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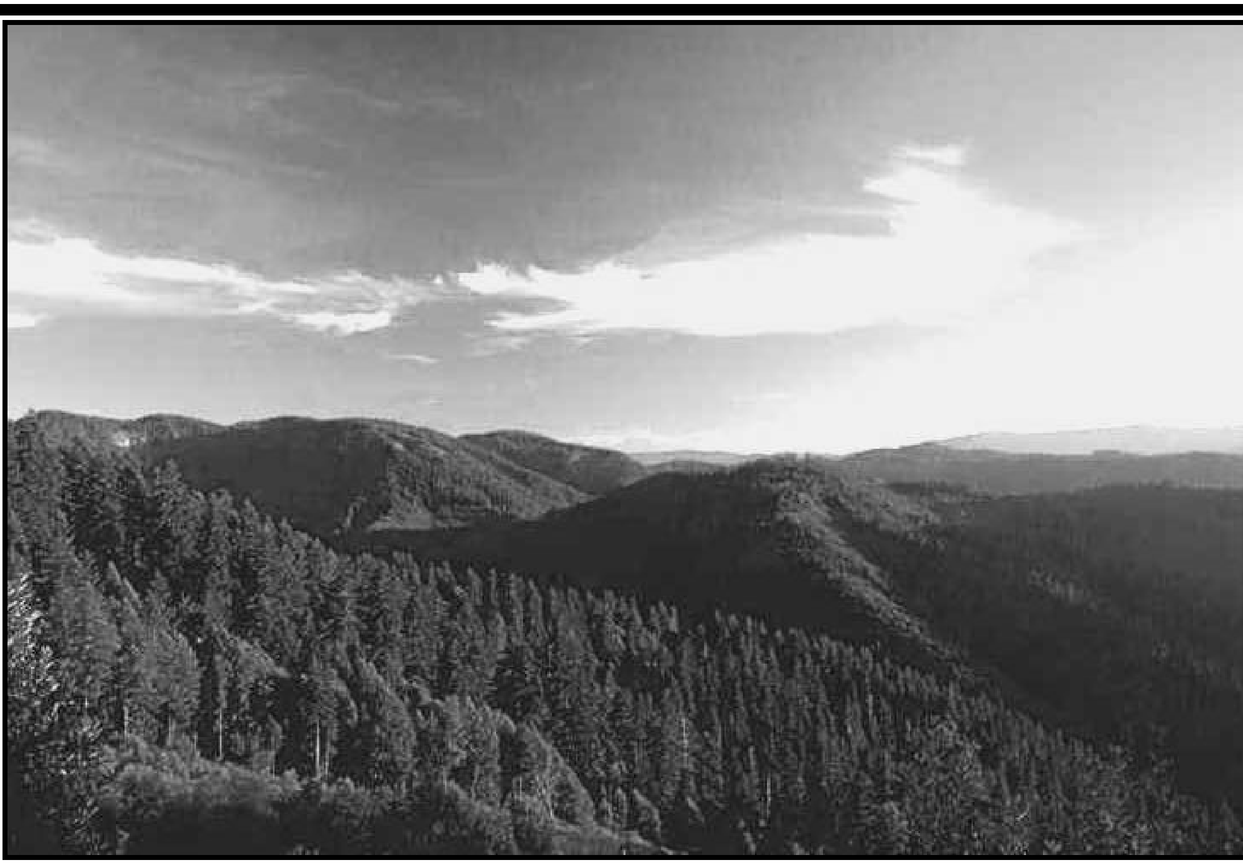
Horse Linto, Mill and Tish Tang Creek Watershed Analysis

Version 1.0



Watershed Analysis
For
Horse Linto, Mill, and Tish Tang Creeks
Version 1.0

Six Rivers National Forest
Forest Service
U.S. Department of Agriculture

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INTRODUCTION

The Purpose of Watershed Analysis

Watershed analysis (WA) is a procedure used to characterize the human, aquatic, riparian, and terrestrial features, conditions, processes and interactions (collectively referred to as "ecosystem elements") within a watershed. It provides a systematic way to understand and organize ecosystem information. In doing so, watershed analysis enhances our ability to estimate direct, indirect and cumulative effects of our management activities and guide the general type, location and sequence of appropriate management activities within the watershed.

Watershed analysis is essentially ecosystem analysis at the watershed scale that provides the watershed context for fishery protection, restoration and enhancement efforts. The understanding gained through watershed analysis is critical to sustaining the health and productivity of natural resources. Healthy ecological functions are essential to maintain current and create future social and economic opportunities.

Watershed analyses are conducted by a team of journey-level specialists who follow the six-step process outlined in *"Ecosystem Analysis at the Watershed Scale – Federal Guide for Watershed Analysis".* This process is issue driven. Rather than attempting to identify and address everything in the ecosystem, teams focus on seven core analysis topics along with watershed-specific problems or concerns. These problems or concerns may be known or suspected before undertaking the analysis or may be discovered during the analysis. Analysis Teams identify and describe ecological processes of greatest concern, establish how well or poorly these processes are functioning and determine the conditions under which management activities should and should not be taken. The process is incremental, meaning that new information from surveys, inventories, monitoring reports or other analyses can be added at any time.

Watershed analysis is not a decision-making process. Rather it is a stage-setting process. The results of watershed analysis establish the context for subsequent decision-making processes. The results of watershed analysis can be used to:

- Assist in developing ecologically sustainable programs to produce water, timber, recreation and other commodities.
- Facilitate program and budget development by identifying and setting priorities for social, economic and ecological needs within and among watersheds.
- Establish consistent, watershed-wide context for project level National Environmental Policy Act (NEPA) analyses.
- Establish a watershed context for evaluating management activity and project consistency given existing plan objectives.
- Establish consistent, watershed-wide context for implementing the Endangered Species Act.
- Establish a consistent, watershed-wide context for local government water quality efforts and for protection of beneficial uses identified by the states and tribes in their water quality standards under the Federal Clean Water Act.

Focus of This Watershed Analysis

On August 23, 1999, dry lightning storms ignited the Megram and Fawn Fires in the Trinity Alps Wilderness on the Shasta-Trinity National Forest. These two fires burned together during the second week of September and became the Megram Fire. On September 27, high northeast winds pushed the fire across the control lines and onto the Six Rivers National Forest. The fire made major runs within the Horse Linto Creek and Tish Tang Creek drainages. Another northeast wind on October 16 blew the fire out of Red Cap Creek into Mill Creek. By the time the Megram fire was controlled on November 4, it had burned through a total of 125,000 acres: 59,220 acres on the Six Rivers National Forest; 63,340 on the Shasta Trinity National Forest; 1,680 acres on the Hoopa Valley Indian Reservation; and 800 acres on private lands.

The focus of this watershed analysis is to assess the affects the Megram Fire had on the physical, biological and human processes within the Horse Linto Creek, Mill Creek and Tish Tang Creek Watersheds. The WA will provide information on the current condition in these watersheds as well as the desired condition based on the Land and Resource Management Plan (LRMP) and the Forest-wide Late-Successional Reserve Assessment (LSRA). It will also identify opportunities and possible management practices that could be implemented to meet the following objectives:

1. Recovery of high intensity burned areas
2. Recovery of burned plantations
3. Watershed restoration in Tish Tang, Mill, Horse Linto and Red Cap drainages
4. Fuels management for community protection and protection of the Late Successional Reserve (LSR)
5. Long term health and recovery of the LSR

Note: the Red Cap watershed is being analyzed in a separate effort.

This watershed analysis will focus primarily on the lands within these three watersheds that are administered by the Six Rivers National Forest. Lands on the Hoopa Valley Indian Reservation and other private lands will be addressed when they influence the management of Six Rivers National Forest lands, or to provide the context for analysis.

Previous Watershed Analyses

This is not the first watershed analysis of these watersheds. The Forest completed a watershed analysis for the Horse Linto Creek watershed in 1994 that focused on watershed restoration. The Lower Trinity Ranger District performed focused watershed analyses for all three watersheds in 1996 to address a large-scale blowdown event that occurred in the winter of 1995/1996. The Hoopa Tribe has performed watershed analyses on both the Mill and Tish Tang Creek watersheds; these analyses focus on watershed management issues.

Public Participation

One important component of watershed analysis is public input. Briefings and field trips have been held for the Klamath and Coastal Province Advisory Committees, Congressional representatives, other elected officials, National Marine Fisheries Service, U. S. Fish and Wildlife Service, local tribal representatives, the news media and the general public. Information about the severity of the fire, the rehabilitation work accomplished so far and future plans was provided. This dialogue has continued at several follow-up public meetings in the communities of Willow Creek, Hoopa and Eureka. These meetings have been well attended by individuals representing the full spectrum of interest groups. Valuable input about land management activities that may be appropriate to restore the fire area has been gathered. Formal consultation with local tribal governments has also been conducted.

Format of the Document

This document is organized into five chapters.

Chapter 1 – Characterization of the Watershed: This chapter provides an overview of the dominant physical, biological and human processes or features of the watershed that affect ecosystem functions or conditions. The relationships among these ecosystem elements and those occurring in the river basin or province are briefly described. It also includes the most important land allocations, Forest Plan objectives and regulatory constraints that influence resource management in the watersheds. The watershed context is used to identify the primary ecosystem elements that will be analyzed in detail.

Chapter 2 – Issues and Key Question: This chapter provides the key elements of the ecosystem that are most relevant to the management questions or objectives, human values, or resource conditions within the watersheds. These issues and key questions are developed by the team, considering input received from the public.

Chapter 3 – Current and Reference Conditions: This chapter addresses in detail the dominant physical, biological and human processes or features of the watershed that affect ecosystem functions or conditions (more detailed than the characterization in chapter 1) relevant to the issues and key questions identified in Chapter 2. The current range, distribution and condition of these ecosystem elements are documented. This chapter also explains how ecological conditions have changed over time because of human influence and natural disturbances. Reference conditions are developed for subsequent comparison with current conditions over the period that the system evolved and with key management plan objectives.

Chapter 4 – Synthesis and Interpretation: This chapter compares existing and reference conditions of specific ecosystem elements and explains significant differences, similarities or trends and their causes. It also discusses the interrelationships among ecosystem components to ensure that management recommendations are based on interdisciplinary considerations. The capability of the system to achieve key management plan objectives is also provided.

Chapter 5 – Recommendations: This chapter brings the results to conclusion, focusing on management recommendations that are responsive to ecosystem processes identified in the preceding synthesis and interpretation. Specifically, it summarizes the opportunities to resolve issues and move from existing conditions to the desired conditions identified in the Forest Plan or LSRA. It also includes possible management practices that could be implemented to meet each opportunity.

CHAPTER 1

CHARACTERIZATION OF THE WATERSHEDS

Introduction

This chapter provides an overview of the Horse Linto Creek, Mill Creek and Tish Tang a Tang Creek (HLMTT) watersheds in terms of the dominant physical, biological and human processes and features of the watershed and their effect on ecosystem function or condition. It also relates these features and processes with those occurring in the river basin, and provides the watershed context for identifying elements that need to be addressed in this analysis.

Location

The watershed analysis area encompasses approximately 91,990 acres: 42,090 acres in the Horse Linto Creek watershed; 30,740 acres in the Mill Creek watershed; and 19,160 acres in the Tish Tang a Tang (Tish Tang) Creek watershed. The HLMTT watersheds are located in northeastern Humboldt County, California, primarily on the Lower Trinity Ranger District of the Six Rivers National Forest and the Hoopa Valley Indian Reservation (see Figure 1-1). They are situated near the downstream end of the Trinity River basin. Nearby communities include Hoopa and Willow Creek. The Megram Fire of 1999 affected large portions of these watersheds; Figure 1-2 shows the Megram Fire boundary in relation to the watersheds.

Land Allocations and Management Direction

Planning direction for the Six Rivers National Forest is covered in the 1995 Six Rivers National Forest Land and Resource Management Plan (LRMP). The LRMP incorporated the direction in the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl, or ROD, as it is commonly known. Figure 1-3 shows the land allocations within the HLMTT watersheds. Table 1-1 shows the land allocations by watershed.

Table 1-1. Six Rivers National Forest Land Allocations by Watershed in HLMTT Area

Management Area	Horse Linto	Mill Creek	Tish Tang	Total
Wilderness	9,960	2,000	2,840	13,800
LSR 305	31,830	11,050	7,950	50,830
Roadless	4,880	1,850	5,770	12,500
Roaded	26,950	9,210	2,180	38,340
Partial Retention	0	560	0	560
General Forest	360	0	0	360
Grand Total	42,150	13,610	10,790	65,550

Figure 1-1. **Vicinity Map of HLMTT Watersheds:**

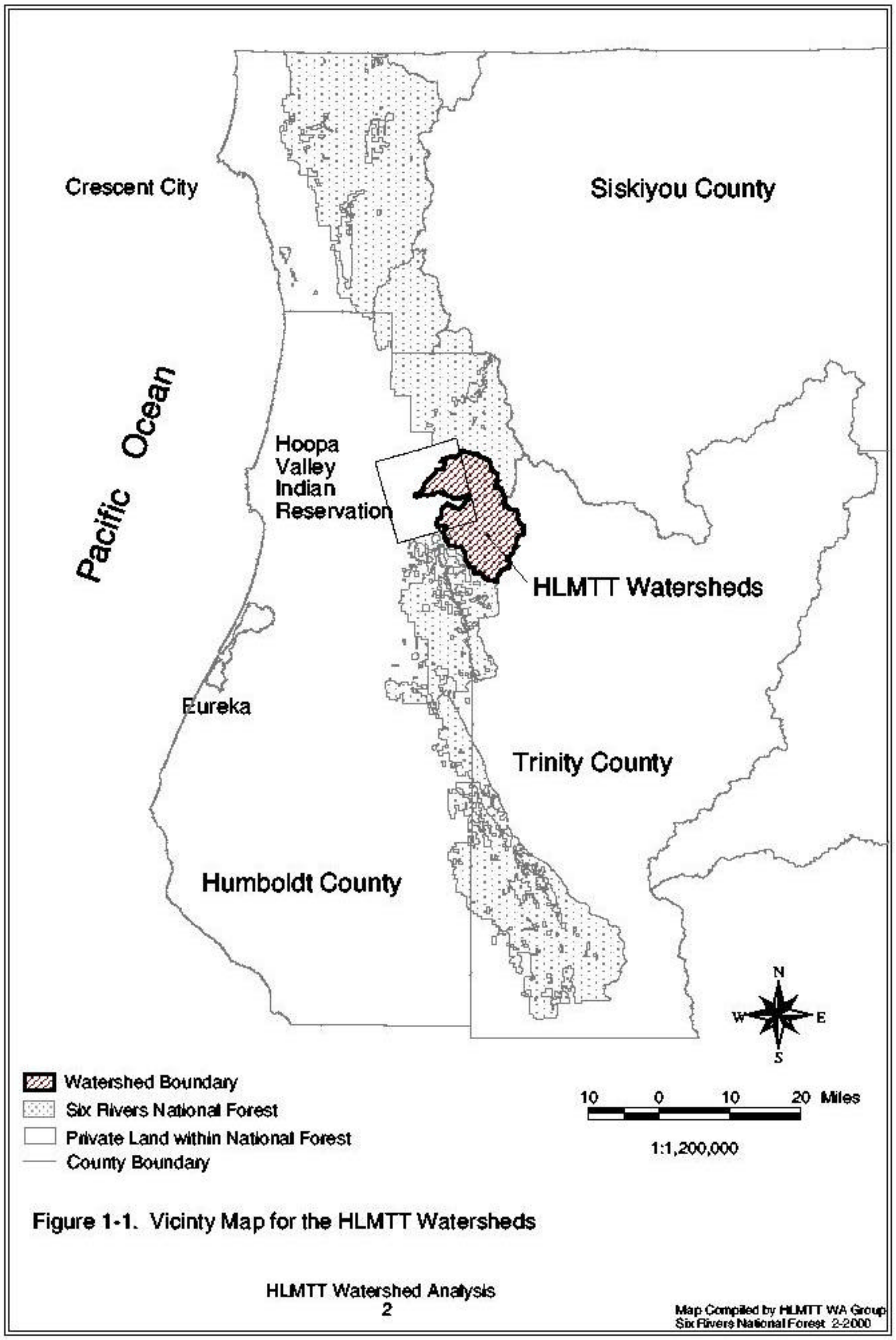


Figure 1-2. **The Megram Fire in Relation to the HLMTT Watersheds:**

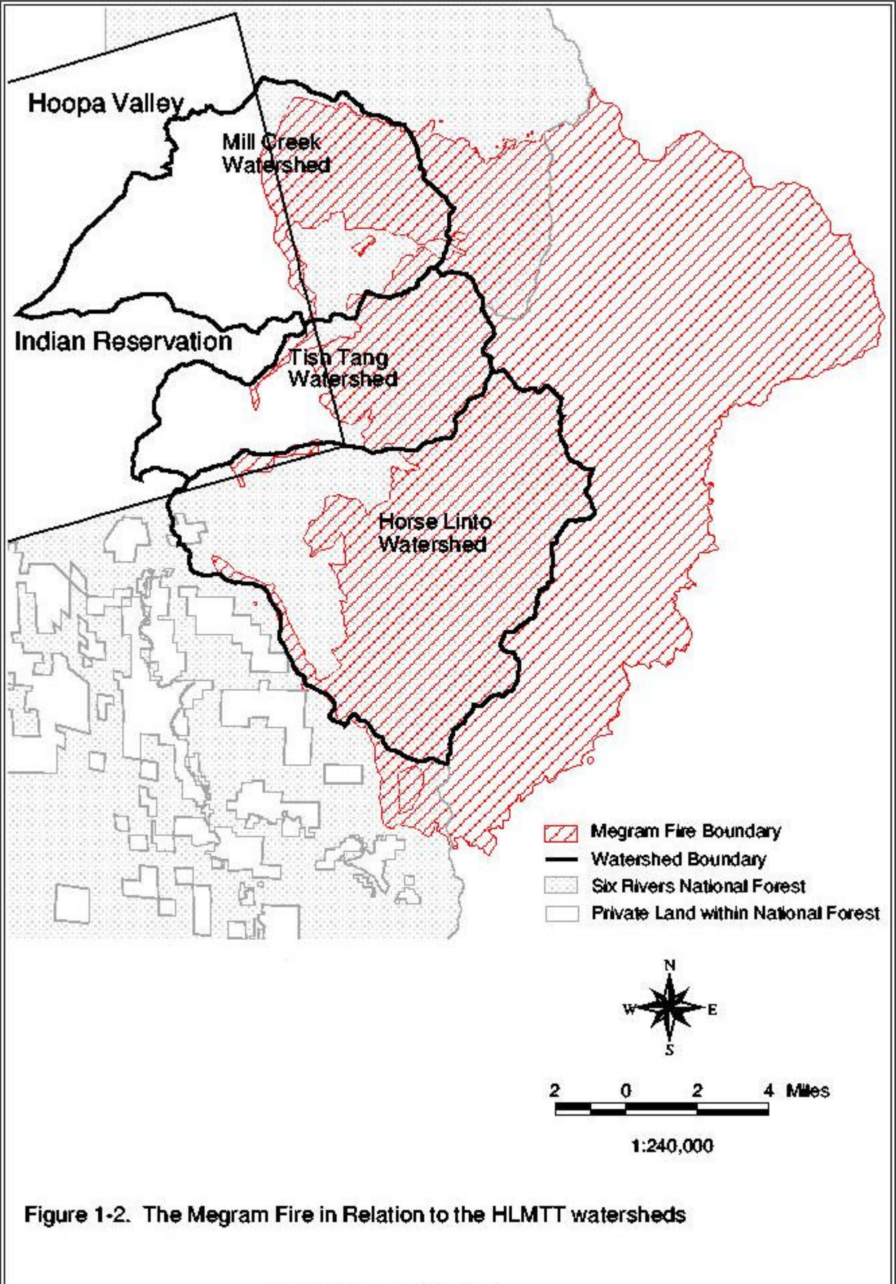
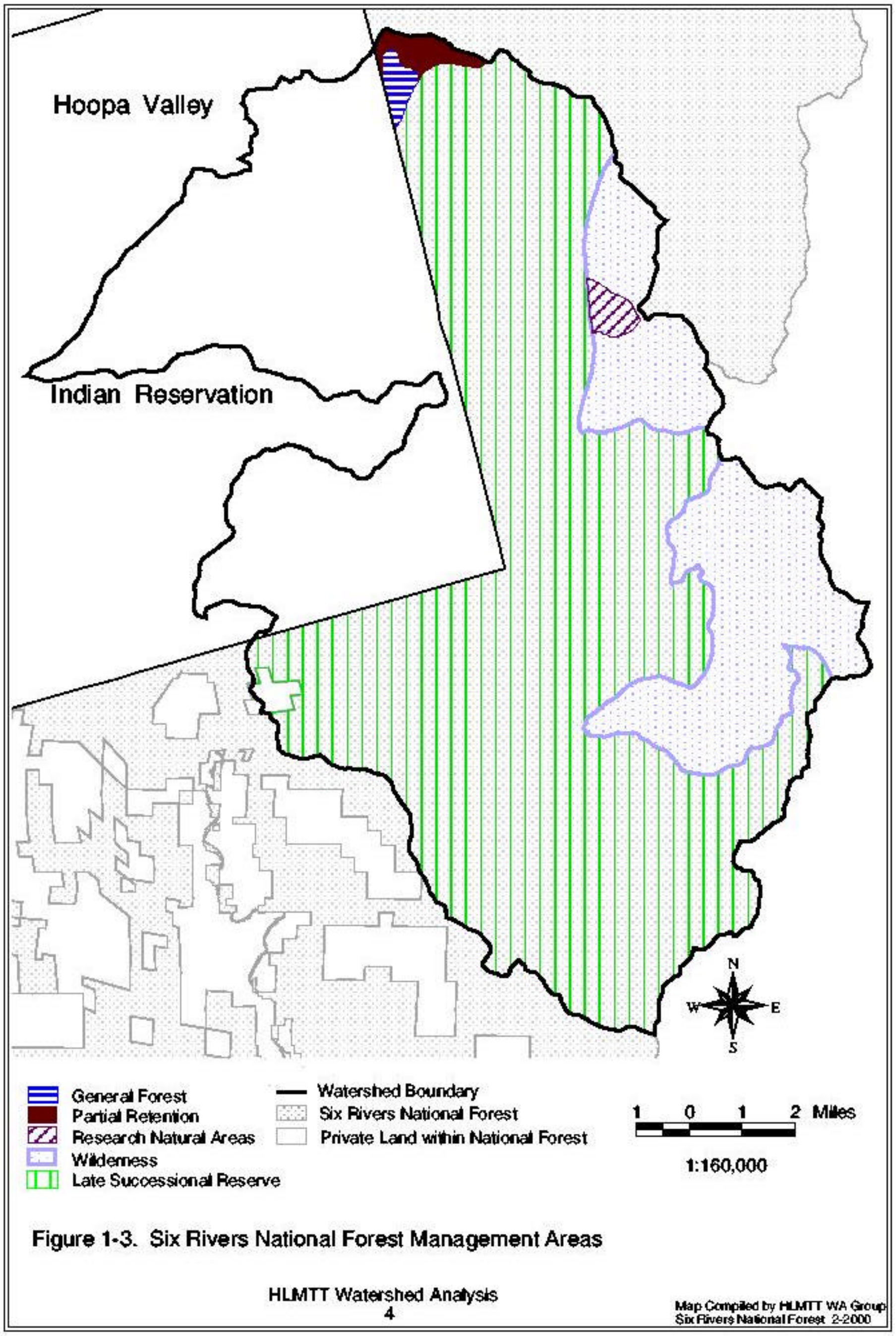


Figure 1-2. The Megram Fire in Relation to the HLMTT watersheds

Figure 1-3. **Six Rivers National Forest Management Areas:**



Late-Successional Reserve

A large portion of the HLMTT area (50,830 acres) is located within Late-Successional Reverse (LSR) 305. Late-Successional Reserves are to be managed to protect and enhance conditions of late-successional and old growth forest ecosystems, which serve as habitat for late-successional and old-growth related species. These reserves are designated to maintain a functional, interacting, late-successional and old growth forest ecosystem.

The Six Rivers Forest-wide LSR Assessment was approved by the Regional Ecosystem Office in March 2000. The LSR assessment outlines the management strategy for the LSRs and provides information to decision-makers who are managing to achieve LSR goals and objectives.

Wilderness

A portion of the Trinity Alps Wilderness is within the HLMTT area (13,800 acres). Wilderness areas are managed according to the Wilderness Act of 1984, the California Wilderness Act of 1984, and regulations pursuant to those acts and the Forest Service Manual. The Forest's wilderness areas are managed to preserve the integrity of the wilderness resources to meet the purposes described in the Wilderness Act to protect and preserve natural conditions so that the wilderness: 1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; and 2) has outstanding opportunities for solitude or primitive and unconfined recreation.

Partial Retention

A small portion of the Mill Creek watershed (560 acres) that is located in the foreground of Road 10N02 is classified as partial retention in the Forest Plan. The goal for this management area is to maintain the area in a near-natural appearing condition, where management activities are visually subordinate to the character of the landscape. The partial retention management area is part of the matrix, and is managed for a programmed, sustained harvest of forest products in areas that are suited for timber management.

General Forest

A small portion of the Mill Creek watershed (360 acres) is within the general forest management area. This management area is part of the matrix, and includes forested land programmed for commercial timber management. The primary goal for this area is to produce a sustained yield of timber, and silvicultural treatments are designed to help achieve the recommended management ranges identified in the Forest Plan for each vegetation series and seral stage.

Riparian Reserves

Riparian Reserves are interspersed throughout the analysis area. Riparian Reserves are to be managed to provide benefits to riparian associated species, enhance habitat conservation for organisms that are dependent on the transition zone between upslope and riparian areas, improve travel and dispersal for many terrestrial animals and plants, and provide for habitat connectivity within the watershed. The Riparian Reserves also serve as corridors to connect Late

Successional Reserves. Interim widths of the five categories of riparian reserves have been established in the LRMP. These interim widths are designed to provide a high level of fish habitat and riparian protection until watershed and site analysis can be completed. Riparian Reserves are intended to maintain and restore riparian structures and functions to five categories of water bodies: 1) fish-bearing streams, 2) permanently flowing nonfish-bearing streams, 3) constructed ponds and reservoirs, and wetlands greater than 1 acre, 4) lakes and natural ponds, and 5) seasonally flowing or intermittent streams, wetlands less than 1 acre, and unstable and potentially unstable areas.

Standards and guidelines prohibit and regulate activities in Riparian Reserves that retard or prevent attainment of the Aquatic Conservation Strategy objectives. The Aquatic Conservation Strategy was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands. The strategy protects salmon and steelhead habitat on federal lands managed by the Forest Service and Bureau of Land Management within the range of northern spotted owl.

Tier 1 Key Watershed

Horse Linto Creek is a Tier 1 Watershed. Tier 1 Key Watersheds serve as refugia for maintaining and recovering habitat for at-risk stocks of anadromous salmonids and resident fish species. This designation recognizes the presence of habitat for threatened or endangered species, the importance of the watershed for maintaining anadromous fish stocks, and carries with it the requirement that watershed analysis be completed prior to implementing significant projects. They also have a high potential of being restored as part of a watershed restoration program. Horse Linto Creek was a properly functioning refugia for anadromous salmonids prior to the Megram Fire.

Roadless Area

The 27,290-acre Orleans Mountain “C” Roadless Area is located within Horse Linto, Mill and Tish Tang watersheds. This roadless area was evaluated for wilderness suitability during the Forest Service Roadless Area Review and Evaluation process (RARE II) in 1979 and again during the development of the California Wilderness Act in 1984. Based on the results of the evaluation and legislation, some portions (11,760 acres) of the Orleans Mountain “C” Roadless Area were designated as part of the Trinity Alps Wilderness, while other portions (15,530 acres were designated non-wilderness and made available for multiple use.

In 1995, the LRMP analyzed former RARE II areas that were previously designated non-wilderness (see Appendix C of the FEIS for the LRMP). As a result of the analysis, the Orleans Mountain “C” Roadless Area was not recommended for inclusion in the National Wilderness Preservation System. The LRMP also determined that the southernmost portion of the area (3,030 acres) had been developed to an extent that it no longer retained roadless characteristics. The boundary of the roadless area was subsequently adjusted to exclude the southernmost portion from the roadless area, and the area is now 12,500 acres in size (10 of these acres were transferred to the Hoopa Valley Indian Reservation in the recent boundary adjustment). The remaining portions of the Orleans Mountain “C” Roadless Area are within LSR 305, and are managed to protect and enhance conditions of late-successional and old-growth forest ecosystems.

Research Natural Area

Research Natural Areas (RNAs) are part of a national network of areas that, when complete, will identify and preserve a representative array of major North American ecosystems. The North Trinity Alps RNA was established to study a white fir ecosystem; this 420-acre area lies entirely within the Trinity Alps wilderness. RNAs are designated for nonmanipulative research, observation and study, and to contribute to maintaining biological diversity on National Forest System lands. RNAs are intended to serve as outdoor laboratories for students and researchers; they are not designated for general public recreation use.

Hoopa Valley Indian Reservation Land Allocations

The Hoopa Valley Indian Reservation (HVIR) Forest Management Plan provides direction for the management of Tribal lands in these watersheds. There are a number of land allocations in these watersheds, each with its own standards and guidelines. There are three cultural sites in the Tish Tang watershed directly west of lands managed by the Forest Service: Box Camp, the Denoto Trail Corridor, and the South Tribal Reserve. Both Tish Tang Creek and Mill Creek watersheds contain timberlands and noncommercial woodlands. Portions of both watersheds also contain geologically unstable and inaccessible lands, wildlife activity centers and wildlife travel corridors. A variety of land allocations guide management activities near the confluence of both creeks with the Trinity River, including valley viewshed, the Trinity Wild and Scenic River corridor (recreational designation), and urban use areas.

Physical Setting

Climate and Hydrology

The climate of the Horse Linto, Mill Creek and Tish Tang watersheds is hot and dry in the summer with temperatures commonly above 100^{o}F, and cold and wet in the winter with temperatures often below freezing. Snow frequently accumulates above 4,000 feet elevation during the winter months. Elevations between 3,000 feet and 4,000 feet are frequently subjected to rain on snow events. Mean annual precipitation varies from 70 to 80 inches with Mill Creek having the highest precipitation and Tish Tang Creek the lowest. About 90 percent of the precipitation falls between October and April. However, snow usually remains at higher elevations through May or June.

The Horse Linto, Mill Creek, and Tish Tang watersheds drain into the Trinity River sub-basin. The yearly runoff for Horse Linto, Tish Tang and Mill Creek watersheds is 157,151 acre-feet, 38,373 acre-feet, and 62,986 acre-feet respectively.

Geology and Landforms

The analysis area lies on the western side of the Klamath Mountains physiographic province. It is crossed by the Orleans thrust fault that separates Galice metasedimentary rocks on the west from the Ironside Mountain diorite and both sedimentary and volcanic rocks of the Triassic-Paleozoic Belt (TRpz) on the east (see Figure 1-4). Each of these principal rock units has distinctive expression in the terrain. Areas underlain by Galice bedrock are moderately steep with many ancient landslide deposits. The two narrow zones of TRpz bedrock contain fairly rugged terrain, while the diorite occupies most of the upper watersheds and forms both steep and gentle terrain. The steeper areas contain many rockslide zones and headwall areas, and glacial processes have formed some of this steep terrain. Glacial deposits are scattered across the gentler uplands.

The major streams have cut deep canyons in the middle and lower parts of these watersheds due to persistent geologic uplift of the regional landscape. Historic landslides are widespread on these lower slopes, especially where inner gorges are present, and they have delivered much fine and coarse sediment to streams. Mass wasting has been most intense on the weaker and erodible Galice metasediments and ancient landslide deposits in the lower watersheds. Considerable coarse sediment has also been generated and delivered from the steeper, rocky slopes along these canyons.

Human Uses, Values, and Expectations

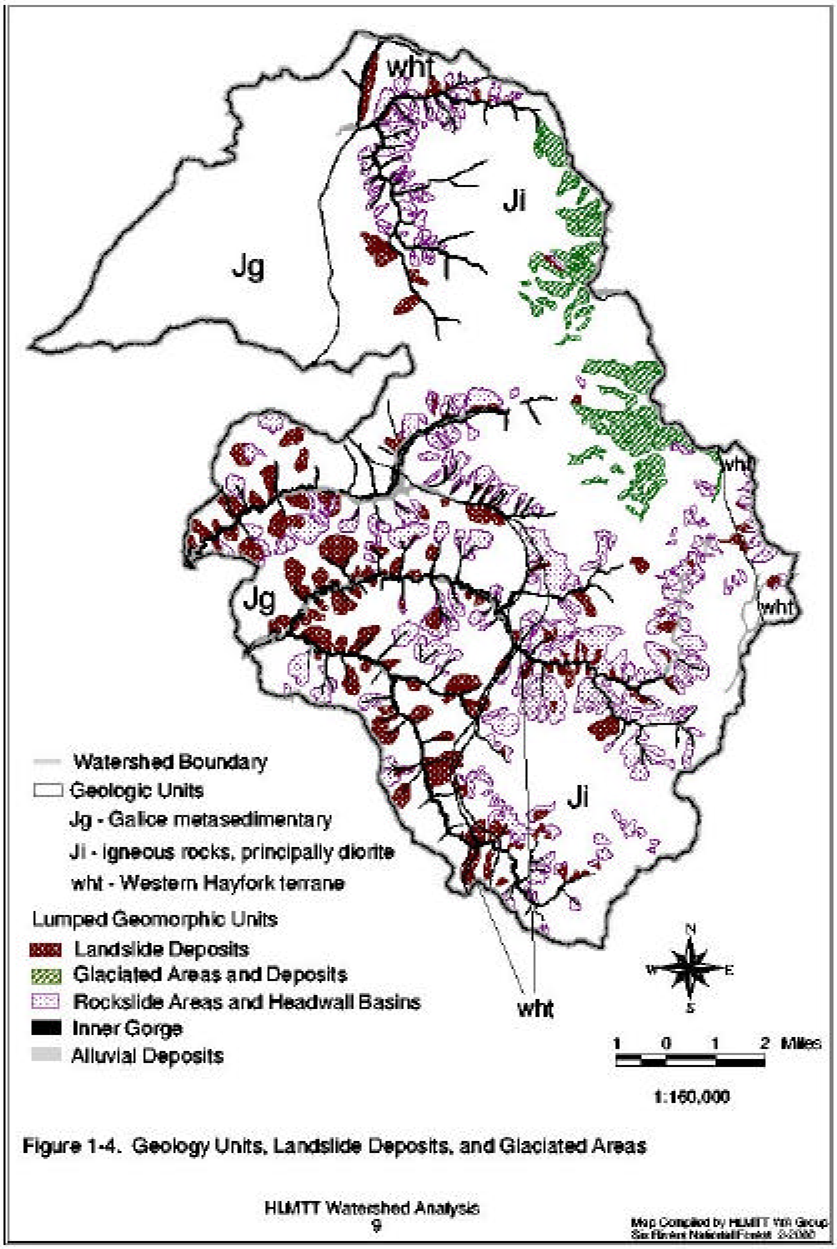
Communities

Humans have inhabited these watersheds for over 5,000 years. There are numerous prehistoric and historic sites documenting human use of the HLMTT area

The community of Willow Creek, the Hoopa Valley Indian Reservation and dispersed neighbors are within the influence of the analysis area. The population of the area is about 3,000 according to the 1995 Census. The main industries are service, tourism associated with recreation, agriculture, forest products, local branches of state, county, and federal agencies, and the Hoopa tribal government. The Hupa Tribe is a federally recognized tribe, and as such, the federal government has trust responsibilities towards them.

The Hupa are located on the Hoopa Valley Indian Reservation, comprising 144 square miles of Tribal lands. The Trinity River flows through the center of the reservation. There are several small businesses, three of which are part of larger chain businesses, a major bank branch, several industries, a small cattle industry, and tribal government offices and enterprises, including a development corporation that runs tribal business enterprises. The Tribe manages its lands administering timber, fisheries, wildlife, cultural plants and sites, and other natural resource-based programs. They have trust resources that are affected by off-reservation management, such as fish and water.

Figure 1-4. **Geologic Units, Landslide Deposits, and Glaciated Areas:**



The community of Willow Creek is located on Highway 299. The community has several small businesses, a major bank branch, service businesses, forest products industry, and government agencies, which comprise the mainstay of the economic base for the community.

Water quality is a significant value held by all segments of the various communities. Water quality is a rallying point and is viewed as an economic necessity, and the desire to improve fisheries is associated with this value. Domestic and environmental water quality is viewed as key to achieving economic success.

Land Ownership

Currently, less than 1 percent of the analysis area (300 acres) is in private ownership, 28 percent (26,150 acres) is within the boundary of the Hoopa Valley Indian Reservation, and the remaining 71 percent (65,540 acres) is public land (see Figure 1-5). All of the public lands are managed by the Six Rivers National Forest. Table 1-2 displays the land ownership by watershed.

Table 1-2. Land Ownership by Watershed in the HLMTT Area

Ownership	Horse Linto Acres	Mill Acres	Tish Tang Acres	Total Acres
Six Rivers NF	40,790	13,960	10,790	65,540
Hoopa	1,000	16,780	8,370	26,150
Other	300	0	0	300

Transportation System

The transportation system in the analysis area is made up of roads and trails that provide access for motorized and non-motorized vehicles, livestock, and foot traffic. Since most trails are typically used for recreational purposes, trails are described under the “Recreation” headings throughout this document; roads are discussed in the “Transportation System” sections.

The road system in these three watersheds consists of two arterial routes, several collector routes, and a series of local spur roads. The major routes (arterial and collectors) are part of the transportation network that links the analysis area to State Highway 96 to the west and State Highway 299 to the south. In general, these roads extend from the lower reaches of the drainages to the higher elevations by following major ridge systems. Most of the stream crossings occur at tributaries to the main drainages in the middle to upper reaches of these watersheds. Shorter local roads spur off the major routes, providing access to specific sites or limited land areas. The arterial and collector roads generally offer improved surfaces and can accommodate passenger vehicles. The local roads tend to be low standard, and typically were designed and maintained only for high clearance vehicles.

