National Park Service
U.S. Department of the Interior
Point Reyes National Seashore, Point Reyes Station, CA 94956

Point Reyes National Seashore during the 1995 Vision Fire

Point Reyes National Seashore
Wildland Fire Resource Advisor Guide
July 2007

Contents

1.0 Introduction

This Resource Advisor (READ) guide is intended to be used as a tool by resource advisors in the event of a suppression incident at Point Reyes National Seashore (PRNS). This document contains recommended guidelines for fires within the PRNS jurisdictional area. The jurisdictional area is comprised of the 70,046 acres of PRNS and the 19,265 acres in the northern district of Golden Gate National Recreation Area (GGNRA) that is managed by PRNS through an agreement with GGNRA. For the purposes of this FMP, the use of the acronym PRNS in reference to a geographic area will encompass the 90,311 acres managed by Point Reyes National Seashore including the northern lands of GGNRA.

Point Reyes National Seashore policy requires that all wildland fires within the Seashore and within the North District of Golden Gate National Recreation Area are suppressed. Primary goals with respect to fire suppression include firefighter and public safety, the protection of private and public property, and the protection of natural and cultural resources.

1.1 Purpose and Need for this Guide

This document describes the natural and cultural resources at Point Reyes National Seashore and the North District of Golden Gate National Recreation Area that may be impacted during wildland fire incidents. It lists resource protection and/or mitigation measures sufficient to minimize the negative impacts resulting from certain fire management actions.

The resource protection and mitigation measures listed in this document are in compliance with:

- The National Environmental Policy Act (NEPA) of 1969 (42 United States Code (USC) 4321 et seq.), which requires an environmental analysis for major Federal Actions having the potential to impact the quality of the human environment;
- The National Historic Preservation Act (NHPA) (16 USC 470), which requires protection of historic properties significant to the Nation's heritage;
- The Wilderness Act (16 USC 1131 et seq.), because the park manages areas proposed for wilderness designation;
- The Endangered Species Act of 1973 (ESA) (19 U.S.C. 1536 (c), 50 CFR 402), as the Wildland Fire Management Program affects several Federally listed species and designated critical habitat.

This guide is intended to serve as the primary reference for a Resource Advisor assigned to a wildland fire incident managed by the Seashore.

1.2 Background

Point Reyes National Seashore was established by Congress on September 13, 1962 “to save and preserve, for the purposes of public recreation, benefit and inspiration, a portion of the diminishing seashore of the United States that remains undeveloped (Public Law 87-657). An amendment to Public Law 94-544 (passed in 1976) instructs the NPS to administer the Seashore without impairment of its natural values. Congress established GGNRA by Public Law 92-589 “in order to preserve for public use and enjoyment certain areas of Marin and San Francisco

Counties, California (San Mateo County added by P.L. #96-607)." In addition to providing for recreation and educational opportunities consistent with sound principles of land use planning and management, the NPS was also instructed to "preserve the recreation area, as far as possible, in its natural setting, and protect it from development and uses which would destroy the scenic beauty and natural character of the area…" where park management is "supportive of the maximum protection, restoration, and preservation of the natural environment within the area."

The Seashore and the North District of GGNRA are bounded by California State Parks, Marin Municipal Water District, and private lands on the east and by the Pacific Ocean on the west. See Figure 1.

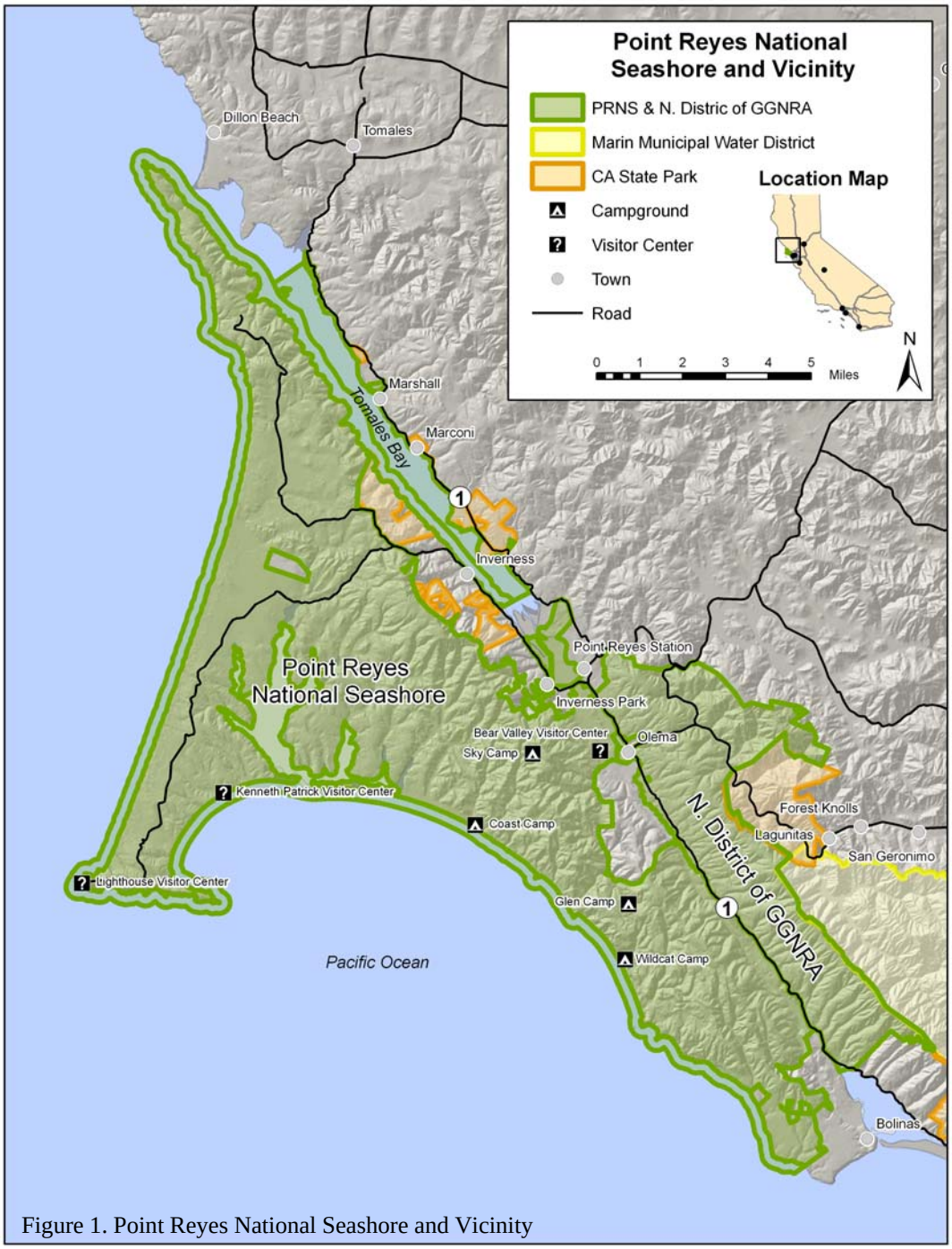

Figure 1. Point Reyes National Seashore and Vicinity

1.3 The Park Environment

Point Reyes National Seashore is located in coastal Marin County, approximately 40 miles north of San Francisco. Most of the Seashore is comprised of an 88,046 acre peninsula that is separated from the California mainland by the San Andreas Fault. Inverness Ridge runs northeast along the peninsula and is paralleled by Bolinas Ridge on the east side of the San Andreas Fault. Elevation ranges from sea level to 1407' at Mt. Wittenberg on Inverness Ridge. The climate in the study area is Mediterranean with wet winters and cool, dry summers. Average temperatures (°F) during the summer vary from the high 40s to the low-to-middle 70s. Summer precipitation is low, averaging less than 0.2 inches per month, due to the strong stationary high-pressure system located off the coast which prevents weather systems from moving through the area. Summer months are characterized by coastal fog. During the winter, average temperatures (°F) vary from the mid-to-upper 30s to the upper 50s-low 60s. About 84% of the precipitation in the area occurs between November and March. Average annual precipitation ranges from 20" near the coast to as much as 40" near the Bear Valley visitor center. Precipitation from fog drip has not been quantified for PRNS, but one study further north on the California coast (Requa, CA) found summer fog drip provided an additional 9-18" of water annually (Dawson 1998).

Following the cessation of winter rains in mid-April, fuels dry rapidly and the light fuels of the annual grassland (2,000-7,000 lbs/acre) cure. During the summer months, live, dead and downed round wood material and duff in the understory of PRNS's forest stands gradually lose moisture. Fire season at Point Reyes begins in early June. At this time, high-pressure air masses frequently stagnate over the Great Basin. Strong foehn winds, referred to as Mono winds in central California, may develop if there is a low-pressure trough off the coast. These winds bring warm, dry air to Point Reyes and cause rapid drying of fuels. These episodes usually last 1-2 days and fire danger can be extreme. In typical years, a persistent coastal fog bank is formed by July l, following the stabilization of the Pacific high over central California. From July through early September fog moves inland and back out to sea in a 3-4 day cycle in response to heating and cooling in California's Central Valley. Fine fuel moisture fluctuates in this cycle, while wood fuels and duff remain relatively wet. In mid-September the fog pattern changes and fuel moistures drop steadily. It is at this time that conditions contributing to Mono winds occur. The combination of prolonged drought, low relative humidity and a peak in fuel production often causes fire danger to be high through September and October.

PRNS is comprised of a mosaic of forest, scrub, and grassland vegetation types. The mosaic of these vegetation types has been shifting on the peninsula for thousands of years (Anderson 2005). Natural and human disturbances such as lightning fires, Native American burning and ranching have caused these shifts. These three broad vegetation groups can be divided into more specific vegetation types. The main text of this guide provides a brief overview of the fire ecology of each of seven more specific vegetation types: bishop pine forest, Douglas-fir/mixed evergreen forest, coast redwood forest, maritime chaparral, coastal scrub, coastal grassland and coastal dune. Appendix 1 details the fire ecology of these vegetation types.

1.4 Fire History

Fire regimes at PRNS have been affected by a long history of human settlement on the peninsula. The Coast Miwok are thought to have occupied the peninsula from at least 10,000 years ago (Cook 1976). One study (Treganza 1961) estimated that there were as many as 113 Miwok villages on the peninsula. While it is unlikely that they were all occupied concurrently, there

were likely more humans inhabiting the peninsula at the time of Euro-American contact than there are presently.

There is extensive evidence that Native Americans throughout California used fire to manage vegetation. There are many accounts that tribes living in areas dominated by a mixture of grassland and scrub vegetation used fire on an annual basis to improve seed harvests and to control scrub encroachment into grasslands (Keeley 2002; Lewis 1973; Clar 1957; Stewart 1951; Menzies 1924; Fletcher 1628). These accounts come from early settlers of the area as well as from Native Americans themselves. For example, one author quotes an elderly woman from the Pomo tribe, who were found on the coast just north of the Coast Miwok of Point Reyes:

> As one old Pomo Indian told me: "The grass was burned every year. The fires were started and allowed to burn in every place. Burning was to make the weeds grow better and to keep down the brush (Stewart 1951)."

Early explorers provide some first hand accounts of Native American use of fire specific to the Point Reyes peninsula and vicinity. For example, the Coast Miwok apparently set fire to the vegetation on the bluffs above Drake's Bay upon the departure of Sir Francis Drake in 1579 (Fletcher 1628). More than 200 years later, in late October of 1793, Archibald Menzies sailed into Tomales Bay. He went ashore at Tomales Point with the intention of collecting botanical specimens, but "the grass and brush wood on this headland had been lately burned down so that I had little opportunity here to augment my botanical collection..." (Menzies 1924).

There is also evidence from fire scars on coast redwood and Douglas-fir which indicates that Native Americans either burned intentionally in forested areas or that fire escaped from village sites or grassland fires into neighboring forested areas (Brown et al. 1999; Jacobs et al. 1978; McBride and Jacobs 1978). For example, one study (Jacobs et al. 1978) indicated a 20 to 30 year fire return interval (FRI) in coast redwood forests near Muir Woods from the period between 1400 and 1850. This would have been significantly more frequent than could be explained by lightning occurrence. A fire and vegetation history study of the Seashore used sediment cores to examine trends in vegetation and fire occurrence over the last 15,000 years. This study showed a marked increase in the presence of charcoal in sediment cores at several sites between ~3,500 years before present and the historic period. This may correspond with increases in the Native American population on the peninsula (Anderson 2005).

The Spanish influence in the Point Reyes area increased rapidly after the discovery of San Francisco Bay in 1769 and the establishment of a mission in San Rafael in 1817 (Toogood 1980). According to Slaymaker (1983), the majority of the Coast Miwok were gone from the peninsula by 1823. Two large Mexican land grants were given for the Point Reyes area in 1836 (Sugnet and Martin 1984). With the land grants, came the introduction of cattle and the extirpation of elk (Revere 1947). It is likely that grasslands began to shift from native perennial grasses to non-native annual grasses during this time. Fire regimes also shifted during the Mexican era. The Mexican ranchers burned scrub areas but avoided burning grasslands that they needed as year-round forage for cattle (Sugnet and Martin 1984).

