ridge, in habitat types subject to prescribed burning. Under all alternatives, these plots would continue to be monitored according to the FMH schedule and new plots would be established as necessary to determine the effects of fire. Further, the data from this program would be analyzed and reviewed on a regular basis to help direct the GGNRA fire program as well as to identify areas where fire research or other monitoring efforts should be focused, such as evaluating the effectiveness of mechanical fuel treatments and follow-up, and effects on threatened and endangered species.

As part of the Fire Effects Monitoring Program, both prescribed burns and wildfires are monitored during a fire event for weather conditions, fire behavior, and air quality. This monitoring would also continue under all alternatives. Both live fire monitoring as well as the establishment and monitoring of FMH plots as described above are carried out by the Fire Effects Monitoring Crew, which is hosted at Point Reyes National Seashore. Funding for the Fire Effects Monitoring Crew is provided through the National Fire Office.

2.5 Alternatives

Alternative A – 1993 FMP, No Action

Description of Alternative

Under this alternative, GGNRA staff would update the 1993 FMP to reflect changed conditions – including changes recently made to the national fire management policy, the establishment of the Wildland-Urban Interface Initiative program, and the addition of new parklands (since 1993) – and would continue to apply existing fire management practices by implementing elements of the 1993 FMP. Very few action items called for in the approved 1993 FMP have been implemented, due to a variety of factors including funding and staffing availability. Under Alternative A, it is assumed that the actions identified in the 1993 plan (primarily prescribed burns to achieve vegetation management goals) would be implemented and the fire and fuels management actions would not differ from current practices.

The objectives of the 1993 FMP are to develop an integrated program where managed fires are used to perpetuate fire-dependent natural systems and wildfires are suppressed in a manner that results in a minimum of damage to resources. The program would use prescribed fire, mechanical manipulation of hazard fuels, and suppression of all wildfires. Key elements of the 1993 FMP, updated to reflect current policies, are to:

- Protect life;
- Protect park resources and private property;
- Reduce fuels in the wildland urban interface;
- Use fire as a management tool to reduce fire hazards;
- Restore native ecosystems and special status species habitat through a program of prescribed fire and fire suppression; and
- Suppress all unplanned fires.

In ecosystems modified by prolonged exclusion of fire (primarily coastal grassland/scrub mosaic, oak woodland, and coastal redwood), prescribed burning would be used to restore fuel loading or vegetative composition to natural levels. Additionally, fire and/or mechanical manipulation of hazard fuels would be used to create narrow fuel breaks along boundaries of a fire management area and thereby reduce the probability of wildfires crossing into or out of that area. This alternative would result in a very gradual reduction of fire risk and would have an emphasis on achieving natural resource objectives.

Strategic Approach

Under this alternative, management-ignited prescribed fire would primarily be used to gain the missing ecological benefit of natural fire, and mechanical manipulation would be used primarily to reduce hazardous accumulations of vegetation. A combination of prescribed burning, mechanical manipulation of fuels, fire suppression, and fire effects monitoring would be implemented. All fires would be

monitored at the appropriate level (NPS 2003b), and research projects may be involved with specific burns.

Under this alternative, a maximum of 100 acres would be subject to mechanical fuel treatments, and a maximum of 110 acres would be subject to prescribed burning. Every five years, fire management and resource management personnel would develop specific plans for prescribed burning and mechanical treatments that would be subject to an NPS internal project review process. These five-year burn plans would be reviewed annually and updated as needed.

Mechanical Treatment

Consistent with the 1993 FMP as well as current practice under the Wildland-Urban Interface Initiative program and National Fire Plan, a number of mechanical fuels reduction projects are currently conducted to manage hazardous fuels. Mechanical manipulation also allows for effective fuel reduction adjacent to structures or high-value areas.

Recent projects completed or initiated primarily focused on the removal of nonnative, highly flammable eucalyptus trees close to park boundaries. Most of these project sites were strategically located with the intent to help protect adjacent communities from wildfire and also to break up the continuity of fuels within a few large stands. Projects were sited to take advantage of fuel reduction projects implemented by the community for areas along the park boundary. The removal projects focused on containing the spread of existing stands, reducing ladder fuels, and providing breaks in the canopy to help limit the ability of fire to spread from tree crown to tree crown. The projects typically involved the felling of eucalyptus trees with chain saws, which can then be piled, burned onsite, cut into lengths and loaded on haul trucks for removal, or chipped and spread evenly over the project area. Eucalyptus wood removed from the park in the past has been recycled as firewood, used in stream restoration projects, and made into flooring. On average there have been two projects completed each year totaling approximately 10 acres. The work has been completed by park staff and through the use of private contractors. Some mechanical removal of French broom and other dense roadside nonnative vegetation has occurred in an effort to contain its spread and ensure that fire roads have adequate clearance for safe usage by emergency equipment.

Every year, fire management and resource management personnel identify priority areas for mechanical treatments such as mowing or hand fuels removal. Projects then are scheduled for implementation. After a project area is selected, fire personnel visit the site to define and map its boundaries. Treatments are documented to ensure that a park has a historical record of the types of landscape treatments used in each area. After the site and project environmental review process is completed, the project is approved by the superintendent with mitigations if appropriate. For example, specific mitigation measures could include leaving buffers along riparian zones and wetlands and/or creating a larger buffer around an archeological site.

The most common method of mechanical fuel reduction is the use of chain saws to thin or remove targeted vegetation, which is then either piled to be chipped, removed, or burned at a later date through the use of pile burns. In some instances, the materials are left in place. Other equipment used during mechanical fuel reduction may include weedwackers, mowers, and masticators. If herbicides are used

during any project, they are applied according to strict specifications provided by the park's Integrated Pest Management (IPM) coordinator per the product label and applicable regulations, on nonnative tree and brush species that vigorously resprout. Any application requires the approval of the park's integrated pest manager and the Washington Office coordinator for herbicide application. The pesticides used on GGNRA lands are registered with EPA and the California Department of Pesticide Regulation and are used according to the label directions and federal and state pesticide laws.

For all projects that propose an herbicide use, a site specific environmental analysis is conducted by GGNRA staff. This assessment is conducted by, at a minimum, the supervisory vegetation ecologist, the chief of natural resources, and the GGNRA IPM coordinator; the latter also reviews it under his/her capacity as a licensed California Pest Control Adviser. If terrestrial or aquatic threatened or endangered wildlife species are in the vicinity of the application site, the park's wildlife biologist and/or aquatic biologist are also consulted. If there is the potential for the listed species to be affected, the park would contact the USFWS for consultation under Section 7 of the Endangered Species Act. Any stipulations provided by the NPS staff and USFWS biologists are included in the written pest control recommendation by the IPM coordinator and issued to the herbicide applicator(s) to provide exact herbicide usage and application requirements. No applications occur in riparian or wetland areas with the exception of the use of specifically formulated herbicides in or near ephemeral drainages of seasonal wetlands applied during the dry season. Using aquatic formulations of herbicide, these areas would only be treated when targeted nonnative invasive plant species cannot feasibly or effectively be controlled by mechanical means and the threat posed by the infestation is considerable. This could be due to the plant's persistent resprouting, its high rate of spread, or the extensive size of the existing infestation. All use of herbicide must follow federal, state, and county regulations.

To protect sensitive species found in the treatment area, a variety of application techniques are used. These techniques may include the use of stump treatment using paint brushes or wick applicators, and/or the use of "shields" to prevent herbicide drift. The use of landscape fabric may also be considered as an alternative to herbicide application in cases where a smaller number of trees are involved, and when other conditions permit. If goats or other animals are used as a type of mechanical treatment in the future, they would be closely monitored and contained by electric fences to eliminate the potential for feral animals or contamination of sensitive watersheds and wetlands.

Following the mechanical treatment, the site would be reviewed by park staff for any newly uncovered and previously unknown archeological material that may need preservation treatment. As appropriate, treated areas would be revegetated to avoid erosion and retain natural and/or cultural resource values over the long term. As recommended by staff, through the park's project review process, the NPS would monitor sites over the course of several years to review the success of the treatments. If nonnative plants are found, other treatments would be planted and implemented on the project area.

File Burning

All vegetation burning within the boundaries of GGNRA must have a burn plan completed and approved before any ignition can begin. Fire engines or portable pumps are on-scene to extinguish any unwanted fire spread. Piles are lit in a manner that distributes the heat released from piles throughout the unit.

Crews “tend” piles, rearranging fuels at the edges of the piles to reach objectives and ensure minimum potential for escape, and providing maximum consumption. Pile burning and prescribed burning have the same air quality and smoke emissions requirements and regulations. The park’s practice is to limit piles to 4 cubic yards of material for each burn. All actions require compliance with and approval from the Bay Area Air Quality Management District (BAAQMD) prior to any actions being initiated. Prescriptions are based on a fire behavior prediction computer program (BEHAVE) model, which is a predictive model of fire based on a set of parameters such as fuel type and weather, with firefighter safety as a determinant.

Prescribed Fire

Under the 1993 FMP, prescribed fire operations have played an important role in fuel and resource management activities within GGNRA, and under Alternative A they would continue to be used. Prescribed burns have been initiated to reduce hazard fuels in strategic locations, to mimic the effects of natural fires, and to aid in the control of nonnative plant species.

Numerous prescribed burns were successfully executed under the 1993 FMP, including Whitegate in 1996 (16 acres), Deer Park in 1996 (10 acres), Deer Park 2 in 1997 (52.5 acres), Conlin in 1997 (20 acres), Ben Johnson in 1998 (35 acres), Whitegate 2 in 1998 (35 acres), Pablo in 1998 (35 acres), and Conlin in 1999 (20 acres). During this period, pile burning was also used to clear additional acres of hazard fuels. Several other burns were planned but not executed due to the various controls and constraints that regulate the use of prescribed fire.

Under Alternative A, prescribed burns would be conducted in coastal prairies, coastal scrub, oak woodlands, and redwood forest; used to lower the fuel hazard in the eucalyptus understory; and used to determine fire’s effect on nonnative plants as well as fire’s contributing effect in the restoration of native plant communities. Through the use of prescribed fire, other resulting benefits include an increased regulation of forest density, the release of nutrients into the soil, the creation of a favorable reproductive environment for fire-dependent species, and the creation of improved habitat for wildlife. Prescribed burning would also allow for fuel modification in large areas away from structures and high-value areas.

Every year fire management and resource management personnel identify priority areas for prescribed burning based upon fuels management and resource management objectives. Projects are then scheduled for implementation. After a project area is selected, fire and resource personnel visit the site to define its boundaries. After surveying for cultural and historic resources and completing internal environmental and overall project screening for other affected physical or natural resources, a burn plan is prepared for each unit.

The burn plan estimates the percentage of the unit covered by different fuel types (i.e., grass, timber, shrubs) and the tons per acre of material within the unit. The BEHAVE model is used to determine potential fire behavior based on a range of possible environmental factors that may be present during burn operations: wind speed and direction, temperature, relative humidity, slope, aspect, and fuel moisture. A decision is then made about the optimal burning conditions that will achieve the desired goals and remain within the control abilities of firefighters on the ground.

Chapter 2 – Alternatives, Alternatives

The onsite fuel loading information is also fed into an air quality model (SASEM) for the burn, which estimates the amount of particulate matter that would be released into the air during the burn and its potential direction based on various wind models. This information is submitted as part of the application to the Bay Area Air Quality Management District (BAAQMD) for approval along with a smoke management plan (SMP) at least 30 days before the proposed burn date. The burn plan is submitted to an outside expert, and both the expert and the park's fire management officer provide a recommendation to the superintendent. After the burn plan is approved by the superintendent, and approval of the SMP is received from BAAQMD, the project site is prepared for the burn. To prepare for a burn in grassland habitat, as an example, a line is mowed around the perimeter of the burn by cutting grasses with a weed whacker, mower, or tractor. In shrub or forested habitats a fire line, kept as narrow as possible for the purposes of stopping fire spread, is typically cut and cleared and vegetation density reduced. Whenever possible, roads and trails are used as fire lines to reduce the amount of line that must be created. A hose lay or direct fire engine supports operations along the burn perimeter.