Figure 1-5. **Land Ownership within the HLMTT Watersheds:**

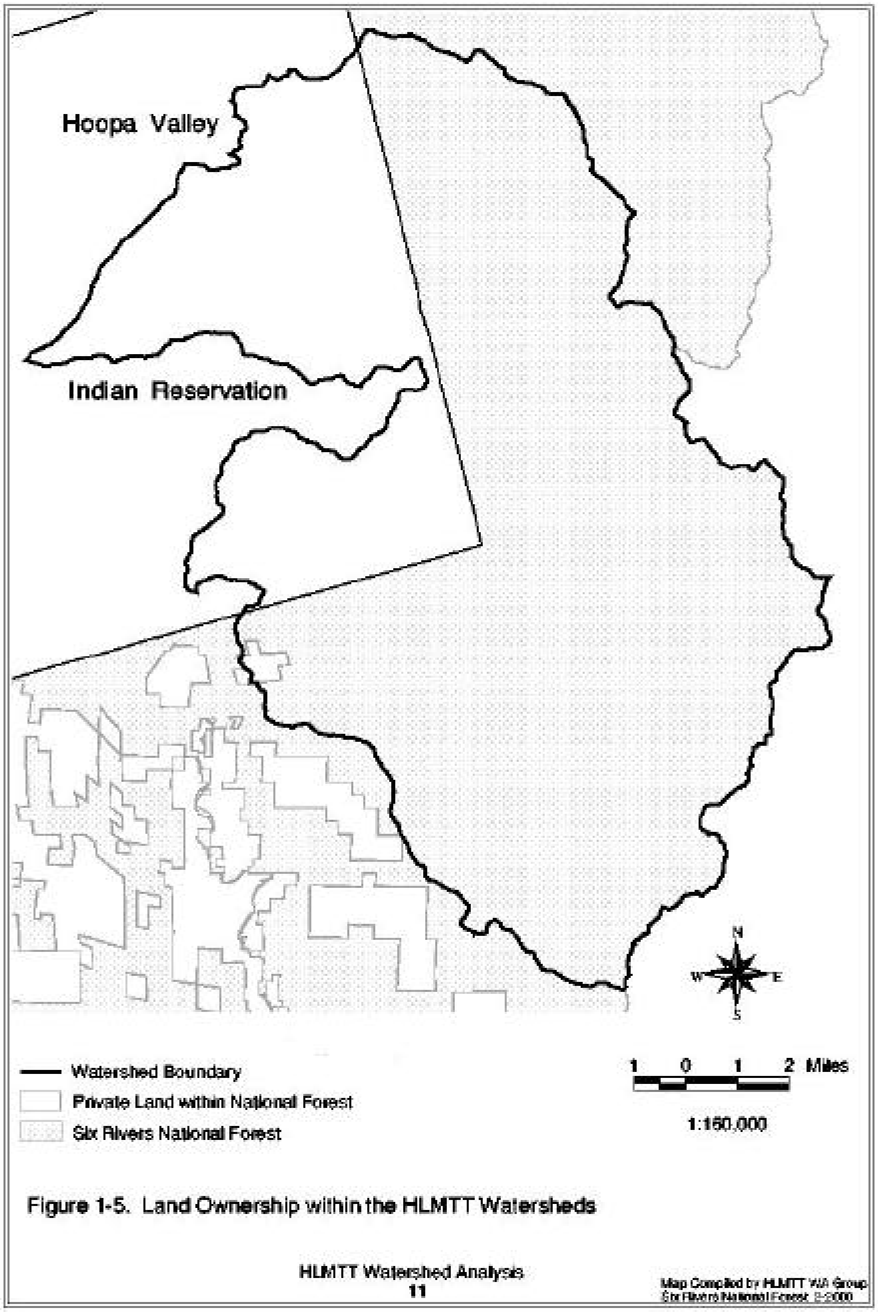


Figure 1-5. Land Ownership within the HLMTT Watersheds

Road densities are highly variable within the analysis area, but overall are fairly low. Much of the HLMTT watersheds are roadless, including the wilderness area where trails offer the only developed access. The HLMTT watersheds within the Hoopa Valley Indian Reservation contain a well-developed road network, but only a few of the roads cross the Reservation - National Forest boundary. Figure 1-6 shows existing roads within the analysis area, as well as some of the adjacent arterial and collector routes.

Recreation Resources

There are a variety of recreational opportunities in the area, many of which occur along the Trinity River (which have Wild and Scenic River designation) and other creeks. These river oriented opportunities include rafting, kayaking, canoeing, sunbathing, swimming and fishing. Other opportunities in the area include camping, hiking, backpacking, mountain biking, picnicking, hunting, scenic driving, OHV, snow play, cross-country skiing and wildlife observation. A small contingent of outfitter/guides provides guided fishing, hunting, rafting and wilderness pack trips. Special events regularly held include a mountain biking rally, a Society for Creative Anachronism campout, river clean-up days, Bigfoot Days, and selected tribal cultural events open to the public.

Developed recreation facilities in the area consist of federal, local and privately sites. These include campgrounds, trailheads, a park, trails, and river access sites. Trailheads are the main access points into the Trinity Alps Wilderness, a wilderness area jointly managed by the Six Rivers and Shasta-Trinity National Forests. The Trinity Scenic Byway crosses from east to west along Highway 299; another proposed scenic byway, the Bigfoot Scenic Byway, would follow Highway 96 to the north.

A partnership was developed in the early 1990s among the Willow Creek Municipal Service District, the Hupa Tribe and the Six Rivers National Forest to promote the area and work cooperatively to develop tourism and recreation opportunities. Recreation and tourism are important economic stimuli and contributors to the local area's sustained economic health; many opportunities exist to improve them.

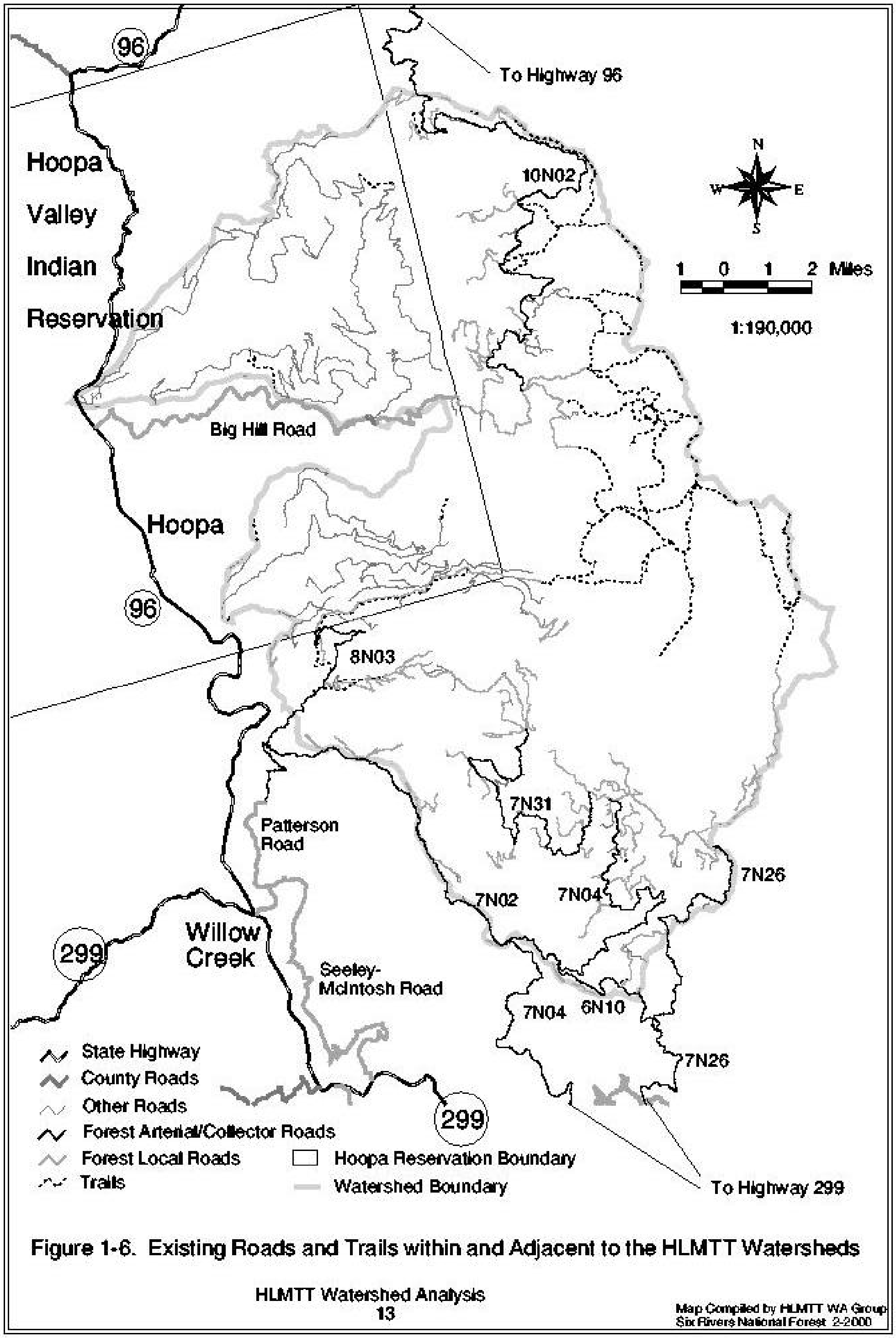
Terrestrial System

Vegetation

Vegetation Data

The vegetation data used in this analysis come from the ecology program on the Six Rivers National Forest. One of the main roles of the ecology program in Region 5 is the classification of potential natural plant communities. This classification is based on a hierarchical system that provides environmental variables as indicators of ecosystem process and function at each level. This hierarchy includes series, sub-series and plant association. The vegetation series represent the dominant overstory and regenerating species in a stand. The sub-series represents the sub-dominant tree species or the shrub species that reflect environmental

Figure 1-6. **Existing Roads within and Adjacent to the HLMTT Watersheds:**



relationships. The plant association is the lowest level of classification and represents the indicator species or the herb or shrub species that exist in a stand due to specific microenvironment conditions. Each level of the hierarchy is distinguished from the others by differences in species composition, soils, productivity, physiography, and expected response to management (Allen, 1987). The potential natural vegetation sub series, along with their seral stages, are mapped and have been used for this analysis.

Five seral stages, along with various modifiers, were used in this analysis. These seral stages are: shrub/forb, pole, early mature, mid-mature, late mature, and old growth. Several modifiers were also used to define the land use or habitat potential associated with these seral stages. An ‘H’ was added if a stand had been harvested, either clearcut or selection cut. An ‘A’ was added if a stand had a pre-dominant overstory or a remnant stand of older trees that could be potential habitat for the marbled murrelet. A ‘B’ was added if a stand with pre-dominant trees had been harvested. Modifiers were also added for stands that had been burned, or burned and then salvage logged.

The 1999 Megram Fire had a significant impact on the vegetation of these watersheds. In order to assess the impacts, the fire severity was mapped and classified by fire severity classes. These seven severity classes are described in Table 1-3 and can be lumped into low, moderate and high severity.

Vegetation Distribution and Structure

The HLMTT watersheds, like most of the area in the central part of the Forest, are dominated by conifer forests and mixed conifer/hardwood forests (94 percent of the watershed), with interspersed alder stringers (2 percent) and mountain meadows (2 percent). The white fir series is the dominant conifer type (Table 1-4), followed by the tanoak series. White fir and red fir dominate on upper elevation sites. The mid and lower slope positions throughout the area are dominated by Douglas-fir and tanoak. Steep rocky slopes covered by canyon live oak are also scattered throughout the area.

Table 1-3. Burn Severity Mapping Codes and Categories

Burn Code	Burn Severity	Definition
0	No burn	No burn
1	Low	Low severity; < 25% vegetation cover killed
2	Moderate	Low-moderate severity; 25-40% vegetation cover killed
2a	Moderate	Moderate severity; 40-60% vegetation cover killed
3	Moderate	High-moderate severity; 60-70% vegetation cover killed
4a	High	High severity; > 70% vegetation cover killed
4b	High	High severity; > 70% (closer to 100%) vegetation cover killed

Table 1-4. Vegetation Series in the HLMTT Watersheds

Series	Acres	Percent of Watershed
White fir	27,829	41
Tanoak	26,250	39
Douglas-fir	4,848	7
Red fir	4,430	7
Alder	1,210	2
Canyon live oak	1,096	2
Mtn. meadow	508	1
White oak	91	< 1
Riparian	77	< 1
Black oak	3	< 1
Non-vegetated	1,370	2
Total	67,711	100

The primary disturbance agents in these watersheds have been fire, logging, flood, wind, insects and disease, cattle grazing and recreation. Fire has by far had the greatest effect in shaping the vegetation seral stages of the area. Prior to the Megram Fire, the old growth seral stage was most abundant (26 percent of the HLMTT watersheds). It was followed by the mid-mature (21 percent), early mature (18 percent) and late mature (18 percent) seral stages. The early and mid mature seral stages appear to have resulted from stand-replacing fires that occurred throughout the area in the late 1860s and early 1910s. Shrub/forb and pole stands comprise 16 percent of the watershed; a majority of these are the result of timber harvesting.

During the winter of 1995-1996, a powerful windstorm caused extensive blowdown of timber, which created fuel loadings that were significantly higher than background levels. This was followed in 1999 by the Megram Fire, which burned with variable intensity in these watersheds. These two events have had a major impact on the seral stage distribution within the HLMTT area.

Plant Species of Concern

The analysis area supports known locations of Forest sensitive plants, special interest species (SIS), species considered rare by the California Native Plant Society (CNPS), and survey and manage (S&M) plant species. Habitats for species of concern include late seral stage conifer forests, meadows, grasslands, and outcrops. Suitable habitat for threatened and endangered plant species is not present in the analysis area.

Of the sensitive plants there is one occurrence of bensoniella (*Bensoniella oregana*). Bensoniella is also a member of the survey and manage species list (S&M). Meadows, riparian settings and seeps characterize bensoniella's habitat. SIS, CNPS rare plants and S&M species occur in a variety of habitats in the analysis area, including rocky ridges, grasslands, meadows, riparian areas, micro-habitats in coniferous forests, and outcrops. In addition to the aforementioned known occurrences of species, potential habitat for other plant species of concern occurs within the analysis area.

Relative to the fire, the conditions of plant occurrences and plant habitats have been differentially affected by the Megram Fire. Depending on the plant species and burn severity, the effects could be detrimental (short or long-term) or beneficial. It is reasonable to assume that stands which burned with high severity (complete loss of crown and duff layer) were so significantly altered than any species of concern no longer exist there. Stands that burned at low to moderate severities could still support plant species of interest and their habitats.

Noxious Weeds

Noxious weeds are species that are not native to a given area and tend to dominate a site to the exclusion of other species. Most of the noxious weeds on the Forest are native to the Mediterranean or Asia. Once introduced and established, noxious weeds have the potential to displace native plant species and entire plant communities.

The composition and distribution of noxious weeds in the analysis area is poorly known. Scotch broom (*Cystisus scoparius*), ripgut brome (*Bromus diandrus*), and bull thistle (*Cirsium vulgare*) have been observed in the area but specifics are lacking.

Noxious weeds are particularly well adapted to establishment in areas that have been recently disturbed. Some species, such as scotch broom, are associated with road banks or slide areas, whereas ripgut brome occurs in areas subject to grazing. Depending on burn intensity (i.e. complete canopy removal versus a mosaic burn in the understory), the fire and subsequent ground disturbance related to fire suppression may have created conditions which promote the introduction and spread of noxious weeds, including those which can disperse seed over many miles (e.g. yellow star thistle, *Centaurea solstitialis*).

Fire and Fuels

Wildfires are a critical component in the development and maintenance of western ecosystems, especially within the interior West (GAO/RCED-99-65, April 1999). Forests within this dry, inland portion of the western United States (which includes the entire Six Rivers National Forest) were shaped by distinct ecological processes that were driven largely by climate and topography. Historically, frequent low-intensity wildfires played a major role in determining the dispersion and succession of tree stands in the interior west. A lack of rainfall in this area also slowed the decomposition of dead and downed trees and woody material.

As part of a dry, terrestrial physiographic province (FSEIS/ROD, 1994) within the interior west, the Horse Linto, Mill, and Tish Tang watersheds have experienced highly variable fire frequencies. Fire frequency studies conducted in the general vicinity of these watersheds showed an average interval of 16.2 years in mixed evergreen forests (Adams and Sawyer 1980) and 36 years in white fir forests (Stuart 1997). Lightning is a significant cause of wildfires within these watersheds, with multiple wildfires commonly generated from the same lightning storm. Human are the predominant cause within the Hoopa Valley Indian Reservation.

The most extensive and serious problem related to the health of national forests in the interior west is the over-accumulation of vegetation, which has caused an increasing number of large, intense, uncontrollable, and catastrophically destructive wildfires (GAO/RCED-99-65, April 1999). The recent Megram wildfire of 1999 burned into these watersheds and was lightning-generated. It was the sixth largest wildland fire in California since 1930 and burned the largest acreage on the Six Rivers National Forest since records began in 1910. Analysis conducted after the 1995/1996 blowdown event predicted a wildfire of this type and size would occur. This wildfire displayed a wide variety of fire behavior and resultant effects, mainly depending on weather, topography, and fuel loading and distribution. Air quality was severely degraded for the majority of this wildfire event, which burned for over 70 days. These and other factors within and adjacent to the HLMTT area present future challenges to fire and fuels management. These factors include: large areas of wilderness and limited access (either due to topography or roadless designation), proximity to the Hoopa Valley Indian Reservation, adjacent public inholdings, and mortality and fuel succession following the Megram Fire.

Wildlife Species

Threatened and Endangered Species

There are three federally threatened or endangered wildlife species that are known or suspected to occur within or near the watershed analysis area. These include the bald eagle (*Haliaetus leucocephalus*), northern spotted owl (*Strix occidentalis caurina*) and marbled murrelet (*Brachyramphus marmoratus*). Designated Critical Habitat Units (CHUs) for the northern spotted owl and marbled murrelet are located within and/or adjacent to the watershed analysis area, and LSR 305 overlaps these three watersheds.

There are records of federally threatened bald eagles within the watershed analysis area. However, there are neither designated bald eagle network territories nor suitable nesting habitat designated within the watershed analysis area. Approximately 99 percent of the HLMTT watersheds are contained within the Marbled Murrelet Zone 2, but marbled murrelets have not been detected. There are 33 northern spotted owl activity centers (pairs or territorial singles) on Forest Service lands and 8 activity centers on Hoopa Valley Tribal lands in the watersheds.

Table 1-5 provides a list of wildlife species of concern and known occurrences within the HLMTT watersheds. The list includes threatened, endangered and proposed species as well as Forest Service sensitive species listed in the LRMP.

Forest Service Sensitive Species

Peregrine falcons (*Falco peregrinus anatum*) are known to occur within the watershed analysis area. The two historic nesting territories include the Horse Linto Creek and Mill Creek nesting Territories. There are six designated northern goshawk (*Accipiter gentilis*) territories within the HLMTT watersheds. In 1994 and 1995, a Forest-wide goshawk survey and habitat-use study was initiated in selected areas of the Forest. The only confirmed sightings from that study were on the Lower Trinity Ranger District; two active goshawks sites were found.

Table 1-5. Known Occurrences of TES and Forest Service Sensitive Wildlife Species

Common Name	Scientific Name	Status	Status in HLMTT
Bald eagle	Haliaetus leucocephalus	Threatened	No nesting territories
Northern spotted owl	Strix occidentalis caurina	Threatened	Present
Marbled murrelet	Brachyramphus marmoratus	Threatened	No survey detections
Peregrine falcon	Falco peregrinus anatum	FS sensitive	Present
Northern goshawk	Accipiter gentilis	FS sensitive	Present
Great gray owl	Strix nebulosa	FS sensitive	No recorded presence
Willow flycatcher	Empidonax trailli	FS sensitive	Present
American marten	Martes americana	FS sensitive	No recent detections
Pacific fisher	Martes pennanti	FS sensitive	Present
California wolverine	Gulo gulo luscus	FS sensitive	No recent detections
Pacific big-eared bat	Plecotus townsendii townsendii	FS sensitive	No known records
Northwestern pond turtle	Clemmys marmorata marmorata	FS sensitive	No known records
Foothill yellow-legged frog	Rana boylii	FS sensitive	Present
Northern red-legged frog	Rana aurora aurora	FS sensitive	No known records
Southern torrent salamander	Rhycotriton variegatus	FS sensitive	Present

The Forest has records of Pacific fisher (*Martes pennanti*), American marten (*Martes americana*) and California wolverine (*Gulo gulo luscus*) within the analysis area. There have been four recent Pacific fisher detections, but no recent detections of the American marten or California wolverine in these watersheds.

There are numerous sightings of the Foothill yellow legged frog (*Rana boylii*) within the analysis area. Known detections include Horse Linto Creek and its drainages. There are three records for the southern torrent salamander (*Rhycotriton variegatus*), all of which are located within the Horse Linto drainage.

Survey and Manage Wildlife Species

A number of survey and manage or wildlife protection buffer species are known or suspected to occur in the watershed analysis area.

Del Norte salamanders (*Plethodon elongatus*) are associated with deep, rocky substrates and occur through the analysis area. *Ancotrema voyanum* is a mollusk species that may be affected by grazing and requires protection of known sites from grazing. It has been detected south of Horse Linto Creek. However, no active range allotments occur within the known sites for this species.

Numerous survey and manage species have been detected during project specific surveys in the analysis area. Table 1-6 summarizes the current information on these species.

Table 1-6. Known Occurrences of Survey and Manage Wildlife Species

Common Name	Scientific Name	S&M Category	HLMTT Watersheds
Del Norte Salamander	Plethodon elongatus	1 and 2	Present
Oregon shoulderband Snail	*Helminthoglypta herteini*	1 and 2	Present
Klamath shoulderband Snail	*Helminthoglypta talmadgei*	1 and 2	Present
Church's sideband Snail	*Monadenia churchi*	1 and 2	Present
Pressley hesperian Snail	*Vespericola pressleyi*	1 and 2	Present
Shasta chaparral Snail	*Trilobopsis ropri*	1 and 2	No known records
Tehama chaparral Snail	*Trilobopsis tehamana*	1 and 2	No known records
Papillose tail-dropper Slug	*Prophysaon dubium*	1 and 2	Present
Long-eared myotis	*Myotis evotis*	Protection buffer	No known records
Fringed myotis	*Myotis thysanodes*	Protection buffer	No known records
Long-legged myotis	*Myotis volans*	Protection buffer	No known records
Silver-haired bat	*Lasionycteris noctivigans*	Protection buffer	No known records
Pallid bat	*Antrozous pallidus*	Protection buffer	No known records
Flammulated owl	*Otus flammeolus*	Protection buffer	Present
White-headed woodpecker	*Dendrocopos albolarvatus*	Protection buffer	Present

Other Special Status Species

The Redwood Creek black-tailed deer herd utilize habitat within the HLMTT area. The summer range is generally characterized by habitat over 4,000 feet in elevation. Key fawning areas include portions of the Horse Linto, Mill, and Tish Tang drainages. Only one wintering area has been identified within the analysis area. The Tish Tang Deer Wintering Area lies within the southeast corner of the Hoopa Valley Indian Reservation and portions of this wintering area lie within the SRF boundary

There have been several incidental sightings of Roosevelt elk in recent years. The analysis area is within close proximity to several established herds (the Marble Mountain Herd and the Trinity Alps Herd) and expansion of the herds within the area in the near future is probable.

Riparian and Aquatic Systems

Riparian Corridor Condition

The riparian corridors were greatly affected by the 1964 flood and past management actions such as road building and logging. Substantial habitat recovery has occurred during the last few decades. Prior to the Megram Fire, the riparian areas provided good connectivity for bryophytes, lichens, and vascular plants and for wildlife dispersal. The Megram Fire had varying effects on the riparian corridor based on the fire intensity. In some areas all vegetation was killed, in other areas little vegetation was damaged. The majority of the true riparian vegetation, such as dogwood and willow, survived the fire, but the overstory canopy trees were killed or damaged along many miles of stream corridors in the headwaters of the analysis area. This change may alter the microclimate and habitat values along those streams for several decades.

Riparian-Dependent Species

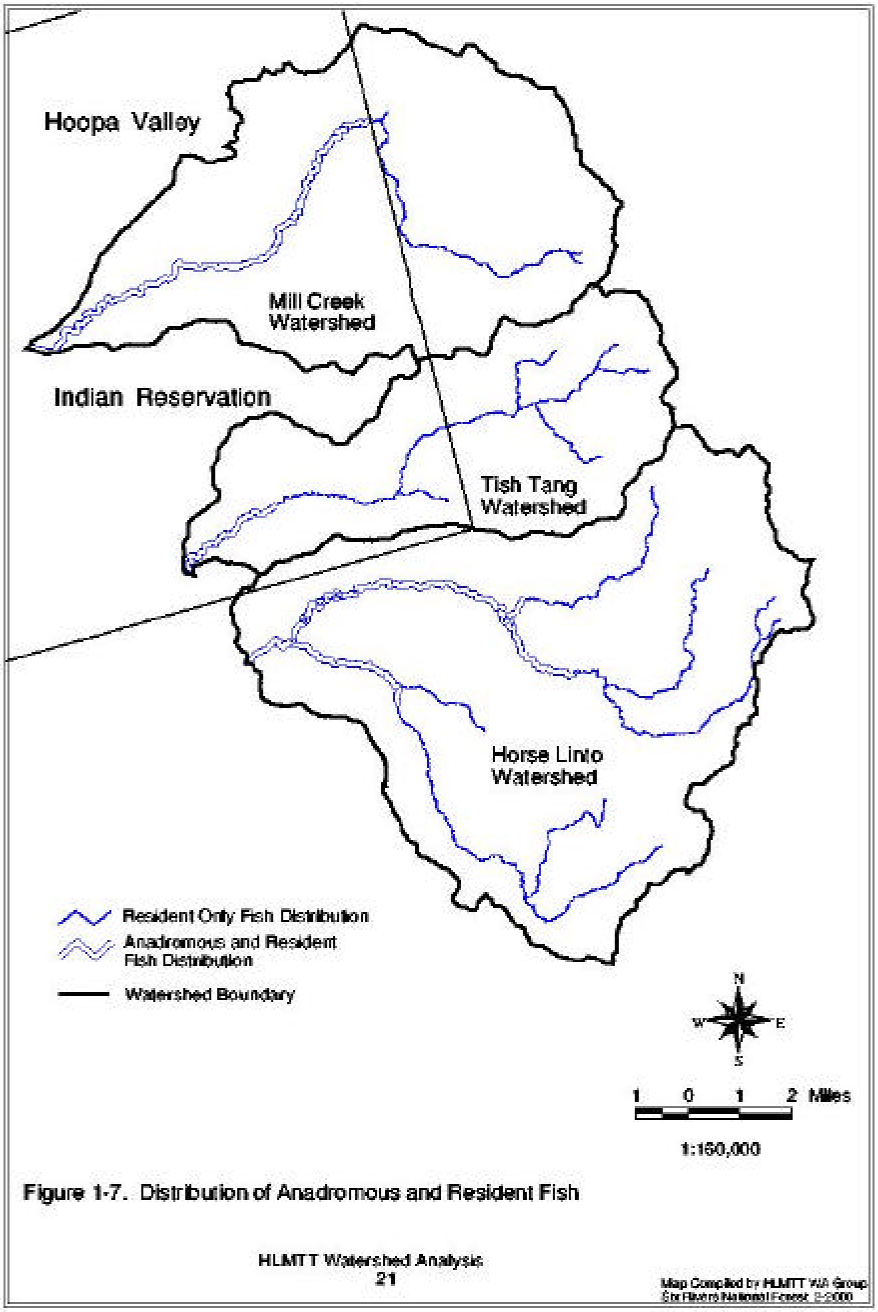
Foothill yellow-legged frogs and southern torrent salamanders are known to exist within the analysis area. Both species are in decline in parts of their range and are designated as Forest Service sensitive species.

Fish Species and Habitats

Figure 1-7 shows the known distribution of resident and anadromous fish within the analysis area. The fishes include anadromous fall chinook salmon, coho salmon, and winter steelhead trout and resident brook and rainbow trout. Recreational fishing for resident fish is allowed within part of the analysis area, but no angling for salmon and steelhead is allowed within these three watersheds. This restriction is in place to protect spawning adult fish and rearing juvenile fish prior to their outmigration.

Fish habitat, especially anadromous habitat, in all three watersheds was greatly degraded in the 1964 flood, which affected the analysis area and most anadromous habitat in California. Substantial habitat recovery has occurred since the 1964 flood, but wild anadromous fish populations have generally not recovered in the Klamath basin. The coho numbers in the analysis area are extremely low. Coho salmon and their habitat have been listed under the Endangered Species Act (ESA). All three watersheds contain designated critical habitat for the threatened Southern Oregon/ Northern California Evolutionary Significant Unit (ESU) of coho salmon. Due to the long-term decline of chinook and steelhead runs in the Trinity sub-basin, the Pacific Southwest Region of the Forest Service has put them on a regional sensitive species list to help ensure that Forest Service activities do not result in a trend towards listing them under the ESA. There are many causes for the general decline of anadromous salmonids in California and scientists are not all in agreement as to which causes are most deleterious to the different fish stocks. Although it is recognized that many problems exist at larger scales than the analysis area, it is beyond the scope of this document to focus on fisheries problems outside the analysis area.

Figure 1-7. **Distribution of Anadromous and Resident Fish:**



The Megram Fire overlapped both anadromous and resident fish habitat, but it did not directly affect the habitat equally. Most of the anadromous habitat was left unburned. Generally, the fire burned hottest in the headwater reaches which contained no fish or only resident fish. However, it is certain that some degree of indirect effects will trickle down to all anadromous and resident fish habitat where upstream headwaters experienced high or medium severity wildfire.

Horse Linto Creek

Horse Linto Creek was a properly functioning refugia for anadromous salmonids prior to the Megram Fire. Chinook and steelhead numbers are strong compared to many other streams in the Trinity River sub-basin. The fishes in Horse Linto benefited from many instream restoration projects and several watershed restoration projects. The chinook population in the watershed had been greatly boosted by a cooperative small-scale hatchery, which propagated native Horse Linto chinook. This hatchery is now closed to test whether the chinook numbers in Horse Linto would stay elevated without the benefit of the hatchery. The Horse Linto watershed contains about 14 miles of fish habitat where anadromous fish are present and about another 33 miles of habitat where only resident trout are present.

Tish Tang Creek and Mill Creek

Tish Tang and Mill were not designated key watersheds but both streams have important fisheries values to the Hoopa Valley Indian Tribe. The known anadromous habitat lies on the Hoopa Valley Indian Reservation. Anadromous fish are found only in the lower 2.8 miles of Tish Tang Creek and resident trout only are present in about 15.5 additional miles of stream.

Mill Creek contains about 6.7miles of fish habitat where anadromous fish are known to be present. Salmon are confined to the lower 2.6 miles of Mill Creek. Past Forest Service fish surveys suggested that steelhead could not reach USFS habitat. The Hoopa Valley Tribal Fisheries staff believe that some steelhead are currently able to ascend Mill Creek at least to the reservation boundary, so that steelhead habitat may encompass 10 or more stream miles. There is about another 8 miles of fish habitat where only resident trout are known present.

Only one lake provides recreational fishing within the analysis area. Mill Creek Lake is located in the Trinity Alps wilderness in the headwaters of the Mill Creek watershed. The lake contains both brook and rainbow trout, which are stocked by the California Department of Fish and Game.

Water Quality

The important water quality parameters that most influence the beneficial uses for the Horse Linto, Tish Tang, and Mill Creek watersheds are sediment and turbidity. Mill Creek is a domestic water source for the Hoopa Reservation during the summer months. Tish Tang Creek is being considered as an additional domestic water source for the Hoopa Reservation. These watersheds are also very important to the anadromous fisheries of the Trinity River sub-basin.

All three watersheds were impacted by the 1964 flood and to varying degrees by land management activities. These combined events and activities have resulted in increased levels of sedimentation that impacted aquatic habitats to varying degrees. Of the three watersheds, Horse Linto has the fewest residual impacts associated with the historic increase in instream sediment levels. The Trinity River is listed as sediment limited by Environmental Protection Agency (EPA) under the Clean Water Act section 303(d) and all three watersheds are included within the Maximum Daily Load (TMDL) listing.

Turbidity is frequently associated with high sedimentation levels. Prior to the fire, turbidity was of most concern in the Mill Creek watershed. Mill Creek is not used as a domestic water source during the winter months due to elevated turbidity levels (Hoopa Valley Tribal Environmental Protection Agency, 1997). Tish Tang Creek had elevated turbidity levels due to management-related erosion problems. Historically, Horse Linto does not have high turbidity levels. After the Megram Fire, a turbidimeter was installed to track turbidity.

CHAPTER 2

ISSUES AND KEY QUESTIONS

The purpose of this chapter is to focus the analysis on the key elements of the ecosystem that are most relevant to the management questions, human values, and resource conditions in the HLMTT watersheds. This watershed analysis is focused on management issues related to the Megram Fire; therefore, the issues and key questions all relate to the fire, its effects, and recovery efforts that may be needed to achieve desired conditions.

Because of the level of public concern about the fire and the Forest's fire recovery effort, Forest staff held a number of field trips to the fire area and public meetings in the communities of Willow Creek, Hoopa, and Eureka. Many interested people attended, sharing their concerns and opinions about fire recovery efforts and the potential future occurrence of other large-scale fires. The issues and key questions in this chapter were developed from the input provided during the meetings and field trips, and from many written comments.

Terrestrial System

Issue 1: Long-Term Health and Recovery of Vegetation

Vegetation management on the Six Rivers National Forest is based on the seral stage distribution within the primary vegetation series on the Forest (tanoak, Douglas-fir, and white fir). A historic range of variability (HRV) and recommended management range (RMR) has been developed for each of these series and seral stages within each of the three zones on the Forest. The HRV and RMR are based on disturbance regimes, including fire, which have created a mosaic of seral stages throughout the landscape. These watersheds lie within the central zone, and contribute to the RMRs for that zone.

The Megram Fire burned with varying severity throughout these watersheds, with both beneficial and detrimental effects to vegetation. In high severity areas, almost all of the vegetation in the stand was killed. In low severity areas, the fire killed little of the overstory, primarily consuming shrubs and small material in the understory. The overall effects of the fire on vegetation should be analyzed in terms of the HRV and RMRs for the Forest's central zone.

The two land allocations in these watersheds (the Trinity Alps Wilderness and LSR 305) provide specific direction regarding vegetation management. Within wilderness, natural ecosystem processes such as fire are to be evident, with minimal human impacts; vegetation manipulation is not permitted. In LSRs vegetation management in general should maintain or enhance late-successional forest conditions and reduce the risk of large-scale disturbance. After stand-replacing events, management should be designed to accelerate or not impede the development of late-successional conditions (Six Rivers National Forest, 1995).

Noxious weeds are documented in the analysis area. Disturbances such as mechanical disruption of the soil, over-grazing, and fire can create conditions suitable for noxious weed establishment. Once established, noxious weeds can readily disperse into newly disturbed areas. The most effective management of noxious weeds is to minimize the chances of introduction and spread, and to treat localized occurrences as soon as detected.

Vegetation Management

1.1 How did the fire affect the distribution of vegetation series and seral stages in these watersheds? Is the resulting distribution within the HRV? Is the RMR still valid? Does the present distribution of late-successional stands comply with the "15 Percent Retention" standard and guideline?
1.2 How did the fire affect the plantations within these watersheds? Should burned plantations be reforested?
1.3 What possible management practices would best achieve or maintain the RMRs for each vegetation series and seral stage as well as the desired conditions identified in the Forest-wide Late-Successional Reserve Assessment (LSRA)?

Pests

1.4 Has the fire increased the risk of pest infestation?

Meadow Habitats

1.5 How did the fire affect the plant communities in high elevation meadows? What possible management practices could maintain desired conditions in these meadows?

Noxious Weeds

1.6 What fire recovery activities may increase the potential for introduction and spread of noxious weeds?
1.7 What opportunities exist to reduce the chances of noxious weed introduction and spread?

Issue 2: Long-Term Health and Recovery of Terrestrial TES Species and Species of Concern

Habitats exist within these three watersheds to support threatened, endangered and sensitive plant and wildlife species, as well as other species of concern (e.g. rare, survey and manage, or culturally significant species). The fire has affected habitat conditions in many ways, including canopy loss, consumption of coarse woody debris and loss of the duff layer. Depending on the species and burn intensity, the effects could be detrimental (short or long term) or beneficial. There are documented locations and suitable habitat for sensitive, rare, and survey and manage (S&M) plant species in these watersheds. Habitats include a wide range of settings, from coniferous forests and meadows to logs of advanced decay class. It is fair to assume that stands which burned intensely during the fire (i.e. complete loss of crown and duff layer) were so significantly altered that any occurrences of sensitive, rare and S&M plant species no longer exist. Furthermore, habitat conditions are currently unsuitable for these species. Stands that burned at low to moderate intensities could still support plant species of interest and their habitats.

Management within these low to moderately burned stands will need to consider the effects on species of concern and their habitats.

The watershed analysis area provides habitat for a wide variety of terrestrial and riparian-dependent wildlife species. There are 16 amphibian, 17 reptile, 120 bird, and 60 mammal species likely to occur within the HLMTT area. Species distribution and habitat has been differentially affected by the Megram Fire.

Plants

2.1 How might the fire have affected plant species of concern and their habitats?
2.2 How may management activities related to fire recovery affect plant species of concern and their habitats?
2.3 Are there opportunities to benefit or enhance habitat conditions for species of concern?

Wildlife

2.4 How has the fire altered habitat conditions for TES and special status species in these watersheds?
2.5 Within the LSR, how has the fire altered the habitat conditions for the northern spotted owl and how has the fire affected functionality of the LSR?
2.6 What possible management practices, if any, are needed to facilitate the recovery of habitat for these species?

Issue 3: Fire, Fuels, and Air Quality

Fire is a major disturbance factor within the Horse Linto, Mill, and Tish Tang watersheds, as evidenced by the Megram Fire of 1999. This wildfire was a trigger event for executing this watershed analysis due to the fire's size and intensity, along with off-site human impacts. Human health impacts, mainly related to severely degraded air quality, were significant enough to warrant a federal and state declaration of emergency. Visibility impacts were also severe locally and noticeable for hundreds of miles. Wildfire protection of local communities and Tribal Trust responsibilities for the Hoopa Valley Indian Reservation are critical components of future management in this area.

3.1 What is the trend of fire risk within and adjacent to the HLMTT watersheds?
3.2 What is the current, near-term (5-7 years), and longer-term (10-12 years) fire hazard within and adjacent to these watersheds, especially focusing on those areas directly affected by the Megram Fire? What are the potential fire behavior and mortality from future wildfires within these watersheds?
3.3 What is the degree of threat from future wildfires to local communities?
3.4 What possible management practices could help reduce adverse wildfire impacts (including impaired air quality) and/or risk to these watersheds and adjacent areas? Which are the priority areas to treat?
3.5 What possible management practices could reduce the potential for extended exposure to smoke from wildfires?