In 1849, California was annexed by the United States and land use in Marin shifted to logging and dairying. The first mill in the Point Reyes vicinity was built in Bolinas in 1851. By 1858 four mills were operating in the area. Logging initially focused on the large redwoods growing in gullies at the base of Bolinas Ridge. One lumberman estimated that the average redwood tree coming through the mills was six feet in diameter. As the supply of redwood dwindled, the industry shifted to cutting pine, alder, and oak for fire firewood. An 1880 history of Marin

provided estimates of the extent of logging. According to this history, the four Bolinas mills removed a total of thirteen million boardfeet of redwood. Over the period from 1855 to 1880 an additional 500,000 cords of firewood were harvested (Toogood 1980).

Starting in the late 1800's, there are newspaper records of wildfires in the area. There are mentions of large fires in Olema Valley and on Bolinas Ridge in 1889, 1904, 1906, 1923, 1927 and 1945 (Brown et al. 1999; Sugnet and Martin 1984). Smaller fires occurred in the mid-1950's and in 1970 (Sugnet and Martin 1984). The only large fire in recent years was the 1995 Vision Fire. All of the recent fire ignitions have been human caused. Lightning occurrence in the area is low. The Seashore averages 5 lightning strikes per year. Most of these occur in the fall, when fire danger is highest (van Wagtendonk 2006).

2.0 Vegetation Overview

PRNS is comprised of a mosaic of forest, scrub, and grassland vegetation types. These three broad vegetation groups can be divided into more specific vegetation types: bishop pine forest, Douglas-fir/mixed evergreen forest, coast redwood forest, maritime chaparral, coastal scrub, coastal grassland and coastal dune (See Figure 2).

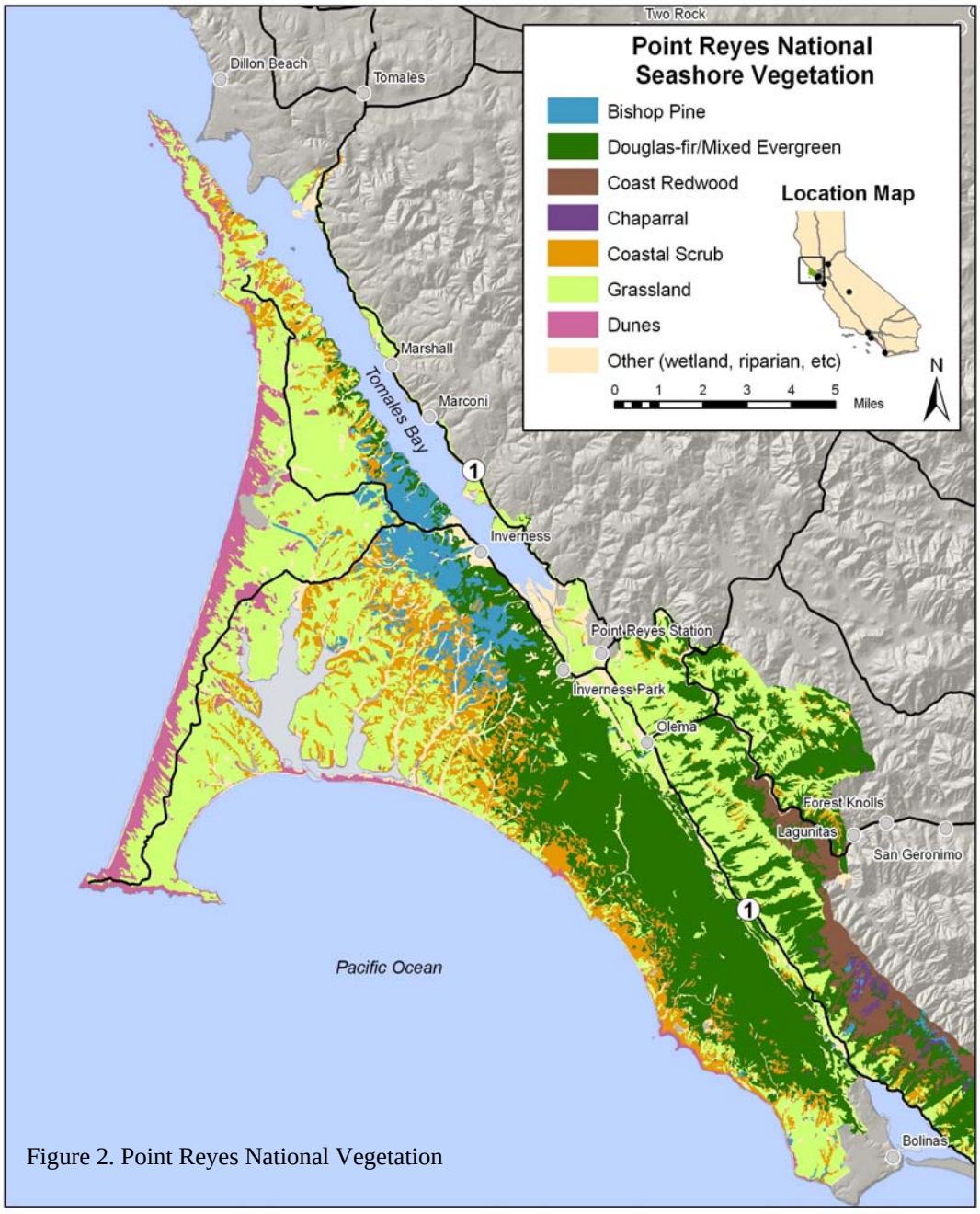

Figure 2. Point Reyes National Vegetation

Table 1 provides a brief overview of these vegetation types. Appendix 1 provides detailed descriptions and references the most current literature to describe their fire ecology.

Table 1. Brief Description of Vegetation Types

Vegetation Type	Description	Acreage*
Bishop Pine	Bishop pine is fire dependent, serotinous species. Trees live up to 100 to 120 years and require fire to reproduce in large numbers. Fire regime is high severity and trees do not typically survive fire.	3,570
Douglas-fir/Mixed Evergreen	Douglas-fir and mixed evergreen forest can tolerate a variable fire regime. These forests experienced a FRI of 10 to 30 years prior to Euro-American settlement due to Native American land management and other human-caused fire, but in the absence of humans, FRI's might have been much longer.	30,000
Coast Redwood	Mature coast redwoods are very resistant to fire. These forests experienced a FRI of 20 to 30 years prior to Euro-American settlement due to Native American land management and other human-caused fire, but in the absence of humans, FRI's might have been much longer. Coast redwoods require bare mineral soil exposed by fire or flooding to reproduce.	3,000
Chaparral	Chaparral is a fire dependent vegetation type consisting of a mixture of sprouting and non-sprouting shrubs and a high diversity of forbs. Non-sprouting (obligate seeding) shrubs require infrequent, high-severity fire to reproduce. These high severity fires kill mature obligate-seeding individuals, scarify the seedbank and create bare mineral soil which allows a new cohort to germinate.	400
Coastal Scrub	Coastal scrub vegetation does not require fire to reproduce, but does respond well to fire. Many coastal scrub species are able to sprout post-fire. Grassland is seral to coastal scrub and frequent fire will favor grassland communities.	15,500
Grassland	Coastal grasslands had a long history of frequent (1 – 3 years) burning by Native Americans. However, the invasion of these grasslands by non-native species since Euro-American settlement has drastically changed grassland species composition. Fire may facilitate further non-native species invasion in some situations, especially in the case of very short fire return intervals. Grassland is seral to coastal scrub and frequent fire will favor grassland communities.	20,000
Dune	Dune vegetation types have sparse vegetation cover and are therefore not very flammable and seldom burn.	2,000

* All acreages are based on pre-1995 Vision Fire vegetation maps

3.0 Sensitive Resources

This section summarizes the sensitive resources known to occur within the park along with a list of recommended measures to ensure their protection from unintended or undesirable effects from wildland fire management actions.

3.1 Air Quality

Point Reyes National Seashore is classified as a mandatory Class I area under the Federal Clean Air Act and Amendments. The northern lands of the GGNRA are a federal Class II area and protecting visibility is a major concern to park management. Class I & II designation provide for the highest degree of regulatory protection from air pollution impacts. The primary means by which the protection and enhancement of air quality is accomplished is through implementation of National Ambient Air Quality Standards (NAAQS). These standards address six pollutants known to harm human health including ozone, carbon monoxide, particulate matter, sulfur dioxide, lead, and nitrogen oxides.

All wildland fire incidents on which suppression strategies are employed are exempt from air quality regulations. It is anticipated that suppression strategies will be successful in limiting air quality problems by confine, contain, and control strategies.

3.2 Soil Resources

The Marin County Soils Survey provides generalized baseline information on soils within the project area (USDA 1985). Soils are classified into broad associations comprised of one or two major soil types, from which the name of the association is taken, and several minor soil types. There are ten major (>1,000 acres) soil mapping units found within Point Reyes NS: Maymen-Maymen Variant gravelly loams, Olompali-Soulajule-Felton Variant, Blucher-Cole, Tocaloma-Saurin, Dune land-Sirdrak, Kehoe-Sheridan Variant, Pablo-Bayview, Tomales-Steinbeck, Cronkhite-Dipsea-Centissima and Palomarin-Wittenberg. See Figure 3 on the following page for a map of the soil mapping units within the Seashore.

Blucher-Cole soils are generally deep and poorly drained. Their origin is alluvial deposition and they are found on 2-5 percent slopes. Blucher soils have a grayish brown silt loam surface underlain by gray silty clay loam and clay loam. Cole soils have a gray clay loam surface layer underlain by dark gray and grayish brown silty clay. This mapping unit covers just over 2,000 acres and is found in Olema Valley, along Lagunitas Creek and in the Point Reyes headlands.

The Dune land-Sirdrak soils are literally dune soils and are generally very deep and well drained. They form in windblown deposits on beaches. This soil mapping unit covers almost 8,000 acres and are found primarily in the vicinity of North Beach and South Beach, but also along many other of the Seashore's beaches.

The Kehoe-Sheridan Variant soils are moderately deep, well drained soils that are found on hillsides and are underlain by sandstone and quartz-diorite. Kehoe soils have a very dark grayish brown loam surface layer. The underlying material is very pale brown loam over weathered, soft sandstone. Sheridan Variant soils have a brown coarse sandy loam surface underlain by a strong

brown coarse sandy loam over weathered quartz-diorite. This soil mapping unit covers almost 9,000 acres of the Seashore and is found along the northern end of Inverness Ridge.

Palomarin-Wittenberg soils are deep well-drained soils underlain by siliceous shale and sandstone and are generally found on hillsides. Palomarin soils are have a dark grayish brown loam surface. This is underlain by grayish brown and brown loam over hard highly fractured siliceous shale and sandstone. Wittenberg soils have a dark graying brown very gravelly loam surface. Underlying materials are yellowish brown and brown very gravelly loam over hard highly fractured siliceous shale. This mapping unit is found along the southern end of Inverness Ridge and covers more than 19,000 acres.

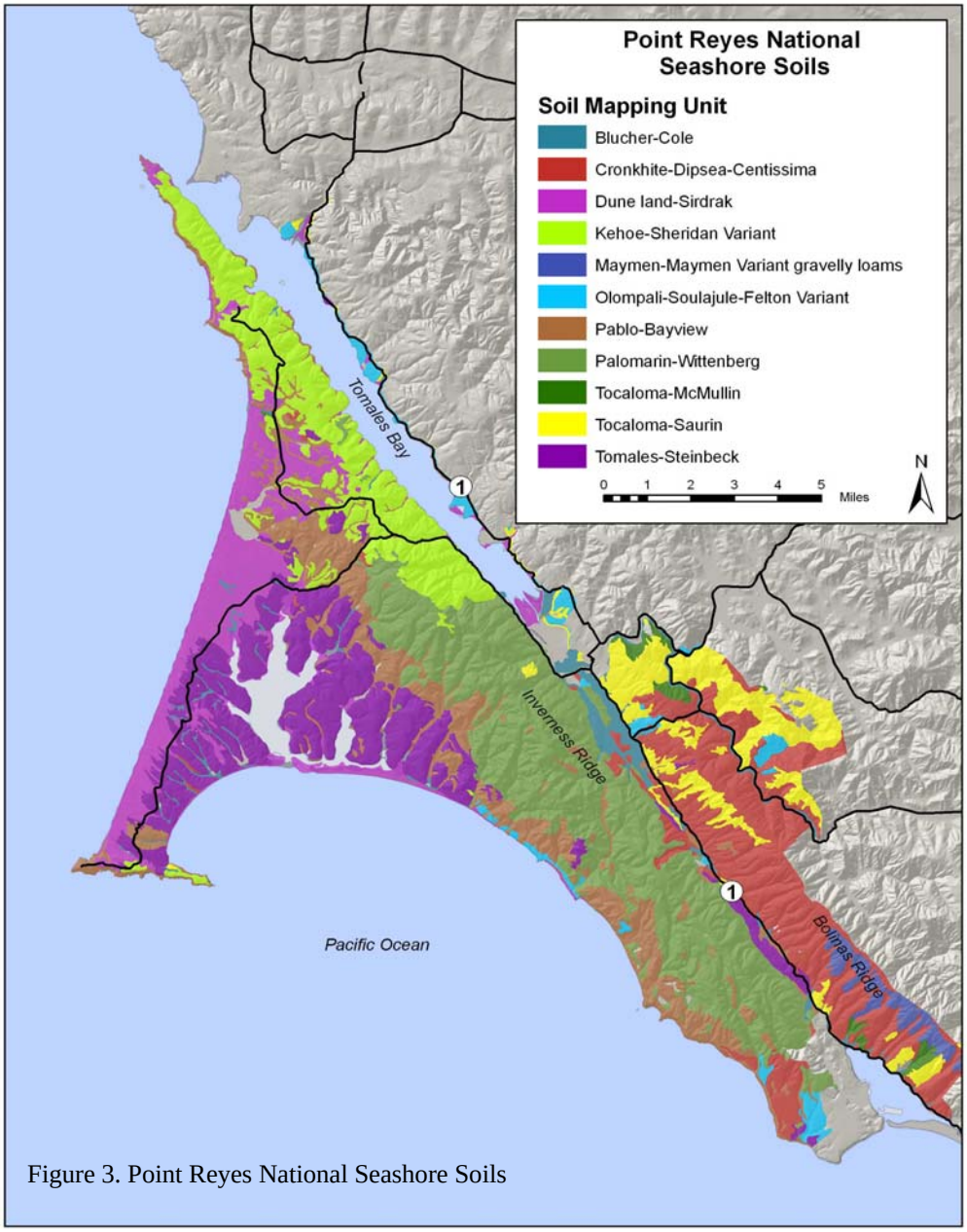

Figure 3. Point Reyes National Seashore Soils

Pablo Bayview soils are shallow, steep, well drained soils underlain by siliceous shale and sandstones. Pablo soils are a dark gray loam underlain hard highly fractured siliceous shale. The Bayview soils are dark grayish brown very gravelly loam underlain by hard highly fractured siliceous shale and sandstone. These soils are found on the westward slope of Inverness Ridge, just down slope from the ridge top areas. This mapping unit covers approximately 10,000 acres of the Seashore.