If the burn is being conducted in nonnative tree or shrub stands (e.g., Monterey pine or Scotch broom), the nonnatives may be cut down or mowed and left in the burn unit to dry before burning. This increases mortality of the targeted nonnative species.

As the proposed burn day approaches, NPS staff contact BAAQMD's Meteorology and Data Analysis (MDA) section, which provides forecasting services to assist with tentative scheduling of prescribed burns. The MDA section will provide 96-hour, 72-hour, 48-hour, and 24-hour forecasts and a 24-hour confidence level of receiving the final approval on the day of the burn itself. The NPS receives final approval from BAAQMD on the burn day and an acreage burning allocation for that day. BAAQMD requires verification that the meteorological conditions fall within the range described in the SMP. Based on wind and weather, BAAQMD makes a final decision about whether it will permit the burn. Onsite weather information is gathered to predict the day's weather and future trends, and to ensure that conditions fall within desired conditions. A detailed Go/No-Go checklist is completed immediately before the burn and has a superintendent's final signature.

The burn is ignited using a combination of fusees, flare guns, and drip torches with a mixture of diesel and gasoline (at a three-to-one ratio). During the burn, fire staff patrols the fire line and keeps it secure by watching for and suppressing any spot fires and turning any logs that could potentially roll out of the burn and spread the fire. If needed to control spot fires, additional fire lines may be cut using hand tools or chain saws. Any spot fires are extinguished using water, hand tools, and if necessary, power tools. Fire weather and behavior are carefully monitored during the burn to ensure that the conditions stay within the prescribed parameters.

Following the burn, the burn crew determines whether or not "mop-up" is necessary to ensure that all fire is completely extinguished. Mop-up activities include digging, cutting, trenching (to prevent debris from rolling), chunking (putting smoldering material into one pile and letting it burn up), and mixing dirt with water from backpack pumps or from hoses. Any smoldering material causing nuisance smoke is extinguished.

Fire personnel monitor the fire until dark or until the perimeter is secured. Personnel stay onsite overnight for burns in forested habitats. The burn area is patrolled daily until the fire is determined to be completely out. As required by BAAQMD, the total acreage of burned vegetation is reported by telephone the following day.

Research

Specific research projects regarding the application and effects of prescribed burning, mechanical treatments, and suppression actions in all of the FMUs would continue under this alternative.

Goals by Fire Management Unit (FMU)

The vegetation zones described in the 1993 FMP would continue to be used as Fire Management Units, and prescribed fire would be used in each of the units.

1. Grassland and Coastal Scrub. The intent would be to reduce nonnative plant densities while encouraging native perennials by conducting prescribed burns in fall or early winter. The prescribed fire program would consist of small burns (1 to 35 acres). The objective of these burns would be to maintain species diversity, reduce fire hazard by reducing fuel loadings, return the role of fire to this community, monitor fire behavior and the distribution of nonnative plant species, and monitor effects on the ecosystem and sensitive species habitat.
2. Chaparral. Since the health of the plant community's diversity depends on fire, prescribed fire would be used within this community to maintain species diversity, reduce fire hazard by reducing fuel loadings, and return the role of fire to the community.
3. Broadleaf Evergreen Forest. Prescribed research fires in this community would be done to study fire behavior and effects on mixed broadleaf communities, to refine prescriptions, and to return the natural process of fire into the community. Management fires would mimic the fire behavior and frequency traits that would best preserve the ecology of these species.
4. Old-Growth Redwood. Prescribed fire would be used in Muir Woods National Monument in order to restore the role of fire into the community, reduce fuel loads, research the effects of fire on Sudden Oak Death syndrome and special status species habitat, and reduce the potential for a catastrophic fire. Burns would be from 0.5 to 50 acres with some mechanical fuel treatment on up to 5.0 acres per year.
5. Second-Growth Redwood and Douglas-Fir. Prescribed fire would be used to restore the role of fire into this vegetation community, research the effects of fire on Sudden Oak Death syndrome, reduce fire hazards by reducing fuel loading, and monitor the effect of fire on the ecosystem.
6. Eucalyptus/Other Nonnatives. To address the problems of the buildup of flammable fuels in proximity to urban areas and the encroachment of eucalyptus on native plant communities, a combination of mechanical removal and prescribed fire would be employed. The intent of prescribed fire, at a low intensity, would be to prevent populations from invading natural habitats, to reduce the

fuel loading and therefore reduce the fire hazard, and to determine the frequency needed to accomplish the first two objectives. Burns could also be conducted to manage historic forest stands through implementation of low-intensity burns to remove nonhistoric saplings and ground and ladder fuels.

Alternative B – Hazard Reduction and Restricted Fire Use for Research and Resource Enhancement

Description of Alternative

Under this alternative, fire management actions would be focused on using mechanical methods to reduce fire hazards and fuel loads in areas with the highest risks. Specific project objectives would be to reduce fire threats to developed private parcels along the park boundary as well as to developed enclaves within the park. Natural and cultural resource goals and objectives would be integrated into the design and implementation of mechanical fuel reduction projects. Mechanical fuel reduction projects would create areas of reduced fuels to slow the rate of fire spread and facilitate fire suppression. Treatments would be applied in areas where fuel reduction activities would have the highest likelihood of reducing the risk of wildland fire to lives and property.

Under Alternative B, the lands within the Wildland Urban Interface (WUI) FMU would not be subject to prescribed burning, though pile burns would be allowed. Limited use of fire for research purposes would occur within the Park Interior FMU. The objective of these burns would be to add to NPS staff's knowledge of fire effects on specific resources through monitoring and analysis of the results with feedback to the Fire Management Office to refine burn prescriptions, implementation techniques, and data collection efforts.

Strategic Approach

Under this alternative, mechanical treatments and limited prescribed burns would focus on:

- Reducing fuel accumulations where an unplanned fire in these fuels would directly threaten human lives or property;
- Reducing fuels in areas where doing so could aid firefighters in slowing or stopping the spread of fire in the event of unplanned ignition; and
- Using prescribed fire to answer pertinent research questions and better understand its effects for natural resource management options (such as improving threatened and endangered species habitat or controlling nonnative plant species).

An annual maximum of 230 acres would be subject to mechanical fuel treatments, and an annual maximum of 120 acres would be subject to prescribed burning. Every five years, fire management and resource management personnel would develop specific plans for prescribed burning and mechanical treatments that would be subject to an NPS internal project review process. These five-year burn plans would be reviewed annually and updated as needed.

Mechanical Treatment

The primary fire management activities under this alternative would be mechanical treatments to reduce fire hazards and fuel loads. In addition, mechanical treatment may be used to achieve other resource management goals. When possible, mechanical means would be used to simulate the ecological effects of fire. An example would be use of mechanical treatment to reduce stand densities and the encroachment of fire-intolerant species, and to maintain densities and species composition at prescribed levels. These levels would be determined through consultation with natural and cultural resources staff. In comparison to Alternative A, Alternative B would involve a larger number of mechanical treatment activities to address fire management objectives. Pile burns would be allowed in all FMUs, in association with mechanical fuel reduction projects.

Prescribed Fire

Burns would be allowed within the Park Interior FMU with individual burn size restricted to 0.5 to 15 acres per year, and in the Muir Woods FMU where prescribed burns would be allowed on up to 50 acres per year. Projects would be selected based upon vegetation type and restoration goals, with the intent to test effectiveness of elimination or reduction of nonnative plant species and native plant and/or threatened and endangered species or habitat restoration options. Overall, opportunities for prescribed burns under this alternative would be more restrictive than under Alternative A.

Research

Under Alternative B, current fire research activities would continue and new research would be initiated based on the resource management needs of GGNRA. Potential research topics might include the effects of fire on both nonnative and rare plant species, the interactions between plant diseases such as Sudden Oak Death (SOD) and fire, the effects of wildfires on plant and/or animal communities, and the effectiveness of using fire to reduce fuel loads and manage fire hazards.

Goals by Fire Management Unit (FMU)

Unit 1, WUI

The primary goal in this FMU would be to reduce hazardous fuel loads through mechanical fuel reduction projects. Some pile burning would be allowed following mechanical removal undertakings. Examples of mechanical treatment projects would include:

- Removal of nonnative evergreen trees that do not contribute to the historic setting and that are spreading beyond boundaries of the historic Forts Baker and Barry;
- Removal of nonnative plants in coastal scrub and grassland communities;
- Removal of nonnative evergreen trees in the Alta, Homestead Valley, Muir Beach/Green Gulch, Oakwood Valley, and Tamalpais Valley project areas;

Chapter 2 – Alternatives, Alternatives

- Reduction of fire hazards and maintenance of a zone of reduced fuels between Stinson Beach school and federal lands; and
- Removal of nonnative evergreen trees in Milagra Ridge, Pedro Point, and Sweeney Ridge/Cattle Hill.

Unit 2, Park Interior

Under Alternative B, prescribed burns of restricted extent would be permitted in the Park Interior FMU. The primary treatment method for fuel reduction would be mechanical. Examples of these burns would include:

- Prescribed burns to test the feasibility of managing nonnative perennial grasses and coastal scrub communities with fire in the Marin Headlands;
- Limited prescribed fire for Harding grass and broom removal in the coastal scrub and grassland communities of Tennessee Valley;
- Limited prescribed burns to study effects on mission blue butterfly habitat in Wolfback Ridge;
- Limited prescribed burns for management of the chaparral community in areas of the Stinson Beach project area; and
- Mechanical treatments to reduce fuel loading and fire hazard along roads and near sensitive resources and historic properties.

Unit 3, Muir Woods National Monument

Goals for this FMU would be those described in Section 2.4, “Actions Common to All Action Alternatives.”

Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Multiple Treatments

Description of Alternative

This alternative would permit the broadest use of fire management strategies throughout the park – mechanical treatment, pile burns, and prescribed burning to reduce fuel loading near developed areas and resources. Fuel reduction would primarily occur in those areas with the highest risk for being affected by unplanned fires: developed private areas along the park boundary, developed enclaves within the park, and/or areas and habitats that could be adversely affected by unplanned fire. The objective of fuel reduction projects would be to establish areas of reduced fuels to slow the rate of fire spread and facilitate fire suppression. Natural and cultural resource goals and objectives would be integrated into the design and implementation of mechanical fuel reduction and prescribed fire projects. Prescribed fire would be used to assist with restoration and maintenance of the park’s ecosystems and cultural resources in all FMUs where research, monitoring, and experience have proven the efficacy of these activities.

Strategic Approach

Under this alternative, prescribed burns and mechanical treatments would emphasize the following:

- Reduction of hazardous accumulations of vegetation (fuels) in areas where these activities would have the highest likelihood of reducing the potential risk of wildland fire to lives and property;
- Enhancement of the conditions of natural resources (e.g., increasing abundance or distribution of habitat for threatened and endangered species; reducing infestations of nonnative plants; increasing native plant cover); and
- Protection or enhancement of cultural resource elements and values (e.g., burning would be used to reduce vegetation in areas that are identified as important historic views).