Riparian and Aquatic System

Issue 4: Long-Term Health and Recovery of Riparian and Aquatic Systems and Species

Riparian areas are sensitive ecological components of a watershed. They are an important link between upland and aquatic areas and provide critical habitat for many species. Riparian areas within the HLMTT area have been subjected to both natural and human-caused disturbances, including the 1999 Megram Fire. These natural and human-caused disturbances appear to have reduced aquatic habitat value to varying degrees in these watersheds.

Streams in the Pacific Northwest have adapted through centuries of disturbances that have adversely affected water quality and aquatic habitat in the short term, but appear to have renewed and sustained aquatic ecosystems over the long term. During the past 40 years, the Horse Linto, Mill and Tish Tang watersheds have experienced increased levels of human disturbance, which may have compounded the impacts from natural disturbances such as floods and fires. The degree to which erosion rates, water quality and aquatic habitats have been altered from reference conditions, thereby affecting the long-term viability of aquatic species, is a principal concern.

Erosion Processes and Water Quality

4.1 How have natural and human-caused disturbances (floods, landsliding, wildfire & resource management) affected erosion processes in these watersheds? What parts of the watersheds have been most affected?

4.2 How can restoration efforts following the Megram Fire influence erosion processes and benefit water quality, thereby protecting the domestic water supplies in Mill and Tish Tang watersheds and enhancing the values that make Horse Linto a key watershed? How long will it take for the effects of restoration to be evident?

4.3 To what extent are cumulative effects (as defined by the Environmental Protection Agency) evident in these watersheds? How may future management actions in response to the Megram Fire contribute to the level of cumulative effects?

Riparian and Aquatic Species and Habitats

4.4 How have the abundance and distribution of riparian and aquatic species and their habitats changed as a result of natural and human-caused disturbances?

4.5 How did the Megram Fire affect critical habitat components for the maintenance, protection and recovery of anadromous salmonid populations? What additional risks has the fire created for riparian and aquatic species and habitats?

4.6 What possible management actions or practices are needed to facilitate the recovery of habitat for riparian and aquatic species?

4.7 What factors need to be considered when proposing activities in response to the fire, especially in riparian areas?

Social System

Issue 5: Human Uses, Values, and Expectations

Residents of the communities bordering the analysis area (Hoopa, Willow Creek, Salyer, Hawkins Bar, Burnt Ranch), as well as other members of the public, use the resources in these watersheds in a variety of ways, and they value the watersheds for diverse reasons. The Megram Fire affected these uses and values, and people are concerned about the possible management practices the Forest may implement following the fire. They are also concerned about the potential for future wildfires of a similar scale to occur.

Local Community Economies

5.1 How do these watersheds contribute to the economies of local communities? What fire recovery efforts might contribute to local economies?

Recreation

5.2 What recreational opportunities were impacted by the Megram Fire? What possible management practices could be implemented to restore or maintain these opportunities in areas that were affected by the fire?

Tribal Trust Resources

5.3 How has the Megram Fire affected the Hoopa and Yurok Tribes' federally reserved rights in the Trinity and Klamath fisheries?

5.4 How may degraded water quality resulting from the fire affect federally reserved water rights of the Hoopa and Yurok Tribes with respect to domestic use and subsistence fishing?

5.5 How can the Forest minimize the threat from future wildfires and pest infestation to Tribal trust resources?

Tribal Spiritual and Traditional Uses

5.6 What are the effects to contemporary spiritual locations used by Hupa traditionalists in the Trinity Summit area and along the Trail of the Blue Sun? What possible management practices could be implemented to mitigate adverse impacts?

5.7 What are the short and long-term effects of the fire on the availability and quality of culturally significant vegetation and animals? What possible management practices could be implemented to mitigate adverse impacts?

Heritage Resources

5.8 What effects did the fire have on known cultural resource properties located within these watersheds? What kinds of fire recovery efforts might contribute to conserving the values of these sites?

Access

5.9 Has the Megram Fire altered the conclusions of the Lower Trinity Access and Travel Management (ATM) Plan?

5.10 Which roads pose the greatest threat for failure and erosion if inadequately maintained?

5.11 Where is the potential hazard to the public and Forest employees from fire-damaged trees falling on Forest development roads? How should these trees be removed to reduce this hazard in a manner that minimizes potential impacts to other resources?

Roadless

5.12 What factors should be considered when evaluating possible management practices within the remaining portions of the Roadless Area?

Grazing

5.13 What criteria for resuming grazing will prevent adverse impacts to high elevation meadows and riparian areas that were affected by the Megram Fire?

Adaptive Management

5.14 What are the opportunities to learn from the fire?

CHAPTER 3

CURRENT AND REFERENCE CONDITIONS

This chapter describes both reference and current conditions of the various physical, biological, and human ecosystem elements in the HLMTT area. These descriptions pertain to the issues and key questions identified in Chapter 2. The information provided here will be used in Chapter 4 to identify trends in these ecosystem elements and to synthesize our understanding of them.

Much of the discussion under the "current conditions" subheadings of this chapter relates to the Megram Fire and its effects on the various ecosystem elements. The information for these discussions comes from the fire severity mapping the SRNF performed in December-January 1999-2000. The fire severity map was developed through aerial photograph interpretation, with some ground-truthing to verify the severity classes. This mapping will be further field-checked in the summer of 2000, and there will probably be modifications based on the on-the-ground visits.

Human Uses, Values, and Expectations

Heritage Resources

Humans have inhabited the Trinity River area from Salyer, Willow, Tish Tang, Horse Linto and Mill Creeks to the Hoopa Valley for thousands of years. The land use practices of the Native Americans inhabiting the region during the prehistoric era and the ranchers, homesteaders, loggers, miners, and Forest Service activities and administration during the historic period have all influenced the environment. The purpose of the following section is to summarize the environmental and cultural history of the analysis area.

Past History

Past Environment for the Analysis Area

It is clear from pollen data and other research in the region that the climate of the interior portions of northwestern California has not remained static during Holocene (the last 10,000 years). Evidence for climatic fluctuations during the Holocene in the North Coast Ranges has been summarized by James West (1983). West (1993) concluded that interior regions of the North Coast Ranges experienced significant shifts in climate during the last 10,000 years. These shifts in yearly mean temperature, and quite likely the amount of annual precipitation, significantly affected the distribution of plant and animal species across the landscape.

Given the past climatic record for the northcoast ranges situated immediately to the west, it can be hypothesized that similar processes of vegetative succession and environmental change have taken place during the Holocene within the analysis area. Evidence of a more open canopy and a wider distribution of white and black oaks within and along the slopes of Hoopa Valley during 19th

Century and the early 20th Century have been documented in interviews with long-time residents (as well as in historic photographs of the Valley). It appears that cessation of frequent burning of the hillsides by the Hupa subsequent to historic era has resulted in an increase in the distribution of Douglas-fir at lower altitudes and on the more southerly oriented slopes of the region. Unlike regions further to the south, tanoak and Douglas-fir probably dominated the north facing slopes and in general were more widely distributed at lower elevations within the project area prior to the Contact Period.

Anthropogenic (human-caused) fire along with natural fires was common prior to the historic era. In the early 1900s, the Forest Service took over administration of most of the lands to the east of the reservation. One of the most notable changes at that time was the effort to control wildfires. Human-initiated fires were prohibited (for example burning to encourage the growth of desirable plants by the Hupa or to keep open grazing lands) and natural fires were extinguished as soon as possible.

Prehistory

Several archaeological investigations over the last two decades on Six Rivers National Forest, including the excavation of a number of prehistoric sites, are relevant for the HLMTT Area. These sites are for the most part are located along the divide between the Mad River and South Fork Trinity River watersheds along Pilot Ridge, Whiting Ridge and Last Chance Ridge. During the 1982, 1983 and 1984 field seasons, a series of 15 prehistoric sites were excavated in this area by Sonoma State University in cooperation and under contract with the Forest Service. These sites ranged in elevation from between 4,500 feet to about 6,000 feet. These studies (Hildebrandt and Hayes 1983, Hildebrandt and Hayes 1984, and Hayes and Hildebrandt 1985) and more recent studies in the North Coast Ranges suggest three broad cultural patterns for this region of the northern California. Definition of these cultural patterns is based on chronology and artifact patterning.

The Early Period (Borax Lake Pattern)

The Early Period of human occupation in the North Coast Ranges is also sometimes referred to as the Borax Lake Tradition, which spans that period of time from the entry of aboriginal peoples into the region, approximately 4,000 to 5,000 B.P. to about 3,000 B.P. Little is known about the first people to enter this portion of northwest California, neither the language they spoke nor where they came from. The artifacts found on prehistoric sites within and adjacent to the region dating to this period include the Borax Lake Pattern assemblage defined by Borax-Lake wide-stemmed projectile points, milling slabs, hand stones and relatively large serrated bifaces (worked on both sides with a saw-like edge on some portion of the artifact).

Several "single component" Borax Lake deposits (i.e. all the materials recovered from a specific area of the prehistoric site dated from this time period) were identified on Pilot Ridge. These assemblages show little variability from site to site (Hildebrandt and Hayes 1993:110) and for the most part appear to be locations where a number of subsistence oriented activities (processing of both animal and plant resources) took place--inferring that family groups were camped at these locations. Further supporting this hypothesis is the recovery from the Borax Lake component of these sites of a greater percentage of artifacts associated with food processing and household maintenance activities than were recovered from either Middle or Late Period single component sites. Early Period artifactual materials included handstones, spall tools, cobble tools, and drills.

One of the sites excavated on Pilot Ridge contained a feature that appears to be the remains of a structure approximately five feet by five feet in size. Structural indicators included a possible compacted floor surrounded by three post holes (Hildebrandt and Hayes 1993:110). This feature contained a Borax Lake component with a significant number of artifacts including 12 milling slabs (two of which were stacked one on the other), four hand stones, three hammer stones and numerous bifaces, projectile points, flaked tools and cores. This feature represents the oldest structural remains to be found to date in this region of the North Coast Ranges. Bill Hildebrandt, principal investigator for the Pilot Ridge Project in the 1980s, informed us that a sample from the structural feature (possibly a post) was recently dated using carbon-14 radiocarbon dating. The date of this sample was about 7,000 years B.P. This date, if it holds up after further analysis, will make this site the oldest dated site in northwestern California.

It has been hypothesized that the peoples living in this region during the Early Period lived in small, highly mobile bands, probably consisting of one or a small number of extended families. These small groups utilized a "foraging" resource procurement strategy oriented towards a wide range of resources but emphasizing little handling or processing time - for example big game (elk and deer) and hard seeds. With this resource procurement strategy, little emphasis is placed on storage of food resources, rather "incongruities in the distribution of resources over time and space are solved by moving people from places of declining productivity to areas where foraging opportunities are enhanced" (Hildebrandt and Hayes 1993:115). Thus, within the project area during the Early Period it is likely that relatively small, highly mobile groups inhabited the region for at least some portion of the year moving from location to location as various kinds of resources became seasonally available for procurement. This subsistence strategy requires frequent moves by entire social units resulting in homogenous settlement site structure (i.e. little site-to-site variability) with similar generalized artifact assemblages (Hildebrandt and Hayes 1993:115).

Even at this early date, land-use activities related to subsistence resource procurement were, quite likely, having an effect on the environment and the species composition of both plants and animals. By this time, anthropogenic fires, along with natural fires, were quite likely a major force influencing vegetation trajectories and environmental dynamics in this region. In addition, collection of certain plant species and the hunting of animals also influenced environmental dynamics and trajectories. The large Borax Lake projectile points were probably used on spear points or darts for the hunting of large game animals including elk. For example, it has been hypothesized that the over-hunting of elk and the resulting reduction in their numbers may have influenced the shift to the utilization of a wider range of resources, including acorns.

The Middle Period (Mendocino Pattern)

The Middle Period spans the interval of time between approximately 3,000 B.P. and 1500 B.P. The beginning of this period is roughly coincidental with the change in climate at the end of the Xerothermic Period. This change in climate has implications for the prehistoric record. It appears that montane forest began to increasingly dominate at higher elevations. This change in vegetation distributions through time resulted in a shift in resource procurement strategies. The artifact assemblages recovered from single component site areas dating from this period include projectile points, bifaces, flake tools, and hammerstones indicative of an emphasis on game.

Archaeological evidence suggests it was during this period that the shift from a forager to a "collector" based subsistence strategy began to take place. Collectors store foods for some part of the year - usually in sedentary or semi-sedentary villages. In addition, rather than a need for group mobility, as in the forager resource procurement model, distributions of resources across time and space are solved by moving the resources to consumers resulting in fewer residential moves. Land-use activities in relation to settlement patterns are, therefore, also changed. Under the collector strategy, intersite variability becomes more pronounced. There are, for example, residential sites (villages) as well as various other kinds of specialized sites used for the collection of specific resources. These resources (such as acorns, grass seeds, or deer) were gathered and/or processed at special use sites then transported back to the main village locations (Simons 1983:1.23).

In addition to changes in climate and vegetation species trajectories, another factor that might have influenced both site settlement patterns was the increase in population density. Population growth necessitates that more energy be extracted per unit of land. Generally, this is accomplished by an increase in the range of resources utilized. That is, there is an increased use of lower ranked resources.

Given the intensification in the procurement of subsistence resources resulting from an increase in population density, the procurement of a wider range of resources, and the use of fire to promote the productivity of desired resources, it is probable that by the end of this period the environment of the region was being affected to some extent by human land-use activities.

Late Period (Gunther Pattern)

This period extends from approximately 1,500 B.P. to the beginning of the historic period (often referred to as the contact period) and includes the ethnographic period (which will be discussed in greater detail in the next section). The artifact assemblages recovered from these Pilot Ridge sites were predominately of flaked stone tools (i.e. projectile points, cores, bifaces and other flaked tools [Hildebrandt and Hayes 1993:112]) similar to artifact assemblages found in Middle Period components. It appears that there was a continuing increase in population density and intensification in the collection of lowland subsistence resources like fish and acorns. There was also more emphasis placed on the storage of resources for winter consumption. Sites located away from the sedentary village locations along the rivers were of a more limited and specialized nature reflecting their use as temporary camps visited for specialized resource procurement activities (Simon 1983:1.26). Thus, by the Late Period, aboriginal peoples, through their land-use activities and increased population density, were significant factors influencing the mix of plant species and animal species found in the region.

A theoretical dispute among archaeologists exists in this region related to the relationship between the peoples occupying area towards the end of the Late Period (i.e. the ethnographic period) and those living here during the earlier time periods. One hypothesis suggests that the changing adaptations to the environment and the ethnographic cultural patterns present at the time of historic contact occurred in place and were relatively early in origin. The alternative hypothesis, supported by linguistic data (Whistler 1979), contends that many of adaptations related to the exploitation of subsistence resources and cultural patterns present during the ethnographic period were brought in by immigrant groups with "technological systems preadapted to the local resource base" (Hildebrandt and Hayes 1993:116).

This theory suggests that the original inhabitants of northwestern California were ancestral Karuk (Hokan Stock) with a culture focused on an inland-oriented big game subsistence resource procurement strategy. The evolution of both inland and coastal cultures during the later portion of the Late Period is summarized by Hayes and Hildebrandt (1993:116).

> At around 1100 B.P., the Wiyot arrived and occupied previously under-used coastal habitats. Soon thereafter, the Yurok settled along the lower Klamath and adjacent coastline, a process made possible by their superior technological abilities to fish, build boats, and store salmon. Marking the beginning of the Gunther Pattern, these arrivals are thought to be manifested archaeologically at a series of coastal sites containing dentalium shells, bone and antler harpoon points, various woodworking tools, ceremonial obsidian bifaces, ground stone zoomorphs, as well as a variety of other artifact forms.
>
> The final hypothetical wave of immigration was speakers of the Athabaskan languages (Tolowa, Hupa, Chilula, and Whilkut). Arriving about 700 B.P. and occupying areas peripheral to the Wiyot and Yurok, these groups possessed an acute knowledge of forest and riverine environment, and possibly an improved technological system that included the toggle harpoon and sinew-backed bow.

The Analysis Area and the Prehistoric Record

To date, no archaeological excavations have taken place within the HLMTT area. There have been, however, several studies within Hupa territory that can provide some insights. In late 1970s, two sites (CA-HUM-245 and CA-HUM-246) located to the west of Hoopa Valley on Pine Ridge and Stormy Saddle were excavated under contract to the Bureau of Land Management (Flynn and Roop 1975, Jackson 1979). Although some disagreement about the antiquity of these sites exists among archaeologists, the consensus suggests that some of the artifactual materials date back at least 2,500 years. In addition, one site located to the east of Hoopa Valley within the HLMTT area on Hostler Ridge (CA-HUM-435) recorded in the late 1970s, contained artifactual materials that were similar in nature to those found both on Pilot Ridge and Pine Ridge suggestive of the Borax Lake tradition.

It also appears that a radiocarbon date was secured for a village site in Hoopa Valley in about 1973. The unpublished manuscript was not available for review (Norton 1973). According to Winter, (see Theodoratus 1979:125) a radiocarbon date of about 6,000 B.P. was obtained for one sample from this site. This date should be viewed with some caution until the documentation for this dating is confirmed. The evidence gathered to date, however, suggests that the analysis area has been inhabited and utilized by humans for thousands of years

Surface lithics materials and diagnostic artifacts for prehistoric sites recorded to date within the analysis area are nearly all limited to higher elevations (above 4,000’). These artifactual materials are in agreement with the general prehistoric model for this region that suggests that high altitude areas were used on a seasonal basis. Given the rich resource base of anadromous fish, seeds, acorns and wildlife found at lower elevations in Hupa territory, it is not surprising that the higher elevations were used less intensively.

Ethnogeography

Part of the problem with defining the territorial boundaries in this region of California is related to differences in world view and cultures between the anthropologists who documented group boundaries and the Indians they interviewed. To the anthropologists working in the area, defining boundaries was a product of western logic conceived as strict demarcations that were well defined and agreed upon. However, as George Foster (1944:157) noted, "in the minds of the Indians exact boundaries were never known." It is likely, therefore, that the territorial boundaries of the peoples living in this region were more complex and ambiguous than those confidently drawn on maps by early 20th Century ethnographers.

During the ethnographic period, the Athabaskan speaking Hupa inhabited the HLMTT area. Martin Baumhoff (1958) summarized the ethnogeographic data (primarily the field notes of Pliny Goddard, C. Hart Merriam, and the published ethnographies of Alfred Kroeber) for the Hupa. Hupa territory occupied the lower portion of the Trinity River from just below its confluence with the Klamath south for about 20 miles. The closely related South Fork Hupa, known today as the Tsnungwe, occupied the lower portion of the South Fork of the Trinity south to Wintu territory and the main stem of the Trinity from the mouth of the South Fork east to Chimariko territory, which began about the mouth of the New River (Baumhoff 1958:210). The eastern boundary was the Trinity Mountain region and the northern boundary, east of Hoopa Valley, was along the ridge separating Red Cap and Mill Creeks and then a westerly line drawn approximately to the mouth of Bull Creek (Deerhorn Creek) about two miles south of the confluence of the Trinity and Klamath Rivers.

Mill Creek, Horse Linto Creek, and Tish Tang Creek were important streams to the Hupa supporting large populations of anadromous fish. Villages were situated at the confluence of Mill Creek, Horse Linto Creek and Tish Tang Creek with the Trinity River (Baumhoff 1958:212). The lower reaches of these canyons contained large groves of tanoak and the headwaters regions of these watersheds are high altitude country and were a major summering area for deer and elk. There were also some groves of Oregon oak and black oak along the edges of the valley floor and the lower reaches of the creek canyons on the south facing slopes. In addition to acorns, grass seeds, bear grass, ferns and other plant resources were harvested seasonally within both the lower and upper reaches of the watersheds

Given the facts presented above, it is likely that during the ethnographic period era these watersheds were used intensively. More recent interview data as summarized by Winter et al (1978) confirms that vast tanoak groves were located on the slopes above Mill Creek, Tish Tang Creek, and Horse Linto Creek and were accessed from the villages located at the mouth of each creek. Interviews with Hoopa residents indicates that acorns and mushrooms are still gathered on the Horse Linto side of Tish Tang Ridge (SRNF I#290) and other areas in the lower river canyons.

As noted earlier, during the ethnographic period at the southern edge of Hupa territory centered on the confluence of the South Fork of the Trinity and the main river was a tribe ethnographers referred to as the South Fork Hupa. Today, this tribe is known as the Tsunegwe. Pliny Goddard (1903:7), who accomplished extensive linguistic work with the Hupa, suggested that they were a division of the Hupa. Despite their close linguistic ties, Goddard noted that there were important differences in religious matters.

Although the Tsunegwe territory was some distance from the analysis area, they are mentioned in this study since it is possible that some of the territory within the southern portions of the analysis area may experience contemporary use (possibly for plant gathering, but also possible religious use) by the Tsunegwe and this use may have extended into the past.

Hupa Subsistence Strategies and Land-use Practices

During the ethnographic period, it is likely that the main focus of subsistence procurement activities in this region were related to fishing, with slightly less emphasis placed on acorn and seed collecting and hunting. While most of the major villages were located within Hoopa Valley on river terraces or flats adjacent to the river, there were a number of villages located to the south of the valley in the Trinity River canyon. The Hupa villages were permanent with substantial houses. The rectangular houses were semi-subterranean and were usually made of cedar planks (Wallace 1978:166). For a complete listing of villages and their locations, refer to Baumhoff (1958:213). The surrounding hills and mountains were visited seasonally to secure both plant and animal resources.

In this region of northwestern California, resource procurement strategies can be divided into two major types. Kroeber (1925:898-899) discussed these types in his *Handbook*. The Hupa and the more coastal or lower river-oriented groups (Tolowa, Yurok, Karuk) in northwestern California practiced subsistence strategies and had cultural affinities with the aboriginal groups extending north along the coast into Oregon, Washington and British Colombia. These groups were dependent on anadromous fish as a major subsistence resource. For this reason, they tended to inhabit permanent village sites located along the major waterways within their territory. To the south of the Northwest Culture Area (immediately to the south of Hupa territory) begins what has been termed the California Culture Area. Here, southern Athabascan territory begins. These groups, although closely related linguistically with the Hupa, have cultural characteristics more in common with the aboriginal groups within greater California - including a more generalized subsistence resource procurement strategy.

The following is a generalized model of river-oriented resource procurement strategies used by the Hupa. The principal subsistence resources utilized by the Hupa were anadromous fish and acorns. There were runs of anadromous fish several times each year including in the spring and fall. Fishing grounds were traditionally owned by families and were inherited (Theodoratus 1979:93). Salmon, lamprey eel, and steelhead trout were caught in the river and tributaries during their annual migrations. In some strategic locations, fishing dams or weirs were constructed each year. Acorns were collected in the fall. Acorns of the tanoak were preferred, but most kinds were collected and utilized. Various plants in the hills were used for food resources (for example grass seeds and bulbs) and for basketry materials. Villages or extended families had ownership of some of these gathering areas for instance specific tanoak groves.

Wallace (1978:165) writes, "although their land was rich in game, the Hupa did not exploit this source of food extensively." Hunters did occasionally hunt deer and elk, as well as other small game. The Hupa were known for the beauty and quality of their baskets and the plant materials needed for their fabrication were secured at various locations within their territory including the high country. Ethnographers (Curtis 1924, Goddard 1903, Wallace 1978) also noted that the Hupa used fire to drive deer, enhance the quality of basketry materials and to keep the areas open and clear of duff under the oak trees where they collected annually. Based on the ethnographic data, in general, it appears, that the Hupa spent less time in the hills away from their main village sites than those southern Athabascan groups located immediately to the south. However, the use of the upland areas away from the river was still relatively substantial and given the use of fire, hunting and the gathering of plants it probable that the environment of the entire analysis area was influenced to a substantial degree by Hupa subsistence activities and land-use practices.

Religion

Religious activities were an integral part of everyday Hupa life. The high mountains east of Hoopa Valley, that form the headwaters region of the analysis area, were used extensively for doctor training and other purposes related to spiritual and religious activities. Trails and resting spots along the ridges east of Hoopa Valley were also considered sacred and travelers would stop in specific spots to rest, smoke and make offerings (Goddard 1903:88). Religious sites varied but included rock circles, cairns and fire hearths for praying, dancing, singing and the invocation of various incantations. The rock rings usually commanded an imposing view of the surrounding countryside.

Studies by Six Rivers Heritage Staff (Winter and Heffner 1979, Heffner 1983, 1986) have concluded that the traditional religious practices of the Hupa are still taking place within the high country east of the valley. As a result of these studies, the De-No-To District was determined eligible for the National Register of Historic Places based on the ethnographical and contemporary values of these sites centered on the Trinity Summit area (nomination on file Six Rivers National Forest).

Trails

The Hupa had an extensive trails network linking river villages with the high country in the Trinity Summit region. These trails were used for subsistence activities and trade with the groups living to the east. As noted above, certain trails were used for religious purposes.

Recent History

The first contact between the Hupa and Euro-Americans took place in 1828 when the Jedediah Smith Party traveled along the Trinity River on their way to the coast. Intensive contact began after the discovery of gold in 1848 in the upper reaches of the Trinity River. The coastal ports of Union (Arcata), Humboldt City, Buck's Port and Eureka competed for primacy in supplying the Trinity Mines with supplies. The first development within the region occurred in the early 1850s with development of supply trails to the mines from the coast. Several trails crossed the Trinity

River, with one through Hoopa Valley. The trail ran along the crest of Tish Tang Ridge towards the New River mines in the Denny area.

During the first decade and a half that the trails were open, there were numerous skirmishes with the local Indian population. Many of these confrontations are discussed in *Indian Wars of the Northwest* (Bledsoe 1885). The violence escalated and between about 1862 and 1864 when the "Two Years War" between the settlers and Indians was being waged throughout interior sections of Humboldt and Trinity Counties. During this period, the Board Camp Mountain, Pilot Creek and Grouse Creek Watersheds, and the Trinity Summit region were refuge locations where local Indian groups could hide out to avoid the soldiers and parties of armed civilians who were searching for Indian encampments. The conflicts, when they occurred, were nearly always one-sided, with the Stone-Age weapons and lack of organization among the aboriginal groups no match for the firearms of the settlers and the well-supplied army troops

By 1865, the last of the violent conflicts with the Indian tribes had ended and this event opened up interior sections of Humboldt County to development and settlement. A number of settlers homesteaded in Hoopa Valley, eventually however, agreements were reached that created the Hupa Indian Reservation. The reservation boundaries included the most strategically important part of the Hupa territory - the Hoopa Valley - within the “Hoopa Square.” Lands to the east of the valley within the HLMTT area remained within the public domain. [The history of Hoopa Valley and establishment of the reservation is beyond the scope of this study. Those interested in this fascinating part of northwestern California history are referred to *Our Home Forever a Hupa Tribal History*, Nelson 1978).]

Historical Development

Due to the steep terrain and higher altitudes of the Trinity Summit region, little historical settlement took place within the analysis area. Establishment of the Hupa Reservation in the 1860s led to increased use of the area by the Hupa for seasonal grazing. In 1903, Frances Berry settled near the mouth of Horse Linto Creek and filed a homestead claim in 1907. Some fruit trees remain on this site (Gmoser 1984 Hoopa Timber Sale).

For the most part, historic use within the watersheds has centered on subsistence activities such as acorn and seed gathering along the lower reaches of the creek canyons and livestock grazing and hunting in the upper reaches of the watersheds in the Trinity Summit region. Also, during the mid-to-late 19^{th} century, camps were often established in this region for miners traveling to the Trinity mines. For example, Grizzly Camp is supposed to have been used in the 1850s by miners heading to the gold fields.

In addition to the Hupa, some ranchers used the Trinity Summit area for the grazing of livestock. For example, in the 1870s and 1880s, a Scotts Valley rancher grazed horses in the Trinity Summit region (SRNF I#331). Also, the U.S. Army troops stationed in Hoopa Valley grazed their mules “on the summit of Trinity Mountain where grass and good water are abundant” as late as 1897 (as quoted in Winter et al 1979:23).

Some known camps associated with hunting and grazing activities were located at McKay Meadows, Andy's (or Meskets) Camp, Waterdog Lakes, Crogan Hole, Bret Hole, and the Trinity Summit Guard Station.

In April of 1905, President Theodore Roosevelt signed legislation creating a number of Forest Reserves including the Trinity Reserve, which encompassed the public lands within the analysis area. The Forest Reserve was headquartered in Weaverville. Two Ranger Districts were established as administrative sites. One, the Lower Trinity Ranger District, encompassing approximately 450,000 acres, included the analysis area. By 1923, (and possibly earlier) an administrative site was established on the newly created Ranger District near the confluence of the South Fork Trinity and main Trinity River.

Creation of the Trinity Reserve signaled a major change in the management of public lands by the federal government, with increased regulation and management of human land-use activities such as grazing and mining. In addition, steps were taken to establish and maintain a trail system, control wildfires and to establish communications links between the Forest Service Guard stations, lookouts and local homesteads (the Forest Service supplied each homestead with a phone and telephone line; homesteaders supplied the batteries to operate it).

During the late 1930s and early 1940s, a Civilian Conservation Corps (CCC) camp was established at Salyer. The men from these camps worked on a number of projects within the Trinity Summit region including trail construction and maintenance and the construction of a new Trinity Guard station.

The principal recreation activities historically within the analysis area have been hunting and hiking. Recreation use has increased recently with the creation of the Trinity Alps Wilderness area. In 1947 (USDA Six Rivers National Forest, 1947) a campground and summer homes tract was proposed for Groves Prairie; however, that recommendation was never acted upon.

Within the lands of the Trinity National Forest, there was little in the way of grazing land on what is now the Lower Trinity Ranger District. Most of these lands were to the south along Pilot Ridge and in the Board Camp Mountain areas. Although the lower reaches of the creek canyons within the analysis area were heavily forested, there were some excellent grazing lands in the headwaters region. This region, known as the Trinity Summit area, was mostly above 5,000 feet in elevation and was a mix of forest and expansive meadows.

Many of the permittees using the Trinity Summit area were residents of Hoopa Valley. In addition, it appears from the historic record that a number of Hupa residents without permits grazed livestock in the Trinity Summit area. Since the Hupa had used this area for centuries, the District Ranger at that time took a rather permissive attitude when it came to enforcing the law in this area (Theodoratus 1979:26). One Lower Trinity Ranger noted this fact in his yearly report:

> Most of the Hoopa Indians own small subsistence ranches, and have small herds of cattle. It is the Indian sentiment that the use of National Forest ranges adjoining their Reservation for grazing their cattle in summer is part of their heritage based on generations of use by their forefathers.

> This is therefore, not a case, which involves only the use of some grass; it involves a pattern of Indian use and tradition. The whole Indian problem and our relations with them revolves around our judicious handling of such cases as this one. Ranger ____ feels that Approval of these applications will definitely lead to better relations with the Indians, and help to solve a rather delicate situation. [Six Rivers HRM Grazing files, letter March 15, 1948]

In the 1940s and 1950s, grazing records indicate that grazing was taking place in the Trinity Summit region as well as to the west in the Mill Creek watershed, Waterdog Lake, Fern Prairie, and Packer's Prairie. There were also plans to build the "Trinity Summit Stock Driveway" and "Mud Springs Drift Fence" in 1942 charging every grazing permittee a fee to help pay for the construction (Theodoratus 1979:26).

In 1947 (Annual Report 1947:C-22) records indicate that there were several grazing allotments within the HLMTT area. Table 3-1 displays the information for each allotment.

Table 3-1. Allotment Information from 1947

Allotment Name	Total Acreage	Total Useable Government Acreage	Estimated Total AUMs
Red Cap	13,967	4,820	281
Trinity Summit	31,000	535	178
Groves Prairie	19,840	4,640	150

Groves Prairie Ranger Station was constructed in 1909. It was a one-room log cabin. In 1922, a larger log house, staffed seasonally by a guard, was constructed. The station had a pasture for grazing livestock and was located strategically in an area of dense timberlands that were susceptible to fire in the summer due to heavy use in the area by hunters.

No information could be located on exactly when logging began within the analysis area. It is clear, however, that by 1947 timber sales were taking place on the Forest east of the Hoopa Reservation. In 1947, Forest Service Records (Forest Report 1947:C-21) indicate that 400 mmbf board feet of timber were harvested in the Mill Creek watershed and 550 mmbf in the Groves Prairie area. Notes in this document (1947:C-21) also indicate that it was estimated that there was approximately 1 billion board feet of standing timber existing on the Hoopa Reservation, 90 percent of which was Douglas-fir. In addition, 500 acres in Section 18 T8N/R6E was cruised with a volume averaging 28,886 board feet per acre with a recommended cut of 17,000 board feet per acre.

Hotelling (1978:100) noted that large-scale timber harvesting within the project area began in about the early 1950s. He also notes that in the early 1950s some of the first reforestation on the National Forest began. One of these areas was in the upper reaches of Mill Creek where Jeffery, ponderosa and Douglas-fir were planted.

Heritage Resources Management

To date approximately 3,200 acres have been surveyed within the Horse Linto and Tish Tang watersheds. Since most of the work has been associated with timber sales, many of the more archaeologically sensitive areas such as ridge tops, open meadows, and terraces along the inner gorges of Horse Linto and Tish Tang Creek have not been surveyed. Given the heavy historical and prehistorical use of the area it is likely that these areas contain some heritage sites. The lower portions of the Mill Creek watershed is within the Hupa Reservation and is not included within the heritage portion of this study. The upper portions of the watershed east of the boundary were included in some Forest Service projects. The total area surveyed on Forest Service lands within the upper Mill Creeks region east of the Hupa Square is approximately 1,200 acres.

In addition to the cultural resource inventories and site recordation that have taken place within and adjacent to the analysis area, a number of ethnographic studies were authored by members of the heritage resources staff at Six Rivers. These studies provide important information on both the traditional historical and contemporary use of the area east of the Hupa Indian Reservation. In addition to these studies, a number of interviews with knowledgeable Hupa on the cultural use of the Trinity summit region are on file. Numerous heritage resources have been recorded within the project area. The number and types of sites recorded are presented in Table 3-2.

Table 3-2. Recorded Heritage Resource Sites in the Analysis Area

Watershed	Sites	Prehistoric	Historic	Prehistoric/Historic	Trail	TCP[1]
Mill Creek	19	4	6	2	4	3
Horse Linto Creek	17	9	3	2	3	0
Tish Tang Creek	23	8	6	2	4[2]	4

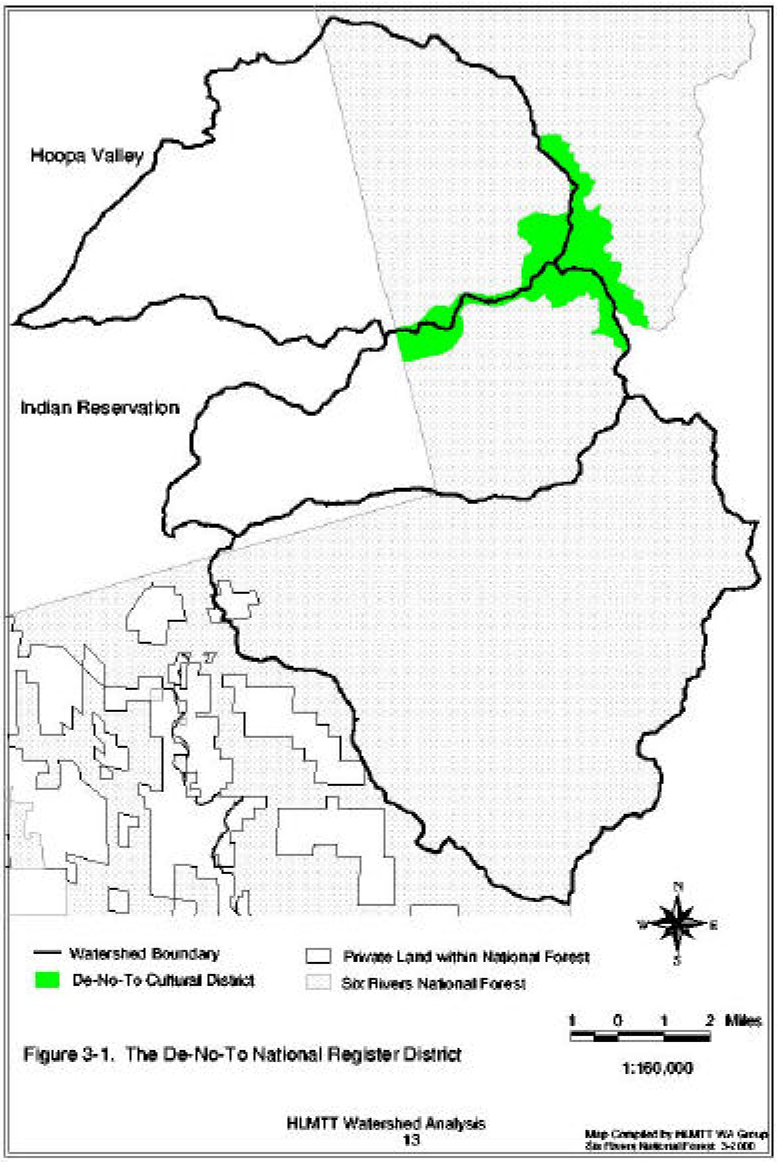
[1]Traditional Cultural Property/prehistoric
[2]Several trails listed as within this watershed are on the divide with Horse Linto and Mill Creeks

To date, 18 prehistoric sites, predominately flake and tool scatters, have been recorded within the analysis area. Most are located in the higher reaches of the drainage along ridges or adjacent to water sources. Most of these sites contain chert and obsidian flakes and archaeologists recording the sites have noted the presence of formed artifacts including projectile points on many of the sites. Most formed artifacts date from the Late Period. Interestingly, a cursory review of the site records suggests that the makeup of the lithics materials for these sites varies significantly from those sites recorded and excavated on Pilot Ridge and South Fork Mountain. The most important difference is in the ratio between the numbers of chert flakes/tools when compared to obsidian flakes/tools. On Pilot Ridge and areas to the south, sites that have been excavated or recorded only about 5 percent of the artifactual materials encountered are of obsidian. Within the HLMTT area on many of the sites recorded (none have been excavated) up to 50 percent of flakes/tools observed on the surface are obsidian. In addition, the presence of basalt flakes was noted on a number of sites (for example 05-10-53-221, 222, and 224). Basalt is rarely found on sites located within Six Rivers National Forest. Further to the south on Pilot Ridge and the Mad River Ranger District, perhaps one site in 100 contains a basalt flake or two.

Despite the fact that there are references in the literature referring to the collection of tanoak acorns within the analysis area, to date, no sites containing groundstone artifacts have been recorded. This lack of groundstone artifacts may be the result of the bias towards surveying proposed timber harvest units.