Cronkhite-Dipsea-Centissima soils are moderately deep, steep, well drained soils underlain by sandstone and shale. The surface of Cronkhite soils is a brown loam. The subsurface is yellowish brown and strong brown clay underlain by weathered sandstone and shale. Dipsea soils are characterized by a dark brown very gravelly loam surface and a brown very gravelly clay loam subsurface underlain by weathered sandstone and shale. Centissima soils have a brown loam surface, a light yellowish brown loam subsoil and a light brown gravelly clay loam substratum underlain by weathered sandstone and shale. This soil mapping unit covers almost 12,000 acres of the Seashore and is found along Bolinas Ridge.

Tomales Steinbeck soils are deep, moderately well drained soils underlain by soft sandstones. Tomales soils have a brown loam surface layer, a pale brown to very pale brown clay loam subsurface, and a light brownish gray to pale yellow clay subsoil underlain by soft, weathered sandstone. Steinbeck soils have a dark grayish brown loam surface, pale brown and pale brown loam subsurface, grayish brown and light yellowish brown upper subsoil and yellow clay lower subsoil underlain by soft, weathered sandstone. This mapping unit covers almost 12,000 acres of the Seashore and is found in the area surrounding Drakes Estero.

Olompali-Soulajule-Felton Variant soils are moderately deep and deep, somewhat poorly drained and well drained soils. Olompali soils have a grayish brown loam surface. The upper subsoil is yellowish brown and brown clay and the lower subsoil is pale brown and light yellowish brown clay. Soulajule soils have a reddish brown clay loam surface with a reddish brown gravelly clay upper subsoil and yellowish red very gravelly clay lower subsoil underlain by highly weathered sandstone. Felton soils have a brown loam surface layer, yellowish brown clay loam upper subsoil and strong brown clay lower subsoil underlain by soft, weathered shale. This mapping unit covers almost 2,000 acres of the Seashore, mostly along the east side of Tomales Bay.

Tocaloma-Saurin soils are deep well drained soils underlain by sandstone and shale. Tocaloma soils have a grayish brown loam surface and light yellowish brown very gravelly loam subsoil underlain by sandstone and shale. Saurin soils have a yellowish brown clay loam surface and subsoil underlain by sandstone. This mapping unit covers more than 5,800 acres of the Seashore and is found primarily in the Golden Gate NRA lands in the vicinity of Zandardi, McIsaac, and Cheda Ranches.

Maymen-Maymen Variant soils are shallow and moderately deep, somewhat excessively and well drained soils underlain by sandstone and shale. Maymen soils have a pale brown gravelly loam surface underlain by hard, fractured sandstone. Maymen Variant soils have a light brown gravelly loam surface, strong brown to reddish brown gravelly clay subsoil underlain by hard, fractured sandstone. This mapping unit is found at the southern end of Bolinas Ridge and covers just over 1,200 acres of the Seashore.

Protection Measures

- Avoid use of heavy earth-moving equipment such as tractors, graders, bulldozers or other tracked vehicles. The Superintendent can authorize the use of heavy earthmoving equipment in extreme circumstances in the face of loss of human life and/or property.

- Implement Minimum Impact Techniques (MIT) fire suppression guidelines to minimize and/or eliminate adverse soil impacts resulting from ground crew activities.
- Implement erosion control methods for line construction on slopes exceeding 10%.
- To the extent practicable, rehabilitate all sites where improvements are made or obstructions removed to pre-fire conditions.
- Locate fire lines outside of highly erosive areas, steep slopes, and other sensitive areas.
- Construct firebreaks or firelines in previously disturbed areas whenever possible.

3.3 Water and Riparian Resources

Point Reyes National Seashore includes a significant number of perennial and intermittent streams, human-made impoundments, wetlands, natural lakes and sag ponds. The water resources support a variety of threatened and endangered species including coho salmon, steelhead trout, California freshwater shrimp, and California red-legged frog.

Figure 4 shows the watersheds that comprise the Seashore. A summary of the important features of the watersheds follows. The Tomales Bay watershed is located in the northern portion of the Seashore and is home to a number of oyster production operations. Along with Drake's Estero, this watershed accounts for nearly 35% of the oyster production in the state. The Lagunitas Creek watershed is located in the eastern portion of the PRNS. This watershed drains to the head of Tomales Bay and provides much of Marin County's drinking water through the Marin Municipal Water District. Four dams with storage in excess of 60,000 acre-feet are located on Lagunitas and Nicasio creeks. The Bolinas watershed includes Arroyo Hondo Creek. The upper sections of this watershed are located within the Philip Burton Wilderness and are managed as a Public Water Supply Watershed for the town of Bolinas. The Bolinas Lagoon is now the subject of an intensive restoration plan process coordinated through Marin County and the US Army Corps of Engineers exploring dredging to restore tidal prism. Important watershed management issues in the study are the protection of the stream and lagoon from additional sedimentation and deposition.

There are four Areas of Special Biological Significance (ASBS) within the Seashore. These areas are Bird Rock, the Point Reyes Headlands, Double Point, and Duxbury Reef. They are designated in the California Ocean Plan because of their unique or fragile biological communities. According to this plan, waste discharge is prohibited within ASBS's and therefore retardant drops are prohibited within ASBS's.

The Seashore also contains more than 75 impoundments and many are known to support the California red-legged frog. Most of these facilities were constructed by former landowners for stock watering or development. Within the Olema Valley, a number of naturally occurring sag ponds associated with the San Andreas Fault provide unique aquatic habitat. The southwestern part of the project area, from Palomarin to Double Point is dotted with ponds and lakes derived from massive slope failure events. These water bodies, such as Bass, Pelican, and Crystal Lake are naturally occurring.

Wetlands and Riparian Areas

The term "wetlands" includes wet environments such as marshes, swamps and bogs. Wetlands provide critical habitats for fish and wildlife, purify water, and help check the destructive power of floods, storms, and fires. Nutrients and plant material flushed from some wetland systems during storms provide essential food for plants, fish, and wildlife in downstream ecosystems. Point Reyes National Seashore includes many different wetland and riparian areas. These areas are host to specialized plant communities. These communities are centers of plant and animal biodiversity. Riparian communities act as filters for down-slope soil and nutrient movement for aquatic resources, and are considered important habitat components.

Wildfire could potentially have adverse effects on wetland and riparian areas by increasing sedimentation and/or erosion.

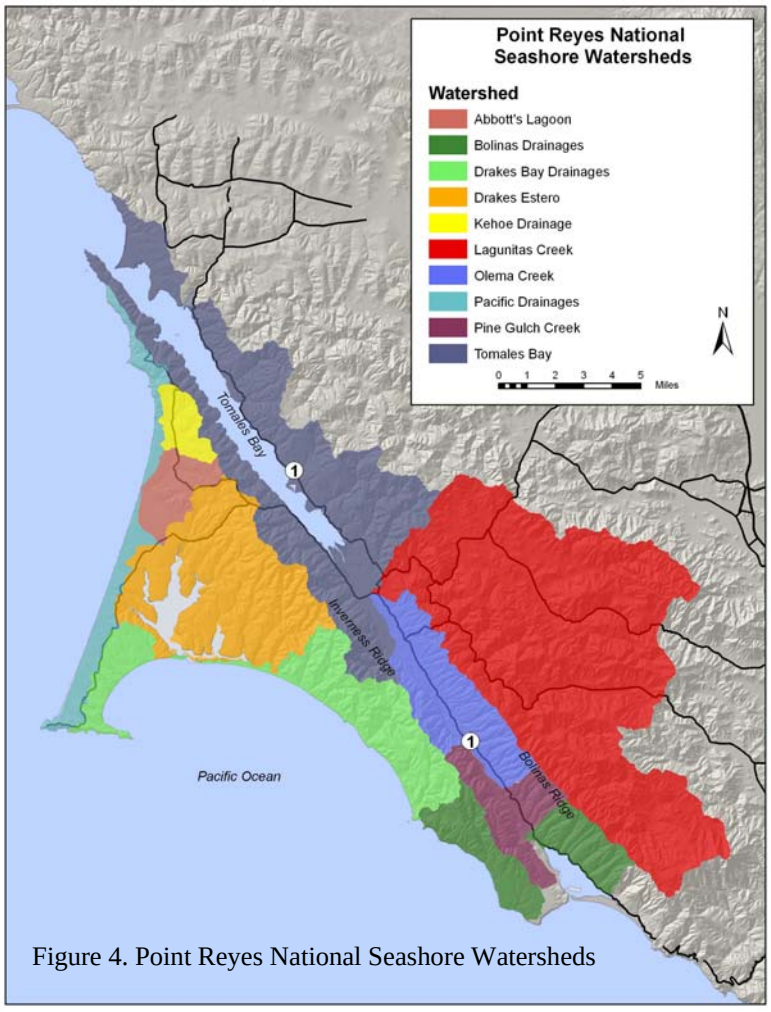

Figure 4. Point Reyes National Seashore Watersheds

Protection Measures

- Limit creek or river crossings set and existing locations.

- Prohibit fire suppression activities within wetlands unless there are no alternatives available to control the spread of a wildland fire.

- Prohibit use of foam or other fire retardants in watersheds that drain into state designated ASBS's. These areas are listed below. See also the READ Natural Resource Maps 1, 7, 10, 11 and 12.
    - Bird Rock
    - The Point Reyes Headlands from the Lighthouse to Chimney Rock
    - Double Point
    - Duxbury Reef/Arroyo Honda Creek watershed

- Implement MIT fire suppression guidelines to minimize and/or eliminate adverse impacts to surface water resources. These include:

    - Use water for aerial drops whenever possible

    - Prohibit use of foams or other fire retardants in or near wetlands

    - Prohibit only certain water bodies as water sources. See Wildlife section.

    - Locate helispots, staging areas, and spike camps at least 300 feet away from streams, creeks, and other water bodies

3.4 Vegetation

The Seashore has 50 federal, state, and locally listed plant species that receive equal protection and attention under NPS policy. Some of these species are fire dependent. Others have the potential to be harmed by an unplanned ignition. See Appendix 3 for a listed of all rare plant species with comments on their fire effects where information is available.

Protection Measures

- Locate helispots or spike camps on previously disturbed sites and open areas whenever possible to minimize additional disturbance.

- Consult with READ to locate fire lines to avoid rare plant populations when possible.

Non-Native Plants

Non-native plant species are a major threat to biodiversity at Point Reyes National Seashore. Most invasive, non-native species are spread and established via human-caused disturbance, Logging, brush clearing, soil disturbance, and fire can all result in temporary or permanent invasion of non-native species into a national park. After the 1995 Vision Fire park staff and volunteers put in many hours removing weed infestations that occurred post-fire. Particular species of concern include giant plumeless thistle, pampas grass, Scotch broom, French broom and cape ivy.

Protection Measures

- Clean fire management equipment upon arrival to and departure from an incident to prevent the spread of noxious weeds.

- Stage fire management operations away from known noxious weed infestations to the greatest extent possible.

- Avoid using waterbodies infested with exotic weeds for dip sites when possible. Two waterbodies are known to have Spartina infestations at Point Reyes NS:
    - Drakes Estero
    - Limantour Estero

- Consult with READ to avoid fire line construction in known weed patches when possible.

3.5 Wildlife

Point Reyes National Seashore is home to 47 listed animal species. Of these 14 are federally listed as endangered, 8 as threatened, and 24 as species of concern. These species are listed in Appendix 2 along with their status. One general mitigation is listed along with specific mitigations for the three species below.