Annually, a maximum of 275 acres would be subject to mechanical fuel treatments, and a maximum of 320 acres would be subject to prescribed burning. Every five years, fire management and resource management personnel would develop specific plans for prescribed burning and mechanical treatments that would be subject to an NPS internal project review process. These five-year burn projects would be reviewed annually and updated as needed.

Mechanical Treatment

The approach to mechanical treatment under Alternative C would be the same as under Alternative B. Mechanical treatments would be used to reduce hazardous fuel accumulations and to create and maintain defensible space and fuel breaks. Some of the acres to be mechanically treated would be the same acres that are subject to prescribed burning (e.g., Scotch broom may be mowed prior to burning). In many instances, mechanical treatments would be used to complement prescribed burning, with the two treatments being used hand-in-hand to address specific fire management and vegetation needs. Therefore, in comparison to Alternative B, a larger number of acres could be treated annually with mechanical means.

Prescribed Fire

Implementation of Alternative C would result in a substantial increase in the acres that could be subject to prescribed burning. The focus for prescribed burns under this alternative would be in areas where NPS ecologists believe ecosystem health would be enhanced by burning and in areas where fuel accumulations create fire hazards. To the extent possible, prescribed burns would be conducted to approximate natural fire intensity and fire intervals. The intent would be to allow the process of fire to act on the landscape as it has for thousands of years, to the greatest extent possible, while ensuring human safety and protecting property. Prescribed fire would be used to reduce infestations of highly nonnative plant species, restore native habitat, and rehabilitate cultural landscape settings.

Prescribed burns intended for resource enhancement would initially be small and would be subject to intensive monitoring and research. If research results indicated that ecological conditions were improving after prescribed burns in certain habitat types, the size of prescribed burns in these habitat types could

increase. All prescribed burns would be conducted under specific burn plans in accordance with national fire policy requirements.

Research

Under Alternative C, current fire research would continue. New research would be initiated as needed to direct the prescribed burning program. Potential research topics might include the following:

1. The effects of fire on management of nonnative plant species such as eucalyptus, Scotch/French broom, and Harding grass;
2. The effects of fire on the species composition and fuel load of coastal grassland and scrub communities;
3. The role of fire in Douglas-fir/coastal redwood communities and the effect of fire on fuel loading in these communities;
4. The interaction between plant diseases such as Sudden Oak Death (SOD) and fire; and
5. The effects of prescribed fires and wildfires on plant and/or animal communities, including rare or sensitive species and their habitat.

Goals by Fire Management Unit (FMU)

Unit 1, WUI

The primary goal in this FMU would be to reduce hazardous fuel loads through mechanical fuel reduction projects and some prescribed burning to complement mechanical treatments. Prescribed fire would be available as a management tool, but restricted in its use and applied strategically to answer research questions and inform proposed project work for the Park Interior FMU. Examples of fire management treatments in this FMU would include:

- Removal of nonnative evergreen trees in most project areas where needed to achieve fire management objectives;
- Removal of nonnative evergreen trees that do not contribute to the historic setting and that are spreading beyond boundaries of the historic Forts Baker and Barry;
- Control and reduction of nonnative plant species in coastal scrub and grassland communities with mechanical treatments in combination with follow-up burning treatments in most project areas, and when possible, restoration and expansion of these native plant communities;
- Prescribed test burns for enhancing mission blue butterfly habitat;
- Limited research burns for Douglas-fir/redwood areas to reduce fuel loads in the Phleger Estate project area; and

- Research into prescribed burning for restoration of grassland communities.

Unit 2, Park Interior

Under Alternative C, prescribed burns would be used to reduce fuel loads and also to implement natural and cultural resource management goals. Prescribed burn projects would be based upon an understanding of vegetation type, restoration goals, and location. Projects would have a strong research and monitoring component. Examples of the types of projects that would occur in this FMU include:

- Prescribed burns, including broadcast burns, to manage nonnative perennial grasses;
- Research burns, and potentially broadcast burns, for management of coastal scrub communities in the Marin Headlands;
- Research into use of fire for managing Sudden Oak Death syndrome in key locations;
- Use of some prescribed fire, including broadcast burns, for management of Harding grass and broom in the coastal scrub and grassland communities in Tennessee Valley.
- Mechanical treatment to reduce fuel loading and fire hazard along roads and near sensitive resources and historic properties.

Unit 3, Muir Woods National Monument

Goals for this FMU would be the same as described in Section 2.4, “Actions Common to All Action Alternatives.”

2.6 Alternatives Considered but Rejected

During the course of alternatives formulation, the multidisciplinary team considered, but rejected, several other alternatives, as explained below.

Hazard Reduction and Focused Resource Enhancement (No Prescribed Fire, No Pile Burning)

Under this alternative, all fire management actions would focus only on risk reduction. Only mechanical methods, such as chain saws, chippers, weed wrenches, and heavy equipment, would be used to reduce fuels. No prescribed fire use would occur in any part of the park and natural and cultural resource goals would only be accomplished through mechanical means as part of fuel reduction actions.

The alternative was rejected because it would not conform with the guidance provided in the 2001 Federal Wildland Fire Management Policy. The Working Group on Wildland Fire Management concluded that federal fire management activities and programs are to provide for firefighter and public safety, protect and enhance land management objectives and human welfare, integrate programs and disciplines, require interagency collaboration, emphasize the natural ecological role of fire, and contribute to ecosystem sustainability. This policy serves as the basis for the goals developed for the FMP.

Chapter 2 – Alternatives, Alternatives Considered but Rejected

Focusing only on risk reduction without pile burning would not provide for a sustainable solution to debris disposal. Often only part or sometimes none of the vegetation cut at a site can be chipped and broadcast in place. Without the recourse for pile burning, all cut vegetation must be deposited in a state-licensed landfill at standard costs. Chipping onsite can be restricted due to the presence of sensitive plant or animal species, the risk of spread of nonnative plant seeds or viable parts, the potential for suppressing native seed bank revegetation, or the risk of fire represented by an overly thick duff and debris. Pile burning is important for vegetation that harbors SOD, pitch pine canker, or other infectious diseases or pests that threaten native or landscaped vegetation. The need to deposit cut vegetation at a landfill runs contrary to the concept of sustainability, which is promoted when vegetation does not need to be removed from the work site and is treated by either chipping or burning.

The mechanical-treatment-only alternative would also reduce the potential for interdisciplinary benefits from the project by eliminating the potential for research burns to be conducted. As is apparent from the description of this alternative, it would not emphasize the ecological role of fire in the park or reintroduce the role of fire into the park ecosystem. The limited benefits from this alternative and its failure to meet FMP goals resulted in its rejection from further consideration in the FEIS.

Hazard Reduction and Focused Resource Enhancement (No Prescribed Fire, Pile Burns Allowed)

This alternative would be the same as the alternative above but pile burning of cut materials would be permitted. This alternative was considered but rejected because it neither fully met the purposes and goals of the FMP nor conformed with federal wildland fire management policy. As with the mechanical-treatment-only alternative, the ecological role of fire in the ecosystem could not be emphasized under this alternative, nor could the cultural and natural resource benefits accrued from prescribed burning be researched or implemented on a broader scale. The current strategy for fire hazard reduction and resource benefits at Muir Woods National Monument, which relies on a series of prescribed burns, would have to be abandoned. For these reasons, this alternative was considered but rejected from further assessment in the FEIS.

2.7 Mitigation Measures

The NPS will implement the following mitigation measures as they apply to each of the three alternatives, and therefore the mitigation measures can be considered common to all alternatives. The measures are designed to minimize or avoid the potential environmental impacts of the actions implemented under the FMP or to create a beneficial effect. These measures would not be fully applicable in the event of a catastrophic fire. A complete discussion of the environmental consequences of the alternatives with these mitigation measures applied is provided in Chapter 4 of this EIS. The NPS will regularly evaluate and monitor the mitigation measures during FMP implementation to determine their continued effectiveness in reducing impacts. The NPS, as Lead Agency, will have primary and full responsibility for coordinating the specific elements of each mitigation measure and will be responsible for ensuring that each mitigation measure has been implemented as specified in this document.

Many of the FMP mitigation measures have been developed to avoid or minimize potential effects on plant and animal species found at GGNRA that are listed as threatened or endangered by the U.S. Fish and Wildlife Service (USFWS) or NOAA Fisheries under the federal Endangered Species Act (ESA). As required by the ESA, the NPS is consulting with the USFWS and NOAA Fisheries to ensure that the FMP will not jeopardize the survival of these listed species but rather protect the species and their habitats. As part of the consultation process, the NPS has prepared a biological assessment that discusses the potential effects of the FMP on listed species and recommends measures for their protection. The measures presented here are consistent with those submitted by the NPS to the USFWS and NOAA Fisheries for their consideration and may be altered based on the guidance provided in the biological opinions issued by these agencies at the end of the consultation process.

Review of proposed projects for conformance with Section 106 of the National Historic Preservation Act (NHPA) will be conducted according to the Advisory Council on Historic Preservation's regulations for implementing the NHPA (described in the Code of Federal Regulations, Title 36, Section 800), or through a process defined in a Programmatic Agreement that will be developed specifically for GGNRA's fire management program. The potential effects of fire management projects and annual work programs on cultural and natural resources will be evaluated for all fire management activities through the park's NHPA and NEPA review processes (see FMP 1(a) and -1(b) below). A variety of treatments and techniques, as detailed in the mitigation measures that follow, would be applied where appropriate to the site preparation, project implementation, and post-action rehabilitation phases of projects for the protection of cultural and natural resources.

General FMP Mitigation Measures

- FMP-1(a)** To ensure that GGNRA fire management actions are in conformance with NEPA, the Record of Decision on the Final EIS, and NPS policy, individual fire management projects and modifications to the GGNRA five-year implementation plan will be subject to the GGNRA project review. Through the project review process, an interdisciplinary team will evaluate whether the potential effects of a proposed action or five-year plan, including appropriate mitigation measures, are adequately addressed by the Final EIS and reflect NPS management policies. If it is determined that the project has the potential for new environmental effects not addressed in this EIS or effects greater than those described in this EIS, a separate environmental process will be conducted.
- FMP-1(b)** To ensure compliance with 36 CFR 800, the regulations for implementing the NHPA, the Programmatic Agreement that will be developed specific to this park's fire management program will stipulate that each five-year implementation plan will be made available to the State Historic Preservation Officer, the Advisory Council on Historic Preservation, and the public for comment.
- FMP-2** GGNRA staff will meet with representatives of local fire agencies that could respond to wildfires in GGNRA lands in Marin, San Francisco, and San Mateo counties. The purpose of the meeting will be to provide information to fire agencies on the location and preferred strategies for suppression actions that will minimize damage or afford protection to important

Chapter 2 – Alternatives, Mitigation Measures

- park resources in the event of a wildfire. The information exchanged between the NPS and local fire agencies will include notification procedures, new or modified facilities in the park, updated information on cultural and natural resources, low-impact suppression techniques, or potential protection techniques for certain locales in GGNRA.
- FMP-3** GGNRA cultural and natural resources staff will work with the fire management staff in preparing and updating maps and other data sources showing areas of the park with sensitive resources such as National Register properties; archaeological sensitivity; cultural landscapes; plant communities of special management concern (e.g., wetlands, riparian areas, dunes, and Special Ecological Areas identified in the park’s Natural Resource Management Plan); habitat of federal, state, and locally listed species; and other important natural and cultural resources.
- FMP-4** GGNRA staff will conduct a training session for all contractor crews at the beginning of new fuel reduction projects to familiarize the crews with sensitive resources at the project site and review project conditions. Training sessions may include identification of NPS staff resource contacts; special status plants, wildlife, or other sensitive resources in the work area; identification and specific removal techniques to protect cultural resources from disturbance or prevent resprouting of nonnative plants; markings for the limit line of disturbance; thresholds that trigger a change in implementation techniques or require a halt in project implementation; proper disposal of food waste and garbage to discourage feeding by vectors and corvids; daily close-up of the project site to assure public safety; and information for public contacts during project implementation.
- FMP-5** An education program for field personnel involved with implementation of FMP projects will be conducted prior to the initiation of field activities. The program may include a brief presentation on any listed species at the work area, including a description of the species and its ecology, habitat needs, legal status, and protection afforded to the species. Cultural resource issues may include the type of artifacts or soils that could indicate the presence of subsurface cultural resources, the presence of known resources at the site, and important elements of the cultural landscape that must be left undisturbed, among other issues.
- FMP-6** The superintendent of GGNRA will appoint members of GGNRA staff to act as resource specialists to consult with operations crews in the event of wildland fire and during planning and execution of prescribed fire. The resource specialists will meet with local fire agencies likely to command wildland fire suppression actions on GGNRA lands and develop strategies for implementing flexible suppression to protect important resources.
- FMP-7** Natural and cultural resources staff will be notified of wildland fires as soon as possible so that appropriate staff can advise the lead fire agency on the location of sensitive resources and preferred suppression techniques and begin planning for rehabilitation of the burned area. Natural and cultural resource advisors will be assigned to the incident as needed.