To date, six historic sites have been recorded within the analysis area. These range from a "stump house" used as a hunters camp, several hunters camps and associated historic artifacts including cans and bottles, and the CCC era constructed Trinity Guard Station. Numerous trails

Figure 3-1. **The DE-NO-TO National Register District:**



lace the analysis area. To date most of these trails have not been recorded. Six trails have been formally recorded and most probably date to the prehistoric era. Religious practitioners have linked use of some of the trails within the analysis area to traditional and contemporary use.

As noted earlier, the De-No-To National Register District is located within the analysis area (Figure 3-1). This National Register District was determined eligible in 1984. Given the critical nature of this area in relation to both the Hupa and the fact that rehabilitation efforts related to the Megram Fire might take place within the District boundaries, a large portion of the "Significance" section of the National Register nomination is quoted below.

De-No-to is a significant cultural district eligible under:

Criteria A Association with a broad pattern of events significant in local prehistory and history - due to its association with a complex of high country medicine making which has persisted since prehistoric times.

Criteria C As a district whose components taken together make up a distinguishable entity which conveys an important sense of time and place - due to its recognition as a concentrated area of sacred significance to the Hupa, an area which retains qualities of environmental setting along with objects and sites which are characteristic of past and continuing spiritual use; and

Criteria D has yielded and may be likely to yield information important in prehistory or history- due to the ongoing use of the area of an indigenous religious system, thereby providing a living source of information on traditional practices and beliefs along with archaeological manifestations of those practices. This information provides an important data base for anthropological study of northwest California belief systems, notably the World Renewal Complex participated in by the Hupa and also the Karuk, Yurok, and Tolowa. Most importantly, the district and its continuing use provides a focus for retention and transmission of cultural knowledge amongst current and future generations of Hupa practitioners, not only for an understanding of how things were done in the past but also as a dynamic core of cultural identity.

The primary significance of the De-No-To district rests in its value as an area that has been sacred to the Hupa people throughout their history. Their feelings for this area and its association with the ongoing system of traditional cultural practices and beliefs constitute and integral aspect of Hupa cultural identity.

The medicine making, doctor training and ceremonial activities carried on here are part of an indigenous religious system know n as the "World Renewal Complex" (Kreober 1925, Kroeber and Gifford 1949) which has persisted in Northwest California since prehistoric times. Ethnohistorical data confirm the functional significance of the World Renewal ceremonies in creating and maintaining social stability and cohesion (Goldschmidt and Driver 1940). Religious beliefs continue to play a vital role in the maintenance and transmission of cultural values and identity....

...The De-No-To area is the source of the "medicine" utilized by the doctors and ceremonial leaders to attend to the spiritual and physical well being of the people. The sacred power of the area results from its identification as a place where the "spirituals" dwell. Therefore, here is where communication with the supernaturals takes place and their messages are translated to this world. Medicine made here is vital to the success of the ceremonies carried out in Hoopa Valley. Here is where doctors still continue to undergo training to gain spiritual knowledge with curing powers, and where they continually return to reinforce and extend that knowledge. This is also the place for personal medicines, where anyone who approaches the area with the proper respect may seek the assistance of supernatural forces. A sense of place and the importance of particular localities is an integral aspect of those religious beliefs. "Such a thing as transplanting a ceremony to another place is wholly foreign to native views...here indeed is a cult rooted in the environment" (Kroeber and Gifford 1949:107).

The De-No-To District has retained its integrity of location and environmental setting, feeling, and association, and thereby conveys an important sense of time and place. While archaeological manifestations may be quite subtle - in some cases only a small hearth (CA-HUM-506), a cairn and cache of coins or flakes (CA-HUM-500), or a rock circle (CA-HUM-496) - these sites represent a complex of highly significant cultural activities that has remained essentially unchanged. The continuing use of these same places for generation after generation is a key to the transmission, maintenance, and transformation of those practices. Awareness of the continuity of use and integrity of these places provides for the users a sense of spiritual affinity and bonding with past users; their own teachers and relatives as well as distant ancestors. Spiritual objects, such as pipes, have been left here for later spiritual seekers who can thereby gain the knowledge and guidance of past and current users (Heffner 1983:25). One stone pipe hidden in the area is said to be over 600 years old with over 30 generations of medicine people using it (Winter et al 1979:38). While different localities within the district are recognized for particular spiritual activities, it is not possible to isolate particular sites from the importance of the area as a whole. The area is a "...concentrated spot of spiritual knowledge of greater meaning. The medicine people can step through these doors and circle the universe obtaining knowledge..." (Hupa consultant in Heffner 1983:13).

The presence of a viable ongoing religious tradition in this area, which has deep roots in the aboriginal past of northwest California, has proven to be a valuable source of information important in prehistory and history. The information volunteered by users of the area has already added significantly to the store of knowledge on high country medicine practices and the nature of northwest California belief systems, especially of those groups participating in what is known as the World Renewal complex....

More important than scientific anthropological information, the district and its users provide a source of highly significant cultural knowledge for the Hupa themselves. The sacred sites and their use for spiritual activities provide a focus for the retention and transmission of cultural knowledge not only to current users but also to future generations as well. This knowledge provides a core through which cultural identity is maintained even though outward forms of practice and life-style may change. According to one Hupa consultant (in Heffner 1983:51), these sacred areas are "storehouses of knowledge, which through the young, will restore a reviving and continuing culture. There is very important information there. I won't say for the taking, but for the receiving by the proper person who is trained and very sincere in his quest. It is essential for the survival of our culture."

Social and Human Uses

The analysis area is predominately composed of public lands under the jurisdiction of the Six Rivers National Forest and the Hoopa Valley Indian Reservation under the jurisdiction of the Hoopa Valley Business Council. The local communities have a long history within the HLMTT area and have a high level of interest in the environment and economic conditions that surround their communities.

The following sections discuss the findings as they pertain to the socio-cultural values that were obtained during the Megram Fire event and information provided by public written and verbal input at four public meetings held in Eureka, Willow Creek, and Hoopa Valley. Data has been taken from USDI-BIA written letters and reports and Yurok and Hoopa Valley Tribes' written letters and reports, as well as formal government-to-government consultation with the Tribal Councils of Yurok and Hoopa. Date was also obtained other written materials generated by the communities, tribal governments, other federal agencies and groups utilizing or having interest in the analysis area.

Local Communities

Indian Tribes

Aboriginal lands of the Hupa include the analysis area. Hupa individuals and the tribal government are actively concerned about what occurs within the watersheds. The Hupa are federally recognized, and as such, has authority under their constitution to represent enrolled Tribal members' interests and rights; also, with this recognition comes the responsibility of the federal government to meet a trust responsibility towards the Tribe. Hoopa Valley Indian Reservation abuts National Forest lands on the south, east and north boundaries of the Reservation. The Trinity River dissects the Reservation as it flows toward the Klamath River. Tish Tang and Mill Creeks headwaters are east of the Hoopa Valley Indian Reservation and both streams flow down into the reservation. The downstream ends of both streams contain anadromous fish that are important to the Hoopa Valley Indian Tribe. Roughly half of the combined watersheds are within the reservation and about 26,000 acres is part of the Six Rivers National Forest. Horse Linto Creek lies just south and south east of the reservation. This 42,000-acre watershed has runs of steelhead, coho and chinook. The watershed, with the exception of about one section of private land, is part of the Six Rivers National Forest. The Hupa people are very active in gathering plant resources, spiritual uses, and hunting within the HLMTT area. The Tribe is active in representing Hupa socio-cultural and political values to land management agencies. Traditionalist, be they plant gatherers, doctors, or spiritual practitioners are also active and vocal.

The Tsnungwe is an organized tribe but is not a federally recognized tribe at this time, although they are currently seeking such federal recognition. The Tsnungwe Council speaks on behalf of its membership for cultural issues within the aboriginal territory of what is anthropologically known as the Southern Hupa. The Tsnungwe Tribal Council is active in supporting their members' gathering of plant resources, spiritual uses and hunting within their identified aboriginal lands, which include some of the analysis area.

The Hupa, Tsnungwe, and their respective Tribal government and Council, express similar values about the analysis area and share concerns with respect to the availability and quality of the materials they gather, protection of spiritual locations and cultural sites and quality and quantity of water in the Trinity River. They express concern for fisheries survival and habitat improvement. Along with those views, they express a desire for the analysis area to return to conditions that are more natural.

Willow Creek and Vicinity

Willow Creek has a population of approximately 1,500 people and is located along Highway 299 at its junction with Highway 96. The Trinity River, which includes a section of wild and scenic river, runs adjacent to the town and provides for an economic basis of tourism associated with white water rafting, canoeing and kayaking. The river also offers salmon, steelhead and trout fishing that attracts both local and out-of-state anglers. Swimming is a big attraction for the coastal residents. Several businesses in Willow Creek offer services that support these activities.

Tribal Trust Resources

Hoopa Reservation

The Big Bar Fire Complex totaled 141,600 acres and consisted of the Megram (125,000 acres) and Onion (16,600 acres) Fires. Approximately 4,830 acres of reservation lands lie within the fire line perimeter. Approximately 2,020 acres of reservation lands actually experienced fire. The complex began burning on National Forest lands and later burned onto the Hoopa Valley Indian Reservation. Of this, 330 acres were impacted by wildfire and 1,690 acres by burn out operations. In anticipation of the fire spreading onto Hoopa lands, a cooperative governmental effort developed to reduce any potential adverse effects to tribal trust resources. Back firing occurred on approximately 2,090 acres; 146 acres were cleared of vegetation during construction of 17.62 miles of dozer line; 0.46 miles of hand line and 20 safety zones were constructed; 9 pre-existing stream waterholes were used; 7 drop points were improved; 2 water dipping sites were used; 2.49 miles of closed road were re-opened; and 13 miles of road were brushed. Dozer line construction resulted in all live vegetation being removed, including old-growth trees. The majority of the vegetation affected by the wildfire, burnout operations and dozer/hand lines on the reservation were forests. (USDI 1999:54, 59, 89)

After of the fire, the USDI Southern Burned Area Emergency Rehabilitation (BAER) Team produced the “Big Bar Fire Complex Burned Area Emergency Rehabilitation Plan for the Hoopa Valley Tribe”. The Plan was prepared for the Bureau of Indian Affairs, and so it documented concerns of other federally recognized tribes (Yurok and Karuk) in addition to those of the Hoopa. The concerns identified outside the Hoopa Reservation itself were related to fire effects on National Forest lands. The report, however, examined both short and potential long-term effects to Hoopa Tribal trust resources and interests (USDI 1999:48).

Hoopa Tribal Council Consultation

The Hoopa Tribe stated that they supported the data and recommendations in the USDI BAER report. Tribal staff participated in the data analysis and recommendations. The Tribe signed off on the final document (February 2, 2000).

Yurok Tribal Chair Consultation

The Yurok Chair stated that the information reflected in the USDI report basically covers the concerns expressed by the Tribal Council of being kept informed of the results of post fire monitoring. Additionally, the Council had requested that, if possible, there would be active participation in the rehabilitation work of the area (February 3, 2000).

Timber Trust Resource

Much of the Hoopa Valley Indian Reservation is dominated by Douglas-fir (*Pseudotsuga menziesii)* timber and it is this timber resource that provides the primary economic base of the community (Hoopa Valley Tribe 1997:2). Forests affected by the Megram Fire and suppression activities include old growth, mature, and early seral (plantations) stands. Forest types include Douglas-fir (*Pseudotsuga menziesii)/*mixed evergreen hardwood, mixed conifer at elevations above approximately 4,000 feet, and riparian forests associated with streams and springs. Approximately 1,720 acres within the Megram Fire line perimeter occur within areas designated as Wilderness Management and Cultural Use in the Tribe's Forest Management Plan. Harvesting and fuels treatment has occurred within the affected area since as early as the mid 1940s. Of the 4,830 acres of tribal lands within the fire line perimeter, about 1,490 acres have been harvested to date. All but six of the harvested areas had been site prepared and planted prior to the fire. Some plantations had been early released from competing vegetation, and many of the older plantations had been pre-commercially thinned and released (USDI 1999:59).

The fire damaged or killed very few mature trees; damage to mature trees was limited to isolated small (one to two acre) groups. The fire did kill a substantial number of young trees in established Douglas-fir plantations. Damage to plantations varied from isolated mortality of individual trees or small groups of trees, to nearly complete mortality of continuous blocks of land within the plantations. All of this damage occurred as a direct result of burn out operations along the Long Ridge and Horse Linto roads.

Trees were also killed as a result of dozer line and safety zone construction. In total, 491 acres of tree mortality were related to suppression related efforts (Ibid: 67).

Fish & Water Trust Resource Associated with National Forest Lands

The Hoopa Valley Indian Reservation was established in 1864. The reservation generally consists of approximately a 12-mile square block of land bisected by the lower Trinity River. In 1988, Congress, via the Hupa-Yurok Settlement Act, established the Yurok Indian Reservation, which is bisected by the Lower Klamath River. Several court rulings have established that an important "Indian purpose" for the reservations was to reserve the tribes' rights to take fish from the Klamath and Trinity rivers (USFW 1999 EIS for Trinity River Fisheries Restoration).

The Hoopa and Yurok Tribes retain and fully exercise federally recognized fishing rights within the Klamath-Trinity watershed basin. Protection of these rights is a federal government trust responsibility. In managing these rights, the federal government recognizes the vested interest the Tribe retains in habitat and fish production outside the reservation in the Klamath-Trinity basin. Tribal fishing rights are vested property rights held in trust by the U.S. for the benefit of the Indians (Ibid).

Much of the eastern portion of the Hoopa Valley Reservation is within the analysis area and portions were burned during the Megram Fire. Mill, Hostler and Tish Tang creeks all provide habitat for anadromous fish (Hoopa Valley Tribe 1997:2).

The Hoopa Valley Indian Reservation has been granted "Program Authority" status under several sections of the Federal Clean Water Act. Under that authority and following due process, the Hoopa Valley Tribal Council adopted a Tribal Water Quality Control Plan in July 1997. The Hoopa Valley Tribe Water Quality Control Plan has water temperature, suspended sediment, turbidity, pesticide and herbicide standards that are more stringent than those of the State of California. The Tribe currently monitors water quality in Mill Creek and has extensive background data. Continuous data recorders are also presently maintained and the data analyzed in the Mill Creek watershed. Water leaving National Forest lands and flowing into the Hoopa Valley Indian Reservation is subject to meeting the Tribe's standards under their Water Quality Control Plan.

The Hoopa Tribe depends on Mill Creek for domestic water supply for the eastern portions of the Reservation, with approximately 280 metered service connections (Hoopa Valley Tribe 1997:31). Tish Tang Creek is under an engineering feasibility and design study for use as domestic water supply. Currently their Water Quality Plan identifies a goal to reduce turbidity during high flows on reservation domestic water supply streams that lead to unacceptable water quality problems during the winter months on Mill Creek and Tish Tang Creek (Ibid: 20-21).

The USDI-BAER report analyzed effects of the burned area as it related to impacts to the domestic waters supply. The report indicated that the burned area within Tribal lands is relatively small. Portions of the headwaters of Mill Creek and Tish Tang watersheds on National Forest lands have burned at high severity but the percentage of the burned areas within those watersheds is small. The Colegrove Branch of Mill Creek had significant burn severity and will likely receive erosion control treatment. Potential for runoff and erosion from these headwater areas may impact water quality in Mill Creek and Tish Tang Creek but the effect will not be great and will be short-lived, as vegetation communities begin to restore themselves after the first year (USDI BAER 1999:70-73). They further state:

> "Threat to water quality and fisheries: Water quality in the Trinity River and tributaries will receive short term impacts from increased ash and sediment contributions as a result of the fire. All impacted tributary streams will experience an initial flush of ash and sediment, with a possible increase in water temperature. This will affect water quality in all watersheds with live streams. However, these effects will be short term, most likely lasting one to two years. All of these creeks have potential Coho Salmon populations or habitat. Populations could be adversely affected by short-term water quality impacts. The burn conditions and locations appear to conform to historical burn patterns (geomorphic observation). These patterns will provide impacts that are a natural part of these ecosystems. The short term impacts will be greatly outweighed by benefits to the system as a whole." (Ibid: 74)

The report recommended monitoring of water quality for a period of no less than three years to assess impacts on fisheries and domestic water supply (Ibid).

Hoopa Valley Business Council Consultation

The Tribe has in place monitoring, restoration, and enhancement guidelines and programmatic systems. The Tribe, through established policy, has addressed the need for Best Management Practices (BMP) to be implemented when threats to Tribal vested fish rights occur, including habitat and water quality degradation. To ensure protection of fishing related rights, Tribal scientific staffs are requesting that off-reservation jurisdictional agencies coordinate and consult with the Council on rehabilitation and monitoring efforts associated with the Big Bar Fire Complex (USDI memo November 1, 1999).

Yurok Tribe Consultation

Consultation with the Yurok Tribal Chair (February 3, 2000) confirmed the consultation information in the USDI BAER report:

“As the largest fishing tribe in the Basin, the Yurok wish to be kept informed on the results of post fire water quality monitoring, and if possible, involved in data collection. Requested from the BIA and USFS that post fire monitoring be required for at least one year in Hostler, Tish Tang, New River, Horse Linto, Mill Creek, Red Cap Creek and the North Fork of the Trinity.” (USDI 1999)

Hoopa Valley Business Council Consultation

Consultation with the Hoopa Council regarding the HLMTT watershed analysis identified that the Tribe is concerned with the entire area east of the reservation. They are very concerned with the potential for forest pathogens to get to epidemic proportions on National Forest lands and spread into timber trust resources on reservation lands. In a letter dated February 2, 2000 they state:

> “We have completed watershed analysis on both Mill Creek and Tish-Tang, and we have invested a great deal of time and tribal money into the restoration of these watersheds. The suppression efforts of the Megram Fire impacted a tremendous amount of Tribal lands and compromised many acres of previously rehabilitated work in these watersheds.” …
>
> The fire has affected many acres of previously healthy trees and weakened them dramatically, making them extremely susceptible to damaging agents. The fire has also leveled many acres of forest that will now convert to brush fields for 15-25 years, which poses an increased threat of similar fire events in the future. These issues need to be dealt with tangibly…The Megram Fire has altered the forest composition substantially. The policies that managed the forest pre-fire need to be re-evaluated to better meet the needs of the current situation. The concept of “Fire” being a natural part of the ecosystem is one that we sincerely believe in, however, the Megram Fire effects were not natural. On the contrary, many of the negative affects were due to conflicts between the USFS, public, and the industry which led to many land management policies that have excluded the use of fire as a land management tool for years.”

Subsistence Uses

Subsistence uses within the analysis area include fuel wood, poles/posts, mushrooms, acorns (tanoak), hunting (deer primarily), fishing, berries, and water for domestic use.

Plant Gathering

The Hupa people are the primary subsistence users of these watersheds. The Hoopa Valley Tribe has identified sixteen Hupa Traditional Plants of Special Concern and seven Abundant Hupa Traditional Plants within their Land Management Plan. They are shown in Tables 3-3 and Table 3-4.

Table 3-3. Traditional Plants of Special Concern

Species of Concern	Common Name
Adiatum pedatum	five-fingered fern
Boschniakia strobilacea	ground cone
Corylus cornuta	hazel sticks
Polypodium californium	licorice fern
Cercocarpus betuloides var. *betuloides*	ironwood
Tricholoma magnivelare	tan oak mushroom
Xerophyllum tenax	bear grass
Rhamnus californicus	coffee berry
Angelica arguta	Indian root
Chimaphila umbellate	prince's pine
Evemia vulpine	tree fern
Polystichum munitum	sword fern
Taxus brevifolia	Pacific yew
Woodwardia fimbriat	chain fern
Chameocypris lawsoniana	Port-Orford cedar

The analysis area had previous botanical on-site field investigations conducted for the Hoopa Tribe by Karen Theiss and Associates. These investigations have identified several species of concern present. The investigations were conducted in the Box Camp area, South Tish Tang Compartment, and the Long Ridge Compartment on the Reservation all within the area of the Megram Fire.

Table 3-4. Abundant Traditional Plants

Species of Concern	Common Name
Alnum rubra	red alder
Mahonia nervosa	barberry
Quercus kelloggii	black oak
Vaccinium ovatum	evergreen huckleberry
Equisetum arvense	horsetail
Oxalis oregana	redwood sorrel
Ranunculus spp.	Buttercup
Pteridium aquilinum	bracken fern

The Long Ridge compartment is located along the central eastern boundary of the reservation adjacent to National Forest lands. It is bounded along its westerly and northerly sides by Long Ridge, along its easterly side by the Reservation boundary, and along the southern side by Big Hill Ridge. Eighteen significant populations of six traditional Hupa species were found in this compartment (Table 3-5).

Table 3-5. Significant Populations of Traditional Species found in the Long Ridge Compartment

Species	Common Name
Adiantum aleuticum	five-fingered fern
Berberis nervosa	barberry
Boschniakia strobilacea	ground-cone
Chimaphila umbellate	prince's pine
Corylus cornuta	hazel sticks
Taxus brevifolia	Pacific yew

The South Tish Tang Compartment on-site field investigation located six significant populations of three traditional Hupa species. The South Tish Tang Compartment is located in the southeasterly portion of the Reservation. Tish Tang A Tang Creek, South Tish Tang A Tang Creek bound it on its northerly side along its northerly boundary, and West Tish Tang Compartment on its westerly boundary, and the Reservation boundary adjacent to National Forest lands along the southerly side. The species are listed in Table 3-6.

Table 3-6. Significant Populations of Traditional Species found in the South Tish Tang Compartment

Species	Common Name
Polypodium californicum	licorice fern
Polystichum munitum	sword fern
Vaccinium ovatum	evergreen huckleberry
Woodwardia fimbriata	chain fern

The Box Camp Salvage Sale on-site field investigation located eleven significant populations of four traditional Hupa species. The area of investigation is located on the easterly boundary of the Reservation adjacent to National Forest lands. It is roughly bounded by the South Tribal Reserve, on the Reservation, along the south, Big Hill Road to the north, Upper Hostler Creek Compartment to the west, and Six Rivers National Forest to the east. The species are listed in Table 3-7.

Table 3-7. Significant Populations of Traditional Species found in the Box Camp Salvage Sale Area

Species	Common Name
Berberis nervosa	barberry
Chimaphila umbellate	prince's pine
Corylus cornuta	hazel sticks
Pteridium aquilinum	bracken fern

In all the above investigations Theiss concludes that most of the traditional Hupa species, which occurred along the Long Ridge Compartment, appear to have narrow light and moisture requirements and that all of these species would be directly impacted by the removal of substantial canopy cover. She further states that some species, for example *Equisetum arvense* and *Pteridium aquilinum*, *and Corylus cornuta*, are fairly tolerant to disturbance and will colonize disturbed areas relatively rapidly, assuming moisture and shade are present. *Corylus cornuta* is one of the species that benefits from burning, provided there is at least partial shade, because the new growth is preferred for gathering for basket making.

The Hupa people have identified the entire south Tish Tang Compartment as an area for contemporary mountain gathering; it is a general area of subsistence, craft, and medicinal gathering (Theiss 1991 & 1992; Heffner 1984). Theiss' South Tish Tang work (1992) concludes that there are some traditional Hupa species that have narrow light and moisture requirements, such as *Polypodium californicum* and *Woodwardia fimbriata*. Other species, such as *Polystichum munitum*, appear to thrive in shady areas with a more mesic regime. All species identified, she concludes, would be directly impacted by the removal of substantial canopy cover. Optimum conditions are edaphic conditions of moderate to extensive canopy, low-density shrub layer and accumulation of organic duff/litter layer.

Heffner's 1984 work identifies National Forest lands within the analysis area as having extensive Hupa subsistence, ceremonial, and shaman gathering occurring. The work identifies significantly more species being gathered by the Hupa than identified in the Tribe's Land Management Plan. This species list can be located in A Field guide to the Tanoak and the Douglas-fir Plant Associations in Northwest California (USDI-FS 1996:E-158).

In consultation, the Hoopa Tribal Council has expressed concern regarding traditional plant gatherers having access into the Megram burn areas in order to continue gathering. They identify that this area is significant for Hupa traditional gatherers, specifically for basket makers.

Plant gatherers have identified in previous interviews that low intensity fires improve the quality of certain plant species used in basketry. However, they expressed concern that the fire retardants would contaminate the plants and other forest edibles (Burcell 1994:42).

Wildlife

The USDI BAER report identified wildlife species of importance to tribal members for sustenance, as well as, cultural significance. Hunting, fishing, gathering and observation of these animals are considered important to the livelihood, as well as cultural and traditional values of Hupa, Karuk and Yurok people. (USDI 1999:96-98) Table 3-8 lists the species identified as traditional species of concern in the Hoopa's Land Management Plan.

Table 3-8. Hoopa Traditional Species of Special Concern

Species	Common Name
Dryocopus pileatus	Pileated woodpecker
Martes pennanti pacifica	Pacific fisher
Odocoileus hemionus	Black-tail deer
Mustela vison	Mink
Bassariscus astutus	Ring-tailed cat
Oncorhynchus kisutch	Coho salmon
Oncorhynchus mykiss	Klamath Mtns. Province steelhead
Oncorphychus tshawytscha	Chinook salmon
Diadophis punctatus	Ring neck snake
Lutra Canadensis	River otter
Haliaeetus leucocephalus	Bald eagle
Aquila chrysaetos	Golden eagle
Colaptes auratus	Northern flicker
Bonasa umbellus	Ruffed grouse
Dendragapus obscurus	Blue grouse
Cyanocitta stelleri	Stellars jay

The USDI report further states that the above species have been found to occur, have potential habitat within the fire area, or may be affected because their habitat is down stream from the fire. They recommend:

1. Post fire monitoring to identify changes in turbidity and water quality resulting from the Big Bar Complex fires that may affect the federally listed SONCC coho salmon, and traditional species of special concern. Monitoring of water quality will help determine effectiveness of the proposed emergency rehabilitation treatments (both DOI and FS), and will help to determine if additional watershed treatments are necessary to protect these species and other fish populations of the Trinity River Basin. Macro invertebrate sampling will provide data that is indicative of water quality and watershed health. The data should be analyzed and compared with pre-fire monitoring data collected on the reservation, and adjacent National Forest lands. Results from both the DOI BAER fire related monitoring and similar

FS BAER monitoring should be shared with all involved. Solutions should be developed collaboratively for any problems identified.

2. Conduct TES fish counts to determine post fire presence. The results of this monitoring will help determine the effectiveness of proposed emergency rehabilitation treatments (both DOI and FS), and will determine post fire presence of the federally listed SONCC coho salmon, and traditional species of special concern: Klamath Mts. Province steelhead and Chinook salmon. The data should be analyzed and compared with pre fire monitoring data collected on the reservation and adjacent National Forest lands. Results from both the DOI BAER TES species monitoring and similar FS BAER monitoring should be shared with all involved. Solutions should be developed collaboratively for any problems identified.

The report further had specific recommendations to the Forest Service:

1. Consult with the Hoopa, Karuk, and Yurok Tribes regarding any proposed emergency or other post-fire activities that may affect the Hoopa Valley Indian Reservation watersheds or any traditional species of special concern that occur on aboriginal or ancestral lands. FS data will be required by FSW to address cumulative effects concerns as part of the Emergency Consultation process.
2. Conduct water quality and fisheries surveys and monitoring, including immediate spawning surveys within the New River, Horse Linto and lower Trinity River drainages.
3. Involve Tribal employees in all BAER monitoring within the context of co-management of the Trinity River Basin.
4. Share post fire-monitoring results with the Hoopa Valley Tribal Council and representatives of the Karuk and Yurok Tribes. (USID 1999:102)

Fisheries

Fishing is part of the norm of these communities. The Trinity River fisheries and rehabilitation of necessary habitat has been a focus of these communities for several years. Fishing is part of the major recreational attraction to the area and many of the local residents relay on fish as part of their yearly subsistence. The Hupa and Yurok peoples have relied on this resource for generations and today are active leaders in restoring the fisheries.

Both Yurok and Hoopa have trust resource rights in the fisheries of the Klamath and Trinity River and are concerned about the impacts of the Big Bar Complex Fires on the streams that could or should be maintaining healthy populations of fish. Specifically the concern is regarding sediment flow from the burned areas into the creeks and ultimately into the Trinity River affecting the fish populations. The USDI-BAER report, utilizing preliminary information, concluded that the sediment which would flow from the burned area is not likely to reach the Trinity River in relatively large quantities during normal rain events. This report, the Yurok Tribal Council, and the Hoopa Tribal Council all recommend fisheries surveys and water quality monitoring within the New River, Horse Linto, Mill Creek, Tish Tang Creek, and lower Trinity River drainages to identify changes in turbidity and water quality as it may affect fish and domestic water use. (USDI 1999:101-102)

Domestic Water Use

Mill Creek provides domestic water supply for the Hoopa Valley Reservation. Tish Tang Creek is identified as a potential source of domestic water on the Hoopa Valley Reservation. The East Fork Horse Linto Creek has an out-of-basin diversion that contributes to Quimby Creek, the water supply for the town of Denny.

Fuelwood Cutting

Fuelwood cutting takes place by the local communities within these watersheds. It is a major activity for local people that are conducted yearly. Currently it occurs along existing roads on both National Forest lands and Reservation lands.

Spiritual and Cultural Uses

Contemporary Cultural Concerns

The contemporary concerns of the Hupa for the analysis area are based on continuing cultural traditions. These cultural traditions influence the attitudes towards the high country as well as the contemporary uses of the analysis area by members of the Hupa tribe.

During the past two decades Forest Service initiated projects, including road building and timber harvesting, have frequently received project-related comments from the Hupa tribe and members of the local community. In addition, as presented earlier in this study, ethnographic studies, interviews with knowledgeable Hupa including religious practitioners have provided input on the significance of the region to the east of Hoopa Valley. It is clear that the watersheds of Horse Linto Creek, Mill Creek, and Tish Tang Creek are of critical concern to the Hupa.

These concerns can be categorized under two broad themes; impacts to the environment affecting spiritual and religious activities and affects to localities where the gathering of traditional subsistence resources takes place. There is also a more generalized concern on potential effects to the environment of the region east of Hoopa Valley voiced by members of the Hupa tribe. This concern is because the lands within the analysis area are viewed as being within their traditional tribal boundaries.

Traditional Cultural Properties and Contemporary Use

A number of Traditional Cultural Properties (TCP) have been recorded within the analysis area. Traditional Cultural Properties are those heritage resources sites that are recognized as cultural sites that have in the past or are being used currently by native religious and spiritual users from Hoopa Valley. Due to the extremely sensitive nature of this information and location of religious and spiritual sites, specific location data is not included in this study.

Although most of the TCPs are within the De-No-To National Register District caution should be exercised in any projects undertaken within the analysis area since trails, camps, and locations with religious or cultural significance are likely to occur throughout the territory east of Hoopa Valley.

Contemporary use of the high country is not limited to religious and spiritual activities. Gathering of traditional plant materials for basketry and for subsistence purposes as well as hunting has continued within the watersheds. Deer and until more recently elk were hunted in this area. Over the years, members of the Hupa community have repeatedly informed the Forest Service about the importance of the area east of Hoopa Valley and have requested modifications or in some instances the cancellation of proposed projects for this area. The letter quoted below from the Hoopa Valley Business Council (Aug 14, 1985, to the Forest Supervisor, in Cultural Resources Inventory Report 400. On File Heritage Resources, Six Rivers National Forest) is included in this study to illustrate the strong feelings of Hupa tribal members to proposed Forest Service projects within the HLMTT area.

> [The Horse Linto Creek watershed] "encompasses aboriginal territory of the Hupa which have traditionally and continue to be utilized as a source of food, materials, medicine and spiritual resources. This area is sacred and the greatest respect for wildlife, land, and water should be exercised...
>
> ...Horse Linto Creek is considered a source of divine assistance and a youth seeking power will travel up the stream to reach areas of sacred inspiration. A major ridge between Tish Tang and Horse Linto Creek was also used to access the ceremonial and religious sites of the Trinity Summit area. The trail and resting places along the way are considered sacred themselves since reaching the high country is part of the process of power and purification...

As noted earlier, although Tsunegwe territory was some distance from the analysis area it is possible that some of the territory within the southern portions of the area may experience contemporary use (possibly for plant gathering but also possible religious use) by the Tsunegwe.

Some local residents and long-time visitors have historically used the region for such activities as hunting, wood cutting, and recreational purposes. Some of this use goes back generations. Subsequent to the fire, heritage resources staff mapped the locations of all known cultural resources sites within the burn area. Using GIS fire intensity maps, each site was evaluated for potential effects resulting from the fire based on whether it was located within a no burn, low, moderate, or high intensity burn area. The results of the analysis are shown in Table 3-9.

The Hoopa Tribe's Land Management Plan identified culturally protected areas which also lay within the analysis area: De-No-To trail corridor (which is the lower trail system of the De-No-To Cultural District that lies on Reservation lands), Box Camp and a South Tribal Reserve all of which abut on the eastern boundary of the Reservation and adjacent to National Forest lands.

Table 3-9. Heritage Resource Sites in the Burned Area

Watershed	no burn	low	low to moderate	moderate	moderate to high	high
Horse Linto Creek	2	0	1	1	8	5
Mill Creek	2	2	2	7	5	1
Tish Tang Creek	1	0	0	8	12	2

The South Tribal Reserve is a wilderness with the objective by resolution of the Council to be managed as a wilderness. The Tribe's Land Management Plan calls for Box Camp to managed as a wilderness with no timber harvest; a campground would be constructed, as would trails to various scenic sites or potential campsites. The Tribe's Plan identifies the De-No-To trail as a cultural use area with no harvest. Protection of the existing trail corridor, cultural, visual, aesthetic and biological resources would be the overall goal for the area.

Cultural resources were a priority throughout the Big Bar Complex incident, and the Hoopa Valley Tribe and its representatives and resource managers were involved throughout the fire. Reasonable efforts were made to protect cultural resources, to assess fire and fire suppression damages to these resources, and to address all incident-related damages. (USDI 1999:76)

Documents issued by both the Hoopa Council and the Forest Service state that the De-No-To trail corridor has been impacted by fire suppression efforts that resulted in a tractor line being constructed up the middle of the trail corridor (USDI-BAER appendices). Temporary treatment for erosion control was employed during fire suppression rehabilitation work on both National Forest and Tribal lands along within the trail corridor. The Hoopa Council in a letter to BIA (October 29, 1999) stated that the South Tribal Reserve, Box Camp areas, and the De-No-To trail area were severely impacted by fire dozer line construction as well as impacts associated with a temporary fire camp located in the Box Camp area.

The USDI –BAER report conclude that the thermal effects of the Big Bar Complex fire on cultural resources are unknown at present. More serious concern includes suppression-related effects, disturbance of cultural traditions, and destabilization of watersheds that host the cultural resources. The report recommended that the Tribe assess the nature and extent of the incident effects on the De-No-To National Register Historic District. (USDI 1999:70)

Hoopa Valley Business Council Consultation

The Hoopa Council stated they were not only concerned with the rehabilitation of the watersheds, but also equally concerned with the protection of cultural areas. They stated they are directly tied to the area spiritually and culturally in many ways and that the Council has spoken with great concern and a consistent voice over the past 30 years regarding the need to protect and preserve this spiritual area for current and future generations.

Economics

Commercial Uses

Special Forest Products

Commercial users of special forest products are concentrated within the Lower Trinity – Big Bar area. There is a concerted effort by the Hayfork Watershed Center to encourage this activity and promote the possible economic opportunities for displaced timber workers. The collection of the Tan Oak mushroom is occurring under Forest Service special use permits in the analysis area but the extent of that is unknown at this time.

Grazing

Three grazing allotments overlay the analysis area and cattle use is tied strongly to riparian areas due to the presence of water and green forage in riparian areas. These allotments are also discussed in the Human Uses, Values and Expectations section of this chapter. Cattle grazing has occurred in these watersheds for more than a century. Several small drift fences used to help control cattle distribution, but these fences are not in good repair, especially after the Megram Fire.

Cattle grazing use has occasionally conflicted with riparian values. Stream banks have been trampled, riparian vegetation has been set back by livestock and erosion elevated in parts of each allotment. These problems are not extensive, nor severe, but rather are localized problems.

Several corrective actions were taken, or were in the process of being implemented, to deal with grazing and riparian concerns prior to the Megram Fire. Annual operating instructions are modified when problems are noted. Salting is no longer allowed next to streams, since that encourages cattle to congregate there. Groves Prairie meadow was fenced to protect that site. A small exclosure was proposed for Patterson Meadow to monitor riparian and meadow condition and trend in the absence of grazing.

A portion of each allotment burned at a high or moderate intensity. All three allotments also include lands where post fire rehabilitation has or will occur. It is expected that this watershed analysis will give guidance on how to decide when grazing should be allowed to resume and what monitoring should be implemented to ensure the activity is consistent with ACS objectives. There is a concern that cattle grazing may disturb fragile sites, elevate erosion and delay post fire recovery. It appears that the majority of the wet meadows and riparian areas burned at low to moderate severity. Also, the areas slated for rehabilitation efforts are mainly not locations where livestock have congregated before. Still, the fire rehabilitation team anticipates that there could be a conflict with grazing in areas that are to be seeded with grasses or rice straw applied to reduce erosion.

Grazing of cattle in the analysis areas has been an economic activity for Hupa individuals since the introduction of cattle in the 1860s to the Reservation system; in association with this activity, there are numerous cattle camps. (Heffner 1983:42) Eight individuals, five Hoopa Tribal members, have grazing permits on lands administrated by the Forest Service. The grazing allotments affected by the wildfire are the Trinity Summit, Mill Creek, and Groves Prairie allotments. A total of 387 Animal Unit Months (AUMs) are within these allotments. The breakdown for the Term Permits is shown in Table 3-10.

Table 3-10. Grazing Allotment Season of Use and AUMs

Allotment & Unit	Number of Cattle	Season of Use	AUMs
Trinity Summit: Ferguson	70	7/16-9/30	175
Trinity Summit: Grogan Hole	15	7/16-9/30	38
Trinity Summit: Water Dog	27	7/16-9/30	68
Mill Creek: Red Cap – Horse Trail	15	7/16-9/30	38
Mill Creek: Mill Creek Lake	15	7/16-9/30	38
Groves Prairie: Groves Prairie	15	7/16-9/30	30

Grazing issues have been raised by a small segment of the community. They believe that any grazing term permits in existence should be honored and any structures and camps associated with this activity that were destroyed by the fire should be rebuilt.

The Hoopa Valley Tribal Council expressed concern about potential impacts to people who graze cattle in that area during the summer months if the Forest Service closed the area to grazing as a result of the Megram Fire. They expressed that there was no other place for these individuals to put their cattle during these months due to the Reservation's closed range policy. The Council suggested that if the Forest Service closed the grazing options while the area recovered from fire effects, that they look into the opportunity of providing hay for the cattle during this recovery period.