Protection Measures

- Aircraft will avoid seal haulouts and seabird nesting and roosting sites to the greatest extent possible.

Northern Spotted Owl (*Strix occidentalis caurina*) - Threatened
Habitat within the project area supports one of the densest populations of Northern spotted owl in the world. In Marin County, the owls live in Douglas-fir/mixed evergreen, Bishop pine and coast redwood forests. The habitat types for the Northern spotted owl are defined as multilayered, multi-species with >60% total canopy cover for nesting/roosting with large overstory trees, large amounts of down woody debris, presence of trees with defects or signs of decadence in the stand. Small isolated pieces of habitat are not regarded as suitable. A severe wildfire may alter the owls' habitat, making it unsuitable for the species.

Protection Measures

- Protect occupied and previously used nest sites from unplanned ignitions. (see READ Natural Resource Maps).

Red-legged Frog (*Rana aurora draytonii*) – Threatened
PRNS and GGNRA support one of the largest known populations of California red-legged frogs. This frog frequents marshes, slow parts of streams, lakes, stock ponds, and other usually permanent waters. The frog is generally found near water but disperses during rain events and after breeding season to non-breeding habitat adjacent to water bodies. The non-breeding habitat is usually a moist area with some cover such as a willow or blackberry thicket.

Protection Measures

- Avoid all water bodies known to support red-legged frogs. All park waterbodies are considered 'no dip' and are to be avoided except for the following waterbodies. Acceptable dip sites are:
    - Abbott's Lagoon; preference for the lower lagoon
    - Drake's Estero (Spartina infestation – avoid when possible; no dipping March – June; oyster beds are a hazard at edges of Estero)
    - Limantour Estero (Spartina infestation – avoid when possible)
    - Pelican Lake (no dipping March – June)
    - Bass Lake

- Crystal Lake
- Five Brooks
- Tomales Bay

Point Reyes Mountain Beaver *(Aplodontia rufa phaea) - Federal Species of Concern.*
The US Fish and Wildlife Service and the California Department of Fish and Game list the Point Reyes mountain beaver, a muskrat-sized rodent found only in scrub habitat in western Marin, as a Species of Concern. Mountain beaver may be adversely affected by large-scale unplanned ignitions. Studies conducted following the 1995 Vision Fire in Point Reyes revealed that Point Reyes mountain beaver suffered high mortality. Surveys indicated that pre-fire estimates of approximately 5,000 individuals were in the burned area. After the Vision Fire, major changes in the habitat occurred. For example, there was a reduction in coastal scrub to charred sword fern bases and blackened skeletons of coyote brush. Post Vision Fire surveys suggested that only 19 mountain beavers survived within the surveyed fire area. This number represents only 0.4 – 1.2% of the population that park staff estimate had previously inhabited the surveyed area (Fellers et al. 2003).

Protection Measures

- Protect known and potential habitat from unplanned ignitions. (See READ Natural Resource Maps)

3.6 Cultural Resources

In addition to a diverse mosaic of natural and physical features, Point Reyes contains a varied array of cultural resources within its boundaries. The Coast Miwok people inhabited the area for thousands of years before European explorers arrived, and human population density before contact was probably greater than it is today (Cook 1943).

Archeological Resources
The Park estimates that approximately 87% of its terrestrial acres have not yet been surveyed for archeological resources. In 2002 the Park determined that there were at least 124 recorded prehistoric, terrestrial sites. It was also estimated that there were from 41 to 123 additional, unknown terrestrial prehistoric sites within current Park boundaries. Most of the known prehistoric sites are shell middens of various sizes. The park also has counted 92 historic terrestrial archeological sites that have been recorded in various documents at different levels of intensity. In addition, it was estimated that 5 to 37 additional, unknown, historic terrestrial sites are likely to exist within the boundaries of PRNS. These sites typically reflect historic occupations and use of the peninsula; first by homesteaders and dairy ranch communities, and later by government lighthouse and lifesaving personnel and private radio telecommunications companies. They range in size and complexity from discrete trash pits containing old bottles, tins, broken tools and crockery; to now buried corduroy roads, ruined ranch sites, and radio communication facilities complete with antennae farms. Park cultural resource staff has also counted 9 known and recorded terrestrial archeological sites that contain both prehistoric and historic components (not necessarily related to each other). They estimate another 5 to 14 such sites within park boundaries exist but have not yet been identified.

Cultural Landscapes
PRNS manages 39 cultural landscapes; 23 are within the boundaries of Point Reyes National Seashore and 16 are within the North District of GGNRA. The landscapes primarily reflect the

maritime, ranching, communications, and military history of the park. Two are ranching districts, which together comprise approximately 30,000 acres of parkland in the northern district of Point Reyes and the Olema Valley. Two other landscapes have national significance: the Lifeboat Station is a National Landmark and the Marconi/RCA sites are in the process of being nominated to the national register. Cultural landscapes identified in the NPS Cultural Landscapes Automated Information Management System (CLAIMS) are listed in Appendix 4.

Structures
Over 300 hundred historic structures are found on land managed by PRNS. Structures range from simple timber-framed barns to the cast-iron Point Reyes Lighthouse to the concrete Mission Revival Marconi transmitting station. Approximately two thirds of PRNS's listed structures are ranch structures managed under leases and permits. The remaining structures primarily reflect the Park's maritime and radio communication history. Four sites are listed on the National Register, including the Point Reyes Lifeboat Station - a National Historic Landmark. Three additional properties have been determined eligible for the National Register and several additional properties are in review (see Appendix 4). 297 historic structures are on the List of Classified Structures, the NPS inventory of historic and prehistoric structures.

Protection Measures

- Avoid suppression activities that expose mineral soil within cultural sites as defined or delineated in archeological survey reports. Activities include: handline construction, road construction, staging areas and helispots.
- Prohibit fire retardant in the vicinity of any historic structure. May be used as a last resort where there is an imminent threat from wildfire to the historic structure.
- Locate camps and toilet facilities at least 200 feet from known cultural resource sites.
- Implement Minimum Impact Techniques (MIT) fire suppression guidelines to minimize and/or eliminate adverse soil impacts resulting from ground crew activities.

3.7 Wilderness Values

More than half of PRNS, the 32,373-acre Philip Burton Wilderness Area, must be managed in conformance with the 1964 Wilderness Act, NPS Management Policies (NPS 2000), and the Director's Order and Reference Manual 41 for Wilderness Preservation and Management. Generally, the public purpose of wilderness in the national parks includes the preservation of wilderness character and wilderness resources in an unimpaired condition, as well as for the purposes of recreational, scenic, scientific, educational, conservation, and historical use. Management includes the protection of the areas, the preservation of the wilderness character, and the gathering and dissemination of information regarding their use and enjoyment as wilderness. The Wilderness Act requires that "there shall be no commercial enterprise and no permanent road within any wilderness area designated by this chapter and, except as necessary to meet minimum requirements for the administration of the area for the purpose of this chapter (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area."

Director's Order 41 (NPS 1999) states that all wildland fires within wilderness would be managed to include the application of minimum requirement suppression techniques, the consideration of firefighter and public safety, a cost/benefit analysis sensitive to natural and cultural resources, and the strategic and tactical options described in an approved fire management plan. Given the proximity of the Philip Burton Wilderness Area to developed areas and the potential for a wildland fire to spread beyond park boundaries, fire management planning at PRNS puts special emphasis on suppression of wildland fire in wilderness. According to Director's Order 41, if a wildland fire requires Point Reyes management to delegate fire-fighting authority, park personnel would first inform them of the appropriate emphasis on the protection of wilderness resources. The methods used to suppress all wildland fires should be those that minimize the impacts of the suppression action and the fire itself, commensurate with effective control and the preservation of wilderness values. Fire suppression teams at the park are trained in the concepts of wilderness fire management and minimum tool use. These techniques would be implemented to the extent feasible to control wildland fire and protect life and property.

Protection Measures

- Wildland fire operations within wilderness will adhere to the requirements of the Wilderness Act, NPS Management Policies, and the NPS Director's Orders 18 and 41 Wilderness Preservation and Management.

- All fire management activities within wilderness will employ minimum actions and tools necessary based upon the Minimum Requirement and Minimum Tool Determination.

- All fire management activities within wilderness will follow established MIT implementation guidelines.

- All fire management activities within wilderness will follow established Rehabilitation Guidelines for Wilderness Fire Suppression Activities.

- Ensure a Resource Advisor is available for advice and support with the crew(s) as well as for quality control.

3.8 Maps of Interest

The following maps are available in the Park's Fire Management Office. They are intended to provide site-specific guidance for the recommendations. They are not included in the Guide itself because of the sensitive nature of the resources:

Rare Plants
Other Natural Resources
Cultural Resources
Ranch Boundaries
Wilderness Areas
Ownership
Wetlands

Appendix 1: Detailed Fire Ecology of Vegetation Types

1.1 Bishop Pine Forests

Bishop pine (*Pinus muricata*) forests are found primarily on the northern section of Inverness Ridge (see Vegetation Map, page 8 Figure 2) on granitic quartz-diorite soils (Kashiwagi 1985). The Point Reyes population is part of a larger population with limited distribution. The species is found in relict stands along the coast of California from Humboldt to Santa Barbara counties, on Santa Cruz and Santa Rosa islands, and in isolated populations south to central Baja (Vogl et al. 1988). The distribution of Bishop pine is maritime and populations are found between sea level and about 400m elevation. The climate in this coastal band is dominated by summer fog which is probably an important moisture source during the dry summer months(Vogl et al. 1988). According to the 1994 vegetation map for the Seashore, there were 3,570 acres of Bishop pine forest prior to the Vision Fire. Approximately 35% of this total forest area was burned in the 1995 Vision Fire.

Bishop pine is the dominant tree species in this community. Madrone (*Arbutus menziesii*), tanoak (*Lithocarpus densiflorus*), coast live oak (*Quercus agrifolia*) and California bay (*Umbellularia californica*) are often present in significant cover. Huckleberry (*Vaccinium ovatum*) is important to dominant in the shrub layer. Other species common in the understory include salal (*Gaultheria shallon*) and swordfern (*Polystichum munitum*). The areas burned in 1995 are characterized by a patchwork of extremely dense stands of 12 to 15 foot tall, regenerating pines alternating with extremely dense stands of blue blossom (*Ceanothus thrysiflorus*) and Marin manzanita (*Arctostaphylos virgata).*

Bishop pine is a fire dependent, serotinous pine species. Cones are produced each year, but remain closed. Typically, cones are opened by fire, but they can also occasionally be opened on a hot day. The fire regime in Bishop pine forests is generally a stand replacement regime. Bishop pine is not considered to be fire resistant (Sugnet and Martin 1984). Mature trees are killed by even low intensity fires and seeds are dispersed onto the newly burned ground where they germinate (Vogl et al. 1988). Bishop pine stands are normally even aged and for the first 10-20 years after fire are extremely dense. Cone production was observed as early as five years after the Vision Fire (Holzman 2003). Holzman (2003) found seedling densities as high as 71 seedlings/m^2 with an average value of 25 seedlings/m^2 in the year immediately after the after the Vision Fire (See Figure 3).

Figure 3. Left: Close view of 10 year old Bishop pine regeneration; Right: mature Bishop pine forest.

Much of the Bishop pine forest in the Seashore currently is about 12 years old, having established after the 1995 Vision Fire. Older stands were sampled by Sugnet and Martin (1984) and were found to have established after the 1927 fire and after fires set by Ottinger during the 1950s. Bishop pines in Tomales Bay State Park were found to be as old as 71 years. Vogl (1988) suggests that trees not exposed to fire a period in excess of 80 years will begin to succumb to diseases such as western gall rust and die without reproducing. The non-native pathogen pine pitch canker was recently discovered in the Bishop pine forest at Point Reyes. The effects this disease will have on the population are unknown, but they are likely to be significant (Gordon et al. 2001).

1.2 Douglas-Fir/Mixed Evergreen Forests

Douglas-fir (*Pseudotsuga menziesii*)/mixed evergreen forests at Point Reyes National Seashore are found primarily along the southern section of Inverness Ridge (see page 8, Figure 2). They are found on marine derived sedimentary soils and also experience the coastal influence in the form of summer fog (Kashiwagi 1985). This forest type is found from southern Oregon to southern California and is typified across its range by the dominance of broad-leaved sclerophyllous species with little to significant coniferous presence (Sawyer et al. 1988). At PRNS, the coniferous influence is significant and most mixed evergreen forests in the Seashore are dominated by Douglas-fir. This vegetation type comprises over 30,000 acres of the Seashore.

Douglas-fir-dominated forest is characterized by a significant component of hardwood trees, usually California bay (*Umbellularia californica*), but tanoak (*Lithocarpus densiflorus*) or individual coast live oaks (*Quercus agrifolia*) may be present. The shrub understory is highly variable, but is usually moderate to very dense. Coffeberry (*Rhamnus californica*), huckleberry (*Vaccinium ovatum*), California hazel (*Corylus cornuta*), poison oak (*Toxicodendron diversilobum*) and coyote brush (*Baccharis pilularis*). Swordfern (*Polystichum munitum*) often dominates the herbaceous layer (See Figure 4).