- FMP-8** For any multiday fire suppression event, a local or regional Burned Area Emergency Response team will be requested to facilitate development, in conjunction with park staff, of the emergency suppression stabilization and rehabilitation proposals.

Air Quality Mitigation Measures

- AIR-1** If recommended by BAAQMD, smoke management plans submitted by the NPS for BAAQMD review can be modified to reduce production of pollutants by reducing the amount of fuels available for burning. Options for reducing the amount of fuels available and emissions produced include reducing the area to be burned, reducing fuel loading (e.g., mowing and understory thinning), managing the rate of fuel consumption, and redistributing the emissions. Treatments to reduce overall air emissions from prescribed burns will be based on current smoke management techniques such as those listed in the Western Regional Air Partnership publication “Non-burning Alternatives to Prescribed Fire on Wildlands” (Jones and Stokes, 2004) and those listed in Appendix I of this FEIS.
- AIR-2** The NPS will develop a Smoke Communication Strategy to guide management of smoke events during prescribed fires, managed wildland fires, suppression actions, and fires occurring outside the park. Notification of proposed burns will be disseminated locally to provide adequate advance notice to persons with sensitivities to smoke.
- AIR-3** To reduce smoke and pollutant generation during the prescribed burning season, efforts will be made to burn fuel concentrations, piles, landings, and jackpots at other times of the year.
- AIR-4** To reduce impacts on visibility in the national park, burning will be avoided on holidays or other periods when recreational visitation is typically high.
- AIR-5** To avoid public health and nuisance impacts on neighboring communities, information about upcoming prescribed burns, including guidance for those who are sensitive to smoke, will be provided to park visitors, park employees, and park partners. Prescribed burns will be conducted under meteorological conditions that best avoid smoke drift into nearby residential areas and roadways.
- AIR-6** The NPS will arrange in advance with other parks that routinely monitor air quality (i.e., Yosemite National Park or Sequoia National Park) to monitor particulate levels during larger prescribed burns in GGNRA provided the necessary staff and equipment can be made available for GGNRA use.

Soils and Water Quality Mitigation Measures

- SW-1** Planned and unplanned fire actions will include strategies to minimize impacts from erosion, such as avoiding steep slopes and highly erosive soils, timing burns to minimize erosion potential, avoiding scraping or burning to bare mineral soil (layer below duff), or using erosion control techniques during or after burns. Subject matter experts will ensure that the erosion control plan for each action is sufficient to prevent long-term moderate or major

Chapter 2 – Alternatives, Mitigation Measures

- impacts on the rate of soil erosion. Sites with identified high potential for soil erosion will be monitored.
- SW-2** Following a prescribed fire or wildland fire, visual monitoring will be conducted downslope of the area burned and at down-gradient water bodies (including ditches, streams, and wetlands) for evidence of increased soil erosion or increased sedimentation. Additional erosion control/sediment control measures will be applied where warranted.
- SW-3** Following wildland fires or prescribed burning, all fire lines (both hand and dozer lines) or other areas disturbed by equipment or vehicles will be rehabilitated as quickly as possible to prevent erosion, discourage the spread of nonnative plants and address soil compaction. Burned area rehabilitation techniques, including recontouring, soil stabilization, and removal and monitoring of nonnative plants, will be used for rehabilitation efforts.
- SW-4** Unless no feasible alternative is available, heavy equipment working on fire management actions (excluding suppression) will not be used in areas with soils that are undisturbed, saturated, or subject to extensive compaction. Where staging of heavy equipment, vehicles, or stockpiling is unavoidable, the limit of allowable disturbance will be clearly demarcated by staking, flagging, or fencing. Following the end of work, surface soils will be scarified to retard runoff and promote revegetation.
- SW-5** During implementation of prescribed burns, some of the available coarse, woody debris will be left on the site to foster nutrient recycling and mycorrhizal function and other natural resource benefits.
- SW-6** Mechanical regrading and rehabilitation of fire roads will be conducted to specifications identified in the GGNRA Trails Inventory and Condition Assessment and the Memorandum of Understanding for Maintenance and Management of Dirt Roads with adjacent land management agencies.
- SW-7** After tree felling, stumps will be left in place in areas with highly erosive soils or on steep slopes.
- SW-8** Where surface soils supporting native vegetation will be disturbed as part of fire management actions, the topsoil layer will be excavated and stockpiled separately from other fill and replaced as topsoil at the end of the action.
- SW-9** Erosion and sediment control measures will be implemented as prescribed where project actions could leave soils exposed to runoff prior to revegetation.
- SW-10** Where multiple burn piles are created on undisturbed soils, the size of the piles will be kept small with sufficient distance between piles to minimize impacts on soils from high-intensity fires and to facilitate reestablishment of mycorrhizal fungi and soil microorganisms from adjacent unburned land.

- SW-11** A post-project site stabilization plan will be developed and implemented for all fire management projects.

Wetland Mitigation Measures

- WET-1** Fires will be allowed to back into, around, or through wetlands and meadows to avoid suppression damage. Wetlands will be avoided to the greatest extent possible while constructing fire lines and breaks during wildfire suppression. Where wetlands are used as a natural boundary to help contain a fire, the control line will be sited outside the wetland area. Trample lines (rather than dug lines) may be used if it is necessary to site the control line in the wetland.
- WET-2** Foams, saltwater, or other fire retardants will not be used on or near wetlands to the greatest extent possible.

Vegetation Mitigation Measures

- VEG-1** Prescribed burns will be conducted at a time of year when introduction or spread of nonnative plants will be minimized and mortality of nonnative plant species will be maximized.
- VEG-2** Soil disturbance during mechanical treatments, prescribed burns, and suppression fires will be minimized to the greatest extent possible to reduce the potential for introduction or spread of nonnative plant species, to protect topsoil resources, and to reduce available habitat for new nonnative plant species.
- VEG-3** Areas subject to fire management treatments will be monitored periodically for the presence of nonnative plant species; if such species become established or spread as a result of such activities, the nonnative, nonhistoric plants will be removed.
- VEG-4** All vegetation management actions under the FMP will conform to federal and state regulations governing interstate and intrastate restrictions (respectively) adopted to prevent the artificial spread of Sudden Oak Death (*Phytophthora ramorum*) beyond the currently affected area. It will be the responsibility of the natural resources division chief to ensure that current guidelines and regulations are circulated to GGNRA staff involved in fire management actions. Relevant regulations are the Code of Federal Regulations, Title 7, Section 301.92 (updated 9/27/04) and California Code of Regulations, Title 3, Section 3700 (updated 9/2/04). Current regulations do not permit the movement of plant species and associated material listed in 3700(c) outside of the regulated quarantine area (defined in 3700(b)), which includes all three GGNRA counties.
- VEG-5** All FMP projects will incorporate techniques that control existing populations of weed species at the project site and incorporate practices to reduce the potential spread of weed species to noninfested areas of the park. Practices to reduce the spread of weed species include the following:

Chapter 2 – Alternatives, Mitigation Measures

- Movement or deposition of fill, rock, or other materials containing weed seed or viable plant cuttings to areas relatively free of weeds will be restricted.
- Where feasible based on the density of the weed population present, the fire management project manager will survey the road shoulders of the routes that provide project access for nonnative plant species and coordinate removal of those plants that could be disturbed by passing vehicles.
- When project vehicles are required to move from offroad use in weed-infested areas to relatively weed-free areas, and water lines and water tenders are available for use, the tires and body of heavy equipment and vehicles will be hosed down before each transit to the relatively weed-free area.

VEG-6 All herbicide use will be administered through the park’s integrated pest management (IPM) coordinator, and only licensed personnel will be allowed to apply pesticides. All herbicide use for fire management actions will be reported monthly to the IPM coordinator.

VEG-7 No herbicide foliar spraying or direct stump applications will be allowed in riparian or wetland habitats supporting special status species except in the dry season.

Special Status Species Mitigation Measures

SS-1 When emergency actions must be taken to prevent imminent loss of human life or property and these actions would result in a taking of listed species or adverse modification of critical habitat not covered under existing FMP biological opinion, the NPS will respond to the situation in an expedient manner to protect human health and safety. After the incident is under control, the NPS will initiate emergency consultation procedures with the appropriate agency(ies).

SS-2 The fire management project manager will ensure that contractor crews working in areas designated as habitat of listed species are monitored by a qualified biological monitor to ensure that project actions conform to restrictions developed for species protection.

SS-3 All fire management actions will operate under a policy of No Net Loss of Endangered Species Habitat, which applies to all species federally listed as threatened or endangered or proposed for listing. The project review process will be used to document the no net loss finding through the conformance assessment conducted for each FMP action proposed for listed species habitat.

SS-4 To avoid the spread of highly nonnative animal species (e.g., bullfrogs) and protect the habitat of federally listed threatened or endangered species, GGNRA resource advisors and fire management staff will advise local fire agencies responding to wildland fires in the park and vicinity of the following guidance:

- Drawing water from freshwater bodies in GGNRA and Rodeo Lagoon should be avoided unless there are no alternative sources available. If freshwater is drawn or scooped from water bodies in the park, it should be used on wildfires within the same watershed whenever possible.
- Ocean and bay waters are preferred water sources for fighting wildfires in the park and vicinity. Habitats of sensitive aquatic species and mission blue butterflies should be avoided when saltwater is used.

SS-5 An education program for the field personnel involved with the FMP shall be conducted prior to the initiation of field activities. The program shall consist of a brief presentation by a person(s) knowledgeable in the California red-legged frog, San Francisco garter snake, mission blue butterfly, and other appropriate listed species. The program shall include the following: a description of these species, their ecology, and habitat needs; an explanation of their legal status and their protection under the Act; and an explanation of the measures being taken to avoid or reduce effects to these species during implementation of the FMP. The education may be conducted in an informal manner (e.g., ranger and field personnel in a field setting).

SS-6 If a California red-legged frog(s), San Francisco garter snake, or early stages of the mission blue butterfly are observed in the work/burn areas, a qualified biologist or an individual trained in the biology and ecology of these listed animals and designated by the NPS shall capture it and move the animal(s) to an appropriate aquatic or upland location outside of the work area.

Special Status Plants

SS-7 Potential impacts associated with tree removal in the vicinity of the Raven's manzanita, San Francisco lessingia, and Marin dwarf-flax will be evaluated in consultation with the USFWS.