Timber Harvesting

Timber harvesting occurred within the analysis area managed by the Forest Service in the upper reaches of the watersheds and by BIA and later the Hoopa Valley Tribe in the lower reaches of the analysis area of Mill Creek, Tish Tang, and Horse Linto Creeks. Due to land designations of LSR, roadless and wilderness, timber harvesting has recently be focused on managing for LSR objectives and fuels reduction. Timber management as a program was not addressed by any of the comments received by the public. Rather, they addressed the need to either harvest the salvageable timber to reduce fuels or to leave dead trees in place to allow natural processes to occur without management interference.

Community Economics

The communities recognize that their economic viability rests in the landscape around them focusing in two major areas: timber industry and tourism associated with recreation, both of which rely on the timber and fish resources associated with the National Forest lands.

The Big Bar Fire Complex impacted the economy of the local communities for almost a three-month period. A clear trend in the community view reflects the belief that in managing the area affected by the Megram Fire, the Forest Service should consider the economics of the affected communities as the primary criteria in decision-making. These communities believe strongly that the communities themselves suffered both long and short-term economic impacts from the prolonged fire. Summer tourists, anglers, day-user swimmers, wilderness hikers, and river users were discouraged from coming into the area by the media attention to the smoke, large flashing road signs along Highway 299, which warned of the smoke, and many articles that appeared in various newspapers. Additionally, due to the heavy smoke and the health warning that was issued, many residents left their homes for health reasons, local schools were closed, and youth sports teams cancelled games or switched locations to other areas. The local communities view that all of this created an adverse economic impact to the community that will be felt in the short-term and perhaps in the long-term.

The local communities contend that salvage efforts should begin as soon as weather permits to remove as much salvageable timber out to market within the year. The concern the community holds for the rush to harvest salvage centers around the economic viability of the timber. If the salvageable timber is not removed within a two or three-year period, the volume will be lost to decay. They support an active rehabilitation program for the analysis area that considers the local economic needs as well as the needs for a viable healthy ecosystem. The community looks at the analysis area as a backdrop to their economic viability in the recreation and tourism industry and, as such, desires it to be accessible by roads and trails, enjoyable by the recreationist, and safe by reducing the fuel loads through salvage and potential future stand thinning.

Community Safety

Community protection from future fires is a concern across the broad range of community views. They view that one way to assist in this safety issue is the elimination of the fuel buildup that resulted from the fire. They believe that salvaging this fuel buildup should be a priority.

An idea put forth was the development of a Community Safety Plan in partnership with the Forest Service and the California Department of Forestry (CDF) to assist the community in reducing private property risks from wildfires.

Air Quality

The Megram Fire burned for over 10 weeks. Meteorological conditions, combined with the mountainous terrain and large smoke production from fires, caused numerous localized and regional air quality impacts, including the first declared state of emergency in a California county (Humboldt) due to air pollution. The Hoopa Tribal Environmental Protection Agency and the North Coast Unified Air Quality Management District conducted widespread air monitoring during the fire to provide health officials with data to be used in issuing health alerts and evacuation plans. (Herr 1999:1) Trinity County Public Health also issued a warning that air quality in the Burnt Ranch, Hawkins Bar, and Salyer areas had reached hazardous levels due to smoke from the Megram Fire recommending avoid outdoor activity and remain indoors or to relocate until the smoke clears. (Trinity Journal 10/12/99)

The air quality was measured at a level that was unhealthy for people with chronic heart or lung disease, the elderly and young children. People were advised to remain indoors and avoid vigorous outdoor activity. Many local residents left their homes to during this time due to health concerns. The Red Cross and Northern California Indian Development Council operated emergency shelters for residents who felt it necessary to leave their homes. Over 400 people utilized these shelters the majority of those leaving were from Hoopa Valley (Times Standard 10/26/99 Hoopa Council Consultation 2/2/2000).

Herr (Ibid: 5) states that the reasons these wildfires caused such severe air quality impacts were the long duration of the fire, poor dispersion characteristics, and heavy fuel loading all of which contributed to smoke impacts experienced during the fires.

The local communities continue to be very concerned about potential long-term impacts to individual health.

The Hoopa Tribe had difficultly finding guidelines that would establish criteria to assist in determining when it was necessary to call a full evacuation and how to assess and deal with community fears and concerns. They sought this information from numerous federal agencies and were unable to find assistance. They recommend that the Forest Service get involved in developing criteria for communities to use in wildfire situations. Long-term health problems resulting from extended exposure to smoke from fire is significant to them and their citizens. In response to this concern, they have been proactive and are cooperating with the Center for Disease Control in a long-term study involving the issues of smoke from wildfires.

Public Perspectives

This area had intense public interest after the 1995-96 winter storms that resulted in the blow down situation. The Megram Fire has re-opened this intense and passionate discussion among those who value and have interest in the analysis area. The local residents are very involved in this discussion and actively use and value the natural resources around them in a consistent way. Natural resource oriented organizations and environmental industries also have a high interest in this area.

One perspective put forth supports an active role in the rehabilitation of the fire damaged area, which they believe will ensure that the pre-fire ecosystems will be reestablished in the shortest period of time with the least threat to human health, safety and private property damage. Following are some of the areas of greatest concern:

1. **Economics:** The only source of reliable revenues in the analysis area is the large woody fuels that resulted from the Megram Fire. Timing, slope, geography, species composition and proximity to roads are essential components in the determination to remove any of this material. They urge the use of contracting to complete the work as quickly as possible.

2. **Air Quality:** Regardless of land classification within the Megram Fire Area, the vegetation community and the transportation system need to be managed such that future fires can be controlled in a matter of days rather than months. Air quality health threat should not be a probable consequence of management

activities. The only options available to protect air quality are to minimize the fuels consumed and the duration of the wildfires.

3. **Fuel Conditions:** There is a need to analyze what adjusting the fuel densities could have on reducing the adverse effects of fires and what fuel conditions are desirable to achieve low intensity burns and avoid moderate and high intensity burns. There is large community support for reducing the potential for future fire from the existing vast amounts of fuel in the area. They believe the best solution is through fuel breaks, fuel reduction and maintenance through moderate burns to reduce risks from future fires. The risks they consistently bring forth are concerning the potential of fire effecting private property and individual health risks associated with prolonged exposure to smoke from catastrophic fires.

4. **Timber Management:** Some publics' spoke specifically to the values associated with the LSR and encouraged the Forest to take an aggressive position to manage the damaged LSR. They view that the recovery of the LSR, and protection from future catastrophic fires, depend heavily on the use of timber salvage, re-establishment of plantations and fuel breaks.

A letter provided by several environmental individuals and organizations (Citizens for a Better Forestry, January 26, 2000) summarizes another perspective on the values and management objectives needed in the analysis area:

1. **Roads**: The condition of the transportation system should be reassessed to determine the need for road maintenance, improvement or obliteration. The building of new roads in the burned area should be prohibited

2. **Hazard Tree Removal**: Provide a clear, thorough definition of what is a 'hazard" tree by species. Responsible hazard tree removal on high traffic roads that are adequately maintained is supported. This should be integrated into plans for road closure and road removal. Discourage hazard tree felling within Riparian Reserves; however, any that must be felled should be left in place to provide on site LWD.

3. **Cumulative Watershed Effects and the Aquatic Conservation Strategy**: A cumulative watershed effects analysis needs to be completed and a discussion of these effects related to aquatic habitat conditions, resident and anadromous fisheries, and flooding at the basin, sub-basin and watershed scales.

4. **Assessment of Fire Behavior, Fire Effects and Fire Risk**: The fire is not viewed as a "catastrophe" and may have generally beneficial effects to the landscape. An objective assessment of fire effects and behavior should be completed. The risk of future high intensity fires within the burn area should be objectively assessed based on empirical evidence.

5. **Fire Suppression**: Assess how fire suppression and fuel management activities contributed to existing cumulative watershed impacts in the watersheds and the

potential cumulative impacts resulting from continued fire suppression efforts in the foreseeable future. The overall management goal must be to preserve and re-establish the fire and other disturbance regimes that maintain ecological systems and processes, while protecting human life and property.

6. **Salvage Logging**: Concludes that salvage logging by any method must be prohibited, particularly on sensitive sites, including: severely burned areas (areas with litter destruction), on erosive sites, on fragile soils, in road less areas, in riparian areas, on steep slopes, or any site where accelerated erosion is possible.

7. **Fuels Management**: Concerned with the use of extensive ridgeline fuel breaks. Does not support the construction of extensive shaded fuel break in the steep, inaccessible headwaters of the fire area for future fire suppression efforts, especially in the roadless areas. Finds some merit in developing fire breaks as pretreatment for re-introducing natural fire regimes, but must be considered experimental and located near communities where they would be most effective.

8. **Roadless Areas**: Strongly opposes any salvage logging, road construction (even temporary), mechanical fuels treatments or continued fire suppression within any road less area, including inventoried " RARE II" Road less Areas as well as un-inventoried unroaded lands greater than 1000 acres in size.

9. **Community Protection Plan**: The primary activities of the Forest Service should be to reduce fuels and fire hazards close to communities and homes. The vision is a Community Protection Plan implemented by the Forest Service in coordination with state and county agencies.

10. **Proposed Establishment of a Fire Process Research Natural Area:**_Consider the establishment of a Fire Process Research Natural Area within unroaded portions of Horse Linto Creek, Tish-Tang Creek, Mill Creek, Red Cap Creek and New River watersheds. It would be devoted to monitoring and studying long-term fire recovery processes and dynamics.

The general broader community view regarding the LSR was around making every effort to maintain green trees, recover the LSR, protect from future catastrophic fires and return the Forest to a balanced mixture of openings, young growth, old growth and dense conditions. The methods of how this could be accomplished are diametrically different as discussed above.

Transportation and Access

Reference Conditions

Historic Road Development and Use

Most of the road system in the HLMTT watersheds was developed within the last thirty-five years, though some of the routes have much earlier origins. As was typical in the mountainous regions of the west, road development began in the lower reaches of the watersheds and gradually expanded to the higher elevations. Though early primitive roads and trails predated the first designed road, the Civilian Conservation Corps (CCC) constructed road in the area as early as 1933. The primary transportation system expansion, however, occurred after World War II as commodity development received increased emphasis on public lands. Most of the roads in these watersheds were constructed from the 1960s through the 1980s. Though most were designed to the minimum standard necessary to support commercial timber haul, certain routes were built to higher standards where necessary to insure resource protection and user safety. These roads provide access for resource management, fire protection, recreation and other public and administrative uses.

Pre-Fire Transportation Planning

Road maintenance budgets have generally declined through the years, and road maintenance opportunities associated with timber sales have essentially vanished in the HLMTT area as management direction shifted away from timber production. The lack of sufficient road maintenance funds, as well as specific direction in the Forest Land and Resource Management Plan (LMP) which states that road mileage on the Forest will be reduced by 250 miles over a ten-year period, provided the impetus for a transportation system analysis in the HLMTT area.

In 1997, the Six Rivers National Forest completed an Access and Travel Management (ATM) plan for the lands northeast of the Trinity River, including the Horse Linto, Mill Creek and Tish Tang watersheds. The ATM planning team reviewed the existing transportation system to assess the current access needs for the area and to determine whether existing road standards provided adequate resource protection and user safety. Based on the evaluation, the ATM plan and subsequent Environmental Assessment (EA) identified specific roads that were no longer needed for National Forest resource management, public access or administrative access. The decision for this EA was signed on September 11, 1997. Roads identified as surplus were proposed for decommissioning or for classifying as operational maintenance level 1 (ML1). Decommissioning applies to roads where no long-term need has been identified; all culverts and drainage structures are removed, the roads are physically closed and they are removed from the road inventory system. Maintenance level 1 is the classification for roads that are not needed in the foreseeable future, but may be needed in the long term; these roads are retained in the road inventory as part of the official road system, but are physically closed for periods of at least one year. The ATM plan and EA specified that those roads being downgraded to ML1 would be made “hydrologically maintenance-free”, where culverts are removed, roadways reshaped, and waterbars or other drainage devices installed where necessary to prevent erosion, insure proper drainage, and protect the road investment. Approximately twelve miles of roads were identified for decommissioning, with about 52 miles of roads to be classified as ML1 and made hydrologically maintenance-free. The EA also defined areas where road upgrades were needed for resource protection purposes; the specified work consisted primarily of culvert upgrades.

Most of the projects identified in the ATM plan and EA -- road decommissioning, hydrologically maintenance-free ML1 roads and road upgrading -- were implemented prior to the Megram Fire. For a detailed description of the restoration work completed, refer to the Watershed Restoration section under Aquatic and Riparian Systems. Approximately five miles of additional road decommissioning was planned but not implemented. Grant funding is available to complete the other remaining work identified in the EA. In addition to the roads identified in this EA, a separate decision was made to decommission and convert to a trail a segment of Forest Road 8N10. The affected portion of 8N10 is within a designated wilderness. A contract was awarded last year to complete this work, but not implemented due to the fire. It will be implemented during 2000.

Pre-Fire Road Conditions

Currently there are approximately 246.0 miles of roads in the analysis area, including 136.3 miles of Forest Development Roads ("system" roads), 26.6 miles of Forest non-system roads, and 83.1 miles of private, State and County, and other non-Forest roads (including roads on the Hoopa Valley Indian Reservation). Of the Forest system roads, approximately

- 33.4 miles are maintenance level (ML) 1
- 45.3 miles are ML2
- 55.3 miles are ML3 and
- 2.3 miles are ML4

An estimated 24.4 miles of Forest roads have been decommissioned to date, including 21.2 miles of system roads and 3.2 miles of non-system roads. Miles of road in the analysis area by watershed and surface type are shown in Table 3-11. Though the table displays miles of road for all jurisdictions, all listed surface types except "unknown" depict roads under Forest Service jurisdiction. Approximately 4.6 miles of Forest system roads and 22.2 miles of Forest non-system roads are included in the "unknown" category, with the remaining mileage representing roads under State, County, private, and other jurisdictions.

As described above, road maintenance funding has been inadequate to fully maintain all roads at their design standard. Maintenance has generally been sufficient to address the most critical safety related work needs, but more expensive work items, such as surface replacement, are often necessarily deferred. A road maintenance inventory of all ML3 and ML4 roads on the Forest was completed last year, including the roads in the analysis area. Annual and deferred maintenance needs and capital improvement needs were identified. This information will be used to prioritize future road maintenance work in the area, within the limits of available funding. The Waterman Ridge road (7N02), which runs along the southwest boundary of the Horse Linto watershed, was identified as high priority for resurfacing and reconstruction. Many other work needs were identified on area roads, and these will be accomplished as time and funding permits, with resource protection and safety items receiving the highest priority.

Table 3-11. Miles of Road (All Jurisdictions) by Watershed and Surface Type

Watershed	Surface Type*	Miles
Horse Linto Creek	AC	8.5
	AGG	31.5
	BIT	17.8
	IMP	17.6
	NAT	16.7
	UNK	16.2
	TOTAL	108.3
Mill Creek	AC	0
	AGG	5.0
	BIT	16.3
	IMP	7.9
	NAT	3.7
	UNK	64.9
	TOTAL	97.8
Tish Tang Creek	AC	0
	AGG	0.2
	BIT	3.0
	IMP	1.2
	NAT	2.3
	UNK	33.2
	TOTAL	39.9

* Surface type codes:
AC = Asphalt
AGG = Aggregate
BIT = Bituminous (chip seal)
IMP = Improved (pit run)
NAT = Native surface
UNK = Unknown

Current Conditions

Current Road Use

Post-fire activities in the burned area will increase the amount of traffic on area roads for the next few years. Rehabilitation activities dealing with erosion control, fuel reduction, hazard tree removal, resource monitoring and other fire-related projects will require vehicular access for work crews, monitoring personnel, large trucks and heavy equipment. Public use of the roads will continue, but it is likely to be minor relative to the amount of administrative and rehabilitation-related traffic. The result will be an increase in mixed traffic ranging from pickups to commercial-sized trucks. Maintenance and repair of fire-caused and suppression-related road damage will continue this field season. This work, combined with proposed hazard tree removal along roadways, could add to the congestion of expected heavier-than-normal traffic. Depending on the type, number and timing of any fire rehabilitation projects that are implemented, construction work and travel along area roads may require scheduling to minimize possible delays and threats to personal safety. Detours, scheduled closures or other travel restrictions could be considered if necessary.

Several recently-decommissioned roads were temporarily reopened during the fire to provide emergency access. As a result, the Lower Trinity ATM plan was reviewed to determine whether the plan's proposed actions are still valid under current conditions. The review suggested that only minor adjustments to the plan may be needed, some of which are unrelated to the fire. Two roads proposed for decommissioning may need to be left open temporarily to facilitate fire rehabilitation access and four short spur roads proposed for ML1 closure that access Groves Prairie, a dispersed campsite, be maintained at ML 2. These recommendations are specifically addressed in Chapters 4 and 5.

Post-Fire Road Conditions

Most of the roads in and adjacent to the burned area were used either directly or indirectly for fire suppression or post-fire efforts, including firefighting, reconnaissance, mop up, burned-area assessment or fire rehabilitation efforts. The roads were used to transport personnel, fire engines, crew carriers, large trucks and heavy equipment. As a consequence, substantial damage to the roads and related structures occurred. Examples of direct effects from the fire on roads included: damage to culvert ends, elbows and other drainage structures; burned out stumps and woody debris that undermined fill slopes and road prisms; rocks, snags and debris falling on roadways, culvert ends, ditches and culvert inlets; damage to asphalt or chip-seal surfacing; burned up signs. Suppression-related road damage included: heavy equipment damage to road surfacing, cut and fill slopes, ditches, culvert ends, drivable dips, and other road structures; backfire-caused damage to road signs and structures; felling of trees or snags onto roadway, culvert ends, ditches and culvert inlets.

Forest engineering personnel were actively involved in road-related activities both during and immediately following the fire. In order to identify the appropriate funding source for repair work, road damage was inventoried and classified as either fire-caused or suppression-caused. Much of the identified maintenance and repair work was completed during or immediately after the fire, with priority given to correcting potential safety hazards. Road work was halted prior to completion due to adverse weather and ground conditions. The remaining tasks are planned for completion in the coming field season.

In addition to the fire and suppression caused maintenance and repair work, the Forest hoped to implement critical deferred maintenance projects on major routes adjacent to the burned area. (See discussion on deferred maintenance needs in the "Pre-Fire Road Conditions" section above.) For example, 7N02, Waterman Ridge road, which provides an important link to the Horse Linto watershed, requires extensive resurfacing and reconstruction. Unfortunately, funds normally made available to Forests for completing this type of work were withdrawn this fiscal year. Consequently, the Forest is limited to use of regular programmed road maintenance funds, so additional large-scale projects are not fiscally feasible this year.

Roadside Hazard Trees

The Megram Fire created a situation where many dead or dying trees were left standing in close proximity to area roadways. As these trees deteriorate and fall, either completely or in part, they pose a threat to human safety and to the road facilities. A tree is considered a hazard if all or a portion of the tree has a high potential to fall or roll onto a roadway, trail or facility and cause personal injury or property damage. Distance to trees on the uphill side may exceed one tree height if they are likely to roll or slide onto the roadway, trail or facility (i.e. there are insufficient barriers to prevent trees from reaching the roadway, trail or facility). To be considered a hazard tree, it must also meet one or more of the following criteria:

1. Tree is dead (no live crown)

2. Tree is dying (likely to die within one year). A tree is dying if it meets one or more of the following criteria:
   a. 50% or greater crown foliage is discolored;
   b. For all species, except sugar pine and true fir, 50% or greater dieback (individual branches or branch tips are dead); for sugar pine and true fir, use other criteria (crown, foliage, insects, etc.);
   c. Evidence of successful bark beetle attack (dry frass [excrement, sawdust] in the bark fissure);
   d. Fire damaged trees: (1) white fir and red fir trees with greater than 25% of the cambium (circumference) killed by fire; (2) Douglas-fir and sugar pine trees with greater than 50% of the cambium killed by fire; and (3) Ponderosa pine, Jeffery pine, incense cedar and Port-Orford cedar trees, use other criteria (crown, foliage, insects, etc.) to predict mortality.
   e. Damaged or diseased trees with less than 20% live crown ratio.
   f. Crown loss due to fire is greater than 50% of pre-fire live crown ratio. Green needle retention is less than 40% of pre-fire needle complement, except for Ponderosa pine and Jeffrey pine, where green needle retention is greater or equal to 15% of original needle complement.

3. Tree is damaged and shows one or more of the following characteristics:
   a. A spiked top that has potential to reach the road or improvement and is minimum 12 inch diameter at the base of spike and a minimum 20 ft. in length.
   b. Damaged root system (examples include: root sprung or undercut by 1/3 or more of the root with greater than 20 degree lean toward the road; located on actively moving slope, etc.);
   c. Severe structural damage to the tree bole (examples include: mechanical damage, cracked bole, cat faces affecting 1/3 or more of the bole diameter);
   d. Advanced decay (root disease, bole rots) and the tree is exposed to additional risk factors such as being located in a high wind area***;*** position on the landscape***;*** leaning toward road or improvement***;*** etc.

Due to the anticipated increase in post-fire activities, as described in the “Current Road Use” section above, safe and secure access along the existing road system will be critical to the success of the projects, and consequently to the health of some forest resources. In addition to the fire-related administrative uses, the roads in these three watersheds are frequented by a wide variety of forest users. These roads provide access to five trailheads into the Trinity Alps Wilderness, several dispersed undeveloped camp areas and the general forest for uses such as pleasure driving, firewood cutting, hunting and subsistence gathering. The Forest Service is required to eliminate any known hazards along Forest roads that may constitute a threat to public safety.

An interdisciplinary team has been assembled to analyze the hazard tree situation and complete an Environmental Assessment (EA), for which public scoping has already been initiated. The EA will specifically define what constitutes a hazard tree, where and under what circumstances felled hazard trees will be removed and all other specifics for dealing with hazard trees along the roads, trails, and facilities affected by the fire. To minimize this threat, it is proposed that hazard trees along ML 2, 3 and 4 roads be felled. Most of these trees would also be removed and utilized.

In order to estimate the extent and location of the hazard tree problem, a cursory field review was conducted. Based on the review, it is estimated that during the next five-year period over 3,000 trees will need to be felled if all of the affected roads are to remain open for use. The hazard trees are located along approximately 118 miles of Forest and County roads. Given the critical safety hazard associated with these trees, some road segments may need to be closed in the spring of 2000 and remain closed until the hazards have been eliminated.

The approximate densities (number per mile) of hazard trees that are expected to develop over the next five-year period have been categorized into five groups. The following are definitions of these five categories and the approximate miles of road for each category:

Extreme -	Greater than 100 trees per mile of road (5.5 miles)
High -	Between 51 and 100 trees per mile (12.9 miles)
Medium -	Between 11 and 50 trees per mile (38.0 miles)
Low -	Between 1 and 10 trees per mile (35.1 miles)
Unidentified -	None, or too few trees to remove; however, individual trees may be felled and left in place (26.2 miles)

The vast majority of anticipated hazard trees were killed directly by the fire. Many additional trees will die over the next several years as the fire has predisposed them to the effects of other causal agents such as insects, diseases, windthrow, and breakage. The fire burned across the landscape in varying intensities and durations, and so the levels of hazard trees are also quite variable. As expected, the greatest concentrations of hazard trees occur where the fire burned at the greatest intensity. In those areas classified as "extreme" hazard tree level, essentially all trees have been killed or are expected to die. In areas classified as "low" hazard tree level, the fire was of relatively low intensity, or perhaps did not burn in that vicinity at all.

Besides the threat to human safety, hazard trees can cause direct damage to roads and related drainage structures. Falling and rolling logs can damage road surfacing, culvert inlets and outlets, signs and other structures. Logs and woody debris can plug culverts and ditches, which can lead to surface erosion, diversions or even road failures. Similarly, hazard tree felling or removal can result in road damage due to tree felling, woody debris left in drainages, culvert inlets, and ditches and operation of heavy equipment on or near the roadway. The scoping document for the hazard tree EA states that “All heavy equipment would operate only within existing roadways, landings and other previously disturbed clearings. End-lining or winching for distances up to 150 feet may be necessary to retrieve all portions of hazard trees that are required to be removed.” These activities may serve to reduce resource impacts on the ground, but at the cost of increased road damage. Tracked vehicles should not be allowed on paved surfaces. The use of rubber-tired equipment would reduce damage to these road surfaces.

Desired Conditions

The road system in and adjacent to the HLMTT watersheds should be maintained to provide safe, efficient vehicular access for the anticipated short- and long-term volumes and types of mixed traffic. Hazard trees should be managed to reduce the threat to human safety and road investments. Closures or use restrictions should be applied where necessary to protect employees, workers and the public from safety hazards related to hazard trees, road conditions, or traffic patterns. Roads should be maintained in a manner that would minimize impacts on other resources.

Recreation

Reference Conditions

Historic Recreational Use

Historically, the principal recreation activities within the HLMTT area have been hunting and hiking. The network of trails was established through aboriginal use, miners traveling to and supplies being hauled to the New River mines (1850s), and livestock being herded to grazing lands in the meadows of the Trinity Summit high country. Trails were also used by inland communities and homesteaders as commerce routes with the coast (McClain, 1990). In 1905, the Trinity Reserve was established with the Lower Trinity Ranger District as one of two districts. With the establishment of the Reserve, steps were taken to establish and maintain a trail system, probably as part of a transportation system used for controlling wildfire, getting to fire lookouts and to local homesteads. Developed facilities in the HLMTT area have been minimal. It was probably sometime in the 1960s when a small developed camping area at Horse Linto Creek was developed; facilities consisted of a vault toilet, a couple of picnic tables, and fire rings. The camping area extended over onto the adjacent fish hatchery property. With the closing of the hatchery, the camping area was reduced to the current size of three to four sites. A 1947 annual report proposed a campground and summer homes tract at Groves Prairie; however, the recommendation was never enacted.

Three primitive trailheads – Mill Creek, Grizzly Camp, and Tish Tang - comprising signing, bulletin boards, and parking areas were most likely established following the 1984 designation of the Trinity Alps Wilderness Area. Management of the area is shared between the Six Rivers National Forest and the Shasta-Trinity National Forest. In 1979, the Horse Ridge Trail was designated as a National Recreation Trail (NRT), along with the Salmon Summit NRT - which is not in the analysis area, but to which it is linked. No doubt the combination of the wilderness designation and the national recreation trail designation resulted in increased use and visitation, though the Six Rivers' portion of the Wilderness has always had less visitation than the Shasta-Trinity side, which is easier to access.

Pre-Fire Conditions - Trails

The trails in the fire area are a remnant of the network of trails that were created first as game and aboriginal trails, and then by miners and supply wagons on their way to the New River Mine and between the coast and inland communities. Trails are maintained according to maintenance level and design criteria established in the Trinity Alps Wilderness Management Plan.

There are 56.1 miles of trail in the HLMTT area (see Table 3-12). Maintenance is performed yearly on the main routes with secondary routes maintained every three years as funding allows. The Grizzly Camp trailhead is the most heavily used, primarily by a grazing permittee and by people accessing the Trinity Alps Wilderness and the Trinity Summit area. The other heavily used area is the Mill Creek Lake trailhead. This is used by a grazing permittee and people accessing the Trinity Summit and Mill Creek Lakes areas; both areas have spectacular scenic values as well as tribal cultural values. Trails also provide access to peoples' special places.

Table 3-12. Trails in the HLMTT Area

Number	Trail Name	Miles
6E14	Red Cap Hole	4.5
6E08	Horse Ridge Natl. Rec. Trail	15.3
6E15	Calf Swag	2.5
6E16	Crogan Basin	2.5
6E17	One Mile	1.7
6E18	Tish Tang	5.5
6E19	Long Prairie	1.2
6E20	Bell Swamps	5.0
6E22	Ladder Rock	0.5
6E29	Oregon Creek	3.0
6E31	Graveyard Prairie	2.5
6E35	McKay Meadows	1.3
6E36	Lone Pine	2.1
6E67	Grove's Prairie	1.3
6E73	Mill Creek Lake Loop	1.0
6E74	Crogan Hole	5.2
6E76	Cedar Creek	0.6
5E36	Horse Linto Interp. Trail	0.4
Total		**56.1**

In the winter of 1995-1996, extensive blowdown severely impacted the trail system in the analysis area. Authorization to use chainsaws in the wilderness was given for the FY96 and FY97 field seasons to remove fallen trees across trails. The total cost of clearing the trails of blowdown was approximately $58,000. Additionally, grazing permittees cleared trails important to their operations. Approximately 20 miles and 1,000 trees (many 30-inch diameter and above) were removed from the trailway at a cost of $1,000 per mile. Other recent trail work in the analysis area includes the construction of two-foot bridges, a culvert crossing, and a sweet-smelling toilet (SST) at Groves Prairie approximately four years ago.

Two projects are planned for implementation in the near future. The first project, which is currently under contract, will decommission a portion of the old road 8N10, which became trail 6E74 (Crogan Hole) when the wilderness boundary was expanded. Three log stringer bridges and 34-inch culverts will be removed to maintain stream health while maintaining the integrity of the trail. The second project will reroute trail segments in the Patterson Meadow area to alleviate resource problems.

Pre-Fire Conditions - Wilderness

The Trinity Alps Wilderness was established by the California Wilderness Act of 1984. Management presence in the wilderness is minimal, with a zone wilderness ranger informally monitoring recreation use and performing trail maintenance. Volunteer groups such as the California Backcountry Horsemen assist in trail maintenance efforts and are an important part of the trails program. Grazing permittees also do some trail maintenance on routes most important to their operations. Most public contact is at the District reception area, either in person or by phone. No wilderness permits are required to enter the wilderness from the SRNF side. Trailhead information bulletin boards provide minimal management contact with the wilderness user. Trail maintenance is performed annually on the most heavily used trails and about every three years on the remainder of trails.

Trail systems in the wilderness are a primary influence on movement of recreationists (Lucas 1985). They have the potential to affect a visitor experience in either positive or negative ways. Therefore, trail management is an important component of wilderness management. Trails are especially important with certain types of use, such as horseback travel. Trails should be developed and maintained appropriate for the use received, of various quality and not of uniformly high standard through the wilderness. There is little support for very low-standard trails (blazed routes). There has been a trend in a decline of purist attitudes regarding trails (Cole 1996). Support for high-standard trails, for building bridges over creeks (needed only to keep feet from getting wet), and for administrative use of chainsaws to clear trails increased, while support for low-standard trails and leaving a few trees blown down across the trail decreased.

Wilderness use nationally will continue to increase (Watson and Landres 1999); wildernesses are receiving increasing numbers of visits by backpackers, day hikers, anglers, horseback riders, photographers, berry pickers and hunters. Use increased steadily through the 1960s, 70s, and into the early 80s, when it appeared to level off. By the late 1980s, a resurgence of growth in wilderness visits occurred and it continues today. Use on this side of the Trinity Alps Wilderness, however, is light and offers a high solitude opportunity to the visitor. Some slight increases in use after the fire are predicted due to visitor curiosity about the fire’s impacts to their special areas.

Current Conditions

Interviews were conducted with seven representatives from various organizations and the community of Willow Creek (Backcountry Horsemen, Boy Scouts, Lion's Club, fishing guide, river outfitter/guide, Willow Creek-China Flat Museum, Chamber of Commerce) who are familiar with recreation activities in the analysis area. Information from their comments is incorporated into the "Current Recreation Use" and "Impacts of Fire on Recreation Opportunities" sections. The analysis area supports a diversity of recreation opportunities that are primarily dispersed in use and land base. Most of the Lower Trinity Ranger District's water-based activities occur along the Trinity and the South Fork Trinity Rivers, which are outside of the analysis area and not discussed here. Table 3-13 lists the current recreation facilities and special recreation designations within the HLMTT area.

Table 3-13. Facilities and Special Recreation Designations in the HLMTT Area

Facility/Designation Name	Description
Horse Linto Interpretive Trail	A 0.4 mile self-guided trail with brochure with a salmon habitat restoration theme
Horse Linto Camping Area	Three to four rustic camping sites with an old vault toilet, picnic tables, and fire rings; this is the start site for the Tish Tang Tang mountain bike race
Tish Tang Trailhead	Sign, some parking
Grizzly Camp Trailhead	Wilderness sign, bulletin board, SST, several primitive camp sites
Mill Creek Trailhead	Wilderness sign, parking, bulletin board, old corral
Grove's Prairie Area	Two picnic tables, parking, SST, two small foot bridges over the creek, culvert crossing
Trinity Summit Cabin	Historical cabin with administrative use; not a recreation facility, but often a destination for hikers
Trails	56.1 miles of trail, including the Horse Ridge National Recreation Trail
Trinity Alps Wilderness Area	West side of the wilderness area

Current Recreation Use

National forests are often viewed as peoples' backyards because of the proximity of National Forest System lands to population centers and the amount of private inholdings within their boundaries. Almost anyone can be in a national forest within one hour's driving time. National forests are rarely considered destination attractions the way that national parks are. Consequently, much of the visitation that occurs within a national forest consists of local users - residents who live within an hour or two of the area.

In the regional spectrum of the 19 forest units in California, the SRNF is considered a "rural" forest with low visitation. In comparison, an "urban" forest such as the Angeles National Forest in southern California has a potential visitor population of 12 million people within an hour's drive of the forest boundary.

Many of the SRNF users come from the Northcoast, Redding, and North Central Valley areas, as well as southern Oregon. The major metropolitan centers of Sacramento, the Bay Area, and Portland are six to eight hours' driving distance away, which precludes a weekend visit to the area. Tourism travel trends indicate that most people recreate within a two to three hour drive of home when considering a weekend getaway. Over the past three years, area tourism organizations have been involved in a campaign to educate local business and service providers about the area's tourism and recreation riches and opportunities to encourage and entice visitors to stay "just one more day."

In general, the Lower Trinity Ranger District receives some of the highest use on the SRNF because of its river attractions and proximity to the coastal population centers. Recreational use in the HLLMTT is light with the primary season of use being May through October. Reliable visitation numbers for the analysis area are not available, nor are they available for the rest of the forest. The SRNF is slated in 2003 for a nationally administered recreation use survey.

The District's rivers, trails, snow availability and diverse topography are primary attractions. Willow Creek businesses identified the mountain ecosystem as the second greatest recreational asset after the Trinity River (Trinity River Strategic Planning Business and Visitors Surveys, 1995). A second part of the study surveyed 1,492 people visiting the area from Memorial Day into early fall. Asked what they liked best about the area, the most common responses were the river, the climate (sun and heat), the beauty and scenery. Fishing, serenity and solitude were the most commonly mentioned attributes. The most popular activities were swimming (75 percent), sunbathing (65 percent) and sightseeing, picnicking, and camping (27 percent). The study was focused on the Trinity River and the responses are slanted to that emphasis, but many of the mentioned activities also occur in the analysis area. Other activities worth mentioning are fishing (21 percent), day hiking and rafting (16 percent), photography (10 percent), visiting historic sites (7 percent), and birding/wildlife observation (6 percent). Backpacking, mountain biking, and hunting were also identified in the 1 to 3 percent participation range.

Recreational use of the HLMTT area follows the national trend, with visitors coming from a relatively short driving distance. In the interviews conducted, hunting, enjoying the outdoors and hiking were mentioned most often as being the major recreation activities in the analysis area. Camping, mountain biking, and fishing were also frequently mentioned. Other activities were also identified as occurring in the analysis area but engaged in to a lesser extent. Following is a list of activities that occur within the analysis area:

- Hunting – The primary game hunted in the area is bear and deer. There is some bird hunting, primarily grouse and quail.

- Hiking – The HLMTT area was identified as the major location on the District for hiking activities because of the 56.1-mile trail network and wilderness access there. The presence of the Horse Ridge National Recreation Trail (NRT) and its linkage with the Salmon Summit NRT, which connects with the Devil's Backbone Trail network, offers hikers and trail riders an extensive trail system.

- Communing with nature, enjoying the outdoors – several people had a hard time coming up with a word for a significant type of recreation activity that they know occurs. Most just identified it as “communing with nature”, “being in the outdoors”, “and finding a place to hang out and read, picnic, relax.”

- Backpacking – Tish Tang, Mill Creek Lake, and Grizzly Camp Trailheads are the primary access into the Trinity Alps Wilderness. Backpackers heavily use the wilderness lakes as overnight camping sites, hiking from one lake to the next. Scouts do an annual 25-mile three-night backpack trip that is routed right through the fire area. They are eager to see the fire impacts firsthand as well as learn about fire ecology and fire’s impacts on natural resources. They plan to change the focus of this summer’s trip to a fire impact emphasis.

- Trail riding (stock) – There would be more pleasure riding if facilities were designed with turn arounds for trailers and vehicles. Backcountry Horsemen of America indicated that the one facility of utmost importance to them is a road that allows for unloading of horses and gear without having to backup or puts them miles away from the access area. They are not particularly concerned with having restrooms, corrals, etc., but good turn around capability for vehicles is a must. The physical characteristics of some sites don’t allow for a turn-around road, but there may be possibilities at some others.

- Mountain bike riding - This activity was identified by several interviewees as one of the fastest growing recreation activities in the area, occurring mostly at Grove’s Prairie, the Lone Pine Ridge Area, and along the mountain bike racing event course near Tish Tang. The attraction to riders at Grove’s Prairie and Lone Pine is the flat, open terrain.

- Mountain bike racing event – One of the newer activities occurring on the District is an annual mountain bike race, Tish Tang Tang, which includes two events over a two-day period. One event is a cross-country ride consisting of about 100 cyclists covering about 30 miles; they are broken down into three classes based on skill level. The second event is for more experienced riders and is a five-mile downhill race. The event operates under a special use permit from the District. It is sponsored by the Willow Creek Lions’ Club and Kiwanis Club as one of their big fundraising events. About $3,000 in profits is split evenly between the clubs for scholarships for local students. The event began in 1995 and continues to grow each year. Riders come from southern Oregon, the Bay Area, the Northcoast, and Nevada.

- Fishing – Trout fishing was mentioned as the desired species sought in wilderness mountain lakes as well as in Cedar Creek. Steelhead in various creeks are also desired game fish.

- Camping – Much of the camping is primitive or dispersed camping. People bring all their own facilities such as water, chairs, etc. Many use small trailers or motor homes. A lot of camping occurs during hunting season. There is quite a bit of use at the Horse Linto Camping Area near the Horse Linto Interpretive Trail.

- Picnicking – People mentioned that they engage in this dispersed activity in a variety of locations throughout most of the year when the weather is good.