Figure 4. Douglas-fir with mixed understory

Coast Douglas-fir is a large, coniferous, evergreen tree. Trees 5 to 6 feet in diameter and 250 feet or more in height are common in old-growth stands. Trees often live more than 500 years. Douglas-fir is considered moderately shade tolerant and regenerates best in pasture edges, open areas, and post-disturbance. Further north in its range, Douglas-fir stands will give way to shade-tolerant associates such as western hemlock, western red cedar, and Pacific silver fir, but at PRNS, it is considered the climax species for the mixed evergreen species assemblage (Hermann and Lavender 1990; Sawyer et al. 1988).

Coast Douglas-fir can survive moderately intense fires. Thick, corky bark on the lower bole and roots protects the cambium from heat damage. In addition, tall trees have their foliage concentrated on the upper bole, which makes it difficult for fire to reach the crown; however, it should be noted that trees are typically not free of lower branches up to a height of 33 feet until they are more than 100 years old (Hermann and Lavender 1990). Fire regimes vary greatly over the range of Douglas-fir. In Washington and Oregon, Douglas-fir often burns in infrequent (>100

years), stand-replacing fires. However, further south in its range, Douglas-fir often exhibits a mixed or moderate-low severity fire regime. One study in the Klamath Mountains of Northern California found mean fire return intervals of 12 to 19 years (Taylor and Skinner 1998).

Brown et al (1999) looked at the fire history of the Douglas-fir forest at PRNS. This study was able to obtain cross-dated fire history for two stands dating back to mid-1700's. However, there were relatively few fire occurrences prior to the mid-1800's, which the authors ascribed to missing fire dates. For the period from 1820 to 1905 at one site the MFRI was 7.7 years and for the period from 1825 to 1918 at a second site the MFRI was 8.5 years. No fires were recorded in this study after 1945. Most fires were recorded on one or a few trees, but were not recorded on all trees in a stand. The authors of this study conclude that, since natural ignition sources are infrequent, these fires were caused by Native Americans or by early settlers. The latter seems more likely given Slaymaker's (1983) conclusion that the Coast Miwok had been extirpated from the peninsula by the beginning of the 19th century.

Due to the lack of fires over the last century, there is concern over the encroachment of douglas-fir into meadows and coastal scrub. This has been observed in many areas of the Seashore and other parts of the North Coast Range region.

Some Douglas-fir stands at PRNS have substantial ladder fuel accumulations, which could result in crown fire. In particular, the southern section of Inverness Ridge, which was heavily logged during the mid-to-late 19th century, has high fuel loading. Sudden Oak Death (SOD) was first discovered at the Seashore in 2004 and is likely to have a major effect on fuel loadings in this vegetation type. SOD most significantly affects tanoak and tanoaks have been seeing dying along Bolinas and Inverness Ridges in 2005 and 2006. This tanoak dieback is creating significant fuel buildups.

1.3 Coast Redwood Forests

Coast redwood (*Sequoia sempervirens*) forest is found within the Seashore primarily along Bolinas Ridge with a few small pockets west of Olema Valley (See page 8, Figure 2). Coast redwood, a California endemic, is one of the world's tallest trees (Zinke 1988). This forest type is found in a narrow strip 450 miles long and 5 to 35 miles wide along the California coast from Del Norte county (and a few isolated stands in extreme southern Oregon) in the north to Monterey county in the south (Olson et al. 1990). This species is thought to be fog dependent and intolerant of sea spray (Olson et al. 1990). Coast redwood forest occupies approximately 3,000 acres of PRNS.

Coast redwood at PRNS is found in association with California bay (*Umbellularia californica*), tanoak (*Lithocarpus densiflorus*) and Douglas-fir (*Pseudotsuga menziesii*). The shrub and herbaceous understory is variable, but often includes huckleberry (*Vaccinium ovatum*) and swordfern (*Polystichum munitum*). The PRNS type is somewhat unique in that it grades from redwood forest into chaparral from Bolinas Ridge

Figure 5. Coast redwood forest at Muir Woods NM

down towards Olema Valley. Down slope of the ridge top it is not uncommon to see regenerating redwood trees mixed amongst manzanita and chinquapin.

Coast redwood are adapted to fire and other disturbance. Seeds germinate best on mineral soil as is exposed by flooding, fire, or wind throw for seed germination and establishment. Seeds can also germinate on duff and logs. Redwood seedlings and saplings prefer full sunlight and grow rapidly. Mature trees are extremely large and long-lived. The oldest known tree is 2,200 years old. It is not uncommon for trees to reach heights of 200-300 ft. Redwoods are prolific sprouters and can sprout from stumps, the root collar, or along the bole (Olson et al. 1990).

The fire return interval in coast redwood forests varies drastically with latitude, microclimate and distance from the coast. In general, forests that are further north, closer to the coast, or located on mesic sites tend to burn less frequently. Fire return intervals range from as long as 500 years on wetter, northern sites to 5-25 years on drier, southern sites (Stuart and Stephens 2006). Point Reyes NS falls closer to the shorter end of the fire return interval spectrum. Brown et al (1999) report a fire return interval of 7.7 years for redwood stands at Point Reyes. A study by McBride and Jacobs (1978) of redwood stands on Bolinas Ridge and Mount Tamalpais found point estimates of fire return interval ranging from 21.7 to 27.3 years. Because of the infrequency of natural ignitions in the San Francisco Bay area, it is likely that these relatively high fire frequencies are indicative of Native American burning practices.

1.4 Maritime Chaparral

Maritime chaparral is found within the Seashore primarily along the southwest facing slopes of Bolinas Ridge. There are also patches of this vegetation type along Inverness Ridge. Maritime chaparral is found along the California coast from northern Santa Barbara County to Sonoma County. It is generally found within 6 to 12 miles from the coast. It is characterized by a relatively large number of rare and endemic species and is threatened by development pressure (Davis and Borchert 2006; Van Dyke and Holl 2001). At Point Reyes, this vegetation type covers approximately 400 acres according to the 1994 vegetation map. However, this should be considered just an estimate as this vegetation type occurs as a shifting mosaic with forest types and large areas of manzanita germinated after the 1995 Vision Fire and were not captured by the 1994 mapping process.


Figure 6. *Arctostaphylos virgata* along Bolinas Ridge

Maritime chaparral at PRNS intergrades with mixed evergreen forest and is bordered by coast redwood (*Sequoia sempervirens*) groves and riparian woodlands, which occupy moist drainages. In some locations, maritime chaparral dominated by *Arctostaphylos virgata* is an early successional vegetation type and is eventually shaded out by bishop pine or Douglas-fir. In other locations, such as along Bolinas Ridge, maritime chaparral appears able to persist as the dominant vegetation type indefinitely (Sweicki and Bernhardt 2006). Common maritime chaparral species at PRNS include *Arctostaphylos glandulosa, Arctostaphylos nummularia, Adenostoma fasciculatum, Chrysolepis chrysophylla*, *Ceanothus cuneatus*, and *Pickeringia montana*. Also of importance in this vegetation type are the rare species *Arctostaphylos virgata, Ceanothus*

gloriosus var. *exaltatus,* and *Ceanothus masonii.*

Maritime chaparral is a fire dependent vegetation type. Many maritime chaparral species are obligate seeders are require fire in order to reproduce (Davis and Borchert 2006; Van Dyke and Holl 2001; Odion 2000). Species such as the rare manzanita and ceanothus species listed above are examples of species that reproduce only from seed. Although occasional germination from seed may occur in disturbed areas along trails, these species require fire to scarify seeds and expose mineral soil to allow for reproduction at an ecologically meaningful scale. Although fire has not been observed along Bolinas Ridge since the establishment of the North District of GGNRA, the 1995 Vision fire did burn through areas of chaparral on Inverness Ridge. In these areas all three rare species exhibited vigorous post-fire seedling establishment (Parravano 1999). In some locations these post-fire populations are now (12 years post-fire) being shaded out by tree species such as bishop pine.

The fire regime in maritime chaparral in the absence of humans would probably have been quite long since, as discussed above, lightning along the coast is uncommon. However, fire return intervals may have been shorter prior to Euro-American settlement of the peninsula due to Native America burning. Because fire regimes in maritime chaparral are stand replacing, it is not possible to determine fire return intervals from tree rings. Little is known about seed bank longevity in maritime chaparral. One study of a chaparral community on the Central Coast indicated that a fire return interval of 40 years could be too short for obligate seeding species to build up a sufficient seed bank for recruitment of enough seedlings to maintain the population post-fire (Odion and Tyler 2002). Another study looked at vegetation change in a maritime chaparral community that had not burned in at least 70 years and over the course of their study, the authors noted a shift from chaparral species to oak woodland species and a complete lack of recruitment of obligate seeding species (Van Dyke and Holl 2001).

2.5 Coastal Scrub

Coastal scrub is one of the most widespread plant community types with in the Seashore. Large areas of this vegetation type are found along the western slope of Inverness Ridge out to the coastal bluffs and also on Tomales Point and in the vicinity of Drakes Estero. Coastal scrub is found in a band tens to hundreds of meters wide along the coast from Monterey to Oregon (Stuart and Stephens 2006). Southward from San Francisco and Marin, this vegetation type transitions to coastal sage scrub, which has its northern extent in Marin County (Heady et al. 1988). This vegetation type covers approximately 15,500 acres at the Seashore.

Coastal scrub is dominated by coyote brush (*Baccharis pilularis*), a small-leaved evergreen shrub. Other common associates are California blackberry (*Rubus ursinus*), poison oak (*Toxicodendron diversilobum*), Coffeeberry (*Rhamnus californica*), thimbleberry (*Rubus parviflorus*), yellow bush lupine (*Lupinus arboreus*), mimulus (*Mimulus aurantiacus*), salal (*Gaultheria shallon*) and blue blossom (*Ceanothus thrysiflorus*). It may also be found in association with as well as non-native and native grasses, sedges (*Carex spp*.) and rushes

Figure 7. Coastal scrub intermix with grass & bishop pine

(*Juncus spp*.). Some coastal sage species are also present including California sagebrush (*Artemisia californica*) and buckwheat (*Eriogonum fasciculatum*).

Coastal scrub is the climax community in some sites, seral to mixed evergreen forest in other locations, and exists in a shifting mosaic with grassland and forest in some situations. In many areas of the Seashore grasslands give way to coastal scrub without disturbance from fire or grazing. Similarly, scrub will succeed to mixed evergreen forest in the absence of fire (eg Palomarin/PRBO area) (McBride and Heady 1968). It has been estimated the absence of fire for a 50 year period will lead to site transition from scrub to mixed evergreen forest (Heady et al. 1988). At the northern end of Inverness Ridge, on the slopes from the ridge top westward to the ocean, coastal scrub exists in a mosaic with bishop pine forest and grassland. After the 1995 Vision Fire, large patches of bishop pine established as tree islands in a matrix of scrub in areas that had previously been coastal scrub.

Most coastal scrub species do not need fire to reproduce, but respond well to fire. Many have the ability to sprout vigorously after fire. Coyote brush is normally not killed by fire and is able to sprout from the root crown post-fire. However, in more open coyote brush communities, the herbaceous vegetation component may provide enough surface heat to kill individuals by girdling the root crown so that they cannot resprout.

Pre-European fire regimes in coastal scrub communities were likely greatly influenced by Native Americans in the absence of natural ignition sources (Stuart and Stephens 2006). Fire return intervals would have been longer than in grasslands since with a fire return interval of less than five years, these communities will revert to grasslands. Fire return intervals were probably comparable to the 10 – 20 year intervals found in forests in the area (Brown et al. 1999; McBride and Jacobs 1978).

2.6 Coastal Grassland

Coastal grassland is used here to refer both to pristine coastal prairie and to non-native dominated grazed and ungrazed sites. Pristine coastal prairie is found in California from Santa Cruz County northward and generally within approximately 100 km from the coast (Heady et al. 1988). Native coastal grasslands are an endangered vegetation type in California; the state has lost 99% of its native grasslands overall and 90% of its northern coastal bunchgrass (Noss et al. 1995). Within PRNS, 80% of grasslands are dominated by non-native grasses. Almost 20,000 acres of the Seashore is native or non-native grassland. Of this, approximately 75% is actively grazed by cattle.

Native coastal prairie is dominated perennial bunchgrasses including tufted hairgrass (*Deschampsia cespitosa*), California oatgrass (*Danthonia californica*), meadow barley (*Hordeum brachyantherum*), California brome (*Bromus carinatus*) and Pacific reedgrass (*Calamagrostis nutkaensis*) among other species. Non-native grasslands are dominated by annual grasses, such as annual Italian wild rye (*Lolium multiflorum*), farmer's foxtail (*Hordeum murinum*) and rattail fescue spp.(*Vulpia spp*.). Non-native perennial species are also common and are of management concern. These species include purple velvet grass (*Holcus lanatus*) and Harding grass (*Phalaris aquatica*).

Coastal prairies have been greatly impacted since European settlement due to several factors including lack of fire, increased grazing and the introduction of non-natives (Heady et al. 1988). Native Americans likely burned grasslands in order to improve harvests of grains, tubers, and bulbs(Keeley 2002; Slayermaker 1983; Clar 1957; Menzies 1924; Fletcher 1628). This would have prevented many grasslands from succeeding to shrublands or forests. Coastal prairies have also been impacted by a combination of cattle grazing and the introduction of non-native annual grasses. These non-native species are strong competitors with the native-grasses, particularly in the context of intense grazing pressure (Heady et al. 1988).