SS-8 To address fire actions occurring within special status plant species populations, site- and/or species-specific rehabilitation plans will be developed to minimize or avoid impacts on the greatest extent possible.

SS-9 When FMP actions disturb the habitat of special status plant species, revegetation and weeding plans will be developed in conjunction with project planning.

SS-10 The potential for research burning and/or mechanical fuel treatments to enhance federally listed threatened or endangered plant habitat will be investigated. Burning in these habitats will be limited to carefully prescribed research burns, designed in conjunction with USFWS staff consultation and in accordance with established recovery plan objectives. Experimental treatments will be scientifically designed with replicate controls and a commitment to post-treatment monitoring.

Salmonids

- SS-11** Except in emergency situations, water drafting from park streams and creeks that support salmonids must be halted when water levels drop to a level that could result in disconnected pools of water in the channel. Any water pumping from salmonid streams will require measures to prevent injury to fish, such as using offstream sumps, restricting approach velocities to less than 0.8 foot per second, and screening at intake with openings no greater than 0.25 inch.
- SS-12** A buffer will maintained around riparian areas where fire management activities will be restricted. Staging, fire line construction, and vehicle use will occur outside the buffer area, and any activities such as nonnative vegetation removal and limited prescribed burning will occur under tightly controlled conditions. Any impacts that occur in the buffer area must be correctable by site-specific actions, and must be confined to short-term, minor (or less) adverse effects.
- SS-13** The fire management officer will consult with natural resources subject matter experts to identify rehabilitation and revegetation strategies where fuel reduction projects require bank stabilization in riparian areas. Rehabilitation in riparian areas will be accomplished by hand treatment techniques, using erosion control materials if treatment areas are bare prior to rains, revegetating where needed, and where possible, returning native woody material (large woody debris) to stream banks. No work will be conducted directly in the wetted channel without additional consultation.

Northern Spotted Owl

- SS-14** Treatment activities described in the FMP or any noise generation above ambient noise levels will not occur within 0.40 kilometer (0.25 mile) of a known occupied or previously used northern spotted owl nest site, or within potential spotted owl habitat between February 1 and July 31 (breeding season), or until such date as surveys conforming to accepted protocol have determined that the site is unoccupied or nonnesting or nest failure is confirmed.
- SS-15** Mechanical fuel reduction activities in suitable spotted owl habitat, known or potential, will not substantially alter the percent cover of canopy overstory and will preserve multilayered structure. When shaded fuel break features in suitable northern spotted owl habitat are constructed, the resulting multilayered canopy will only be reduced to a height of 6 to 8 feet, or along roadways as needed for emergency vehicle clearance.
- SS-16** Prior to fire management activities, project areas will be surveyed for the presence of dusky footed woodrat nests. If feasible, woodrat nests will be protected.
- SS-17** Within northern spotted owl habitat, the cutting of native trees greater than 10 inches diameter at breast height (dbh) will be avoided unless a determination is made that the native tree presents a clear hazard in the event of a fire or cutting is the only option to reduce high fuel loading.

- SS-18** The fire management officer will arrange for qualified biologists to conduct post-project monitoring to determine short- and long-term effects of fire management actions on spotted owl activity centers if resources are available.

San Francisco Garter Snake

- SS-19** No heavy equipment will be used off of existing fire roads or developed features in areas of known San Francisco garter snake habitat. If use of heavy equipment and trucks is required during emergency situations or for work that would improve San Francisco garter snake habitat, mitigation measures to avoid mortality will be incorporated into the project schedule. Measures to avoid mortality include hand-clearing areas prior to fire management activities, hand-excavating all burrows, trapping snakes out of the excavation area, using monitors to prevent equipment from injuring listed species, and training workers on identification and avoidance of listed species. Work will be conducted by biologists with a valid 10(a)(1)(A) permit and any collected San Francisco garter snakes will be relocated outside affected areas.

Marbled Murrelet

- SS-20** Where marbled murrelet habitat overlaps northern spotted owl habitat, the restrictions on noise generation in spotted owl habitat above the level of ambient noise will be to August 5. Further, from August 6 through September 30, noise generation will be limited to ambient noise levels from two hours before sunset to two hours after sunrise to protect any nesting marbled murrelets that have not been noted during surveys (USFWS letter to NPS dated April 13, 1994).
- SS-21** In marbled murrelet habitat, felling of very large Douglas-fir or coast redwood trees will be avoided and the fire perimeter will be established at a distance that will preclude the need to fell large trees.

Mission Blue Butterfly

See also Mitigation Measure SS-4 regarding use of ocean and bay waters for suppression actions.

- SS-22** Fire management activities will not occur within or immediately adjacent to existing or potential mission blue butterfly habitat during the flight period of the butterfly from February 15 through July 4.
- SS-23** Pile burning will only be permitted on barren, disturbed soils in mission blue butterfly habitat.
- SS-24** During the information meeting with local fire agencies, the location of mission blue butterfly habitat will be identified. During this meeting and when providing information at an active wildland fire as a resource advisor, natural resources staff will advise the local fire agency of the following guidelines:

Chapter 2 – Alternatives, Mitigation Measures

- Avoid staging fire suppression actions in or directly adjacent to mission blue butterfly habitat;
- Construct fire lines outside of mission blue butterfly habitat to the greatest extent possible;
- Use wet lines wherever feasible, or narrow, hand-constructed fire lines where water is not available to help contain the spread of the fire; and
- Avoid using saltwater or retardant on habitat of the mission blue butterfly.

SS-25 The potential for research burning and/or mechanical fuel treatments to enhance butterfly habitat will be investigated. Burning in mission blue butterfly habitat will be limited to carefully prescribed research burns. Experimental treatments will be scientifically designed with replicate controls and a commitment to post-treatment monitoring. No more than five percent of existing mission blue butterfly habitat in each county will be treated experimentally each year.

SS-26 Where possible, maintain a 100-foot-wide buffer between fire management activities and mission blue butterfly habitat except when fires are being conducted for research purposes. For habitat enhancement projects, additional measures will include establishment of buffer areas, flagging of *Lupinus albus* in the vicinity of activities, installation of temporary fencing, dust control, and worker education (USFWS Biological Opinion for the Fort Baker Plan/EIS, September 29, 1999).

SS-27 The fire management officer will arrange for the removal of nonnative plants within and adjacent to mission blue butterfly habitat following fire management actions, including fire suppression.

San Bruno Elfin Butterfly

SS-28 No planned fire management actions will occur in San Bruno elfin butterfly habitat. Proposed project areas in San Mateo County will be assessed to determine the potential for occurrence of San Bruno elfin butterfly habitat.

SS-29 A 100-foot-wide buffer will be maintained between fire management activities and potential San Bruno elfin butterfly habitat.

SS-30 During the information meeting with local fire agencies, the location of San Bruno elfin butterfly habitat will be identified. During the meeting and when advisors are called to provide information at an active wildland fire, natural resources staff will advise the local fire agency of the following guidelines:

- Avoid staging fire suppression actions in or directly adjacent to San Bruno elfin butterfly habitat;

- Construct fire lines outside of San Bruno elfin butterfly habitat to the greatest extent possible;
- Use wet lines wherever feasible, or narrow, hand-constructed fire lines where water is not available to help contain the spread of the fire; and
- Avoid the use of saltwater or retardant drops on San Bruno elfin butterfly habitat.

SS-31 Conduct fire management activities in areas directly adjacent to San Bruno elfin butterfly habitat outside the flight period of the butterfly, which is from February 1 through May 15.

Tidewater Goby

See also Mitigation Measure SS-4 regarding scooping of Rodeo Lagoon water for use in suppression actions.

SS-32 During information meetings with local fire agencies (see Mitigation Measure NR-1), and on the scene of active suppression actions, natural resource advisors will inform responding fire agencies that Rodeo Lagoon shall not be used for water drafting unless needed to protect life and property and no other feasible water source is available.

California Red-Legged Frog

See also Mitigation Measure SS-4 regarding use of freshwater ponds as a water source for suppression actions and areas of the park sensitive to the use of ocean and bay waters for suppression actions.

SS-33 All suitable habitat within areas proposed for fire management activities will be surveyed and flagged by a qualified biologist to determine whether the site supports suitable breeding or nonbreeding areas for the California red-legged frog.

SS-34 To prevent direct injury to California red-legged frogs, removal of vegetation within suitable frog habitat will be accomplished by a progressive cutting of vegetation from the overstory level to ground level to allow frogs to move out of the treatment area.

SS-35 If likely habitat is identified at the project site, a qualified and permitted biologist will follow accepted protocol and collect and relocate any individual red-legged frogs to nearby suitable habitat, in accordance with the biological opinion from the USFWS.

Western Snowy Plover

SS-35 Where fire management actions involve operation of vehicles or heavy equipment on the beach, the fire management officer or the resource advisor (in the case of a wildfire) will ensure that vehicles will be driven at slow speeds (15 miles per hour maximum) over the wet sand portion of the beach and that natural wave-cast debris will be left on the beach to provide foraging habitat for the western snowy plover.

Chapter 2 – Alternatives, Mitigation Measures

SS-37 To avoid disturbance of western snowy plovers, aircraft assisting the NPS in the implementation of FMP projects will avoid flying directly over and parallel to the beach to the greatest extent possible.

California Brown Pelican

SS-38 To avoid disturbance to the California brown pelican from late spring to early winter:

- Avoid operating aircraft below and within 500 feet of Rodeo Lagoon, Bird Island, and Bolinas Lagoon to the greatest extent possible.
- Avoid drafting water from Rodeo Lagoon, the ocean near Bird Island, or Bolinas Lagoon.

Monarch Butterfly

SS-39 All known clustering sites of monarch butterflies will be considered for protection from fire management actions.

Wildlife and Important Habitat Mitigation Measures

WIL-1 Prescribed burns, mechanical treatments, and mowing of shrubs and grasses taller than 8 inches will not be conducted during the bird-nesting season, from March 1 through July 31, unless a qualified biologist conducts a pre-project survey for nesting birds and determines that birds are not nesting within the project area. To the greatest extent possible, these activities will be planned and conducted outside bird-nesting season. In intensively managed landscapes where mowing is justified for fuel reduction, vegetation will be maintained at a height of less than 8 inches throughout the nesting season (March 1 through July 31) to discourage the nesting of ground-dwelling bird species.

WIL-2 In addition to WIL-1, in order to protect nesting raptors, trees shall not be removed between January 1 and March 1 unless qualified personnel conduct a pre-project survey for nesting birds and determine that birds are not nesting within the project area. If nesting raptors are detected, a qualified biologist will delineate a suitable buffer.

WIL-3 Subject to project review conditions, fire management actions proposed for areas of the park that provide only limited habitat (such as areas dominated by broom or ivy species) may be conducted at any time

WIL-4 Since older burn piles could provide wildlife habitat, the piles will be spread out (to move out animals) as much as possible before burning. If moving the piles is not feasible, the fire management project manager will ensure that piles are lit from one side only (with firefighters on the ignition side), so that any wildlife in the pile can run out.

WIL-5 For prescribed fire projects proposed in the Muir Woods FMU, the fire management officer will arrange for a qualified biologist to conduct bat surveys of the tree hollows within the

burn unit to identify potential maternity colonies. Measures will be implemented to protect active maternity roosts.