- Environmental education – The interpretive trail at Horse Linto/Cedar Creeks has been visited annually by about 40 sixth graders from the Trinity Valley Elementary School since the interpretive trail was developed in the early 1990s. There used to be more school visits when the fish hatchery was open. The interpretive trail is not known to many and is a long drive from Highway 299 (about 30 minutes), so it is not conveniently accessible.

- Wildflower viewing – The Willow Creek-China Flat Museum conducts an annual wildflower tour in the HLMTT area from groups ranging from 6 to 25 people. The tour is a combination of driving and hiking to view and photograph a wide variety of wildflowers in the spring.

- Birding – Some birding occurs within the HLMTT area. The Audubon Society conducts an annual bird count in the area as part of its National Christmas Bird Count.

- Landscape photography, painting, drawing – one interviewee, an art professor at HSU and also a packer, indicated that over the past several years he has packed in artists, including seven Swedish visitors, into the Trinity Alps and Marble Mountain Wildernesses for landscape photography, painting and drawing opportunities. The non-commercial venture occurs about twice a year with about seven people per group.

- Huckleberry collecting – mentioned by one person who has annually done this for many years in the HLMTT area.

- Viewing scenery – Every interviewee indicated that viewing the landscape, the scenery, the natural beauty was one of the primary reasons people come to the area.

- Historical research – One person said he conducts historical research in the HLMTT area on historic sites such as Grove's Prairie and the remnants of the China Flat-New River trail. People in general are quite interested in historical sites.

- Snow shoeing – A scout troop with approximately 15 boys (ages 11-18) and leaders has conducted an annual snow shoeing/hiking overnight trip staying at a special use cabin in Patterson Meadows for the past ten years. The fire burned the McCullough Cabin and the trip has been cancelled to that site. Probably there are other individuals who snowshoe in the area, but the most popular site for snow activities such as snow shoeing, cross-country skiing, and snow play on the district is at Horse Mountain, located outside of the analysis area.

- Firewood cutting – The analysis area has been a popular area for woodcutting by locals.

- Mushroom collecting – One person mentioned mushroom collecting as an activity in the area.

- Wilderness – hiking and lake fishing are the primary activities within the wilderness area. The meadows and lakeshores are popular camping spots with scores of hearths scattered along the trails and elsewhere through the mountains. For example, there are more than a dozen camps that line the shores of Mill Creek Lake, which attracts trout anglers as well as backpackers and hunters. (Heffner 1983:44)

- Driving for pleasure – while not specifically mentioned by anyone interviewed, driving for pleasure or viewing scenery while driving is the most popular recreation activity in the National Forest System. To recreate in the HLMTT area (excluding the wilderness area), one must drive a vehicle to get to the trailheads or to a dispersed area. Depending on the condition of the road, this would be either by passenger vehicle or a high-clearance vehicle. Other vehicles such as greensticker vehicles (motorcycles, all-terrain vehicles) and dual-sport motorcycles are also used. Roads are an important element in the backcountry recreation experience. Highway 96, which is one of the main arteries leading to the analysis area, is a proposed route for the Bigfoot Scenic Byway. This designation may increase use in the analysis area in the future.

Impacts of the Megram Fire on Recreation Opportunities

Both positive and negative effects were mentioned by the interviewees regarding their perceptions of the fire's impacts on recreation opportunities in the analysis area. Comments ranged from the fire having "no impact at all" on recreation opportunities to "there won't be any hunting there for quite a while." Most indicated that they had not yet been able to visit the burn area to view the effects and impacts due to winter weather conditions, but planned to do so in the spring and summer when conditions allows. Several people commented on the loss of timber and the opportunity for salvage as being of importance to the local economy and to woodcutters. Some losses were identified as short-term, i.e. during the fire, one person was not able to hunt a single day during deer season because roads into favorite areas were closed. Another example discussed by one individual was the inability to get firewood cut for the season due to closed areas during firefighting efforts. Several people mentioned that the smoke and air quality at the time of the fires had an adverse impact on their lives and recreation opportunities in general.

Local citizens discussed their opinions of the fire impacts and their recommendations for managing the large fuel buildup resulting from the Megram Fire. The recommendations ranged from using chainsaws and salvage operations in the wilderness to doing nothing and allowing the natural processes to take place.

Wilderness users expressed a desire that visual qualities of the wilderness be maintained and suggested that the fire, by opening up the landscape, gave the opportunity to recognize historic trails. They believe this provides the Forest Service with an opportunity to open these old trails to compensate for the road closures that have taken place in the area. They expressed concern regarding safety for individuals, family, and pack stock. They are concerned with trail repair, hazard tree removal along trailheads and trails, and potential trail closures due to the effects of the Megram Fire. They are also concerned that removal of hazard trees along trails will not take as high a priority as hazard trees along the road system. The local community view tends toward the desire for salvage in the wilderness (which is not permitted under the Wilderness Act) in order to reduce fuel loading that resulted from the Megram Fire. The view expressed is that every attempt should be made to reduce the risk of such a lengthy fire in the future even to the point of allowing chainsaws into the wilderness.

A seasoned park ranger (Martin, personal communication) who has worked at Glacier National Park and in the Bob Marshall Wilderness where there have been fires indicated that visitors did not see recreating in a burned area as being a negative experience. People were curious about the fire's effects to an area. Hiking in a recently burned area was more pleasant since vegetation was no longer dense, more open vistas were available, the ability to see the landscape was enhanced, and wildflower displays could be more prolific and spectacular. His comments tend to support the types of feedback generated from interviews with local residents.

One research publication (Love et al, 1992) concerning the effects of the 1988 Gates Park Fire in the Bob Marshall Wilderness indicated that the fire had little impact on people's choice of whether to recreate in a burned or unburned area. Visitors placed more importance on remoteness and naturalness in selecting trails and campsites than of the effects of fires. Visitors to both burned and unburned areas expressed concerns about being excluded from preferred areas and some feared their businesses would decline.

Fire impacts identified by interviewees:

- Loss of hunting grounds and wildlife
- Fishing guide business down by 60 percent due to fire and smoke
- Impacts to water quality in stream/creeks which may affect fish spawning habitat
- Route changes in annual snowshoe hike due to loss of special use cabin in Patterson Meadows (Boy Scouts)
- Short-term decrease in firewood cutting opportunities due to road closures during fire
- Increased hunting opportunities and wildlife within burned areas once vegetation begins to grow back
- Increased opportunities for packers
- More areas opened up due to brush loss
- Increased opportunities to view the landscape and scenery with less brush
- Increased entry on trails into the burned area to see what the fire's effects were
- Increased educational focus on fire's impacts instead of natural history for outings
- Increased wildflower viewing opportunities
- Increased opportunities to interpret fire, fire management, and rehabilitation efforts
- No impact at all
- Doesn't think there will be impacts to recreation, but opinion may change once able to get into burn area in the spring.
- Increased trail maintenance volunteer opportunities

On-the-ground impacts to trails and wilderness are further discussed in the "Post-Fire Conditions" section. Additionally, several other impacts were identified by forest recreation and trails specialists:

- Loss of trail tread and other trail structures
- Alteration of the wilderness experience
- Hazardous trail conditions may result in temporary trail closures (and loss of trail opportunities) until repaired
- Inability to get all the trail work done if chainsaw authority in wilderness is not given
- Safety hazards for trail crews and trail users
- Inability to get trail rehab work done if funds are limited

Special Places

Interviewees identified places that were special to their members, clients, or themselves for various reasons, including historic significance, remoteness, beauty, flat ground and meadows, access to big trees and a park-like setting, access to water, serenity, and other aesthetic values.

The following locations within the HLMTT area were identified as special places:

- Groves Prairie
- Grizzly Camp
- Crogan Hole
- Bret Hole
- Trinity Summit Cabin
- Signboard Gap
- Horse Linto/Cedar Creek gorge area
- Happy Camp Mountain dispersed recreation site
- Mill Creek Lake
- Box Camp

Post-Fire Conditions - Trails

Post-fire trail condition surveys were conducted after the fire before winter conditions to assess damage caused by the fire as well as impacts from the fire suppression efforts. For detailed information concerning specific trails, see Chapman's report. Not all of the trails within the fire area were surveyed.

Mapping indicates that about 14 miles of trail within the Megram Fire boundary were in the high intensity burn class, approximately 20 miles in the moderate intensity class, and a little over one mile in the low intensity class. Areas of moderate to high severity burn are characterized by many fallen trees, limbs and slash that are obstructing the trails. Burned out stumps holes are common, leaving caverns and cavities that can undermine the trail tread. Root wad holes from downed trees adjacent to the trail have created craters where the trail was. Areas of burned brush typically have fire-hardened stems poking into the trail corridor. The lack of vegetative cover and duff/humus/forest litter has exposed the forest soils to slough and slides. Trails that traverse side hills will have tread covered by slough material. Some sites may have drainage patterns that will result in erosion of the trail tread, as trails act as collectors of runoff and concentrate the drainage.

Surveys were conducted on 6E08 Horse Ridge National Recreation Trail, Horse Ridge Trail North spur (unnumbered), Grove's Prairie Trail network, 6E19 Long Prairie Trail, 6E14 Red Cap Hole, 6E74 Crogan Hole, 6E18 Tish Tang Trail, 6E31 Graveyard Prairie Trail, and 6E15 Calf Swag Trail. The fire affected approximately 30 miles of the 56.1 miles within the HLMTT area. Needs were identified for waterbarring, removal of downed and hazard trees, trail and intersection signing, wilderness boundary signing, route blazing, trail tread reconstruction, flush cutting stumps and stobs along trail, brushing and limbing, outsloping, debris removal and bank armoring at stream crossings, and filling of burned out stump holes with local rock. Additional trail surveys will need to be conducted this summer to ascertain further damage and impacts. Safety hazards along trails may necessitate temporarily closing some trails until work can be accomplished. Signs with safety hazard messages would need to be posted at trailheads and along hazardous sections. Chainsaw authority in the wilderness is desired because of season limitations and both employee and visitor safety.

Post-Fire Conditions - Wilderness

The wilderness experience has been altered where fire suppression activities removed vegetation to create fire control lines and helispots. This current vegetation condition of particular concern where the fire line is in close proximity to trails and campsites. An associated problem occurs where the removed vegetation was left in windrows of slash adjacent to or in view of the trail.

Desired Condition - Trails

The desired condition for the trails in the fire area is that the fire-killed windfall will be cleared from the travel way. This will be an on-going scenario; as the wood decay progresses and winter storms pass, more fire-killed trees will come down each year. Hazard trees will be felled and cleared from the trail corridor in accordance with guidelines for hazard tress removal, for both wilderness and non-wilderness areas. Burned out stump holes and root wad holes will be repaired and the hazards eliminated. Fire-hardened stems will be pruned back from the trail clearing limits. The forest litter will gradually accumulate and soils will stabilize to reduce sloughing. The trail tread will be restored and drainage features installed to correct erosion. A survey of trail needs for the network will identify whether some previously existing and low use trails obliterated by the fire will or will not be replaced. Trails and trailheads throughout the HLMTT area are well signed. Trail work is coordinated with Shasta-Trinity NF for trails that are interlinked. Hikers and wilderness users will be provided educational materials about the fire rehabilitation efforts, management activities, and landscape recovery processes via information posted at trailheads, bulletin boards, forest web site, and in reception areas. Primary emphasis for trail rehabilitation will be on the Horse Ridge National Recreation Trail and high use trails in high intensity burn areas.

Desired Condition - Wilderness

Features and wilderness attributes altered during suppression activities will be restored to natural conditions. The visual impacts of the fire line would be reduced by scattering the brush and slash that was left in windrows, over the fire line area. Stumps from felled trees along the fire line would be naturalized. Fire crew campsite beds that were dug into side slopes would be restored to natural conditions. Fire rings, chainsaw furniture, and firewood would be removed, and campsites naturalized. Firelines that may be mistaken as trails will be put to bed and naturalized. Invasive exotic plant species within the fire area would be controlled and monitored. With the duff and forest litter removed by the fire, airborne thistle seeds may establish exotic plant populations in the wilderness, and a vigorous program would be needed for monitoring, control, and eradication. The desired condition for wilderness in the Six Rivers NF Land and Resource Management Plan is the ultimate condition sought.

Roadless Area

Reference Conditions

Note: the acreages identified in this section differ somewhat from those in the SRNF LRMP. These differences are the result of improved technology (GIS) that was not available to the Forest when the LRMP was prepared. Acreages discussed in this document are considered to be more accurate than those displayed in the LRMP

The original, 27,290-acre, Orleans Mountain “C” Roadless Area is located within the HLMTT watersheds. This area was evaluated for wilderness suitability during the Forest Service Roadless Area Review and Evaluation process (RARE II) in 1979 and again during the development of the California Wilderness Act in 1984. Based on the results of the evaluation and legislation, 11,760 acres of the original Orleans Mountain “C” Roadless Area were designated as wilderness (part of the Trinity Alps Wilderness). The remaining 15,530 acres were designated non-wilderness and made available for multiple use land allocation. These remaining acres were located in two separate parcels. The northern parcel included 1,840 acres and the southern area was 13,690 acres.

In 1995, the Six Rivers National Forest LRMP established Forest-wide multiple use goals, objectives, and management area direction. The analysis of former RARE II areas which were previously designated non-wilderness (see Appendix C of the FEIS for the LRMP), described each roadless area, the resources and values considered, the range of alternative land uses studied, and the effects of management under each alternative. As a result of the analysis, the remaining non-wilderness areas associated with the Orleans Mountain “C” Roadless Area were not recommended for inclusion in the National Wilderness Preservation System. The LRMP assigned the non-wilderness portions of the Orleans Mountain “C” Roadless Area to the Special Habitat Management Area (LSR 305), which is managed to protect and enhance conditions of late-successional and old growth forest ecosystems. Portions of the roadless area are located within Horse Linto Creek, which is a Tier 1 key watershed. Within key watersheds, new road construction is prohibited within remaining portions of inventoried roadless areas that still qualify as roadless

The LRMP analysis also determined that the area (3,030 acres) generally located between Lone Pine Ridge and the East Fork of Horse Linto Creek had been developed to the extent that it no longer retained roadless characteristics. Development in the area included road construction (approximately 5.70 miles) and timber harvest (approximately 290 acres of regeneration), most of which was associated with the Lone Pine Timber Sale (sold in 1988). The boundary of the roadless area was modified to exclude this developed portion of the roadless area. The remaining 12,500 acres are located in three separate parcels. Figure 3-2 shows the location of the original Roadless Area boundary, areas subsequently designated as wilderness, the area dropped due to development, and the location of roads and harvest units associated with the Lone Pine Timber Sale.

Figure 3-2. **Orleans Mountain “C” Roadless Area Boundary History:**

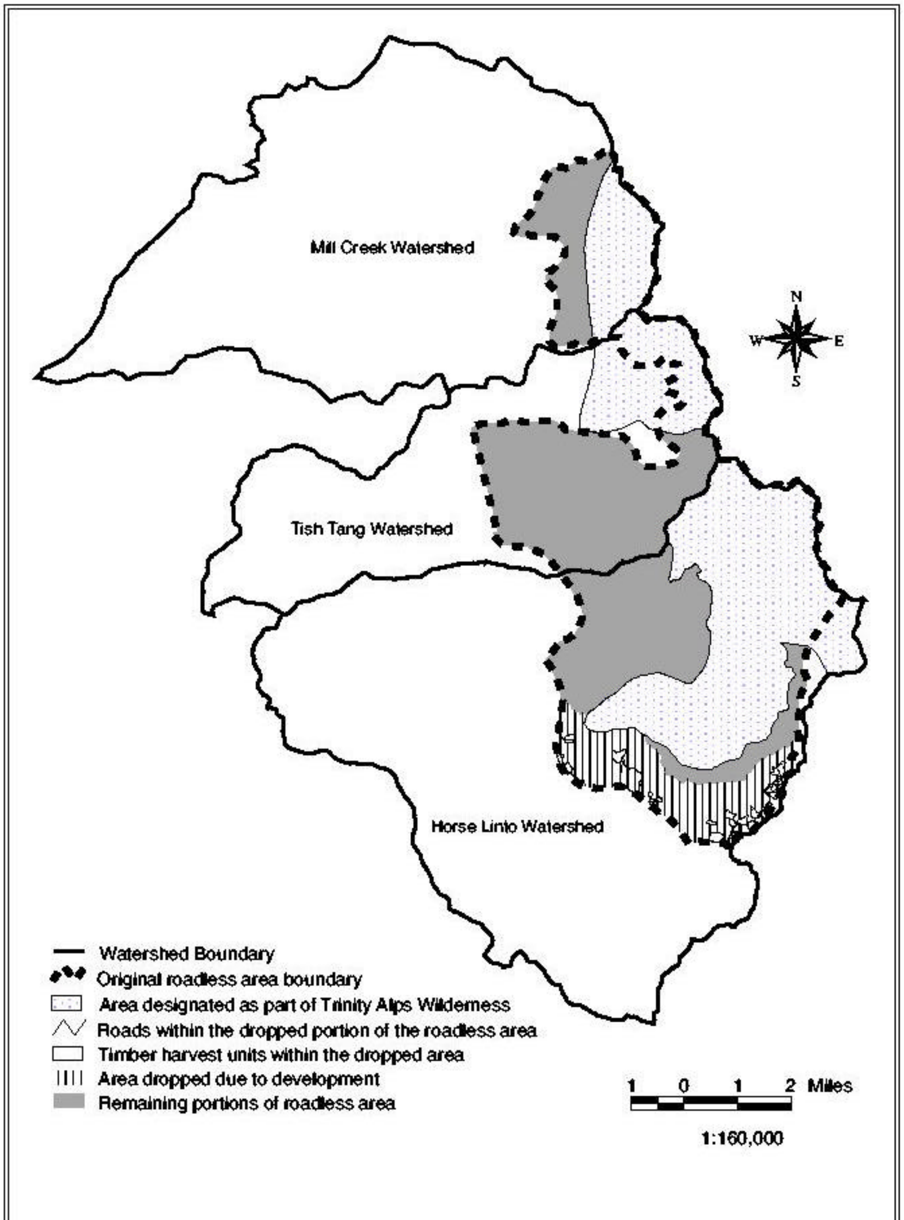


Figure 3-2: Orleans Mountain "C" Roadless Area boundary history.

Current Conditions

The Orleans Mountain “C” Roadless Area is currently composed of three separate parcels. For the purposes of this analysis, the three parcels are referred to as the North, Central and South parcels or portions, which corresponds with their geographic relationship. The following section of this document describes the current conditions across the entire roadless area. Appendix C provides a more refined description of the current conditions within each of the three parcels. The 12,500 acre Orleans Mountain “C” Roadless Area is currently composed of three separate parcels (Figure 3-3), all of which are located adjacent to the Trinity Alps Wilderness. Elevations within the roadless area range from approximately 1,360 feet at the lower end of the Horse Linto Creek watershed to 6,200 feet in the Trinity Summit area. The terrain generally consists of moderately steep sided slopes and benchy ridges. There are numerous stream channels and smaller tributaries located within the area, some of which provide resident fish habitat. Vegetation within the roadless area is primarily comprised of white fir (54 percent), followed by tanoak (17 percent), red fir (11 percent), Douglas-fir (8 percent), alder (4 percent), canyon live oak (3 percent), grasslands/meadows (1 percent), and white oak (less than 1 percent). The remaining area (1 percent) is comprised of riparian areas, rock outcrops, and streams. The roadless area provides habitat or is occupied by several threatened, endangered or sensitive plant and animal species. There are many significant Native American cultural sites located within the roadless area. The Trinity Summit Cabin, which is on the boundary between the roadless area and the Trinity Alps Wilderness, is potentially eligible for listing in the National Register of Historic Places. There are no mining claims within the roadless area and the potential for mineral development is considered low. The LRMP assigned all acres within the roadless area to the Special Habitat Management Area (LSR 305), which is managed to protect and enhance conditions of late-successional and old growth forest ecosystems. The recreation opportunity spectrum (ROS) classification designated by the LRMP is semi-primitive motorized on the north and central parcels, and semi-primitive non-motorized on the south parcel. Approximately 4,840 acres are located within Horse Linto Creek (a tier 1 key watershed), where new road construction is prohibited.

Approximately 212 acres of vegetation within the roadless area show indications of harvest and logging activities, which occurred in the late 1960s or early 1970s (Figure 3-3). Of these acres, 26 are currently in the shrub / forb seral stage, 45 are classified as pole, 118 are mid-mature, and 23 are within late mature seral stage stands.

Ninety-three percent (11,640 acres) of the current roadless area was burned during the 1999 Megram Fire. Extreme fire severities, where almost all of the vegetation cover was killed, occurred on 1,247 acres. High severity fire, where greater than 70 percent of the vegetation cover was killed, occurred on 2,154 acres. Figure 3-4 shows the locations of extreme and high severity fire areas. Moderate severity fire, where 25 to 70 percent of the vegetation cover was killed, occurred on 8,130 acres. The remaining 110 acres incurred low severity fire, where less than 25 percent of the vegetative cover was killed.

Figure 3-3. **Trails, Roads and Harvest Areas Associated with Roadless Area:**

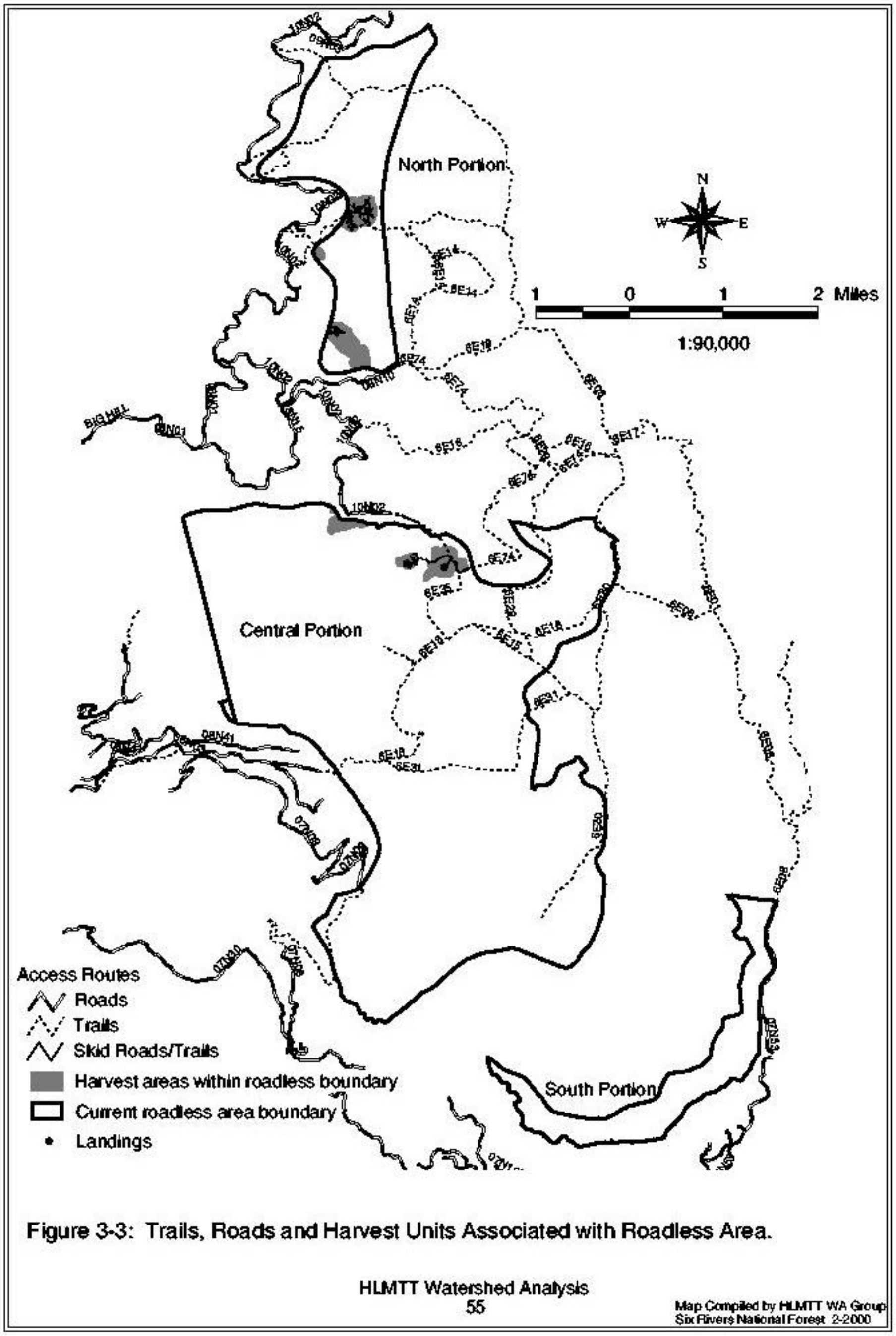
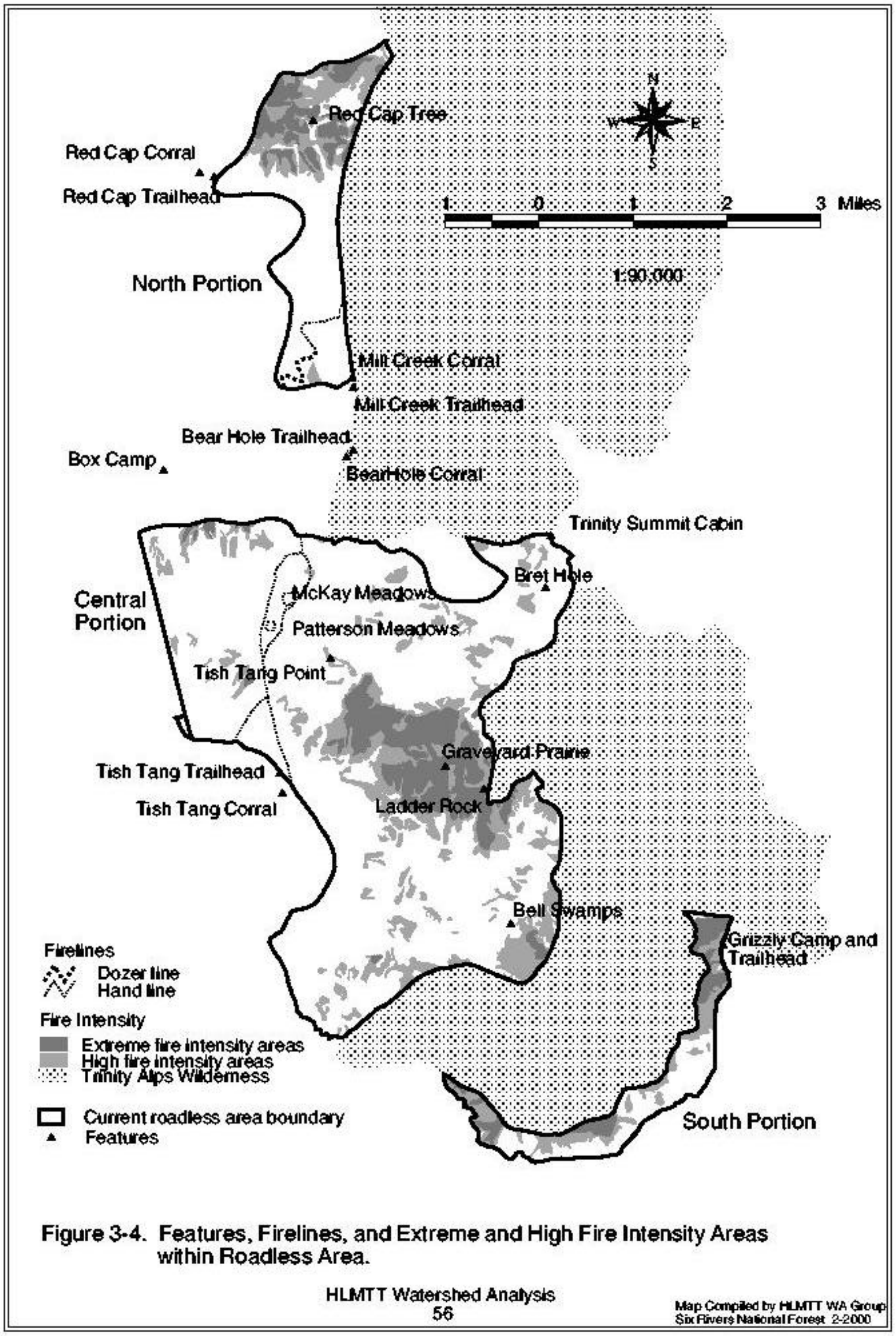


Figure 3-3: Trails, Roads and Harvest Units Associated with Roadless Area.

Figure 3-4. **Features, Firelines, and Extreme and High Fire Intensity Levels within the Roadless Area:**



Approximately 7.2 miles of fireline, constructed during Megram fire suppression efforts, are located within the roadless area (Figure 3-4). Hand lines comprise 6.4 of these miles while the remaining 0.8 miles is dozer line.

There are approximately 17 miles of trail within the roadless area (Figure 3-3). All trails are designated for non-motorized use. Some trails and trail segments are old four-wheel drive routes and skid roads developed to harvest timber. The trails within the roadless area primarily provide access from the west side of the roadless area to the west boundary of the Trinity Alps Wilderness.

Recreational use within the area is relatively low; the primary recreational uses are hiking, horseback riding and hunting. The Grizzly Camp, Mill Creek and Tish Tang Creek trailheads are the most frequently used. The trails are probably most frequently utilized by livestock permittees for allotment access and moving livestock, and by hunters.

Roadless Characteristics

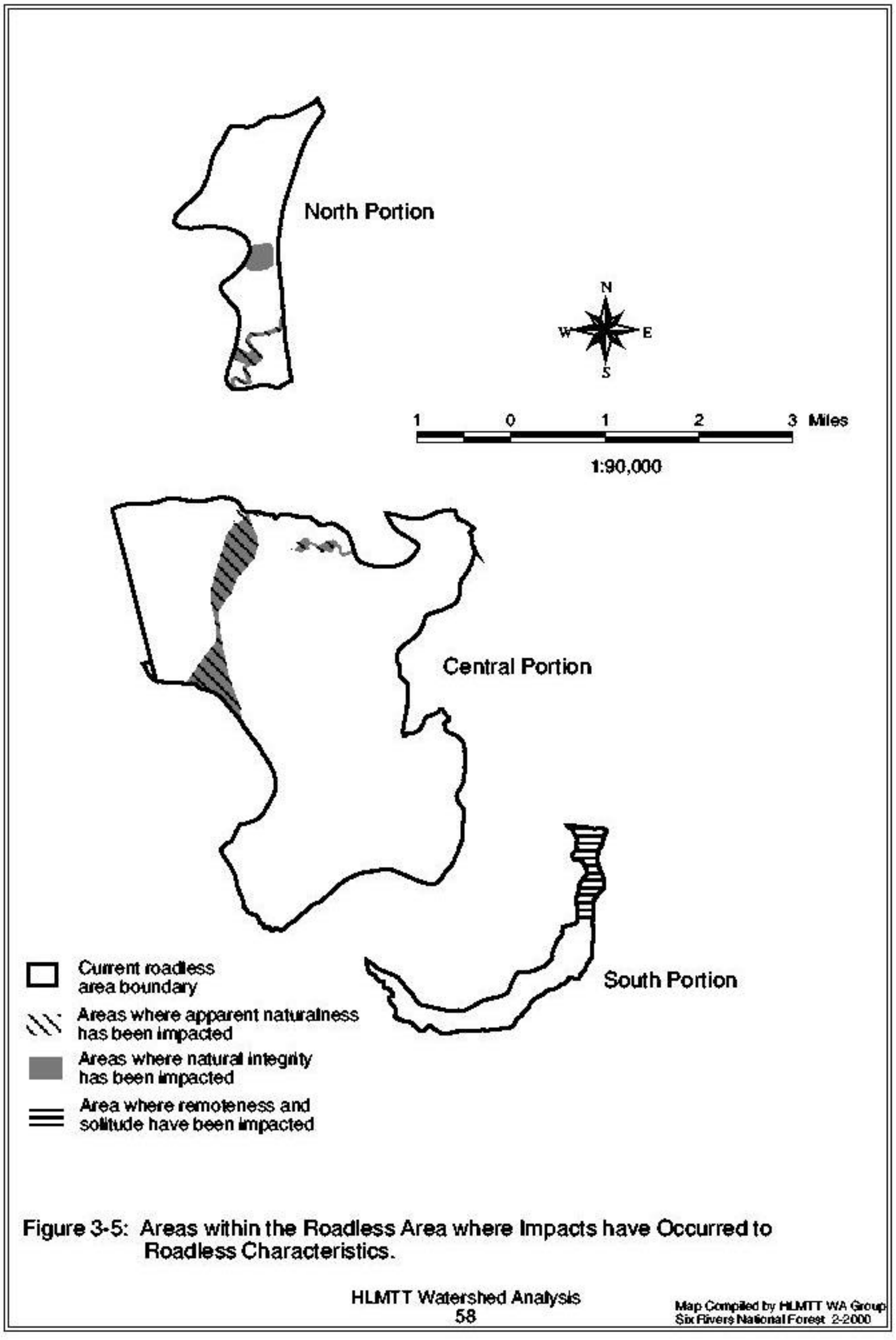
The principle elements of roadless character are natural integrity, apparent naturalness, remoteness, solitude/primitive recreation opportunities, unique features, special places and values, and manageability/boundaries. Natural integrity, apparent naturalness and remoteness relate to the physical setting of an area.

- Natural integrity is the extent to which long-term ecological processes are intact and functioning. It is measured by the presence and magnitude of human induced change to an area.
- Apparent naturalness means that the environment looks natural to most people using the area. It is a measure of importance of visitors' perceptions of human impacts to the area.
- Remoteness is a perceived condition of being secluded, inaccessible, and out of the way.
- Solitude is a personal, subjective value defined as isolation from the sights, sounds and presence of others, and the developments of man. A primitive recreation experience includes the opportunity to experience solitude, a sense of remoteness, closeness to nature, serenity, and spirit of adventure through the application of woodsmen skills in an environment that offers a high degree of challenge and risk.
- Unique features are those unique geological, biological, ecological, cultural, or scenic features that may be present in the area.
- Special places and values are those places and values identified during public involvement as being important components of the roadless resource.
- The manageability/boundaries element relates to the ability to manage an area to meet size criteria and the six characteristics described above.

Natural Integrity

The long-term ecological processes within the remaining portions of the roadless area appear to be in tact and functioning on 95 percent (11,915 acres) of this area. Skid roads/trails, landing construction, and most recently, firelines have impacted long-term ecological process on five percent (583 acres) of this area (Figure 3-5). All of the trees, shrubs, and ground cover have been removed from these areas. Vegetation is reestablishing along some of the skid roads and

Figure 3-5. **Areas within the Roadless Area where impacts have occurred to roadless characteristics:**



landing areas, however compaction and topsoil loss associated with these areas has slowed this process. It is expected that the hand lines will recover in the next year or two, while the dozer line will take longer to recover.

Small areas associated with Trinity Summit Cabin and Grizzly Camp trailhead have been affected by the placement of facilities, and the trampling and compaction resulting from concentrated human activity around these facilities.

Apparent Naturalness

Ninety-six percent (11,970 acres) of the landscape within the roadless area appears primarily to have been affected by the forces of nature. Some human activities associated with timber harvest tend to be disappearing due to natural processes and are not obvious to the casual observer, while other harvest areas remain apparent. It is evident that firelines constructed in association with the recent Megram Fire are not a natural occurrence. Human activities associated with timber harvest and fireline construction have impacted the apparent naturalness on approximately four percent (583 acres) of the landscape (Figure 3-5). The hand lines will recover and are expected to appear natural in a year or two, but the dozer line will take longer to return to a natural appearance.

Human activities are also evident in small scattered isolated areas. These areas are associated with undeveloped campsites, short segments of fence, the Trinity Summit Cabin, and along trails. The presence of, and indicators left by cattle, also detracts from the apparent naturalness of this area and are most evident in areas of concentrated use.

Remoteness

Most (98 percent) of the roadless area could be perceived as quite remote. The size, shape, topography and vegetation associated with this area contribute to the perceived feeling of being remote. Large expanses of land exist where there are no trails or evidence of humans. Benchy ridgelines, steep side slopes, and dense stands of large conifers dominate the landscape and screen much of the area from human impacts. Perceived losses of remoteness are typically limited to areas just inside the perimeter of the roadless area where roads, trailheads, and corrals may be apparent. This perceived loss of remoteness is accentuated in perimeter areas, adjacent to developments, where most screening vegetation was killed by extreme and high intensity fire. This situation exists in one isolated location (Figure 3-5) and affects the perceived feeling of remoteness on approximately two percent (210 acres) of the roadless area.

Solitude/Primitive Recreation Opportunities

The opportunity to experience solitude is high in the majority of area. There are some small, isolated areas along the perimeter of the roadless area where the opportunity for solitude is moderate. These areas are typically near roads, campsites and trailheads where the potential for seeing or hearing other visitors is slightly increased. The opportunity for solitude is considered low on approximately two percent (210 acres) of the roadless area. This area is adjacent to a road, a popular trailhead and a developed campsite, all of which increase the potential of seeing or hearing other visitors or of being exposed to the developments of humans. In addition, extreme and high intensity fire burned throughout the area and killed most of the vegetation that previously screened out some of the sites and sounds associated with human use. This area corresponds with area described in the previous section, where remoteness is impacted.

The Orleans Mountain “C” roadless area provides a range of recreational experiences. Alterations to vegetation and the presence of trails, firelines, dispersed campsites, fences and cabins modify the physical and social settings to the extent that criteria for a primitive recreational experience are probably not met. The roadless area currently meets criteria consistent with a semi-primitive non-motorized recreation experience.

Unique Features

Trinity Summit Cabin is located within the roadless area and is potentially eligible for listing in the National Register of Historic Places. Although not considered unique, there are many prominent landmarks, topographic features and popular destination points including Red Cap Prairie, Red Cap Tree, McKay Meadows, Patterson Meadows, Trinity Summit Cabin, Bret Hole, Tish Tang Point, Graveyard Prairie, Ladder Rock and Bell Swamps.

Special Places or Values

The area is valued by Hupa for culturally important plants and ceremonial activities. Corral Creek, in the vicinity of McKay Meadows, is valued for hunting and brook trout fishing. The rocky area associated with Bret Hole is valued as a good hunting area.

Manageability/Boundaries

All remaining portions of the roadless area are located adjacent to the Trinity Alps Wilderness, so all areas regardless of their size, meet the 5,000-acre size requirement necessary to be considered for future wilderness designation.

The boundaries of the roadless area are currently difficult to identify on the ground, as they frequently do not correspond to topographic features such as streams, ridgelines, or consistent elevations. In areas where roads dictated the extent of the roadless area, the distance between the road and roadless area boundary tends to fluctuate frequently and significantly.