Figure 8. *Deschampsia cespitosa* grassland at PRNS

While coastal prairies probably burned frequently during Native American times, their fire ecology now must be considered in a different context due the presence of large numbers of non-native grasses. One study compared the effects of burning versus grazing in native coastal prairie systems and found that none of the three native grass species present on the site (*D. californica, Nassella pulchra and Nassella lepida)* were significantly affected by fire. Non-native annual grasses are disfavored by fire if burned in spring. Non-native annuals and perennial alike may be favored by fall burning and should be considered on a species by species basis (D'Antonio et al. 2001).

2.7 Coastal Dune

Native dune habitat in California is rare and is threatened both by development and by non-native species. The majority of dune habitat at Point Reyes is dominated by non-native species including European beachgrass. Approximately 2,000 acres of the Seashore is coastal dune habitat.

Figure 9. Native coastal dune vegetation at Abbott's Lagoon

Native dune habitat is comprised primarily of dune sagebrush (*Artemisia pycnocephala*), coast buckwheat (*Eriogonum latifolium*), dune lupine (*Lupinus chamissonis*), or goldenbush (*Ericameria ericoides*). Non-native dunes are dominated by European beachgrass (*Ammophila arenaria*) and iceplant (*Carpobrotus edulis*).

Total vegetation cover in coastal dune ecosystems is often low and

interspersed with bare sand. Although there may be thatch buildups in European beachgrass, these communities are generally not very flammable.

Appendix 2. Federal Threatened, Endangered, Candidate, and Proposed Animal Species of Point Reyes National Seashore

Common Name	Scientific Name	Listing Status[a]	Known to Occur
Mammals			
blue whale	*Balaenoptera musculus*	E	rare
finback (=fin) whale	*Balaenoptera physalus*	E	rare
gray whale	*Eschrictus robustus*	D	yes
Guadalupe fur seal	*Arctocephalus townsendi*	T	yes
humpback whale	*Megaptera novaeangliae*	E	yes
right whale	*Eubalaena glacialis*	E	no
sei whale	*Balaenoptera borealis*	E	no
sperm whale	*Physeter catodon (macrocephalus)*	E	yes
Steller (=northern) sea-lion	*Eumetopias jubatus*	T	yes
Birds			
Aleutian Canada goose	*Branta canadensis*	E	rare
American peregrine falcon	*Falco peregrinus anatum*	D	yes
bald eagle	*Haliaeetus leucocephalus*	T	rare
California brown pelican	*Pelecanus occidentalis californicus*	E	yes
California clapper rail	*Rallus longirostris obsoletus*	E	yes
greater sandhill crane	*Grus canadensis tubida*	T	rare
marbled murrelet	*Brachyramphus marmoratus*	T	yes
northern spotted owl	*Strix occidentalis caurina*	T	yes
short-tailed albatross	*Diomedea albatrus*	PE	rare
western snowy plover	*Charadrius alexandrinus nivosus*	T	yes
Reptiles			
green turtle	*Chelonia mydas (incl. agassizi)*	T	rare
leatherback turtle	*Dermochelys coriacea*	E	yes
loggerhead turtle	*Caretta caretta*	T	rare
olive (=Pacific) ridley sea turtle	*Lepidochelys olivacea*	T	rare
Amphibians			
California red-legged frog	*Rana aurora draytonii*	T	yes
California tiger salamander	*Ambystoma californiense*	C	no
Fish			
central California coho salmon	*Oncorhynchus kisutch*	T	yes
central California coast steelhead	*Oncorhynchus mykiss*	T	yes
delta smelt	*Hypomesus transpacificus*	T	unknown
Sacramento splittail	*Pogonichthys macrolepidotus*	T	unknown

So. OR/CA coastal chinook salmon	*Oncorhynchus tshawytscha*	T	no
threespine stickleback	*Gasterosteus aculeatus williamsonii*	E	no
tidewater goby	*Eucyclogobius newberryi*	E	no
Invertebrates			
black abalone	*Haliotes cracherodii*	C	yes
California freshwater shrimp	*Syncaris pacifica*	E	yes
Myrtle's silverspot butterfly	*Speyeria zerene myrtleae*	E	yes
white abalone	*Haliotes sorenseni*	PE	no

a. Listing status: E: Endangered T: Threatened C: Candidate PE: Proposed Endangered D: Delisted

Appendix 3: Federal Threatened and Endangered Plant Species, Plant Species of Concern, and CA Listed Plant Species of Point Reyes National Seashore

Table 1. Known occurrences

Common Name	Scientific Name	Known to Occur	Comments
Federal & State Endangered			
Robust spineflower	*Chorizanthe robusta* var. *robusta*	yes	
Sonoma spineflower	*Chorizanthe valida*	yes	
beach layia	*Layia carnosa*	yes	
Tidestrom's lupine	*Lupinus tidestromii (*var. *layneae)*	yes	
Federal Endangered (Not State Listed)			
Sonoma alopecurus	*Alopecurus aequalis* var. *sonomensis*	yes	
Federal Species of Concern/State Endangered			
Pt. Reyes meadowfoam	*Limnanthes douglasii ssp. Sulphurea*	yes	
San Francisco popcornflower	*Plagiobothrys diffusus* [a]	yes	
Federal Species of Concern/State Rare			
Point Reyes stickyseed	*Blennosperma nanum var. robustum*	yes	
Mason's ceanothus	*Ceanothus masonii*	yes	Requires fire to reproduce
Federal Species of Concern/CNPS List 1B			
pink sand verbena	*Abronia umbellata ssp.breviflora*	yes	on coastal strand
Blasdale's bentgrass	*Agrostis blasdalei var. blasdalei*[b]	yes	
swamp harebell	*Campanula californica*	yes	
Humboldt Bay owl's-clover	*Castilleja ambigua ssp. Humboldtiensis*	yes	in wetlands
Mt. Vision ceanothus	*Ceanothus gloriosus var. porrectus*	yes	
San Francisco Bay spineflower	*Chorizanthe cuspidata var. cuspidata*	yes	in stabilizing dune habitats
northcoast bird's-beak	*Cordylanthus maritimus ssp. Palustris*	yes	in salt marsh habitat
fragrant fritillary	*Fritillaria liliacea*	yes	
San Francisco gumplant	*Grindelia hirsutula var. maritima*	yes	
Kellogg's horkelia	*Horkelia cuneata ssp. sericea*	no	
Point Reyes horkelia	*Horkelia marinensis*	yes	in grazed pastures
coast lily	*Lilium maritimum*	yes	in grazed pastures
northcoast phacelia	*Phacelia insularis var. continentis*	yes	
San Francisco owl's-clover	*Triphysaria floribunda*	yes	
Federal Species of Concern/CNPS List 2			
Thurber's reedgrass	*Calamagrostis crassiglumis*[c]	yes	
Federal Species of Concern/CNPS List 3			
Marin knotweed	*Polygonum marinense*	yes	in salt marsh
Federal Species of Concern/CNPS List 4			

Gairdner's yampah	*Perideridia gairdneri ssp. Gairdneri*	yes	
No State or Federal Listing/CNPS List 1B			
Marin manzanita	*Arctostaphylos virgata*	yes	requires fire to reproduce
coastal marsh milk-vetch	*Astragalus pycnostachyus var. pycnostachyus*	yes	in coastal strand habitat
coastal bluff morning-glory	*Calystegia purpurata ssp. Saxicola*	yes	
woolly-headed spineflower	*Chorizanthe cuspidata var. villosa*	yes	in sandy dune habitat
Franciscan thistle	*Cirsium andrewsii*	yes	
Marin checker lily	*Fritillaria affinis var. tristulis*	yes	
dune gilia	*Gilia capitata ssp. chamissonis*	yes	in sandy dune habitat
dark-eyed gilia	*Gilia millefoliata*	yes	in sandy dune habitat
perennial goldfields	*Lasthenia macrantha ssp. Macrantha*	yes	
rosy linanthus	*Linanthus rosaceus*	yes	
marsh microseris	*Microseris paludosa*	yes	
Point Reyes rein-orchid	*Piperia elegans ssp. decurtata*	yes	
Point Reyes checkerbloom	*Sidalcea calycosa ssp. rhizomata*	yes	in wet areas
Mt. Tamalpais jewelflower	*Streptanthus glandulosus ssp. Pulchellus*	yes	
No State or Federal Listing/CNPS List 2			
short-leaved evax	*Hesperevax sparsiflora var. brevifolia*	yes	in grazed grassland
delta mudwort	*Limosella subulata*	yes	in mud flats
No State or Federal Listing/CNPS List 3			
white hayfield tarplant	*Hemizonia congesta ssp. Leucocephala*	yes	
No State or Federal Listing/CNPS List 4			
coast rock cress	*Arabis blepharophylla*	yes	
Buxbaum's sedge	*Carex buxbaumii*	yes	in wetlands
Point Reyes ceanothus	*Ceanothus gloriosus var. gloriosus*	yes	
glory brush	*Ceanothus gloriosus var. exaltatus*	yes	requires fire to reproduce
California bottlebrush grass	*Elymus californicus*	yes	
coastal sand verbena	*Erysimum franciscanum*	yes	
large-flowered linanthus	*Linanthus grandiflorus*	yes	
curly leaf monardella	*Monardella undulata*	yes	
nodding semaphore grass	*Pleuropogon refractus*	yes	
Lobb's buttercup	*Ranunculus lobii*	yes	
beach starwort	*Stellaria littoralis*	yes	
No present listing			
unnamed ceanothus	*Ceanothus sp. nov.*	yes	in grazed pastures

a. Recognized by The Jepson Manual (1993) as P. reticulatus var rossianor
b. Recognized by The Jepson Manual (1993) as A. densiflora

Table 2. Potential Occurrences

Common Name	Scientific Name	Known to Occur	Comments
Federal Threatened/State Threatened			
Marin dwarf-flax	*Hesperolinon congestum*	unknown	
Federal Species of Concern/CNPS List 1B			
Tiburon Indian paintbrush	*Castilleja affinis ssp neglectea*	unknown	
Marin checkerbloom	*Sidalcea hickmanii ssp viridis*	unknown	
Santa Cruz silverpuffs	*Stebbinsoseris decipiens*	unknown	
No State or Federal Listing/CNPS List 1B			
roundhead Chinese houses	*Collinsia corymbosa*	unknown	
western leatherwood	*Dirca occidentalis*	unknown	
No State or Federal Listing/CNPS List 2			
flaccid sedge	*Carex leptalea*	unknown	

Appendix 4. Cultural Resources

Table 1. Cultural Landscapes

Landscape Name	CLAIMS #
Bolinas Copper Mines	725194
Hamlet	725193
North Pacific Coast Railway Grade	725195
Olema Valley Ranches Historic District	725001
Cheda Ranch	725209
Five Brooks	725197
Hagmaier Ranch	725212
McFadden Ranch	725203
McIsaac Ranch	725206
Ralph Giacomini Ranch	725014
Stewart Ranch	725199
Teixeira Ranch	725211
Truttman Ranch	725200
Wilkin's Ranch	725003
Zandari Ranch	725191
Tomales Bay Highway One	725482
Coast Guard Facilities	725161
Coast Guard Life Saving Station & Navy Radio Direction Finder Station	725190
Point Reyes Lifeboat Station	725182
Point Reyes Lighthouse	725183
Coastal Defense Sites	725160
Bolinas Military Reservation	725185
Drakes Bay Artillery Installation	725186
SCR Radar Site	725184
Wildcat Military Reservation	725187
Laird's Landing	725159
Olema Lime Kilns	725158
Point Reyes Ranches Historic District	725005
A Ranch	725012
B Ranch	725016
C Ranch	725017
D Ranch	725011
Home Ranch	725006
I Ranch	725167
L Ranch	725013
Upper Pierce Ranch	725177

RCA Marine Radio Station	725162
RCA Receiving Station	725188
RCA Transmitting Station	725189

Table 2. National Register Status

NR Status	Property Name	Property Type & Date
National Register Listed	Olema Lime Kilns, #76000217, 10/08/76	structure/site, c. 1850
	Point Reyes Lifeboat Station, #85002756, 11/07/85 Designated as NHL 12/20/89	complex of buildings/features, c. 1927
	Upper Pierce Ranch, #85003324, 12/06/85	complex of buildings/features, c. 1858-1935
	Point Reyes Light Station, #91001100, 09/03/91	complex of buildings/features, c.1870-1960
Determined Eligible	Sarah Seaver Randall House (GOGA) 08/29/79	single house, c. 1880
	Olema Valley Rural Historic District (GOGA) 01/02/79. Revision & resubmittal in progress.	district c. 1834-present
	Hamlet (Jensen's Oyster Beds) (GOGA) 01/24/90	complex of buildings/features, c. 1900-1945
	Point Reyes NS Rural Historic Landscape District 4/3/1995	district c. 1934-present
National Register Submittal Pending	Point Reyes Peninsula Archeological District	district, prehistoric
Determination of Eligibility Pending	Marconi/RCA Receiving and Transmitting Stations (in review)	complex of buildings/features c. 1914-1945
	Bolinas Copper Mines (GOGA) (in review)	ruins/site, c. 1863-1918
	North Pacific Coast RR Grade (GOGA) (in review)	linear structure/sites, c. 1873-1933
	Tocaloma Bridge (GOGA) (in review)	single structure, c. 1927