Cultural Resources Mitigation Measures

CUL-1 Project Preparation Phase. To assure that cultural resources are considered early in the fire management planning process and afforded the utmost protection, the following preparatory actions will be undertaken:

- Computer and other databases containing cultural resources data will be maintained by cultural resource staff in coordination with the needs of fire management activities.
- Appropriate cultural resources monitoring protocols will be established by cultural resources staff and applied to fire management practices as warranted.
- Potential research opportunities to study the effects of fire management actions on cultural resources will be identified by cultural resources staff.
- Cultural resources specialists from adjacent land management agencies will be consulted by NPS staff, as appropriate, in order to coordinate mitigation efforts prior to fire management actions.
- Indigenous archeological sites, spiritual sites, and important plant communities will be identified and appropriately managed for preservation, maintenance, and/or enhancement by park cultural resources staff. Consultation with local Native American communities will, where pertinent, continue to occur in the context of fire management actions.
- Fire management personnel and other staff will receive annual training in cultural resources in relation to fire management activities.

CUL-2 Project Planning Phase. All areas slated for fire management activities will be considered for pre-action field surveys, based on the recommendations of cultural resource specialists and the need to identify cultural resources in proposed project areas. This includes areas likely to be disturbed during future wildfire suppression activity, such as helispots, staging areas, and spike camps. Site-specific information gathering may include the following:

1. In cultural landscape areas, parameters for identifying vegetation for removal or retention will be incorporated into project planning.
2. Evaluation of the relative hazards of fuel loads in proposed project areas will address the protection of cultural resource values, including:
 - 2(a) Maintenance of light fuel loads on and in close proximity to cultural resources;
 - 2(b) Benefits gained from reduced fuel loads in relation to the need to avoid or minimize adverse effects on cultural resources;

Chapter 2 – Alternatives, Mitigation Measures

- 2(c) Opportunities to restore or enhance the historic character of cultural landscapes;
- 2(d) In developing burn plans, assessment of the potential effects of heat intensity and duration above, at, and below the surface in relation to cultural resources; and
- 2(e) For projects with the potential for accelerating the rates of erosion, potential effects of erosion on cultural resources.

CUL-3 Project Implementation. Adverse effects on known and unknown cultural resources will be avoided or minimized during the implementation of fire management projects. A variety of treatments and techniques, as detailed in the project planning and preparation phase for individual projects, will be used for the protection of cultural landscape features during implementation of both prescribed fire and mechanical treatment activities, as follows:

1. A cultural resource specialist or resource advisor will:
 - 1(a) Be present during fire management actions, as stipulated, where recorded and suspected but not-yet-recorded historic or prehistoric resources are considered at risk;
 - 1(b) Deliver a pre-project briefing to fire management staff as necessary; and
 - 1(c) Share data with fire management personnel as needed to avoid or minimize adverse effects.
2. Vegetation will be flagged, or otherwise identified, in order to properly carry out project planning stipulations for:
 - 2(a) Retention, based upon age determination or diameter thresholds as previously agreed upon;
 - 2(b) Raising the skirts on landmark trees and other tree pruning;
 - 2(c) Flush-cutting trees removed from cultural resource areas unless otherwise stipulated; and
 - 2(d) Brush removal within agreed-upon boundaries.
3. Fences may be a character-defining feature of historic properties. In such cases:
 - 3(a) Avoid fences with heavy equipment;
 - 3(b) Remove brush and scrub only by hand or with hand-tools in a 10-foot-wide buffer zone along fence lines;
 - 3(c) Provide vehicle access at gates where necessary; and

- 3(d) Cut other openings, if necessary, between fence posts.
- 4. Field patterns may be a character-defining feature of historic properties. In such cases:
 - 4(a) Use prescribed burn to restore field patterns;
 - 4(b) Protect fences by not using heavy equipment within a 10-foot-wide buffer zone, and instead using less damaging methods to lessen fire danger, such as watering, hand removal, and hand tools; and
 - 4(c) Use hand removal of noncontributing vegetation near or in historic vegetation.
- 5. Structures and small-scale features may contribute, or be themselves, historic properties. In such cases:
 - 5(a) Remove brush approximately 30 feet from burnable structures, depending on slope, with hand tools being the default method; and
 - 5(b) If there are foundation plantings, create defensible space outside ornamental edge plantings wherever possible.
- 6. Some areas may be sensitive for archeological resources on or near the surface. In such cases:
 - 6(a) Do not drag cut vegetation;
 - 6(b) Do not use rakes;
 - 6(c) Use no burning when surface or subsurface resources are sensitive to heat; and
 - 6(d) Avoid using surface scarification to retard runoff in archeological sites.
- 7. Erosion will be minimized to the extent possible, by methods such as:
 - 7(a) Constructing control lines perpendicular to the slope;
 - 7(b) Using the existing road network;
 - 7(c) Keeping heavy equipment off paths and trails;
 - 7(d) Keeping heavy equipment away from areas adjacent to ponds and riparian corridors; and
 - 7(e) Avoiding these and other areas marked by flagging.

CUL-4 Post-Project Phase. Adverse effects on known and suspected cultural resources will continue to be avoided or minimized through careful consideration of actions during the post-action phase of mechanical treatment, prescribed fire, and fire suppression activities.

Chapter 2 – Alternatives, Mitigation Measures

1. The post-action condition of all recorded cultural resources will be assessed, as necessary.
 - 1(a) Post-action surveys may be conducted both in previously surveyed areas and in unsurveyed areas.
 - 1(b) Previously unrecorded cultural resources will be assessed for condition, and stabilization and other protection needs.
2. Stabilization and other treatment needs of cultural resources will be addressed in the development and implementation of Emergency Stabilization Plans and Burned Area Restoration Plans, and in the development of funding requests for these and other post-fire programs as needed.
3. Monitoring and research data will be compiled, evaluated, and used to help refine cultural resource compliance for future fire management actions and objectives.

Visitor Use and Visitor Experience Mitigation Measures

- VUE-1** Project work hours will normally be limited to normal work hours (8 A.M. to 5 P.M.) to minimize potential noise impacts on nearby residents and park visitors. Exceptions may occur outside of normal work hours where warranted, for example to take advantage of windows of favorable weather or to allow for project completion before wildlife breeding period restrictions begin.
- VUE-2** Where noise levels from project operations could be intrusive to adjacent residents or park trail users, all efforts will be made during project planning to site project staging areas in order to optimize the noise level reduction gained from natural barriers and screening vegetation. Staging areas will be sited to minimize noise levels for sensitive receptors to the extent feasible without causing adverse environmental effects on park resources, values, or public access.
- VUE-3** Park fire staff will avoid temporary closures of areas of the park during fuel reduction projects if spotters can be available to escort the public safely through the work area.
- VUE-4** To the extent feasible while protecting public health and safety, fire management officer will instruct contractors or NPS crews to secure work sites at the end of the work day so that closures around a project site can be lifted prior to and after working hours during weekdays and all day on weekends.
- VUE-5** The fire management office will develop and implement an education and communication plan for all site-specific fire management implementation projects. For large scale fuel reduction projects (more than 1 acre) that could affect mid- to close-range viewsheds for residents on the park boundary, park staff will arrange a meeting with the community to present the scope of work and provide an opportunity for public comment. Communication

plans for projects may include information such as the project scope, schedule, and alternative trail routes, where needed, to be posted in the project vicinity.

Public Health and Safety Mitigation Measures

PHS-1 Site plans for tree removal projects will be reviewed by the project review committee for potential safety hazards from windthrow and wind pattern change as a result of implementation.

2.8 Environmentally Preferred Alternative

The NPS policy regarding implementation of NEPA requires that an environmentally preferred alternative be identified. The environmentally preferred alternative is determined by applying criteria identified in Section 101 of NEPA to each alternative considered. Determination of the preferred alternative occurs after the environmental analysis is complete. In accordance with NEPA, the environmentally preferred alternative would best (1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations; (2) assure for all generations safe, healthful, productive, and esthetically and culturally pleasing surroundings; (3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences; (4) preserve important historic, cultural, and natural aspects of our natural heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice; (5) achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities; and (6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

The environmentally preferred alternative for the FMP is based upon these national environmental policy goals. The environmentally preferred alternative is the one that causes the least damage to the biological and physical environment and is best suited to protect, preserve, and enhance historic, cultural, and natural resources and process. The NPS has considered all alternatives in this analysis in accordance with NEPA and CEQ regulations and has determined that Alternative C, *Hazard Reduction and Resource Enhancement through Multiple Treatments*, is environmentally preferable. Through a careful and thorough review of the alternatives and the environmental consequences as analyzed in this document, the NPS has determined that Alternative C would best achieve the purposes and goals of the plan by allowing for the use of a variety of management tools in order to achieve resource goals in balance with protection of visitors, life, and property. In comparison to Alternatives A and B, Alternative C fire management treatment options would allow for the park to achieve in a timely manner a high level of protection of human health, life, and property while maximizing opportunities for restoring and maintaining ecological integrity and protecting and enhancing cultural resources.

2.9 Preferred Alternative

The NPS has selected Alternative C as the preferred alternative. The superintendent has reviewed the FEIS and has evaluated the three alternatives with respect to how well they meet the fire program objectives, and their beneficial and adverse impacts on all resource topics. Alternative C offers the best

Chapter 2 – Alternatives, Preferred Alternative

combination of benefits with a high level of protection of life property, and greater long- and short-term natural and cultural resource benefits than either Alternatives A or B.

2.10 Comparison of Alternatives

This section compares the key features of the alternatives and summarizes the potential environmental consequences (see Tables 2-4 and 2-5). Potential environmental consequences are analyzed in more detail in Chapter 4, Environmental Consequences.

Table 2-4: Summary of Alternatives by Fire Management Unit (FMU) and Treatment Type

Treatment Type	County	Alternative A		Alternative B				Alternative C			
		All FMUs ¹	Total	WUI FMU	Park Interior FMU	Muir Woods FMU	Total	WUI FMU	Park Interior FMU	Muir Woods FMU	Total
Mechanical Treatment (acres/year)	Marin	75	100	130	45	5	230	130	90	5	275
	San Francisco	5		10	0	0		10	0	0	
	San Mateo	20		30	10	0		30	10	0	
	Total Acres	100		170	55	5		170	100	5	
Prescribed Burning (acres/year)	Marin	100 ²	110	0	70	50	120	50	185	50	320
	San Francisco	<1		<1	NA	NA		<1	NA	NA	
	San Mateo	10		0	0	0		5	30	0	
	Total Acres	110		0	70	50		55	215	50	

Source: GGNRA Fire Management Office Data 2004.

Notes:

¹ Since 1993 FMP did not give number of acres per year for treatments by FMU, and since FMUs are by vegetation type and dispersed throughout park, total acreage is given by county only based upon projects cited in 1993 FMP and current practice.

² Includes 50 acres of prescribed burning in Muir Woods National Monument annually.