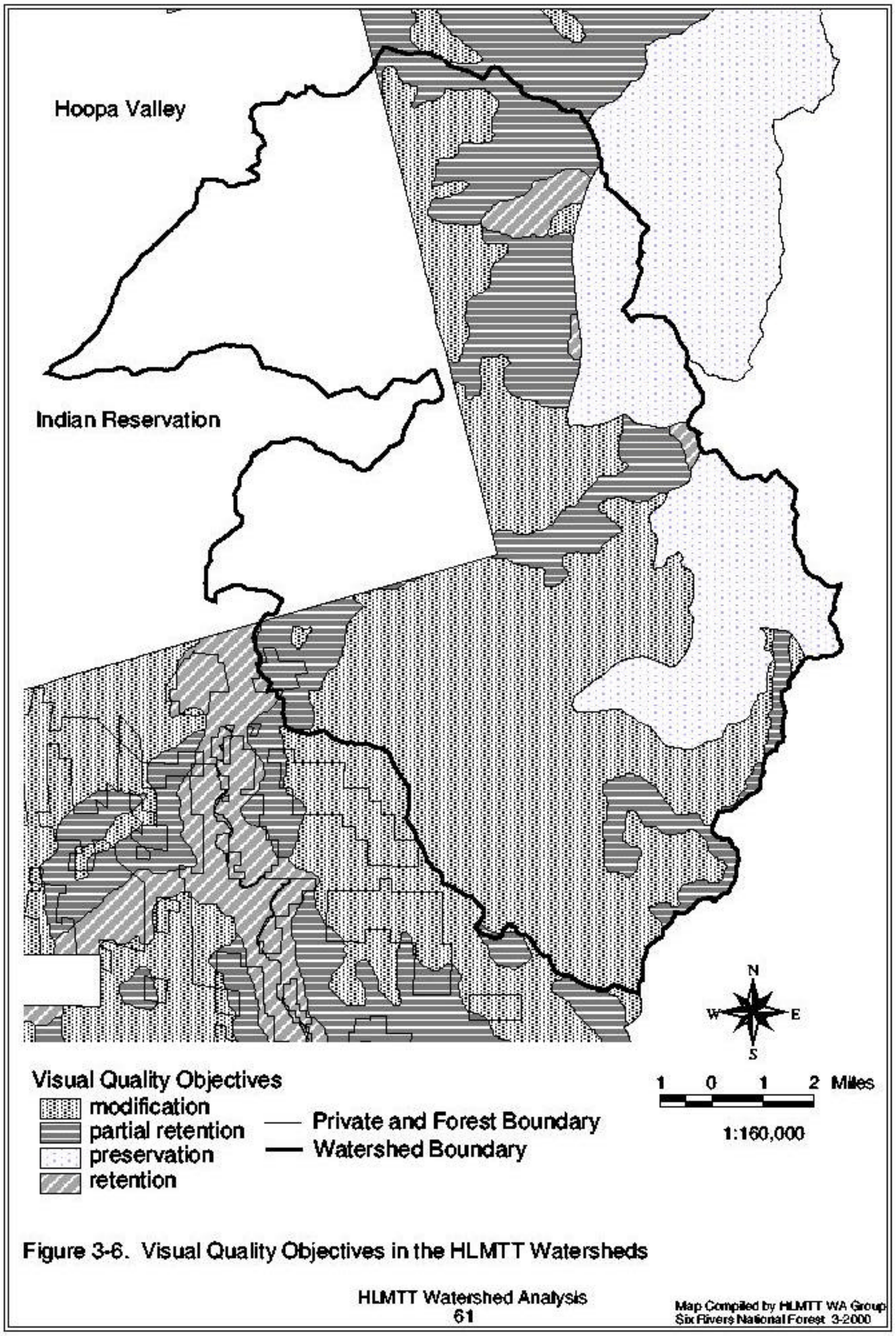
Detailed descriptions of the current conditions and roadless characteristics within the North, Central, and South portions of the roadless area are provided in Appendix C.

Visual Quality

Reference Conditions

The Forest Plan has designated Visual Quality Objectives (VQO) as follows for these watersheds: Preservation, Partial Retention and Modification. Refer to Figure 3-6 for the VQOs in different parts of the analysis area.

Figure 3-6. **Visual Quality Objectives in the HLMTT Watersheds:**



Preservation (P): Management activities are generally not allowed; only natural ecological changes occur (untouched).

Preservation areas have been designated within the analysis area and are located within the Trinity Alps Wilderness Area.

Retention (R): Management activities are tiered to maintaining the area in a condition that appears undisturbed as seen from the viewing location. Management activities are acceptable, considered on a project-by-project basis, and would be designed according to the retention objectives of the visual management system (minor disturbance).

Retention areas have been designated within the analysis area and are generally located in association with the Trinity Alps Wilderness Area and the area along Forest Road 10N02 from Tish Tang Campground to Sign Board Gap.

Partial Retention (PR): Management activities may be evident but must remain subordinate to the characteristic landscape (minor disturbance).

Partial retention areas are seen as foreground and middleground view from the following locations:

- Forest Roads 7N53 and 8N02 to Grizzly Trail Head, which provides access to the wilderness.
- Forest Roads 7N04 and 7N10, which access a dispersed camping area at Groves Prairie.
- Forest Road 8N03 to Tish Tang Trail Head, which provides access to the wilderness.
- Forest Road 8N01 and 10N02, which provides access to a wilderness trailhead.
- Forest Road 8N10, to Mill Creek Trail Head, which provides access to the wilderness.
- Forest Road 10N02 which provides access to Red Cap and Mill Creek Gap in the wilderness.

Modification (M): Management activities may dominate the characteristic landscape, but must follow natural form, line, color, and texture; should appear as a natural occurrence when viewed in the foreground or middleground (moderate disturbance).

Modification areas have been designated within the analysis area and are generally located east and southeast of the Hoopa Valley Indian Reservation.

Current Condition

The main concern is these watersheds are views from along Forest roads that provide access to recreation sites and the wilderness area and are utilized for recreational driving. These watersheds also serve as a scenic backdrop for the communities of Willow Creek and Hoopa Valley.

Fire is considered a natural process that can create mosaic patterns across the landscape. The degree of modification of the landscape varies by burn severity. Low to moderate burn severity can be considered to have a positive effect on the landscape, adding variety to the landscape and creating a more interesting view to the forest visitor. A combination of mosaic and uniform patterns of green trees, along with various sized patches of brown and black snags or trees dominate the landscape. The character of the landscape will change with time, as trees continue to die from the effects of fire and insect infestation. The emergence of new vegetation would begin within five years, with forbs and grasses, then eventually, shrubs and trees. Green trees would start to grow in varying patterns across the landscape. Portions of Forest roads 7N53, 8N02, 7N04, 7N10, 8N03, 8N01, 10N02, 8N10 and 10N02 experienced low to moderate burn severities.

Wildfires having high burn intensities are more likely to have a negative effect on the viewshed, especially when large areas are burned, as is the case with the Megram fire. The Megram fire created a drastic, sudden change to the scenic character and condition in the foreground areas, especially within high severity burn areas. In middle ground view, the fire is not as dominating or seen as such a drastic change. In the high severity burn areas, the change to the landscape is the loss of dominating forested green textural patterns which is replaced by burnt trees. The landscape is highly textured with brown needle and dead and dying trees. When high severity burn impacts a large area, there is a negative visual impact. In such cases, the forest visitor sees a blackened landscape, which unless planted, will take much longer to return to its near-natural appearing condition and provide an attractive, forest landscape. Portions of Forest Roads 7N53 and 8N02, 10N02 and 8N03 experienced a high severity burn.

Desired Condition

The natural phenomena of wildfire creates and alters landscape character through modification of vegetation patterns. There is convincing evidence that the immediate scenic effect of natural disasters is a reduction in the value of scenery for affected and adjacent lands. People seldom, if ever, credit a high intensity wildfire with enhancing scenic quality. Most fire-blackened trees are considered obtrusive to scenic views. However, the scenic impact of natural disturbances gradually diminishes as natural processes heal the landscape over time. The effects of natural disasters are compatible with naturally evolving and natural appearing landscape character goals, except when human intervention creates unnatural scenic deviations.

The primary objective as per the Six Rivers LMP is to manage Forest lands to achieve visual quality commensurate with public uses. The VQOs, as assigned in each management area should be met, however, exceptions include alterations from disturbances such as catastrophic wildfire. Additionally, short-term departures from adopted VQOs that lead toward a desired long-term visual character are acceptable.

The primary goals within the high severity burned areas are to restore the landscape to its near-natural appearing condition and to provide an attractive forest landscape, while maintaining the intent of the designated VQO. Within the low and moderate severity burn areas, future activities should be designed to maintain or improve the visual landscape of the area and should not dominate the characteristic landscape.

Recreation Opportunity Spectrum (ROS)

The ROS system is used to delineate, define, and integrate outdoor recreation opportunities in land and resource management planning (Six Rivers N.F. Plan Appendix I-1). It defines a continuum of outdoor recreation opportunities that range from primitive to urban. The ROS classification for the Megram fire is Roaded Natural (RN) and Semi-Primitive Motorized (SPM) in Figure 3-7.

Roaded Natural (RN): A natural-appearing setting, with moderate sights and sounds of human activities and structures. The overall perception is one of naturalness. Roads and motorized equipment and vehicles are common in this setting. Evidence of human activity varies from area to area and includes improved highways, developed campgrounds, livestock grazing, timber harvesting operations, watershed restoration activities and water diversion structures

Semi-primitive Motorized (SPM): Characterized by predominantly natural or natural-appearing landscapes. The size of these areas gives a strong feeling of remoteness. Experience solitude, closeness to nature, tranquility. High degree of self –reliance, challenge and risk in using motorized equipment. Low concentration of users but often evidence of others on trails. Access for people with disabilities is “DIFFICULT” and challenging.

The fire did not change the ROS for these watersheds.

Figure 3-7. **Recreation Opportunity Spectrum Classification:**

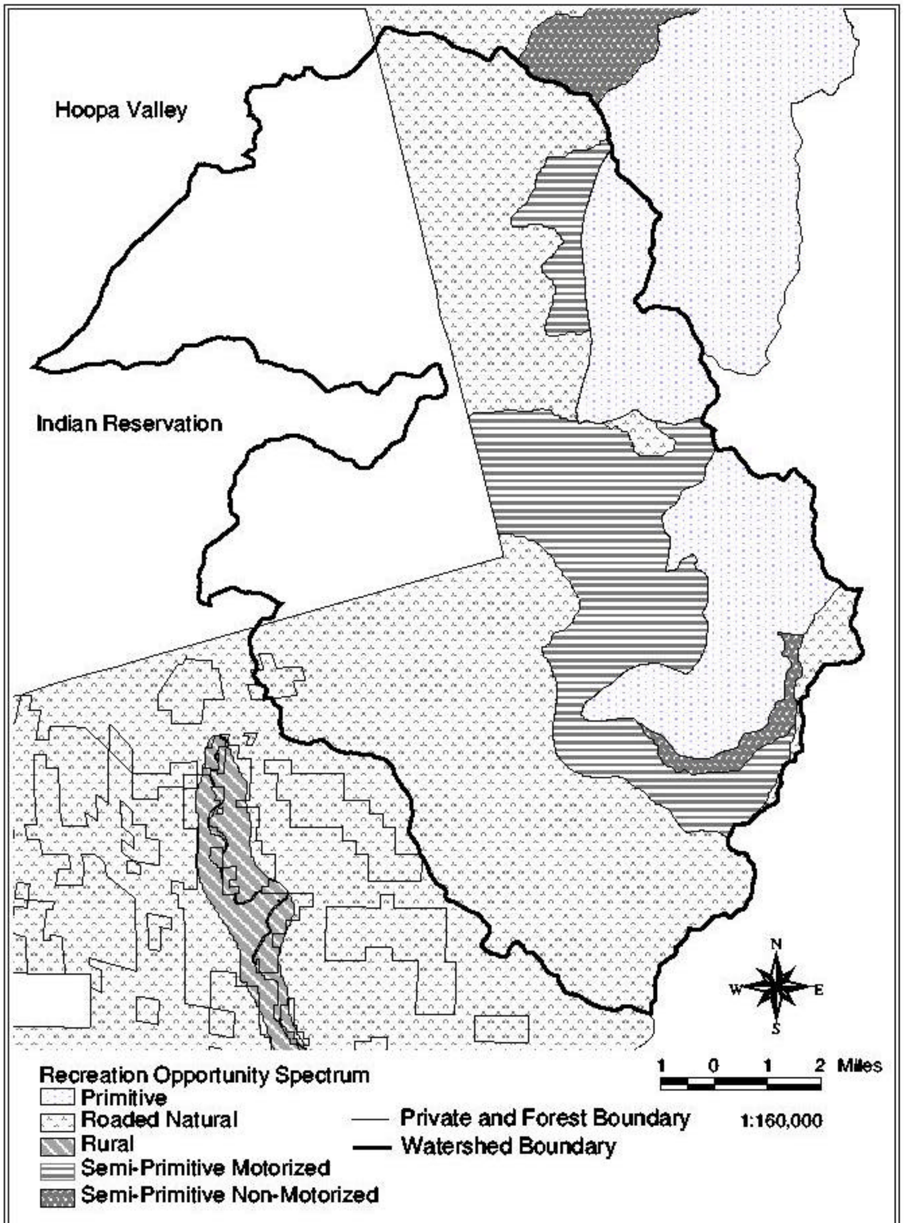


Figure 3-7. Recreation Opportunity Spectrum

Terrestrial System

Vegetation

Reference Conditions

Historical Range of Variability

Disturbance patterns in the past are difficult to assess, however, the frequency and pattern of past disturbance events can be inferred from the distribution of seral stages across the landscape. An analysis of the seral stage distribution of Six Rivers National Forest was done in 1995 and reanalyzed in 1997 upon completion of the Forest vegetation map (Jimerson and others 1997). This analysis modeled the past distribution of seral stages for different vegetation series. To determine the past distribution, stands were projected backward in time over 250 years at 50-year intervals. The past seral stage distribution was compared to the present to develop a Historical Range of Variability (HRV). The Historical Range of Variability is identified for seral stages in the primary vegetation series on the forest. These series are the tanoak, Douglas-fir, white fir and red fir series. The HRV percentages are relevant for analysis at the scale of the Forest zones. The Forest zones are three areas (north, central and south) of the Forest that are distinguished by species composition and seral stage distribution. These differences in vegetation are a reflection of the different disturbance patterns, geologic material and climate conditions of these three zones. The analysis area is part of the central zone.

Although HRV values are specific to the Zone, they can be compared to percentages in watersheds within the Zone. These comparisons can show how the watersheds reflect the HRV percentages of the Zone. For example, the existing conditions of the Central Zone (Table 1) show that old growth in the tanoak, Douglas-fir, white fir and red fir series are currently below the HRV. This is the result of past logging in combination with the Megram fire. These conditions are different in the analysis area where old growth is a much higher percentage. In fact, with the exception of the Douglas-fir series, all types in the analysis area had higher frequencies of old growth than in the zone. This indicates that disturbance (natural and human) within the analysis area was lower over the last 250 years than it was in the Zone. It further demonstrates the capabilities of the analysis area to support a higher frequency of old growth.

The Forest utilized the HRV to develop recommended management ranges (RMRs) for seral stages in the primary vegetation types (tanoak, Douglas-fir, white fir, red fir). The RMR is a subset of the HRV designed to maintain vegetation types and seral stages in an ecologically balanced manner by mimicking past seral distribution. The RMRs provide a buffer against unpredictable large-scale stand replacing events. The RMRs are used as guidelines in assessing all proposed vegetation management treatments. Projects that do not alter seral stage conditions outside of the RMR can go forward while those that do must be altered.

Table 3-14. The HRV for Seral Stages within the Tanoak, Douglas-fir, White Fir and Red Fir Series in the Central Zone of SRNF. These percentages are compared to the existing percentage of each series in the central zone and the pre fire and existing percentages in the analysis area.

	Central Zone HRV %	Central Zone Existing %	Analysis Area Pre-fire %	Analysis Area Existing %
tanoak				
shrub/forb		11	14	20
pole		20	6	5
early mature	14-21	18	15	14
mid mature	12-22	20	22	20
late mature	10-16	14	19	19
old growth	25-39	18	24	23
Douglas-fir				
shrub/forb		8	32	52
pole		4	2	1
early mature	14-37	35	21	17
mid-mature	9-37	34	21	14
late mature	4-11	8	12	10
old growth	12-23	11	11	6
white fir				
shrub/forb		24	6	35
pole		7	6	4
early mature	14-20	17	19	11
mid mature	11-20	17	18s	13
late mature	10-17	13	18	13
old growth	26-39	23	33	23
red fir				
shrub/forb		26	5	46
pole		4	2	1
early mature	14-40	21	23	13
mid-mature	3-28	25	28	17
late mature	1-17	13	24	12
old growth	14-18	13	18	11

Harvest History

The three watersheds total 91,990 acres. Of this, 26,150 acres are under the jurisdiction of the Hoopa Tribe and 65,540 acres are under the jurisdiction of the Forest Service. There are 297 acres of other private ownership. Within the three watersheds, there are a total of 21,795 acres of managed stands: 10,875 acres are on the Hoopa Reservation and 10,800 acres within the SRNF.

There is also a minor amount of private or non-tribal lands that have had some harvest activity. These managed stands have had some type of silvicultural treatment applied, from regeneration harvest or commercial thinning to sanitation and salvage. The earliest regeneration harvest on National Forest lands occurred in late 1950's in the Mill Creek watershed. The most recent National Forest regeneration harvest occurred about 1990 in the Horse Linto watershed.

Following the blowdown events of December 1995 and January 1996, a series of fuel reduction projects were planned on the National Forest within the Horse Linto and Mill Creek watersheds. Prior to the fire, 1,583 acres of the area proposed for fuel reduction treatment were salvage logged to reduce fuel levels. Of this, 300 acres had some previous intermediate harvest activity. An additional 573 acres were under contract to be salvage logged and were involved in the fire, which consumed the salvageable material. The treatments were specifically designed to remove a significant portion of the large fuel component through harvest and much of the smaller fuel through follow-up piling and burning operations. The wind damaged stands were not treated silviculturally. There was no provision to manage stand density or provide for the acceleration of stand structure development. Only damaged and down trees were removed with specific guidelines for snags and logs to be left on site.

Table 3-15 displays the harvest history in the HLMTT watersheds, and Table 3-16 shows the acres harvested after the 1995-1996 blowdown event.

Table 3-15. Harvest History (does not include blowdown treatments)

Ownership	Watershed	Intermediate Harvest	Regeneration Harvest	Total
Hoopa	Horse Linto		176	176
	Mill		7,558	7,558
	Tish Tang		3,140	3,140
Hoopa Total			10,875	10,875
Private	Horse Linto	16	104	120
SRNF	Horse Linto	1,074	4,756	5,918
	Mill Creek	1,346	1,423	2,769
	Tish Tang	51	781	832
SRNF Total		2,471	6,960	9,520
Grand Total		2,487	17,939	20,426

Table 3-16. Blowdown Harvest Acres

Watershed	Horse Linto	Mill Creek	Total
Acres	1,261	322	1,583

Current Conditions

This section provides a basis for the current vegetation conditions in the analysis area. For the purpose of this section, the analysis area is defined as National Forest lands within the Horse Linto, Tish Tang and Mill Creek watersheds. The main purpose of this section is to describe vegetation composition, structure and distribution and to describe the effects of the Megram Fire on these attributes.

Vegetation Series and Subseries

Through the ecology and mapping program at Six Rivers National Forest, potential natural vegetation types have been identified and mapped. Information from this classification and mapping effort was used for this analysis. Potential Natural Vegetation is the vegetation that would exist on the landscape due to specific biotic and abiotic factors and without human influence. The classification of these vegetation types is based on a hierarchal system. This system begins with the vegetation series, which represent the dominant overstory and regenerating species in a stand. The next level of the classification is the subseries. The subseries is the subdominant tree species or the shrub species that have indicator value across multiple plant associations. The plant association is the lowest level of the classification. It represents a potential natural community of definite floristic composition and uniform appearance that repeats itself across the landscape.

Relationship to the Central Zone and Analysis Area

The analysis area covers 22 percent of the Central Zone. The vegetation series in this area (Table 3-17) are representative of the high elevation vegetation in the zone. The Central Zone is dominated by the tanoak, white fir and Douglas-fir series along with the canyon live oak, white oak and grassland series. The analysis area contains 50 percent of the white fir series, 59 percent of the red fir series, 17 percent of the canyon live oak series, 23 percent of the meadow vegetation type and 11 percent of the Douglas-fir series in the Central Zone. This area has a relatively low amount of tanoak (17 percent) because of its high elevation position in the zone.

Influences on Vegetation Distribution

The distribution of the vegetation series in the analysis area is influenced by elevation, soil moisture availability and parent material. The white fir and red fir series are found at the highest elevation sites in the analysis area. Intermixed among these true fir stands are montane meadows and alder stringers. The tanoak series dominates on low elevation sites with deep soils and high water holding capacity. The Douglas-fir series is found upslope from the tanoak series on steeper, drier, south to southeast facing slopes. Canyon live oak dominates on steep, rocky sites.

Vegetation Subseries

The sub-series in the analysis area is an indication of the environmental conditions present. They display a moisture gradient from moderately dry in the tanoak-canyon live oak sub-series to moist in the white fir-Douglas-fir sub-series. They also reflect micro-site conditions. The steep, highly dissected terrain is usually dominated by canyon live oak while the more gentle slopes contain white fir and Douglas-fir. The high elevation wet basins usually contain montane meadows and alder stringers.

Table 3-17. The Distribution of the Primary Vegetation Subseries in the Analysis Area

Sub-Series	Acres	Percent
tanoak-canyon live oak	4,496	6.86
tanoak-chinquapin	531	0.81
tanoak-bigleaf maple	291	0.44
tanoak/evergreen huckleberry	3,062	4.67
tanoak/salal	109	0.17
tanoak/hazelnut	148	0.23
tanoak/dry shrub	15,408	23.51
white fir-tanoak	2,953	4.51
white fir-white-fir	3,177	4.85
white fir-red fir	1,238	1.89
white fir-Douglas-fir	13,596	20.74
white fir-Ponderosa pine	70	0.11
white fir-white oak	22	0.03
white fir-incense cedar	1,905	2.91
white fir-canyon live oak	146	0.22
white fir-chinquapin	4,734	7.22
red fir-white fir	2,884	4.40
red fir-red fir	966	1.47
red fir-incense cedar	610	0.93
Douglas-fir-tanoak	374	0.57
Douglas-fir-Ponderosa pine	27	0.04
Douglas-fir-white oak	365	0.56
Douglas-fir-black oak	83	0.13
Douglas-fir-incense cedar	5	0.01
Douglas-fir-canyon live oak	3,643	5.56
Douglas-fir-chinquapin	228	0.35
Douglas-fir/hazelnut	56	0.09
Douglas-fir/huckleberry oak	46	0.07
alder	1,210	1.85
montane meadow	505	0.77
white oak-canyon live oak	91	0.14
black oak-Douglas-fir	3	0.00
canyon live oak-Douglas-fir	905	1.38
canyon live oak-canyon live oak	181	0.28
riparian	80	0.12
Grand Total	65,537	100.00

Vegetation Seral Stages

Relationship of Seral Stages to the Central Zone

The analysis area has the highest amount of late mature (18 percent) and old growth (26 percent) in the Zone. This is compared to 11 percent late mature and 18 percent old growth in the Central Zone. Early mature and mid-mature stands make up 24 percent and 22 percent of the Central Zone respectively. This is compared to 18 percent and 21 percent in the analysis area. Early seral vegetation was included in the shrub/forb and pole seral stages. They accounted for 10 and 5 percent of the vegetation in the analysis area and 9 and 13 percent respectively of the vegetation in the Central Zone.

It is also important to note that the analysis area contains 3,145 acres of early mature and 1,274 acres of mid mature stands that contain predominant trees. These large overstory trees are the remnants (legacy) of the previous stand. They impart late seral characteristics to mature stands that are often lacking in structural diversity. These large trees can be used, together with innovative silvicultural prescriptions, to attain late seral characteristics quicker than they would appear naturally.

Seral Stages by Vegetation Series

Most of the vegetation in the analysis area is included in the tanoak, white fir, red fir, Douglas-fir and canyon live oak series (Table 3-18). The highest percentage of mature seral stage vegetation is found in the canyon live oak series, followed by the Douglas-fir and red fir series. Most of the old growth and late mature stands are in the white fir, tanoak, red fir and Douglas-fir series. The highest frequency of early seral vegetation is found in the tanoak, white fir, Douglas-fir and red fir series.

Table 3-18. The Distribution of Seral Stages by Vegetation Series within the Analysis Area

	tanoak		white fir		red fir		Douglas-fir		canyon live oak	
Seral Stage	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
shrub/forb	2,480	10.3	1,662	6.0	211	4.7	203	4.2	0	0.0
pole	1,398	5.8	1,585	5.7	90	2.0	162	3.4	0	0.0
early mature	3,639	15.1	5,347	19.2	1,035	23.2	1,110	23.0	852	78.4
mid mature	5,514	22.9	4,974	17.9	1,245	27.9	1,568	32.5	234	21.6
late mature	4,757	19.8	4,988	17.9	1,079	24.2	937	19.4	0	0.0
old growth	6,257	26.0	9,285	33.4	800	17.9	846	17.5	0	0.0
Grand Total	24,044	100.0	27,841	100.0	4,460	100.0	4,827	100.0	1,086	100.0

Harvested Seral Stages

Through the mapping process, stands throughout this area were designated with an ‘H’ if any signs of harvesting were found. The harvested designation for shrub/forb and pole stands is the result of a clearcut harvest. For early mature, mid mature, late mature and old growth stands the designation is generally the result of an intermediate harvest.

Most of the harvesting has taken place in the white fir and tanoak series. Nineteen percent of the white fir series and sixteen percent of the tanoak series has had regeneration or selective harvesting (Table 3-19). Ninety-three percent of the logging in the tanoak series resulted from clearcut harvest. In contrast, fifty-eight percent of the harvesting in the white fir series resulted from clearcut logging and forty-two percent from intermediate harvests. This wide difference is not surprising given the difficulty in managing stands in the tanoak series. The other series that have had harvesting are the red fir and Douglas-fir series.

Table 3-19. Harvested Seral Stages by Vegetation Series within the Analysis Area

Seral Stage	tanoak	white fir	red fir	Douglas-fir
shrub/forb harvest	2,428	1,572	0	203
pole harvest	1,192	1,513	0	140
early mature harvest	109	355	0	41
mid-mature harvest	125	1,324	0	11
late mature harvest	49	405	11	0
old growth harvest	0	123	0	0
Total harvest	3,904	5,296	11	394
Percent of Series Harvested	16	19	1	8

Size Class and Canopy Closure

A majority of the analysis area has large size class 4 and 5 trees (both hardwoods and conifers) (Table 3-20). Most of the vegetation in size class 1 and 2 are the plantations and hardwood stands, such as canyon live oak and alder. The size class 3 and 4 stands are the early mature and mid-mature white fir, red fir, tanoak and Douglas-fir series. A general description for the analysis area outside of the steep inner gorges would be dominance by high site class, large trees. In fact, some of the trees sampled during extensive ecology plot sampling in the area exceed the highest Dunning site class (base age 300 years) category for California (Dunning, 1942).

Table 3-20. The Distribution of Size Classes for Vegetation Series within Analysis Area

Size Class	Acres	Percent
0 (none)	1,512	2
1 (0-5.9")	6,165	9
2 (6-10.9")	3,892	6
3 (11-20.9")	11,720	18
4 (21-35.9")	22,407	34
5 (>36")	19,841	30
Total	65,537	100

Canopy closure is high overall in this analysis area (Table 3-21). Eighty-one percent of the area has a canopy closure between 60 and 100 percent. Areas with no overstory cover are the grasslands and non-vegetated areas or barrens.

Table 3-21. Canopy Closure Classes for all Vegetation Series within the Analysis Area

Total Canopy Closure	Acres	Percent
N (0-9%)	4,069	6
S (10-19%)	969	2
P (20-39%)	2,131	3
M (40-69%)	5,559	8
G (69-100%)	52,809	81
Total	65,537	100

Plantations

On National Forest lands within these three watersheds, there were 6,960 acres of young stands that were reforested following timber harvest activities. They varied in age from 7 to 41 years, with the majority being 20-35 years old. The primary conifer species present were Douglas-fir and ponderosa pine, with sugar pine, incense cedar, and white fir being minor stand components. A large percentage of these plantations were burned at various severities during the fire. Table 3-22 displays the acreages by watershed and the acres within the fire perimeter by burn severity. Remaining acres are unburned.

Table 3-22. Plantations within the Watersheds

Watershed	Acres	Burn Severity		
		High	Moderate	Low
Mill Creek	1620	334	49	396
Tish Tang	625	255	107	27
Horse Linto	4715	2173	532	758

The category of burn severity within plantations is based upon the expected early mortality within the first year following the fire. Young stands between 7 and 40 years of age fall into the sapling and pole seral stages. Closed canopy conifers, with a hardwood component and crown ratios greater than 60 percent, characterize plantations greater than 20 years old. There would have been dead or dying shrubs in the understory. Generally, plantations less than 20 years old had a well-developed shrub layer with hardwoods and live crown ratios of greater than 70 percent. Both of these conditions carry high fuel loadings and potential for catastrophic loss in a fire. Young trees have thin bark, live crowns that are close to the ground and typically intertwined with adjacent conifer, hardwood, and shrub and forb vegetation, creating a “ladder” of fine fuels. Douglas-fir, sugar pine and incense cedar have slender twigs and small terminal buds. This creates a situation that results in high mortality when wildfire enters the stand (Wagener 1961, Weatherspoon 1988). In young stands that naturally regenerate following catastrophic loss to fire, wind or insects, the same conditions exist that are found in plantations except with increased amounts of standing snags and downed woody debris. Dead trees ignite easily and represent a higher potential source of firebrands that can enhance fire spread. Fallen fire-killed trees create a highly concentrated heat source that can cause problems during fire suppression and may result in localized soil degradation (Harrington 1996, Nyland 1996).

Of the approximately 14,850 acres of stand-replacing, high intensity fire, between 2,000 and 3,000 acres of plantations were burned. Actual losses will be field verified in the coming year as crews are able to access and evaluate these young stands.

Fire Effects on Vegetation

Individual Tree Damage

The severity of the Megram Fire in relation to stand damage has been categorized into three classes; high, moderate and low. These categories relate to the amount of live, green canopy remaining based on aerial photo interpretation. Individual tree damage within stands following fire is generally categorized using two characteristics; crown scorch (or crown loss) and cambium damage (Wagener 1961; Weatherspoon, 1988; Reinhardt and Ryan, 1988). Individual species vary greatly in their susceptibility to fire, as do trees of different heights and diameters. Comparatively, pines have thicker bark and larger buds than the firs. These characteristics provide greater protection to cambium and next years' production of replacement foliage (needles) (Wagener 1961). True firs (*Abies sp*) (white and red fir) and Douglas-fir have thin bark on younger trees and on mid and upper boles. Buds are smaller and less resistant to heat damage. These species cannot withstand as much cambium damage and crown loss as the pines. The majority of the natural conifer stands that suffered high and moderate severity fire in these watersheds were composed of white fir and Douglas-fir. Pines were a minor component. Generally for firs, crown losses greater than 65 percent of pre-fire crown volume or cambium damage between 25 and 40 percent of the bole circumference will result in death (Wagener 1961 and Weatherspoon 1988). Insects will likely attack surviving trees that are near the upper limit of these damage thresholds (see section on insects below).
Late season (fall) high intensity fires can also kill fine roots within a few inches of the soil surface and cambium on larger roots near the surface (Weatherspoon 1987). The amount of damage is difficult to predict due to factors such as species differences, soil moisture, duff layer depth and fire duration. Significant root loss can result in mortality or predisposition to insect attack.

Fire Severity

In order to support this analysis and assess the impacts of the Megram Fire, fire severity on the Six Rivers National Forest portion of the fire was mapped. Post-fire aerial photos were used along with limited ground truthing. Seven categories were created for this assessment: 0, 1, 2, 2a, 3, 4a and 4b. Practically speaking, they can be lumped into three categories: low, moderate and high severity. The minimum map unit was approximately one acre for the two highest severest burn categories. Descriptions of each category follow:

Low Severity

0 - No burn. This category included one polygon within the fire perimeter that was identified as no burn.

1 - This category included polygons in which < 25 percent of the canopy was killed. Practically speaking, these are the areas where there was almost no fire activity visible from air photos or where spotting was very infrequent and barely visible. A good majority of this category falls well below the 25 percent demarcation, from an aerial view.

Moderate Severity

2 - This category included polygons in which 25 to 40 percent of the canopy were killed. It included areas of small spot fires too small to delineate, i.e. below minimum map unit size.

2a - This category was established for wildlife purposes. It included polygons where 40 to 60% of the canopy was killed. Most of this category falls closer to the 40% canopy killed rather than the 60 percent. It also seems to be mostly in the higher elevation white fir and red fir early mature stands

3 - This category included polygons where between 60 and 70% of the canopy were killed.

High Severity

4a - This category includes polygons where > 70 percent of the canopy was dead. It's probably more like > 85% of canopy mortality, with mostly dead trees or dead brush and only sporadic green vegetation interspersed. Canopy is mostly dead but not removed.

4b - This category included stands with >70 percent canopy gone, more like 95 to 100 percent gone and also removed, i.e. vaporized. This is characterized by brush fields burned to bare soil and tree stands with only charred "sticks " remaining.

Ground truthing to validate polygon labels will likely be completed during the field season of year 2000.

A description of the effects of the Megram Fire on the vegetation of the analysis area follows. This analysis will concentrate on Federal lands within the fire perimeter and within the analysis area.

Statistical significance was assessed using chi-square (SPSS 1999). For analysis purposes, the assumption was made that all polygons were independent, identical trials.

Fire severity effects on vegetation are described in Table 3-23. The moderate severity category accounted for the highest frequency of burned acres (32,886 acres, 67 percent). It was followed by the high severity category (14,852 acres, 30 percent) and low severity (1,701 acres, 3 percent).

Table 3-23. Fire Severity Classes for all Vegetation Series within the Analysis Area

Burn Code	Acres	Percent
low severity		
no burn	0	0.0
low intensity < 25% mortality	1,701	3.4
moderate severity		
low-moderate intensity 25-40% mortality	17,885	36.2
moderate intensity 40-60% mortality	12,798	25.9
high-moderately intensity60-70% mortality	2,203	4.5
high severity		
high intensity > 70 % mortality	10,718	21.7
extreme intensity > 70% mortality	4,134	8.4
Grand Total	49,439	100.0

Fire Severity vs. Weather

Records kept during the fire indicate that periods of rapid fire movement were associated with high winds and low humidity. Further analysis of the effects of weather will be evaluated later if the data becomes available.

Fire Severity by Vegetation Series

The white fir series had the highest frequency of burned acres (53percent) (Table 3-24). It was followed by the tanoak series (26 percent), Douglas-fir series (10 percent), red fir series (9 percent) and a host of other vegetation types to a lesser extent. These frequencies are somewhat reflective of the frequency of these series in the analysis area. When the series are analyzed independently, it is apparent that they differ in the frequencies of fire severities. For instance, the tanoak series had 64 percent of its burned acres in the 25-40 percent burn category, with only 15 percent in the high severity >70 percent burn category. This contrasts with the white series, where 26 percent of its burned acres were in the 25-40 percent burn category and 36 percent were in the high severity burn category. The red fir series shows even greater differences. It had only 10 percent of its burned acres in the 25-40 percent category, 43 percent in the 40-60 percent category and 44 percent in the high severity category. Red fir stands had significant infections of the parasite dwarf mistletoe (*Arceuthobium abietinum*) and cytospora (*Cytospora abietis*). This complex causes both crown loss and high levels of mortality, which contribute to the increased frequency of high severity fire effects.

Table 3-24. Fire Severity by Forested Vegetation Series within the Analysis Area

Series	tanoak		white fir		red fir		Douglas-fir		Total Acres	Total Percent
Burn Code	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent		
0	0	0	0	0	0	0	0	0	0	0
1	1,400	11	190	1	40	1	10	0	1,640	3
2	7,720	64	6,510	26	440	10	1,790	39	16,460	36
2a	940	8	7,480	30	1,910	43	1,020	23	11,350	25
3	240	2	1,640	7	60	2	180	4	2,120	5
4a	1,640	14	6,100	25	1,060	24	1,310	29	10,110	22
4b	130	1	2,720	11	890	20	210	5	3,950	9
Total	12,070	100	24,640	100	4,400	100	4,520	100	45,630	100

Fire Severity by Seral Stage

Vegetation seral stages were differentially affected by fire (Table 3-25). The highest frequency of affected acres for all severities was in the old growth seral stage (29 percent). This is unfortunate, given the importance of the old growth seral stage in providing habitat to late seral dependent species. In addition, 27 percent of the old growth seral stage was affected by high severity fire. The high severity burn category normally had over 80 percent of the trees killed, which reset the seral stage to shrub/forb. This results in a significant loss of late seral acres, one of the key features of the late seral reserve.

The highest frequency of high severity fire occurred in the early mature seral stages. Here, due to the high degree of mortality, 39 percent of the early mature seral stage was reset to the shrub/forb seral stage. The mid mature and late mature seral stages also suffered from high severity fire, with 29 percent and 26 percent of their extent being reset to the shrub/forb seral stage. These acres are very important to the old growth seral stage, since they are the source of in-growth.

Table 3-25. Fire Severity by Vegetation Seral Stage within the Analysis Area

Burn Code	1	2	2a	3	4a	4b	Total Percent
Seral Stage	Percent	Percent	Percent	Percent	Percent	Percent	
shrub/forb	14.8	7.1	9.6	7.3	11.4	6.3	8.9
pole	3.4	6.7	3.2	2.9	6.5	3.7	5.2
early mature	12.5	18.0	16.5	13.9	20.6	34.6	19.2
mid mature	22.5	21.4	18.5	20.1	18.1	20.2	19.8
late mature	12.3	17.9	20.8	18.6	16.0	11.4	17.5
old growth	34.7	29.0	31.5	37.2	27.5	23.7	29.4
Grand Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Fire Severity by Slope Class

Fire severity by slope class is described in Table 3-26. The highest frequency of burn for all severity categories was in the 35-65 percent slope category (43 percent), followed by the 20-35 percent slope class (27 percent) and the > 65 percent slope class (17 percent). In terms of fire severity class, the moderate severity burn had the highest frequency.