Appendix 5. Summary of Resource Protection Measures

General

- A resource advisor will be available to make recommendations about resource impacts of suppression actions;
- Resource advisor will have an opportunity to comment at daily briefings.
- Avoid use of heavy earth-moving equipment such as tractors, graders, bulldozers or other tracked vehicles. The Superintendent can authorize the use of heavy earthmoving equipment in extreme circumstances in the face of loss of human life and/or property.
- Implement Minimum Impact Suppression Techniques (MIT) fire suppression guidelines to minimize and/or eliminate adverse impacts resulting from ground crew activities. These include:
    - Use water for aerial drops whenever possible
    - Prohibit use of foams or other fire retardants in or near wetlands
    - Permit only the use of the following water bodies as water sources:
        - Abbott's Lagoon; preference for the lower lagoon
        - Drake's Estero (Spartina infestation – avoid when possible)
        - Limantour Estero (Spartina infestation – avoid when possible)
        - Pelican Lake
        - Bass Lake
        - Crystal Lake
        - Five Brooks
        - Muddy Hollow
        - Glenbrook
    - Locate helispots, staging areas, and spike camps at least 300 feet away from streams, creeks, and other water bodies
- Implement erosion control methods for line construction on slopes exceeding 10%.
- To the extent practicable, rehabilitate all sites where improvements are made or obstructions removed to pre-fire conditions.
- Locate fire lines outside of highly erosive areas, steep slopes, and other sensitive areas.
- Construct firebreaks or firelines in previously disturbed areas whenever possible.
- Locate helispots or spike camps on previously disturbed sites and open areas whenever possible to minimize additional disturbance.
- Limit creek or river crossings to existing locations.
- Prohibit fire suppression activities within wetlands unless there are no alternatives available to control the spread of a wildland fire.

- Prohibit use of foam or other fire retardants in watersheds that drain into state designated Areas of Special Biological Significance (ASBS). These areas are listed below. See also the READ Natural Resource Maps 1, 7, 10, 11 and 12.
    - Bird Rock
    - The Point Reyes Headlands from the Lighthouse to Chimney Rock
    - Double Point
    - Duxbury Reef/Arroyo Honda Creek watershed

Vegetation

- Consult with READ to locate fire lines to avoid rare plant populations when possible.
- Clean fire management equipment upon arrival to and departure from an incident to prevent the spread of noxious weeds.
- Stage fire management operations away from known noxious weed infestations to the greatest extent possible.
- Avoid using waterbodies infested with exotic weeds for dip sites when possible. Two waterbodies are known to have Spartina infestations at Point Reyes NS:
    - Drakes Estero
    - Limantour Estero
- Consult with READ to avoid fire line construction in known weed patches when possible.

Wildlife

- Aircraft will avoid seal haulouts and seabird nesting and roosting sites to the greatest extent possible.
- Protect occupied and previously used Spotted Owl nest sites from unplanned ignitions.
- Avoid all water bodies known to support red-legged frogs; these are considered 'no dip' water bodies. Acceptable dip sites are:
    - Abbott's Lagoon; preference for the lower lagoon
    - Drake's Estero
    - Limantour Estero
    - Pelican Lake
    - Bass Lake
    - Crystal Lake
    - Five Brooks
    - Muddy Hollow
    - Glenbrook
- Protect known and potential habitat from unplanned ignitions.

Cultural

- Avoid suppression activities that expose mineral soil within cultural sites as defined or delineated in archeological survey reports. Activities include: handline construction, road construction, staging areas and helispots.

- Prohibit fire retardant in the vicinity of any historic structure. May be used as a last resort where there is an imminent threat from wildfire to the historic structure.

- Locate camps and toilet facilities at least 200 feet from known cultural resource sites.

Wilderness

- Wildland fire operations within wilderness will adhere to the requirements of the Wilderness Act, NPS Management Policies, and the NPS Director's Orders 18 and 41 Wilderness Preservation and Management.

- All fire management activities within wilderness will employ minimum actions and tools necessary based upon the Minimum Requirement and Minimum Tool Determination.

- All fire management activities within wilderness will follow established MIT implementation guidelines.

- All fire management activities within wilderness will follow established Rehabilitation Guidelines for Wilderness Fire Suppression Activities.

- Ensure a Resource Advisor is available for advice and support with the crew(s) as well as for quality control.

Appendix 6: Minimum Impact Suppression Tactics Guidelines

On all wildland fire management actions, use of Minimum Impact Suppression Tactics (referred to in this document at Minimum Impact Tactics or MIT) is the policy of the National Park Service. The following pages detail the MIT guidelines adapted from the Forest Service for PRNS.

CONCEPT

The concept of Minimum impact Tactics (MIT) is to use the minimum amount of forces necessary to effectively achieve the fire management protection objectives consistent with land and resource management objectives. It implies a greater sensitivity to the impacts of suppression tactics and their long-term effects when determining how to implement an appropriate suppression response. In some cases MIT may indicate cold trailing or wet line may be more appropriate than constructed hand line. In another example, the use of an excavator may be used rather than a dozer. Individual determinations will be dependent on the specific situation and circumstances of each fire.

MIT is not intended to represent a separate or distinct classification of firefighting tactics but rather a mind set of how to suppress a wildfire while minimizing the long-term effects of the suppression action. When the term MIT is used in this document it reflects the above principle.

Suppression actions on all wildfires within PRNS protected wilderness will be those having a minimum impact on the physical resources associated with each site. In so doing, the principle of fighting fire aggressively but providing for safety first will not be compromised.

The key challenge to the line officer, fire manager and firefighter is to be able to select the wildfire suppression tactics that are appropriate given the fire's probable or potential behavior. The guiding principle is always least cost plus loss while meeting land and resource management objectives. It is the second part of this statement which must be recognized more than it has in the past. Appreciation of the values associated with wilderness has been more difficult to articulate but, nevertheless, are important. As this recognition emerges, actions must be modified to accommodate a new awareness of them.

These actions, or MIT, may result in an increase in the amount of time spent watching, rather than disturbing, a dying fire to insure it does not rise again. They may also involve additional rehabilitation measures on the site that were not previously carried out.

When selecting an appropriate suppression response, firefighter safety must remain the highest concern. In addition, fire managers must be assured the planned actions will be effective and will remain effective over the expected duration of the fire.

GOAL

The goal of MIT is to halt or delay fire spread in order to maintain the fire within predetermined parameters while producing the least possible impact on the resource being protected. These parameters are represented by the initial attack incident commander's size-up of the situation in the case of a new start or by the escaped fire situation analysis (EFSA) in case of an escaped fire.

It is important to consider probable rehabilitation need as a part of selecting the appropriate suppression response. Tactics that reduce the need for rehab are preferred whenever feasible.

SUPPRESSION RESPONSIBILITY

As stated previously, safety is the highest priority. All action will be anchored to the standard fire orders and watch out situations. Safety will remain the responsibility of each person involved with the incident.

Initial/Extended Attack

Incident Commander – To understand and carry out an appropriate suppression response, which will best meet the land management objectives of the area at the least cost plus loss. Insure all forces used on the fire understand the plan for suppressing the fire in conjunction with MIT.

Keep in communication with responsible fire management or line officer to insure understanding and support of tactics being used on the fire. Evaluate and provide feedback as to the tactical effectiveness during and after fire incident.

Project Fire

Type 1/ Type 2 Incident Commander – To carry out instructions given by the responsible line officer both verbally and through the WFSA. Establish and nurture a close dialogue with the resource advisors assigned to the fire team. Review actions on site and evaluate for compliance with land line officer direction and effectiveness at meeting fire management protection objectives.

Responsible Line Officer –transmits the land management objectives of the fire area to the fire team and to define specific fire management protection objectives. Periodically review for compliance.

Resource Advisor – To insure the interpretation and implementation of WFSA and other oral or written line officer direction is adequately carried out. Provide specific direction and guidelines as needed. Participate at fire team planning sessions, review incident action plans and attend daily briefings to emphasize resource concerns and management's expectations. Provide assistance in updating WFSA when necessary. Participate in incident management team debriefing and assist in evaluation of team performance related to MIT.

IMPLEMENTATION GUIDELINES

Following is a list of considerations for each fire situation.

Hot-Line/Ground Fuels

- Allow fire to burn to natural barriers.
- Use cold-trail, wet line or combination when appropriate.
- If constructed fire line is necessary, use only width and depth to check fire spread.
- Burn out and use low impact tools like swatter or 'gunny' sack.
- Minimize bucking and cutting of trees to establish fire line; build line around logs when possible.
- Use alternative mechanized equipment such as excavators, rubber tired skidders, etc. rather than tracked vehicles. Use high pressure type sprayers to clean equipment prior to assigning equipment to the incident command in order to reduce the potential to spread noxious weeds.
- Constantly re-check cold trailed fire line.

Hot-Line/Aerial Fuels

- Limb vegetation adjacent to fire line only as needed to prevent additional fire spread.
- During fire line construction, cut shrubs or small trees only when necessary. Make all cuts flush with the ground.
- Minimize felling of trees and snags unless they threaten the fire line or seriously endanger workers. In lieu of felling, identify hazard trees with a lookout or flagging.
- Scrape around tree bases near fire line if it is likely they will ignite.

Mop-up/Ground Fuels

- Do minimal spading; restrict spading to hot areas near fire line.
- Cold-trail charred logs near fire line; do minimal tool scarring.
- Minimize bucking of logs to extinguish fire or to check for hotspots; roll the logs instead if possible.
- Return logs to original position after checking and when ground is cool.
- Refrain from making bone yards; burned and partially burned fuels that were moved should be returned to a natural arrangement.

- Consider allowing large logs to burn out. Use a lever rather than bucking to manage large logs that have to be extinguished.

- Use gravity socks in stream sources and/or a combination of water blivits and fold-a-tanks to minimize impacts to streams.

- Consider using infrared detection devices along perimeter to reduce risk.

- Personnel should avoid using rehabilitated fire lines as travel corridors whenever possible because of potential soil compaction and possible detrimental impacts to rehab work, i.e. water bars.

Mop-up/Aerial Fuels

- Remove or limb only those fuels which if ignited have potential to spread fire outside the fire line.

- Before felling consider allowing ignited tree/snag to burn itself out. Ensure adequate safety measures are communicated if this option is chosen.

- Identify hazard trees with a lookout or flagging.

- If burning trees/snag pose a serious threat of spreading fire brands, extinguish fire with water or dirt whenever possible. Consider felling by blasting when feasible. Felling by crosscut or chainsaw should be the last resort.

- Align saw cuts to minimize visual impacts from more heavily traveled corridors. Slope cut away from line of sight when possible.

LOGISTICS

Campsite Considerations

- Locate facilities outside of wilderness whenever possible.

- Coordinate with the Resource Advisor in choosing a site with the most reasonable qualities of resource protection and safety concerns.

- Evaluate short-term low impact camps such as coyote or spike versus use of longer-term higher impact camps.

- Use existing campsites whenever possible.

- New site locations should be on impact resistant and naturally draining areas such as rocky or sandy soils, or openings with heavy timber.

- Avoid camps in meadows, along streams or on lakeshores. Camps should be located at least 300 feet from water resources or other sensitive areas.

- Consider impacts on both present and future users. An agency commitment to wilderness values will promote those values to the public.

- Lay out the camp components carefully from the start. Define cooking, sleeping, latrine, and water supply.

- Minimize the number of trails and ensure adequate marking.

- Consider fabric ground cloth for protection in high use areas such as around cooking facilities.

- Use commercial portable toilet facilities where available. If these cannot be used a latrine hole should be used.

- Select latrine sites a minimum of 200 feet from water sources with natural screening.

- Do not use nails in trees.

- Constantly evaluate the impacts which will occur, both short and long term.

Personal Camp Conduct

- Use "leave no trace" camping techniques.

- Minimize disturbance to land when preparing bedding site. Do not clear vegetation or trench to create bedding sites.

- Use stoves for cooking, when possible. If a campfire is used limit to one site and keep it as small as reasonable. Build either a "pit" or "mound" type fire. Avoid use of rocks to ring fires.

- Use down and dead firewood. Use small diameter wood, which burns down more cleanly.

- Don't burn plastics or aluminum – "pack it out" with other garbage.

- Keep a clean camp and store food and garbage so it is unavailable to wildlife. Ensure items such as empty food containers are clean and odor free, never bury them.

- Select travel routes between camp and fire and define clearly.

- Carry water and bathe away from lakes and streams. Personnel must not introduce soaps, shampoos or other personal grooming chemicals into waterways.

AVIATION MANAGEMENT

One of the goals of wilderness managers is to minimize the disturbance caused by air operations during an incident.