WUI = Wildland Urban Interface

NA = not applicable

Table 2-5: Summary of Alternatives

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Fire Management Units (FMUs)	6 FMUs based upon vegetation communities: <ul style="list-style-type: none"> • Grassland/Coastal Scrub – 10,605 acres • Chaparral – 200 acres • Broadleaf Evergreen Forest – 1,431 acres • Old-Growth Redwood – 471 acres • Second-Growth Redwood/Fir – 1,121 acres • Eucalyptus/Other – 1,325 acres 	3 FMUs based on geography, proximity to developed areas, fuel hazards and values at risk: <ul style="list-style-type: none"> • WUI FMU – 4,926 acres • Park Interior FMU – 9,675 acres • Muir Woods FMU – 552 acres 3 FMUs subdivided into 17 project areas for future project planning.	Same as Alternative B.
Mechanical Treatment	Up to 100 acres would be treated mechanically, including 70 acres roadside treatment, across an FMU Associated pile burning allowed	Up to 230 acres would be treated mechanically, including 70 acres roadside treatment. Total acres treated by FMU: <ul style="list-style-type: none"> • 170 acres in WUI FMU • 55 acres in Park Interior FMU • 5 acres in Muir Woods FMU • Associated pile burning allowed 	Up to 275 acres would be treated mechanically, including 70 acres roadside treatment. Total acres treated by FMU: <ul style="list-style-type: none"> • 170 acres in WUI FMU • 100 acres in Park Interior FMU • 5 acres in Muir Woods FMU • Associated pile burning allowed
Prescribed Fire	Allowed in all 6 FMUs. Up to 110 acres would be treated with prescribed fire annually: <ul style="list-style-type: none"> • 50 acres in Muir Woods National Monument • 60 acres across FMUs • No prescribed fire in San Francisco except small research burns for threatened and endangered species 	Allowed in Muir Woods and Park Interior FMUs. Up to 120 acres would be treated by prescribed fire annually: <ul style="list-style-type: none"> • 50 acres in Muir Woods FMU • 70 acres in Park Interior FMU • No prescribed fire in San Francisco except small research burns for threatened and endangered species 	Allowed in Muir Woods, Park Interior, and WUI FMUs. Up to 320 acres would be treated with prescribed fire annually: <ul style="list-style-type: none"> • 50 acres in Muir Woods FMU • 215 acres in Park Interior FMU • 55 acres in WUI FMU • No prescribed fire in San Francisco except small research burns for threatened and endangered species

Table 2-5: Summary of Alternatives

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
WUI Initiative – Community Projects	Continued cooperative ventures would reduce potential for wildland fire to burn from federal lands to neighboring properties.	Same as Alternative A.	Same as Alternative A.
Defensible Space/Vegetation Clearing Around Structures	Program of hazardous fuel removal projects would continue, including clearing vegetation around park structures based on fuel type and slope, building construction, historic significance, and potential sources of ignition.	Same as Alternative A.	Same as Alternative A.
Roadside Fuel Reduction	70 acres roadside mechanical treatment annually across all FMUs. Maintenance of existing fire roads for emergency evacuation, public safety, and access for fire suppression activities would continue. Road conditions would be regularly evaluated. In future, the NPS would evaluate and consider removal of unnecessary roads, or reconfigure/reroute to address erosion or other concerns.	Same as Alternative A.	Same as Alternative A.
Suppression	Full suppression would be provided using minimum impact suppression tactics and strategy of Confine, Contain, and Control.	Same as Alternative A.	Same as Alternative A.

Table 2-5: Summary of Alternatives

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Treatment of Muir Woods FMU	Mix of prescribed fire, mechanical fuel reduction, and understory thinning would be used; role of fire in redwood ecosystem would be restored. Up to 55 acres would be treated annually to reduce the risk of catastrophic fire.	Same as Alternative A.	Same as Alternative A.
Treatment of San Francisco County Project Area	Emphasis would be on maintenance of defensible space around structures adjacent to wildland fuels, some mechanical removal of nonnative evergreen trees. No prescribed research burns would be conducted except to support recovery plans for threatened and endangered plant species.	Same as Alternative A.	Same as Alternative A.
Public Information and Fire Education Programs	Current programs would continue. Information and education programs on fire safety and prevention, fuels management, role of fire in ecosystems, fire history and cultural use of fire on landscape, fire research programs and opportunities would be enhanced.	Same as Alternative A.	Same as Alternative A.
Fire Cache	Currently in Buildings 1068, 1069, and T1111 at Fort Cronkhite and 407 at Fort Baker. Would be relocated to central location in Marin County, site to be determined in future.	Same as Alternative A.	Same as Alternative A.

Table 2-5: Summary of Alternatives

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Fire Effects Monitoring	Existing program to monitor prescribed burns and wildfires according to the NPS Fire Monitoring Handbook (NPS 2003b) would continue.	Same as Alternative A.	Same as Alternative A.
Research	Research and monitoring projects would be conducted for application and effects of prescribed fire in all FMUs and within Muir Woods National Monument.	Research burns would be conducted in Muir Woods and Park Interior FMUs. New research or monitoring would be initiated based on resource management needs for topics such as effects of fire on nonnative and rare plants and habitats, diseases such as SOD, and effectiveness of fire to reduce fuel loads and manage fire hazards.	Research burns would be conducted in Muir Woods, Park Interior, and WUI FMUs. New research or monitoring would be initiated based on resource management needs for topics such as effects of fire on nonnative and rare plant or wildlife species and habitats, diseases such as SOD, and effectiveness of fire to reduce fuel loads and manage fire hazards.

Table 2-6: Summary of Impacts

	<p align="center">Alternative A – 1993 FMP (No Action)</p>	<p align="center">Alternative B – Hazard Reduction and Restricted Fire Use</p>	<p align="center">Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments</p>
<p>Watershed Processes: Soils, Hydrology, and Aquatic Habitat</p>	<p>Fire management actions under Alternative A would have adverse, short-term, minor effects on water quality, and beneficial, long-term minor-to-moderate effects on restoration of watershed hydrology.</p> <p>Effects of prescribed fire on water quality related to increased erosion would be adverse, minor and short-term.</p> <p>Impacts from soil disturbance related to mechanical treatments would be adverse, short-term, and negligible to minor. However, the watershed effects within the areas treated by mechanical means would be beneficial, long-term, and minor to moderate.</p> <p>Wildland suppression activities would affect soils due to compaction and ground disturbance. Because the number of acres burned by wildfires each year remains quite low, impacts on watersheds would be adverse, short-term, and minor.</p>	<p>Similar to Alternative A, with a small increase in the short-term, minor adverse effects and long-term beneficial effects due to the increased mechanical treatments.</p>	<p>Similar to Alternative A, with both increased short-term, minor adverse impacts and long-term beneficial impacts. The increased mechanical treatments and prescribed burning in this alternative would create the greatest number of beneficial effects.</p>

Table 2-6: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Air Quality	<p>The levels of VOC produced in this alternative would create a long-term, moderate, adverse impact.</p> <p>The levels of NO_x and SO₂ would create a long-term, negligible adverse impact.</p> <p>Smoke generation would create short-term, minor-to-moderate adverse impacts.</p> <p>Particulate matter would create long-term minor adverse impacts.</p> <p>Cumulative impacts would be long-term, moderate, and adverse. There would be long-term major beneficial effects in reducing the potential for catastrophic fires.</p>	<p>The levels of VOC, NO_x, SO₂ produced in this alternative would create impacts similar to Alternative A.</p> <p>Smoke generation would create short-term, minor adverse impacts on visibility during prescribed or pile burning. This level would be reduced compared to Alternative A as burning is restricted to the Interior FMU.</p> <p>Particulate matter would create long-term moderate adverse impacts.</p> <p>Cumulative impacts on basin air quality would be long-term, moderate, and adverse. There would be long-term minor beneficial effects in reducing the potential for catastrophic fires.</p>	<p>The levels of VOC, NO_x, SO₂ produced in this alternative would create impacts similar to Alternative A.</p> <p>Smoke generation would create impacts similar to Alternative B.</p> <p>Particulate matter would create long-term moderate adverse impacts.</p> <p>Cumulative effects would be long-term, moderate, and adverse. Long-term moderate beneficial effects would be created by the accelerated treatment of fire management areas.</p>

Table 2-6: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Vegetation	<p>Overall, Alternative A in combination with other related actions would have cumulative long-term negligible effects on vegetation. Mechanical treatments would have negligible-to-minor long-term beneficial impacts on coastal scrub, chaparral, grasslands, herbaceous wetlands, riparian forest and scrub, native hardwood forests, and Douglas-fir and coast redwood. These benefits would only persist if follow-up actions prevent the encroachment of nonnative species.</p> <p>Short-term minor adverse impacts could occur in these communities due to ground disturbance.</p> <p>Prescribed burning could have negligible-to-minor, long-term beneficial impacts on most native vegetation communities, although more study of grasslands is required.</p>	<p>Similar effects to Alternative A, with a slight increase in beneficial impacts from more mechanical treatment. However, the use of prescribed burning would be more limited than in Alternative A, which would reduce the beneficial effects of this treatment in the WUI.</p>	<p>Increased mechanical treatments and prescribed burning in this alternative relative to Alternatives A and B would result in an overall minor-to moderate, long-term beneficial effects on vegetation. A broader range of management actions and a more comprehensive method for identifying, prioritizing, and implementing specific fire management actions would allow for larger-scale restoration of ecologically sustainable stands of native vegetation.</p>

Table 2-6: Summary of Impacts

	<p align="center">Alternative A – 1993 FMP (No Action)</p>	<p align="center">Alternative B – Hazard Reduction and Restricted Fire Use</p>	<p align="center">Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments</p>
<p>Wetlands</p>	<p>Overall, fire management activities would have minor-to-moderate long-term benefits to wetland communities through reduction of nonnative plant species, stimulation of native species, and reduced potential for a large-scale wildfire.</p> <p>Mechanical treatments and prescribed fire could have adverse, short-term, minor impacts on wetland soils, hydrology, and vegetation.</p> <p>Fire management activities would avoid wetland areas to the greatest extent possible, and a buffer would be maintained around wetland areas where fire management activities would be restricted. Any impacts on wetland soils, hydrology, or vegetation that occur in the buffer area would be correctable by site-specific actions, and must be confined to short-term, minor (or less) adverse effects.</p>	<p>Similar to Alternative A, with a small increase in the short-term, minor adverse effects and long-term beneficial effects due to the increased prescribed burning in the Park Interior FMU.</p>	<p>Similar to Alternative A, with both increased short-term, minor adverse impacts and long-term beneficial impacts due to increased mechanical treatments and prescribed burning in both the Park Interior and WUI FMUs.</p>

Table 2-6: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Wildlife	Fire management activities would have overall long-term, beneficial, minor effects on wildlife and important habitat. Mechanical removals and prescribed burns would create beneficial, long-term impacts by enhancing native habitats and reducing chances for catastrophic fires. These effects would outweigh the minor adverse impacts of vegetation removal and associated disturbance.	Overall, impacts on wildlife under Alternative B would be very similar to those under Alternative A. More areas would be subjected to mechanical treatment under Alternative B, but the impacts would remain beneficial, long-term, and minor.	Impacts on wildlife would be similar to Alternatives A and B, with overall beneficial, long-term, and minor effects. This alternative would allow for the greatest and most flexible use of mechanical treatment and prescribed fires, which would create the highest level of beneficial effects. Alternative C would allow for the greatest amount of research, which would provide park staff the greatest opportunity for adaptive management.
Special Status Species – Wildlife	No impairment to any threatened and endangered species would occur under Alternative A.	No impairment of any threatened and endangered species would occur under Alternative B.	No impairment of any threatened and endangered species would occur under Alternative C.
<i>San Bruno Elfin Butterfly</i>	Mechanical fuel reduction, prescribed burning, pile burning, and research burns would not occur directly in areas supporting San Bruno elfin butterfly habitat, but may occur in adjacent habitat. Adverse impacts would be negligible to minor and short-term. Potential beneficial impacts from reduced risk of catastrophic wildfire and removal of nonnative vegetation would be minor and long-term.	Impacts would be similar to those for Alternative A, with the potential for a slight increase in the extent of impacts as the amount of land that could be treated under Alternative B would be about twice as much as in Alternative A. Beneficial impacts would be the same as in Alternative A.	Same as Alternative A.
<i>Mission Blue Butterfly</i>	Adverse impacts on mission blue butterflies and their habitat from site disturbance and vegetation removal, associated with mechanical fuel reduction and prescribed fire, would be minor and short-term following	Adverse impacts from mechanical fuel reduction in Alternative B would be slightly greater than in Alternative A since more than twice the acreage would be treated, but still minor and	Similar to Alternative B, with a moderate increase in the amount of lands that could be treated under Alternative C. Greatest potential for minor-to-moderate long-term beneficial impacts due to