Aviation Use Guidelines

- Maximize back haul flights as much as possible.
- Use long line remote hook in lieu of constructed helispots for delivery or retrieval of supplies and gear.
- Take precautions to insure noxious weeds are not inadvertently spread through the deployment of cargo nets and other external loads.
- Use natural openings for helispots and paracargo landing zones as far as practical. If construction is necessary, avoid high visitor use areas.
- Consider maintenance of existing helispots over creating new sites.
- Obtain specific instructions for appropriate helispot construction prior to the commencement of any ground work.
- Consider directional falling of trees and snags so they will be in a natural appearing arrangement.
- Buck and limb only what is necessary to achieve safe/practical operating space in and around the landing pad area.
- Avoid all water bodies known to support red-legged frogs. All park waterbodies are considered 'no dip' and are to be avoided except for the following waterbodies. Acceptable dip sites are:
    - Abbott's Lagoon; preference for the lower lagoon
    - Drake's Estero
    - Limantour Estero
    - Pelican Lake
    - Bass Lake
    - Crystal Lake
    - Five Brooks
    - Muddy Hollow
    - Glenbrook
    - Tomales Bay

Retardant Use

During initial attack, fire managers must weigh the non-use of retardant with the probability of initial attack crews being able to successfully control or contain a wildfire. If it is determined that use of retardant may prevent a larger, more damaging wildfire, then the manager might consider retardant use even in sensitive areas. This decision must take into account all values at risk and the consequences of larger firefighting forces' impact on the land.

- Consider impacts of water drops versus use of foam/retardant. If foam/retardant is deemed necessary, consider use of foam before retardant use.
- There may be restrictions on certain types of retardant.

HAZARDOUS MATERIALS

Flammable/Combustible Liquids

- Store and dispense aircraft and equipment fuels in accordance with National Fire Protection Association (NFPA) and Health and Safety Handbook requirements.
- Avoid spilling or leakage of oil or fuel, from sources such as portable pumps, into water sources or soils.
- Store any liquid petroleum gas (propane) downhill and downwind from firecamps and away from ignition sources.

Flammable Solids

- Pick up residual fusees debris from the fire line and dispose of properly.

Fire Retardant/Foaming Agents

- Do not drop retardant or other suppressants near surface waters.
- Do not use retardant within watersheds that drain into Areas of Special Biological Significance:
    - Bird Rock
    - The Point Reyes Headlands from the Lighthouse to Chimney Rock
    - Double Point
    - Duxbury Reef/Arroyo Honda Creek watershed
- Use caution when operating pumps or engines with foaming agents to avoid contamination of water sources.

FIRE REHABILITATION

Rehabilitation is a critical need. This need arises primarily because of the impacts associated with fire suppression and the logistics that support it. The process of constructing control lines, transport of personnel and materials, providing food and shelter for personnel, and other suppression activities has a significant impact on sensitive resources regardless of the mitigating measures used. Therefore, rehabilitation must be undertaken in a timely, professional manner.

During implementation, the resource advisor should be available for expert advice and support of personnel doing this work as well as quality control.

Handlines/Dozerlines

- Pull all soil, litter, and duff disturbed by line construction back into line. Rake berms back into the line and randomly scatter debris to hide line.
- Fill in cup trenches back to original grade.
- Scatter concentrations of slash or debris.
- Leave all freshly fallen trees as they lay. Do not limb or buck.
- For logs that were cut for line construction or cut snags, either:
    - piece the log back together.
    - hide the cut face.
    - slant cut the face.
- Flush cut stumps to the greatest extent possible (Standard is 1"above ground). Scatter cut pieces out of sight. Dress cut surface and cover with debris to appear as natural as possible.
- Leave snags standing unless they must be removed to provide for firefighter safety.
- If impacted trails have developed on slopes greater than six percent, construct waterbars according to the following waterbar spacing guide:

Trail Percent Grade	Maximum Spacing Ft.
6-9	400
10-15	200
15-25	100
25+	50

- Pick up and remove all flagging, garbage, litter, and equipment. Dispose of trash appropriately.

Facilities (camps, helibases, drop points, helispots, etc)

- Where soil has been exposed and compacted, such as in camps, on user-trails, at helispots and pump sites, scarify the top 2-4 inches and scatter with needles, twigs, rocks, and dead branches.

- These areas should be monitored for vegetation damage and invasive species. Any issues should be addressed as they arise.

- Blend campsites with natural surroundings, by filling in and covering latrine with soil, rocks, and other natural material. Naturalize campfire area by scattering ashes in nearby brush (after making sure any sparks are out) and returning site to a natural appearance.
- For logs that were cut for line construction or cut snags, either:
    - piece the log back together.
    - hide the cut face.
    - slant cut the face.

- Flush cut stumps to the greatest extent possible (Standard is 1"above ground). Scatter cut pieces out of sight. Dress cut surface and cover with debris to appear as natural as possible.
- Leave tops of felled trees attached. This will appear more natural than scattering the debris.

- Pick up and remove all flagging, garbage, litter, and equipment. Dispose of trash appropriately.

- Walk through adjacent undisturbed area and take a look at your rehab efforts to determine your success at returning the area to as natural a state as possible. Good examples should be documented and shared with others!

DEMOBILIZATION

Because demob is often a time when people are tired or when weather conditions are less than ideal, enough time must be allowed to do a good job. When moving people and equipment, choose the most efficient and least impactive method to both the landscape and fire organization mission. An on-the-ground analysis of "How Things Went" will be important.

POST-FIRE EVALUATION

Post-fire evaluation is important for any fire occurrence so management can find out how things went. Identify areas needing improvement, to formulate strategies and to produce quality work in the future. This activity is especially important in wilderness and like sensitive areas due to their fragility and inclination to long-term damage by human impacts.

Resource advisors and functional specialists such as wilderness rangers will be responsible for conducting the post-fire evaluation. They are the people who have the experience and knowledge to provide information required to make the evaluation meaningful and productive.

Post-fire evaluation by Burn Area Response Emergency Team will begin during the suppression effort. An emergency stabilization plan will be completed within 7 days of the date of fire containment per 620 DM 3.

DATA COLLECTION/DOCUMENTATION/RECOMMENDATIONS

This phase will be completed by a review of the rehab plan and visit to the fire site as soon after demobilization as possible. An inventory of comps and helispots will be completed. This will also include an objective overview of other areas covered by the rehab plan.

Observations will be documented in a brief report to the line officer with a copy to the appropriate incident commander. In the report, the evaluator will include recommendations for ensuing fire suppression activities on similar lands. It is important that the evaluator recognize and commend the initial attack forces or overhead team for positive activities. Make special note of the extra efforts and sensitivity to suppression impacts.

Appendix 7: References

Anderson, R. (2005). Contrasting Vegetation and Fire Histories on the Point Reyes Peninsula During the Pre-Settlement and Settlement Periods. Flagstaff, AZ, Northern Arizona University**:** 31.

Brown, Kaye, et al. (1999). "Fire history in douglas-fir and coast redwood forests at Point Reyes Nat'l Seashore, CA." Northwest Science **73**(3): 205-216.

Clar, C. (1957). Forest use in Spanish-Mexican California, Division of Forestry, Department of Natural Resources, State of California.

Cook, S. (1976). The Conflict Between the California Indian and White Civilization. Berkeley and Los Angeles, CA, University of California Press.

D'Antonio, C., S. Bainbridge, et al. (2001). Ecology and restoration of California grasslands with a special emphasis on the influence of fire adn grazing on native species. Berkeley, CA, Packard Foundation**:** 99.

Davis, F. and M. Borchert (2006). Central Coast Bioregion. Fire in California's Ecosystems. N. Sugihara, J. van Wagtendonk, K. Shaffer, J. Fites-Kaufman and A. Thode. Berkeley, CA, University of California Press**:** 321-349.

Dawson, T. (1998). "Fog in the California redwood forest: ecosystem inputs and use by plants." Oecologia **117**: 476-485.

Fellers, G., D. Pratt, et al. (2003). Fire Effects on the Point Reyes Mountain Beaver (Aplodontia

rufa phaea) at Point Reyes National Seashore. Point Reyes Station, CA, Western Ecological Research Center, USGS.

Fletcher, F. (1628). The World Encompassed by Sir Francis Drake.

Gordon, T., A. Storer, et al. (2001). "The pitch canker epidemic in California." Plant Disease **85**(11): 1128-1139.

Heady, H., T. Foin, et al. (1988). Coastal prairie and northern coastal scrub. Terrestrial Vegetation of California. M. Barbour and J. Major. Davis, CA, California Native Plant Society. **1988 Edition**.

Hermann, R. and D. Lavender (1990). Psedutsuga menziesii (Mirb.) Franco Douglas-fir. Silvics of North America. R. Burns and B. Honkala. Washington, DC, USDA, Forest Service. **Volume 1, Conifers:** 527-540.

Holzman, B. (2003). Post-fire vegetation response in the Bishop pine forest at Point Reyes National Seashore. Lessons Learned from the October 1995 Vision Fire. Point Reyes Station, CA, Point Reyes National Seashore**:** 64-79.

Jacobs, D., D. Cole, et al. (1978). Fire History and Preservation Management of Coast Redwood Forest. Berkeley, CA, University of California, Berkeley**:** 14.

Kashiwagi, J. (1985). Soil Survey of Marin County, California. S. C. S. USDA, National Cooperative Soil Survey**:** 229.

Keeley, J. E. (2002). "Native American impacts on fire regimes of the California Coast Ranges." Journal of Biogeography **29**: 303-320.

Lewis, H. (1973). Patterns of Indian Burning in California: Ecology and Ethnohistory. Ramona, CA, Ballena Press.

McBride, J. and H. Heady (1968). "Invasion of grassland by Baccharis pilularis DC." Journal of Range Management **21**: 106-108.

McBride, J. and D. Jacobs (1978). Muir Woods: The History of the Vegetation of Muir Woods National Monument. Berkeley, CA, University of California**:** 39.

Menzies, A. (1924). "California Journal Excerpts." California Historical Society Quarterly **2**(4): 302.

Noss, R., E. Laroe, et al. (1995). Endangered ecosystems of the United States: a preliminary assessment of loss and degradation. U.S. Dept. of the Interior. Washington, DC, US Department of the Interior.

NPS (1999). Director's Order 41, Wilderness Preservation and Management. Department of the Interior, National Park Service, Department of the Interior.

NPS (2000). National Park Service Management Policies, Department of the Interior.

Odion, D. (2000). "Seed banks of long-unburned stands of maritime chaparral: composition,

germination behavior, and survival with fire." Madrono **47**(3): 195-203.

Odion, D. and C. Tyler (2002). "Are long fire-free periods needed to maintain the endangered, fire-recruiting shrub Arctostaphylos morroensis(Ericaceae)?" Conservation Ecology **6**(2): 4-15.

Olson, D., D. Roy, et al. (1990). Sequoia sempervirens (D. Don) Endl. Redwood. Silvics of North America. R. Burns and B. Honkala. Washington, DC, USDA, Forest Service. **Volume 1, Conifers:** 541-551.

Parravano, A. (1999). Profiles of Three Rare Plant Taxa on Bolinas Ridge. Point Reyes Station, CA, Point Reyes National Seashore**:** 6.

Revere, J. (1947). Naval duty in California. Oakland, CA, Biobook.

Sawyer, J., D. Thornburgh, et al. (1988). Mixed Evergreen Forest. Terrestrial Vegetation of California. M. Barbour and J. Major. Davis, CA, California Native Plant Society. **1988 Edition:** 359-381.

Slayermaker, C. (1983). Ethnological Study of Coast Miwok. Davis, CA, University of California, Davis.

Stewart, O. (1951). "Burning and natural vegetation in the United States." Geographical Review **41**: 317-320.

Stuart, J. and S. Stephens (2006). North Coast Bioregion. Fire in California's Ecosystems. N. Sugihara, J. Van Wagtendonk, K. Shaffer, J. Fites-Kaufman and A. Thode. Berkeley, CA, University of California Press**:** 147-169.

Sugnet, P. and R. Martin (1984). Fire History and Post-Fire Stand Dynamics of the Inverness Bishop Pine at Point Reyes National Seashore. Berkeley, CA, University of California, Berkeley**:** 82.

Sweicki, T. and E. Bernhardt (2006). Study of Marin Manzanita Population Distribution. Point Reyes Station, CA, Point Reyes National Seashore**:** 6.

Taylor, A. and C. Skinner (1998). "Fire history and landscape dynamics in a late-successional reserve, Klamath Mountains, California, USA." Forest Ecology and Management **111**: 285-301.

Toogood (1980). A Civil History of Golden Gate National Recreation Area and Point Reyes National Seashore, National Park Service, Department of the Interior.

Treganza, R. (1961). The Indian Story of Point Reyes. Land Use Survey, Point Reyes, USDI, National Park Service.

USDA (1985). Soil Survey of Marin County, California. Washington, DC, Soil Conservation Service.

Van Dyke, E. and K. Holl (2001). "Maritime chaparral community transition in the absence of fire." Madrono **48**(4): 221-229.

van Wagtendonk, J. (2006). Pers. Comm.

Vogl, R., W. Armstrong, et al. (1988). The closed-cone pines and cypress. The Terrestrial Vegetation of California. M. Barbour and J. Major. Davis, CA, California Native Plant Society**:** 295-358.

Zinke, P. (1988). The redwood forest and associated north coast forests. The Terrestrial Vegetation of California. M. Barbour and J. Major. Davis, CA, California Native Plant Society**:** 679-698.