Table 2-6: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
	mitigation, with moderate, long-term, beneficial impacts through protection and expansion of mission blue butterfly habitat. Research burns conducted in existing mission blue butterfly habitat would have short- to long-term adverse impacts. Burning less than 5 percent of existing habitat in any one year, under an approved research plan, would minimize impacts. Research burns could result in long-term beneficial effects.	short-term following mitigation. The long-term beneficial impacts from potential increased expansion of mission blue butterfly habitat would be greater in Alternative B.	extensive use of mechanical treatment, prescribed fire and research burns that could be used to improve and expand mission blue butterfly habitat.
<i>Tidewater Goby</i>	Adverse impacts from mechanical fuel reduction, prescribed burning, pile burning, and fire research would be short-term and negligible to minor following mitigation since none of these activities would occur directly within tidewater goby habitat.	Same as Alternative A.	Same as Alternative A.
<i>Coho Salmon and Steelhead</i>	Mechanical fuel reduction would result in short-term, minor adverse impacts resulting from potential disturbance to soils and vegetation in riparian areas, with long-term beneficial impacts from restoration of riparian habitat through removal of nonnative trees.	Impacts would be similar to those for Alternative A, with a slight increase in the extent of impacts as the amount of land that could be treated under Alternative B would be more than twice the amount in Alternative A. Potential for greater long-term beneficial impacts through restoration of riparian habitat by removal of nonnative vegetation.	Similar to Alternatives A and B, with a slight increase in the extent of both adverse (short-term, minor) and beneficial impacts (long-term, minor) due to increased amount of areas treated.

Table 2-6: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
<i>California Red-Legged Frog</i>	Mechanical fuel reduction, prescribed fire, and research burns may result in short-term, negligible-to-minor adverse impacts related to disturbance in or adjacent to red-legged frog habitat. Long-term, minor beneficial impacts could result from reducing the threat of catastrophic wildfire that could adversely affect wetland habitat.	Same as Alternative A.	Same as Alternative A.
<i>San Francisco Garter Snake</i>	Mechanical fuel reductions, use of prescribed fire, research burns, associated vegetation removal, and heavy equipment operation have the potential for adverse, minor, short-term impacts on the San Francisco garter snake following mitigation. Long-term, minor beneficial impacts would result from these actions by reducing the threat of catastrophic wildfire that could adversely affect garter snake habitat, and by restoring and maintaining coastal grassland and scrub habitat.	Impacts associated with mechanical fuel reduction and pile burning would be the same as in Alternative A. Even though twice as many acres may be treated in San Mateo and San Francisco counties, garter snake habitat is unlikely to be targeted for these activities. Prescribed burning and research burns would not occur in San Mateo County under Alternative B so there would be no associated impacts.	Same as Alternative A.
<i>Marbled Murrelet</i>	Potential marbled murrelet habitat is only present in the Muir Woods FMU. Fire management activities that focus on protecting and enhancing coast redwood and Douglas-fir trees, such as mechanical fuel reduction and prescribed burning, would result in overall long-term, beneficial, and minor impacts on this species.	Same as Alternative A.	Same as Alternatives A and B.

Table 2-6: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
<i>Western Snowy Plover</i>	The only potential impacts on western snowy plovers would be from suppression activities that are common to all alternatives. Plovers would not be affected by any other actions in Alternative A.	Same as Alternative A.	Same as Alternative A.
<i>California Brown Pelican</i>	Impacts on roosting brown pelicans would be negligible by avoiding use of helicopters for mechanical fuel reduction in areas adjacent to Bird Island, and Rodeo and Bolinas Lagoons. Impacts from drifting smoke during prescribed burns, pile burning, or research burns would also be negligible.	Same as Alternative A.	Same as Alternative A.
<i>Northern Spotted Owl</i>	Adverse impacts associated with vegetation removal and disturbance during mechanical fuel reduction, prescribed fire, research burns, and pile burning would be minor and short-term, following mitigation. Long-term, minor beneficial impacts on spotted owls and their prey would result from native habitat restoration and enhancement and by reducing the threat of catastrophic wildfire.	Impacts from mechanical fuel reduction and pile burning would be similar to those for Alternative A, with a slight increase in the extent of both adverse and beneficial impacts. Impacts associated with prescribed burning and fire research would be the same as in Alternative A.	Similar to Alternative B, with a moderate increase in the extent of both adverse (short-term, minor) and beneficial impacts (long-term, minor) as the amount of land treated annually under Alternative C would be greater than in Alternative B. Impacts of prescribed fire would be similar to Alternatives A and B, with an increase in the extent of both adverse (short-term, minor) and beneficial impacts (long-term, minor) as the number of acres subject to burning annually under Alternative C would be more than twice that under Alternative A or Alternative B.

Table 2-6: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
<i>Salt Marsh Harvest Mouse</i>	Adverse impacts from mechanical fuel reduction, prescribed burning, pile burning, and fire research would be short-term and negligible to minor following mitigation, since none of these activities would occur directly within potential salt marsh harvest mouse habitat.	Same as Alternative A.	Same as Alternative A.
Special Status Species – Plants	<p>Suppression actions with mitigation measures applied whenever possible would reduce potential effects of wildland fire suppression to short-term, adverse, and negligible to minor.</p> <p>A prescribed burn, properly timed and mitigated, could have a long-term, major, beneficial impact on Oakland star tulip.</p> <p>Prescribed burning would have a short-term, negligible, adverse effect and long-term, beneficial impact on California bottle-brush grass.</p> <p>Most special status plants would have a minor-to-moderate benefit from reduction of nonnative species as a result of prescribed burning and mechanical treatment in all three counties.</p> <p>Removal of nonnative trees and shrubs and carefully conducted research burns (in consultation with the USFWS) could result in long-term, minor, beneficial impacts on the same three federally listed species in San Francisco. Monitoring programs would have a</p>	<p>Effects of mechanical treatment would be more limited in types of plant communities affected and have a reduced adverse effect on special status plants compared to Alternative A – negligible to minor, long-term, and beneficial.</p> <p>Effects of prescribed burning would be the same as in Alternative A with the exception of no burning in San Mateo County and the ability to conduct burns in the chaparral in Marin County.</p> <p>Short- and long-term, minor, beneficial effects on the three species on Bolinas Ridge would occur.</p> <p>Overall, this alternative would have long-term, negligible-to-minor, beneficial effects.</p>	<p>Mechanical treatments would affect more acreage, resulting in minor-to-moderate, long-term, beneficial impacts throughout all FMUs.</p> <p>Prescribed burning would occur in all areas of the park, resulting in a larger number of acres treated than Alternatives A and B.</p> <p>Opportunity for broadcast burns would be minor-to-moderate, long-term, and beneficial.</p>

Table 2-6: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
	<p>minor-to-moderate long-term, beneficial impact.</p> <p>No prescribed burning would occur in chaparral communities, so there would not be beneficial impacts on three locally rare fire-adapted species on Bolinas Ridge.</p>		
Cultural Resources	<p>This alternative would have short-term, moderate, beneficial effects on historic buildings by reducing fuels around these structures.</p> <p>Moderate, long-term, beneficial effects on cultural landscapes would result from their restoration or maintenance through prescribed fire or mechanical treatments.</p> <p>This alternative would have the potential for long-term, adverse, major effects on archeological resources from suppression effort with heavy equipment.</p> <p>A large-scale uncontrolled wildfire could have long-term, major, adverse effects on historic buildings and cultural landscapes with loss of historic features and structures.</p>	<p>Beneficial effects on historic buildings and cultural landscapes would be greater than in Alternative A, as additional acreages for mechanical treatments and prescribed fire would be allowed for resource management objectives.</p> <p>Likewise, there would be a potential for greater adverse impacts on archeological resources, but these could be kept short-term and minor with appropriate mitigation measures.</p>	<p>Beneficial effects would be greater than in Alternatives A and B, but would remain in the moderate category.</p>

Table 2-6: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Human Health and Safety and Nuisance Effects	<p>Overall, this alternative would have a long-term, minor benefit to the public and firefighter safety by decreasing the risk of catastrophic fire.</p> <p>The potential to breathe in particulates and other toxins in the smoke produced by prescribed burning and fire suppression would have a short-term, negligible adverse effect on public and fire staff health and safety.</p>	<p>Similar to Alternative A, except that increased treatments would render long-term, moderate benefits to public and firefighter safety.</p>	<p>Similar to Alternative B, except larger prescription burning component would yield long-term, moderate, beneficial effect.</p>
Visitor Use and Visitor Experience	<p>This alternative would have a short-term, minor adverse effect on visitor experience, public access, aesthetics, and park soundscapes from mechanical fuel reduction and prescribed burning.</p> <p>A long-term, moderate beneficial effect on the visitor experience and aesthetics would be gained due to improved viewsheds and enhanced growth of native vegetation.</p>	<p>Similar to Alternative A. More mechanical fuel reduction than Alternative A would mean more areas would be disturbed in short-term, but projects would be dispersed to reduce impacts on visitor experience in one area.</p>	<p>Similar to Alternative A with potential for larger burn areas. Related activity could result in short-term, minor-to-moderate and adverse effects. Following site restoration, effects would be long-term, moderate, and beneficial.</p>
Park Operations	<p>Moderate, long-term adverse effects on park operations would be anticipated from the full implementation of this alternative due to current staffing limitations throughout the park. Scaling back the implementation of Alternative A may reduce adverse effects on park operations to minor, but could result in reduced accomplishments and a longer time period needed to achieve FMP goals.</p> <p>One-time funding of a new fire cache would have a short-term moderate adverse impact on the park’s budget, but would have long-term</p>	<p>Similar to Alternative A but with an increased budget to conduct additional mechanical treatment projects.</p> <p>Under this alternative, 16.25 FTEs in the Wildland Fire Office would be required.</p>	<p>An overall increase in fire management program in order to conduct additional prescribed burning and mechanical treatment projects compared to Alternatives A and B.</p> <p>This alternative would produce moderate, long-term adverse impacts on park operations compared to the full implementation of Alternative A. FMP goals could be met in expedient timeframe, so long-term effect would be minor and beneficial.</p>

Table 2-6: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
	<p>minor benefits on efficiency in fire management operations.</p> <p>Under any scenario, the suppression of a large-scale wildfire would have a short-term adverse major effect on park operations, management, and budget.</p> <p>Under this alternative, 13 FTEs in the Wildland Fire Office would be required.</p>		<p>Under this alternative, 18 FTEs in the Wildland Fire Office would be required.</p>
Socioeconomics	<p>Overall, socioeconomic impacts associated with budget and payroll under the planned mechanical treatments and prescribed fire could be characterized as negligible, short-term benefits under all three alternatives.</p> <p>Tourism would not be affected by short-term closures, but could be reduced by the occurrence of a catastrophic fire. This would reduce spending on lodging, food, and travel. However, these effects could be offset by an increased demand for services by employees involved in fire suppression and restoration. Hence, the economic impacts of these larger events may have both beneficial and adverse short-term and minor effects.</p>	Same as Alternative A.	Same as Alternative A.

Notes:

WUI = Wildland Urban Interface
 FMU = Fire Management Unit
 SOD = Sudden Oak Death
 VOC = volatile organic compounds

NO_x = nitrogen oxides
 SO₂ = sulfur dioxide
 USFWS = U.S. Fish and Wildlife Service
 FTEs = full-time equivalents