Table 3-26. Fire Severity by Slope Percent Class within the Analysis Area

	Slope Class Acres				Slope Class Percent				Totals	
Burn Code	**>20-35%**	**>35-65%**	**>65%**	**0-20%**	**>20-35%**	**>35-65%**	**>65%**	**0-20%**	**Total Acres**	**Total Percent**
0	0	0	0	0	0.0	0.0	0.0	0.0	0	0.0
1	352	921	284	144	2.7	4.4	3.5	2.1	1,701	3.4
2	3,765	7,789	4,217	2,115	28.5	37.0	51.2	30.4	17,885	36.2
2a	3,833	4,775	1,461	2,728	29.0	22.7	17.8	39.3	12,798	25.9
3	703	918	267	315	5.3	4.4	3.2	4.5	2,203	4.5
4a	3,022	4,764	1,799	1,132	22.9	22.6	21.9	16.3	10,718	21.7
4b	1,535	1,883	202	514	11.6	8.9	2.5	7.4	4,134	8.4
Total	13,210	21,051	8,230	6,949	100.0	100.0	100.0	100.0	49,439	100.0

Fire Severity by Slope Position

Fire severity classes by slope position are displayed in Table 3-27. The moderate severity burn category dominated all slope positions. However, significant differences (P = .0001) were found in fire severity by slope position. For instance, lower slope positions were characterized by moderate severity burn effects (77 percent) with a low frequency of high severity burn (19 percent). This is in contrast to the significantly (P = .001) higher frequency of high severity fire (39 percent) in the upper slope position. The middle slope position was intermediate in terms of burn severity between upper and lower slope positions.

Table 3-27. Fire Severity by Slope Position within the Analysis Area

Slope Position							Total Acres	Total Percent
Burn Code	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**		
0		0.0	0	0.0		0.0	0	0.0
1	613	3.8	701	3.6	387	2.8	1,701	3.4
2	6,986	43.2	6,471	32.9	4,428	32.6	17,885	36.2
2a	4,773	29.5	5,009	25.5	3,016	22.2	12,798	25.9
3	700	4.3	1,011	5.1	492	3.6	2,203	4.5
4a	2,504	15.5	4,732	24.1	3,483	25.6	10,718	21.7
4b	600	3.7	1,738	8.8	1,796	13.2	4,134	8.4
Total	16,177	100.0	19,661	100.0	13,603	100.0	49,439	100.0

Fire Severity vs. the Blowdown Area

In December 1995 and January 1996, a series of high intensity wind storms swept the analysis area shearing the tops and breaking the boles of numerous trees across approximately 30,000 acres. The result of this was a huge increase in fuel loading (up to 400 tons/acre) in parts of the analysis area. In preparation for possible fuel reduction projects, high concentrations of blowdown related fuels were mapped outside of wilderness only. In this analysis, the mapped blowdown areas were compared to areas outside of the mapped units for differences in fire severity (Table 3-28).

High severity fire (>70 percent mortality) appeared to occur with significantly higher (P=.0001) frequency in areas mapped as high severity blowdown. In contrast, moderate severity fire (25-40 percent mortality), appeared to occur with significantly higher (P=.001) frequency in areas outside the mapped blowdown.

Table 3-28. Burn Severity Comparison between Areas Mapped with High Severity Blowdown and Those without High Severity Blowdown

	No Mapped Blowdown		Mapped Blowdown		Total Acres	Total Percent
Burn Code	Acres	Percent	Acres	Percent		
< 25% mortality	1,701	3.8		0.0	1,701	3.4
25-40% mortality	17,291	39.1	594	11.5	17,885	36.2
40-60% mortality	10,886	24.6	1,912	37.0	12,798	25.9
60-70% mortality	1,893	4.3	311	6.0	2,203	4.5
> 70% mortality	9,151	20.7	1,567	30.4	10,718	21.7
> 70% ext.mortality	3,356	7.6	778	15.1	4,134	8.4
Total	44,278	100.0	5,162	100.0	49,439	100.0

Fire Severity vs. Fuel Treatment Units

Outside of wilderness, a variety of fuel reduction treatments were implemented following the 1995-96 windstorms. These treatments occurred within units identified as having high concentrations of blowdown-related fuels (Table 3-29). Treatment units had the majority of blowdown generated large coarse woody debris removed. In addition, most damaged trees with <20 percent live crown ratio were cut and removed. Background levels of snags and logs were maintained on all units. Removal of trees with <20 percent live crown ratio resulted in very small changes in overstory canopy closure because most of the blowdown sheared the tops off the trees rather than topple them. Stand treatments were designed to maintain at least 60 percent canopy closure where it existed after the blowdown event.

After harvesting, follow-up treatments to reduce fuels were at very stages of implementation prior to the fire. They included:

1. no fuels treatment
2. slash was piled
3. slash was piled and burned
4. slash was piled, burned and the unit was understory burned.

The following analysis attempts to measure the severity of fire on stands with these fuel treatments (Table 3-29).

Table 3-29. Burn Severity Comparison between Logged Areas with Various Fuel Treatments

Treatment	Burn Severity Class	Acres	Percent of Treatment	Percent of Total
logged	25-40%	3	2.2	0.2
no fuel	40-60%	36	27.5	2.4
treatment	60-70%	7	5.7	0.5
	> 70%	77	59.3	5.2
	> 70% extreme	7	5.4	0.5
Total		129	100	8.7
logged	< 25%	33	4.8	2.2
piled	25-40%	208	30.7	14.1
	40-60%	201	29.6	13.6
	60-70%	50	7.3	3.4
	> 70%	144	21.1	9.7
	> 70% extreme	44	6.4	3.0
Total		679	100	45.8
logged	25-40%	10	2.2	0.7
piled	40-60%	285	62.0	19.2
piles burned	60-70%	28	6.0	1.9
	> 70%	126	27.5	8.5
	> 70% extreme	11	2.3	0.7
Total		460	100	31.0
logged	25-40%	146	67.8	9.8
piles burned	40-60%	59	27.4	4.0
understory burn	60-70%	4	2.0	0.3
	> 70%	6	2.8	0.4
Total		215	100	14.5
Grand Total		1,483		100.0

The highest frequency of high severity fire occurred in stands with no follow up fuels treatment. Sixty-five percent of these stands suffered high severity fire effects in which >70 percent of the canopy was killed. The background level for high severity fire in upper 1/3 slope positions was 39 percent. This indicates that large coarse woody debris removal without fuels treatment likely increases the risk of high intensity fire. Unfortunately, the fire occurred before fuel treatments

could be completed. Fortunately, this lack of follow up treatment only occurred on 9 percent of the treatment area.
Piling the slash, which occurred in 46 percent of the treatments, resulted in a large reduction in high severity fire mortality compared to no treatment. In comparison, burning the piled slash failed to significantly reduce high severity mortality when compared to piling without burning. These treatments covered 31 percent of the treatment area. Both treatments were below the overall frequency (39percent) for high severity fire in upper 1/3 slope positions.

The most successful treatment in reducing high severity fire involved piling the slash, burning the piles, followed by understory burning. These treatments reduced high severity mortality to three percent of the acres treated. An example comparison of this treatment to an adjacent untreated area is contained in Figure 3-8. These two areas are located immediately adjacent to one another on either side of a side-slope road in an upper 1/3 slope position. The stand below the road was untreated, including no large coarse woody debris removal. It was subjected to high severity mortality with over 90 percent of the trees killed. The treated stand above the road had between 25 and 40 percent mortality.

Special Habitats and Rangelands

Special habitats in the analysis area fall into two categories: riparian vegetation and montane meadows. Cattle graze both of these vegetation types. The descriptions below in combination, with other issues such as water quality, fish and wildlife habitat, culturally significant plants and fire effects, will be used to determine if cattle will be turned out this spring.

Riparian Vegetation

Riparian vegetation falls into three categories: alder stringers, streamside riparian and wet meadows. The alder stringers account for 1,210 acres; streamside riparian includes 77 acres, while the montane meadows cover 508 acres. The alder stringers are dominated by Sitka alder, the streamside riparian by mixed forbs and the montane meadows by the sedge/common cinquefoil-corn lily type. The latter type is found on high elevation basins above 5000 feet, on north and south facing aspects in middle 1/3-slope positions. It is made up of high cover of sedges/grasses and forbs. Perennial native sedges and grasses dominate the grass layer. The forb layer contains a combination of species, some of which have been identified as disturbance indicators. These species include sheep sorrel (*Rumex acetosella*), yarrow (*Achillea millifolium*), corn lily (*Veratrum californicum*) and bull thistle (*Cirsium vulgare*).

Montane Meadows

Montane meadows fell into two categories: dry upland grass types and mesic/wet meadows. The dry upland grass type was found on high elevation sites above 5500 feet, on south-southwest aspects in upper 1/3-slope positions. It is represented by the Lemmon's stipa/bracken fern type. It was made up of high cover of grasses and forbs. The grass layer is primarily made up of native perennial species. The forb layer is dominated by bracken fern. The high cover of bracken fern tends to indicate repeated moderate-high intensity disturbance. It is also known to have an acidifying effect on soils and can impede successful regeneration (Johnson-Maynard 1998). This is born out by the high extent of bare ground in this type. Ecology plot samples identified bare ground averaging 28 percent. Further observations identified low organic matter in the soil surface layer, which tends to lead to exposed mineral soil. Because of this bare soil, some areas displayed surface erosion and rilling.

Figure 3-8. **Photographs of Fire Effects in Adjacent Treated vs. Untreated Areas:**

These photographs compare the fire effects in adjacent treated vs. untreated stands on a mountain sideslope in the upper 1/3 slope position on Lone Pine Ridge. The treated stand on the left had blowdown-related fuels removed and was broadcast burned. Tree mortality in the treated stand was low; less than 25 percent of the trees died. Tree mortality in the untreated stand, which contains a riparian corridor, was high; more than 90 percent of the trees died.

Fire Effects on Special Habitats

Observations within riparian areas and montane meadows indicate low/moderate fire effects. The principal concern in riparian areas is related to the amount of mortality in alder stringers. The alder layer tends to protect streams from cattle related impacts by limiting their access. If cattle graze these areas, it would slow recovery of the alder layer and could lead to reductions in water quality as well as fish and wildlife habitat degradation.

In terms of streamside riparian areas, the vegetation has been removed in some areas. This tends to expose the soil surface and could lead to soil compaction from cattle. This would likely slow revegetation and could lead to deposition of soil particles into streams.

Snags and Logs

The importance of large (>20 inches) snags and logs in late seral stands has been documented throughout the literature. In an effort to understand the relationship of snag and log densities to vegetation type and seral stage, over 1200 plots were sampled across the Forest. These plots were used to generate the background levels of snags and logs displayed in the Forest LRMP. The Megram Fire generated significant increases in snag densities. In some areas, these densities increased 100-fold. Log densities have not reached the same levels as snags, but it is likely they will within the next 10 years.

The desired range of densities for snags and logs by vegetation type and seral stage is displayed in Table 3-30. These levels are a refinement of the levels specified in the LRMP and reflect the desire to maintain higher levels of snags and logs in LSRs.

Table 3-30. Desired Ranges of Snags and Logs per Acre

Vegetation Series and Seral Stages	Snag Range (>20" diameter and 20' tall)	Log Range (>20" diameter and 20’ long)
Tanoak/Douglas-fir		
early mature	2-5	8-12
mid mature	3-6	4-8
late mature	1-3	1-3
old growth	3-8	8-12
White Fir		
early mature	1-4	3-7
mid mature	4-8	3-7
late mature	4-8	7-11
old growth	4-10	10-16

Larger diameter downed logs are preferable, as they are expected to last longer over time. All logs in decay class 3 through 5 should be retained, but hard logs (decay classes 1-2) also need to be left to provide recruitment. These desired ranges should be met over a landscape or project area (e.g. 40 to 100 acres). The number of snags and down logs will vary on any particular acre, depending on site-specific conditions and objectives. For instance, snag and log densities may be very low in fuel breaks.

It is desirable to have scattered individual snags and logs as well as aggregations. Aggregations perform important functions in both terrestrial and riparian habitats. The degree to which aggregations would remain untreated will vary by management objectives for the site.

Insects

Reference and Current Conditions

Insects of significance in these watersheds are typically bark beetles in the genus *Dendroctonus, Ips* and *Scolytus* and the wood borers, genus *Melanophila.* There was an epidemic outbreak of the Douglas-fir bark beetle (*D. pseudotsugae*) in the Tish Tang and Horse Linto watersheds in the mid-1960s. Many of the older plantations in this area resulted from harvest following that outbreak.

Following the wind event in the winter of 1995 -1996, there were individual and groups of trees in the white fir type that died after crown loss weakened the trees and fir engraver beetle (*Scolytus ventralis*) attacked. Aerial detection flights over these watersheds in1998 showed the largest patches of insect killed trees to be three to five acres in size and widely scattered.

Following the fire, with many thousands of acres of dead and weakened trees, insects will play a role similar to what occurred after the blowdown, except on a broader scale. Trees scorched or killed by fire are attractive to many forest insects, which may come from a radius of several miles (Furniss and Carolin 1977). Bark beetles that breed in fire killed or weakened trees can spread and kill nearby green trees (Furniss 1965). Trees that retained some live crown after the fire, but are stressed due to crown and cambium loss, are highly susceptible to insect attack and death over the next one to three years (Wagener 1961, Weatherspoon 1988). Beetles thus can kill trees within the fire area that might have otherwise survived (Miller and Keen 1960). Wood borers enter the dead and weakened trees causing loss of value for wood products and limit the time available for salvage (Kimmey and Furniss 1943). Borers can feed on infested trees a few months to as much as 4 years from the time eggs are laid, causing mortality over extended time periods (Furniss and Carolin 1977). Long after trees are killed by fire or insects, snags invite lightning and can increase the cost, difficulty and danger of controlling the resulting fire. Fire kills or stresses trees that breed insects and insects can help set the stage for another fire (Furniss and Carolin 1977). An example of when the combination of fire and insects help stage for another fire occurred on the Klamath National Forest. In July of 1999, a lightning storm ignited a fire within the Marble Mountains Wilderness within 20 miles of the Megram Fire area. The fire started in steep terrain in a large contiguous area of snags and down logs that resulted from a fire in 1987. Fire fighting resources were not able to suppress this fire due to the extreme danger from burning snags and rolling logs. The fire was monitored, and in August the Stein Fire reached over 800 acres and was eventually suppressed when conditions allowed (Jones, personal observation).

Plant Species of Concern

Reference Conditions

Species of concern include Forest sensitive plants, special interest species (SIS), California Native Plant Society (CNPS) rare plants, and survey and manage (S&M) species. For more detailed information, Appendix D (Table D-1) displays the vascular plant species of concern, and Table D-2 in Appendix D provides information regarding S&M species, including management recommendations. Most of the rare plant data for the analysis area were gathered through the Specimen Label Information Database (SLID) in the early 1980s. Other rare plant information came from review of documents listing rare plants associated with the Long Ridge Compartment (Theiss 1994), South Tish Tang Compartment (Theiss 1992) and Box Camp area (Theiss 1996) located within the Megram Fire area on the Hoopa Reservation. S&M information was derived from the Known Sites Database, Version 2.0 (KSDB). There are no threatened, endangered or proposed plant species, nor is suitable habitat present in the analysis area.

A majority of the species documented in the analysis area is associated with the Ironside Mountain batholith. Rare plant occurrences have not been documented on the galice formation to the west of the batholith. Rare plants are often allied to distinctive lithologies and landforms, serpentinite barrens being one of the most species rich in terms of rarity. Infertility and unique chemical properties are just a few characteristics associated with such rock types as serpentinite, limestone and granite (Kruckeberg 1992). Adaptive features that aid plants in coping with limited resources and habitat specialization partially explain the preponderance of rare and endemic plant species in these seemingly harsh environments.

The Ironside Mountain batholith is composed primarily of diorite. A key characteristic of diorite is the presence of moderate to coarse-grained, sodium feldspar with calcium and magnesium represented in subordinate amounts (M. Smith, personal communication). Perhaps the physical properties of the dioritic soils (well-drained) coupled with the limited amounts of calcium and magnesium, nutrients essential to plant growth, partially explain the presence of rare plant species in association with the batholith.

Species locations in the analysis area coincide with high elevation vegetation types and habitats: red fir-white fir, red fir-incense cedar, and white fir-incense cedar sub-series. Habitats for the species of concern include outcrops, rocky/gravelly settings (i.e. localized serpentinite areas), meadows/wetlands, and micro-habitats within mature coniferous forests.

There is little information available on reference conditions specific to any species of concern. The documented occurrences on the Forest have not been formally visited since the early 1980s, so even current conditions about species and sub-population health are lacking. Given the plant habitats of interest in the analysis area, only inferences can be made about reference conditions and probable changes in the quantity and quality of habitats that support these species.

Outcrops, Cliff faces, and Rocky Habitats

Cliff faces and outcrops support Heckner's lewisia *(Lewisia cotyledon* var. *heckneri*, SIS), pale yellow stonecrop (*Sedum laxum* ssp. *flavidum*, SIS), and Canyon Creek stonecrop (*Sedum paradisum*, Forest sensitive species). These habitats are considered stable in that natural or human-caused disturbances or physical processes have not significantly altered habitat conditions for the species over time.

A concentration of rare plants occurs in the analysis area at high elevations in association with landforms derived from past glacial activity. Tracy's lupine (*Lupinus tracyi*, CNPS rare plant) is the most prominent species along the high elevation ridges, occurring in glacial moraine and outwash areas in association with Tracy's collomia (*Collomia tracyi*, CNPS rare plant). The Trinity Summit area is the type locality for Tracy's lupine, which means the taxon was first discovered (circa 1940) and described from this locale. Sub-populations are scattered along the ridge system to the north of the analysis area into Siskiyou County. Geologically speaking, glacial areas are relatively new terrane. Species in the genus *Lupinus* are considered colonizers, becoming established on young, often rocky/gravelly soils. Processes occurring in these glacially derived settings could have changed habitat conditions from reference, but given the early successional nature of lupines, localized change in habitat conditions would not significantly affect the metapopulation over time.

Meadow and Wetland Habitats

High elevation meadow and wetland habitats in the Trinity Summit area support Klamath gentian (*Gentiana plurisetosa*, CNPS rare) and coast checkerbloom (*Sidalcea oregana* ssp. *eximia*, SIS). Bensoniella (*Bensoniella oregana*, Forest sensitive) occurs in a riparian area adjacent to Grove's Prairie in association with nodding semaphore grass (*Pleuropogon refractus*, CNPS rare), which grows in moist sites of the prairies. Arctic starflower (*Trientalis artica*, CNPS rare), Vollmer's lily (*Lilium pardilinum* ssp. *vollmeri*, CNPS rare), and California globe mallow (*Iliamna latibracteata*, CNPS rare) are other wetland species within the analysis area.

Ongoing processes operating within meadow and wetland habitats can change conditions temporally and spatially for plant species. Meadows respond to precipitation patterns, shrinking in size during drought periods and enlarging during periods of heavy precipitation. Furthermore, it has been shown that species composition and distribution in meadows respond spatially and temporally to snowpack dynamics (Murray 1991). Geologic processes can affect meadows on a local scale in a single event (i.e. mass wasting) and over time and space as hydrologic conditions adjust to geologic instabilities. During fire-free intervals, species composition in meadows can shift from herbaceous to woody species, particularly on the meadow margins. Burrowing mammals overturn the soil, creating disturbance on a small scale resulting in micro-habitats suitable for species tolerant of this disturbance, (i.e. large-seeded exotic annual grasses as compared to small-seeded native perennials) (Stromberg and Griffin 1996). Given the forage value of meadows to wildlife, herbivory (via plant consumption, browsing, grazing or seed predation) by various faunal species is another process that has affected species composition and abundance (i.e. bent grass, *Agrostis pallens*, a native perennial occurring in the meadows, responds to herbivory by sprouting).

Ongoing processes aside, reference conditions for most meadow and wetland habitats in the analysis area have been affected by livestock grazing. Grazing effects include shifts in composition, distribution and abundance of species, loss of species diversity, and destabilization of plant communities (i.e. noxious and non-native species introductions) (Painter 1995). Confounding the effects of grazing are variables related to climate. For example, drought conditions can influence trends already set in motion by grazing activity.

A history of intense grazing would reduce habitat quality for rare plants and could result in complete loss of occurrences or sub-populations across the meadow complexes. In Menke's rangeland assessment for the Sierra Nevada, he identified an array of species indicative of late seral conditions and considered susceptible to grazing and trampling (Menke 1996). Of the species listed, the following are present in the wet meadows of the analysis area: alpine timothy (*Phleum alpinum*) occurs in Patterson, Lower Ferguson and McKay Meadows; fringed gentian (*Gentianopsis simplex*), Klamath gentian (Gentiana plurisetosa), a CNPS rare plant, and American broomline (*Veronica americana*) occur in Lower Ferguson. Although late seral, grazing-intolerant indicators persist in a few of the meadows within the analysis area, habitat quality has been affected by the introduction of non-native species. Presumably, the meadows in the analysis area that now support species indicative of overgrazed conditions (specifically, corn lily [*Veratrum californicum*], California oat grass [*Danthonia californica*], yarrow [*Achillea millifolium*], sheep sorrel [*Rumex acetosella*, an introduced species], and bull thistle [*Cirsium vulgare*, an introduced species] [Menke 1996]) originally supported an array of species native to the region and less weighted toward disturbance-tolerant species.

In addition to grazing pressures, successional trends have affected the meadows. Conifer and hardwood encroachment is evident (ecology plot card data 1998). Sitka alder (*Alnus viridis* ssp. *sinuata*) and incense cedar (*Calocedrus decurrens*) are the species most often observed occupying areas once dominated by herbaceous meadow plants. This succession could be due to a shift in precipitation patterns and the subsequent effects on the hydrologic conditions of meadows or perhaps a tradition of fire exclusion that allowed for woody species encroachment into meadows. Reference conditions would have included meadow settings and periods whereby succession to woody species occurred; however, persistence of woody species and their extent of cover would have been delimited by periodic fire.

Mature Conifer Forest Habitats

Various species of concern are associated with mature forested habitats, particularly those in late and old growth seral stage condition. Association with late seral forests is in part due to the structural diversity of stands that are characterized by canopy openings, vertical diversity allowing light to reach the forest floor, a species mix in the understory, a mosaic burn pattern, presence of large coarse woody debris in various age classes, and simply the age of the stand, which allows for development of fungal relationships essential to the health of certain species.

Vascular Plants

Fascicled lady's slipper (*Cypripedium fasciculatum*, Forest sensitive, S&M), mountain lady's slipper (*Cypripedium montanum*, Forest sensitive, S&M), and a bryophyte, *Ptilidium californicum* are associated with late seral stage forests. The discussion below will focus on the orchid species as indicators of mature conifer forest habitats, with limited assessment of other S&M species.

Fascicled lady's slipper and mountain lady's slipper occur primarily in forests with a 60 to 80 percent canopy cover dominated by conifers, particularly Douglas-fir (*Pseudotsuga menziesii*) and white fir (*Abies concolor*). Sub-populations of these species on the Forest are less than 10 in number and of small size, particularly with respect to mountain lady's slipper. There are no documented occurrences of either species within the analysis area. Two populations of fascicled lady's slipper (1998 findings) occur on the Orleans Ranger District to the north (in the Red Cap and Boise Creek watersheds), and a considerable distance south on the Mad River Ranger District. There is one historic population of mountain lady's slipper just southwest of the analysis area border, with historic populations north in the Slate Creek watershed on the Orleans Ranger District and south in the vicinity of the Horse Mountain Botanical Area. Revisits of the historic mountain lady's slipper populations in 1998 resulted in negative findings at 9 of the 10 known sites (McRae 1998). For orchid species, negative findings from one monitoring season do not always indicate extirpation of sub-populations; however, in all instances the sites surveyed had been disturbed (i.e. fuel break construction, thinning).

Like most orchid species, lady-slipper orchids are sensitive to ground disturbance due to their dependence on fungi, which occur in association with organic material on the forest floor. For establishment and survival, orchids require the presence of a fungal symbiont; therefore, the presence of suitable micro-habitat conditions for the fungus is a prerequisite to orchid establishment. Lady's slipper species may also depend on mycorrhizal associations for months or years before above ground growth begins (Harper and White 1974). In essence, the association of lady's slipper orchids to late seral stage forests is due to its requirement for relatively stable micro-habitat conditions that these older forests provide. Although these orchids can tolerate small-scale disturbance (i.e. canopy gap creation), they fall into a category of plants considered poor survivors of disturbance and poor recruiters after disturbance (Halpern 1989).

Lady's slipper orchids reproduce through both asexual and sexual means. Sexual reproduction requires cross-fertilization in most cases. Pollinators observed include species of bees, wasps, hornets, and flies (Knecht 1996, Luer 1975). Pollinator specificity has not yet been identified. If pollinator specificity is the case, pollinator behavior could be affected by habitat fragmentation. Plants in smaller, isolated populations can be disadvantaged by reduced pollinator activity. Reduced activity can result in reduced seed set (Menges1990). In the case of lady's slipper species, which rely on cross-pollination for sexual reproduction, reduced pollinator activity could have a significant effect on recruitment. Other variables related to the reproduction and ecology of lady's slipper orchids include a low reproductive success rate (Harrod and Knecht 1994) and poor seed dispersal capabilities (Harrod and Everett 1993). In summary, lady's slipper orchids possess various life history traits that limit their distribution, establishment and survival.

Reference conditions could be characterized as a forest mosaic existing in various stages of succession across the landscape, shifting spatially and temporally. Within stands, local perturbations (i.e. individual tree mortality) created structural and age diversity within stands. Historic fire patterns in the Klamath Region have been characterized as relatively frequent and of low to moderate severity; however, burn severity varied spatially, resulting in a diverse landscape pattern (Taylor and Skinner 1998).

Historically, this mosaic pattern of disturbance on a landscape and stand-level scale allowed for habitat persistence over time and space, whereby the metapopulation was sustained. Furthermore, across the landscape, connectivity of mature stands provided dispersal options for the orchids as conditions changed. With this scenario in mind, it is likely that populations of lady's slipper orchids were more widely distributed and larger than populations under current conditions.

Management has affected habitat quality for the orchids by reducing cover, size and distribution of late seral and old growth stands. Furthermore, these stands have been fragmented, creating edge effects considered a threat to the lady's slipper species (Seevers and Lang 1998). Fire suppression activities have allowed for an unnatural accumulation of fuels, leading to fires of greater severity and extent than can be tolerated by lady's slipper species (Harrod et al. 1997).

Non-Vascular and Fungi Species

There are no documented occurrences of any lichen, bryophyte or fungus species of concern within the analysis area (KSDB, version 2.0). Documentations of *Ptilidium californicum, Ulota megalospora, Polyzellus multiplex* and *Otidea onotica* are recorded in fifth field watersheds to the south and west of the analysis area (KSDB, Harpel personal communication). Potential habitat exists in the analysis area for these species as well as a lichen species, *Lobaria hallii*. *Lobaria hallii* has been found on the Forest in association with white and black oaks in early to mid seral stage stands. The association of *Lobaria hallii* with late seral stage forests is currently under question, as is concern for its viability (Lesher 1999); therefore, this species will not be discussed further.

Ptilidium californicum, a bryophyte, occurs at the base of mature Douglas-fir (*Pseudotsuga menziesii*) and white fir (*Abies concolor*) trees. Specifics related to the ecology of *Ptilidium* are not known; however, most bryophytes require relatively stable conditions in regard to substrate and micro-climate. Maintenance of humidity levels and moderate temperatures appear to be important habitat conditions. Fungi such as *Polyzellus multiplex* are associated with the roots of *Abies* sp. Maintenance of the host tree and the soil and humus layer are important habitat conditions for this species. *Otidea onotica* occurs on accumulated duff and humus in conifer forests, thus the integrity of the organic layer of the forest floor is a critical habitat variable for this species (Castellano and O'Dell 1997).

Relative to bryophyte and fungal species, reference conditions for species of concern are akin to those for the lady's slipper orchid. Conditions in common include well-distributed late seral stage forests, relatively stable micro-site conditions, partial shade, and maintenance of the soil, humus, and duff layer. Mosaic patterns of natural disturbance occurring could have extirpated occurrences locally but given the spatial and temporal regime of fires, extirpation levels of significance to population health was not likely.

Similar to the lady's slipper orchids, management has affected habitat quality for the bryophytes and fungi of concern by reducing cover, size and distribution of late seral and old growth stands. At a micro-habitat scale, these species of concern are directly affected by disturbance to the soil, humus and duff layer, removal or loss of substrate/host, and reduced canopy cover. Depending on severity, fires have been identified as a threat to these species, which have already been affected by the reduction of late seral habitats (Castellano and O'Dell 1997, Harpel 1998). Fires that consume the humus and duff layer, large coarse woody debris, or eliminate a considerable amount of the canopy are of particular concern to these species.

Current Conditions

As discussed above, ongoing processes have affected habitat conditions for the species of concern. Specifically, climatic shifts, periods of drought (and contrarily, high precipitation), episodic mass wasting, fire, and herbivory have influenced the composition, abundance, and distribution of plant habitats. These processes operated at both a landscape and local scale, across time and space. Presumably, plant species responded accordingly and metapopulations persisted.

Management (public and private) within and around habitats has interrupted the dynamics of disturbance or change in habitat conditions, and subsequent plant response. The species of interest are differentially affected by management practices. For example, species occupying outcrops or cliffs or barren-type habitats in the analysis area have been little affected by management. Species occupying wetland habitats and mature conifer forests have been affected by logging, road and trail construction, plant collection, over-grazing, fire exclusion, and subsequent habitat fragmentation.

With specific reference to the Megram Fire and its effect on the quality and quantity of plant habitat, it is fair to assume that stands which burned intensely (complete loss of crown and duff layer) were so significantly altered than any occurrences of plant species of concern no longer exist. Furthermore, suitable habitat has been lost in the short-term. Stands that burned at low to moderate intensities could still support plant species of interest and their habitats.

Rocky habitats and most of the meadows were not directly or significantly affected by the Megram Fire. Many of the documented sensitive, SIS and CNPS rare plants were associated with these habitats, so the fire's direct effects were minimal to these species groups. Habitats associated with mature conifer forests were affected as evidenced by the shift in age class structure from mid, late and old growth seral stages to shrub/forb and pole (Table 3-31). Although the presence of individual or pockets of older trees can provide suitable habitat in early mature stands, these stands are generally considered unsuitable. Only the shrub/forb and pole seral stages were addressed in the table below since they are clearly unsuitable.

Table 3-31. Changes in Seral Stage due to the Megram Fire

Early Seral Stages by Vegetation Type	Example of Species Affected	Pre-Fire Acres	Post-Fire Acres	Difference	% mid, late, old-growth	
Shrub/Forb and Pole Seral Stage (Red fir, White Fir, and Douglas-fir series)	*Cypripedium montanum, Ptilidium californicum, Polyzellus multiplex*	6,165	17,121	10,956	Pre-Fire	Post-Fire
Red fir		301	2,099	1,798	70	30
White fir		3,270	10,975	7,705	69	49

Douglas-fir	2,594	4,047	1,453	44	40

Across the conifer series, there was a shift in age class structure from stands in the mid, late and old growth condition to those in the pole and shrub/forb seral stages. Perhaps the most significant change was in the white fir series. Prior to the fire, there were 3,270 acres in the shrub/forb and pole seral stages; after the fire the number of acres increased to 10,975, reducing the number of acres in the mid, late and old growth seral stage by roughly 40 percent. Mature white fir and red fir stands provide suitable habitat for *Ptilidium californicum* that grows on the base of white fir trees and *Polyzellus multiplex* which is associated with the roots of *Abies* sp. As a result of the fire, distribution and extent of habitat for these species as well as the lady's slipper orchids has changed.

Noxious Weeds

Reference Conditions

One can assume that, in it's reference condition, the analysis area was void of noxious weeds. ("Noxious weeds" in the context of this discussion refers to those species that are not native to the ecosystem and particularly aggressive). Environments most susceptible to weed introductions include grasslands and meadows. In their reference condition, grasslands and meadows were likely dominated by perennial grasses in association with forbs. With perhaps a bias toward forage plants, Davy (1902) generated a partial species list for northwestern California meadows that substantiates the preponderance of native perennial grasses. The list covering the Trinity Mountains and inner Coast Range did not indicate the presence of any weed species at that time, but consisted of perennial grasses currently present in meadow complexes of the analysis area: needlegrass (*Achnatherum lemmonii*), wild blue rye (*Elymus glaucus*) and California oatgrass (*Danthonia californica*).

Noxious weeds began arriving in the west in the early half of the 19th century by settlers from eastern North America and Europe. It is presumed that introductions occurred before this time, dispersed by Native American activities. Weed introductions corresponded most often with pulses of western migration. Specifics of introduction periods do exist; for example, yellow starthistle (*Centaurea solstitialis*), which is native to the Mediterranean and southern Europe, was introduced into southeastern Washington in the early 1900s as a contaminant of alfalfa seed and is reported throughout most of the west. Cheatgrass (*Bromus tectorum*), a native to the Mediterranean, was introduced into the U.S. with packing material in the late 1800s and is currently reported throughout the U.S. (Westbrooks 1998); scotch broom (*Cystisus scoparius*), native to southern Europe, was introduced in the San Francisco Bay area around 1860 where it was sold as an ornamental (McClintock 1985).

Ecologically speaking, noxious weeds displace native plants and plant communities, reduce overall species diversity, alter successional patterns, change physical characteristics of a given ecosystem, and alter ecosystem processes (Vitousek 1986). Relative to physical characteristics, noxious weed establishment changes the structure of the vegetation both above and below the ground. The former may include interstitial spaces between plants that allow for raindrop impact and subsequent erosion. Regarding below-ground structure, a tap root architecture (such is evident for yellow starthistle) is less effective in anchoring the soil than the fibrous root systems of perennial grasses (Huenneke 1995). Disturbance cycles are affected by noxious weeds. Cheatgrass, one of the most widely distributed noxious weeds, is highly flammable, thereby having the potential to alter frequency and severity of fire (Westbrooks 1998).

Noxious weeds maintain myriad adaptive mechanisms for dispersal, persistence and exploitation of newly disturbed ground. For example, yellow starthistle can be wind dispersed and with sharp spines around the base of the flower, it can readily attach to livestock, wildlife species, machinery tires, and clothing. Seed production can be as high as 29,000 seeds per square meter, with 95 percent seed viability and soil banking longevity for 10 years or more. After germinating, yellow starthistle can extend its roots three feet or deeper into the soil profile, thereby fully exploiting water resources in the soil throughout the summer and thus outcompeting other species (Lanini 1996).

Most of the noxious weeds of concern in the analysis area are shade intolerant; therefore, of the vegetation types and habitats, open settings such as grasslands and meadows are most vulnerable to introductions. Land cleared for any reason that disturbs the substrate and removes overstory cover, becomes a suitable environment for establishment and spread of noxious weeds. In forested systems, depending on the severity, fire can create an environment suitable for noxious weed establishment. Suppression and recovery activities that disturb the ground surface promote weed establishment. Furthermore, equipment, personnel and materials (i.e. mulch) brought in to implement these activities can be a vector for noxious weed importation.

Current Conditions

The composition, abundance and distribution of noxious weeds in the analysis area are poorly known. Observations by district specialists indicate the presence of scotch broom, black locust (planted intentionally for erosion control), and yellow starthistle. Information from a report generated for the Hoopa Tribe covering lands within the vicinity of the Megram Fire indicates the presence of ripgut brome (*Bromus diandrus*), cheatgrass (*Bromus tectorum*), bull thistle (*Cirsium vulgare*), and Himalaya berry (*Rubus discolor*). These species are likely associated with cleared sites, roadsides and overgrazed areas. Of the species listed, yellow starthistle and scotch broom are of greatest concern in grasslands and other open settings. Himalaya berry can be of concern in riparian areas.

Given the ability of these species to readily disperse into disturbed areas (even from considerable distance), disturbance caused by the wildfire and wildfire suppression activities could have introduced noxious weeds or exacerbated their spread in the fire area. Sites cleared by heavy equipment are particularly suitable for noxious weed establishment. In forested areas, the effects of weeds are temporal. Depending on the density, the weeds could set back re-establishment of native plants in the short-term; however, over time, as the canopy develops and closes, shade intolerant weeds will die out. Grasslands or meadows that burned are most vulnerable to noxious weed introductions and spread. Vulnerability increases with ongoing livestock grazing, which disturb the soil, creating a suitable habitat for weeds to spread.

Research Natural Area

Reference Conditions

The North Trinity Mountain Research Natural Area (RNA) was formally established in 1994. It encompasses 423 acres, all of which are within the Trinity Alps Wilderness.
RNAs are established to provide a spectrum of representative target vegetation types considered of scientific interest. The target element for the North Trinity Mountain RNA is white fir (*Abies concolor*); however, the RNA supports red fir (*Abies magnifica*) stands and meadow habitats that are also of scientific interest. Integrations of Shasta red fir (*Abies magnifica* var. *shastensis*) and noble fir (*Abies procera*) also occur in the RNA.

With regard to reference conditions, the North Trinity Mountain RNA is situated along a continuous high elevation range. This continuity of habitat allowed for montane species to shift spatially with changes in climate. Historic disturbance agents affecting these stands include fire and mass wasting events. The mean fire interval for white fir on the Orleans Ranger District is estimated at 36 years (Stuart 1997), with tree mortality associated with individuals or clumps of trees where burn severity was localized. Species in the red fir group are considered fire intolerant, having evolved in settings characterized by high snowfall and cool summer temperatures (Barbour 1998). Fires that do burn in these stands are typically patchy and of low severity, due to the natural terrain breaks. Stand-replacing fires are considered rare in these environments. Disturbance operates at a relatively small scale in the form of individual tree or small group mortality, whereby canopy gaps are created. Red fir is considered a gap species.

Reference conditions for the high elevation meadows are discussed in the “Plants Species of Concern” section under “Meadow and Wetland Habitats.” Reference conditions pertain to a meadow dynamics influenced by such variables as precipitation changes and herbivory. These dynamics affect composition, size, and distribution of meadows, both temporally and spatially.

Management’s effects on reference conditions include fire suppression, which may increase the severity of fires in a system historically more prone to low or moderately severity fires. Furthermore, fire suppression has resulted in denser stands than if fire had been allowed to burn at historic intervals. In addition, the Trinity Summit range allotment overlaps the RNA. Livestock grazing effects are discussed under “Meadow and Wetland Habitats.

Current Conditions

In regard to the Megram Fire and its effects within the boundary of the RNA, of the 306 acres within the white fir series, roughly 12 percent were subjected to high severity fires. Within the red fir series, 50% of the 52 acres were subjected to high severity fires. The remaining acres were within the low to moderate fire severity. A majority of the remaining forested areas were subjected to low to moderate severity fire. All of the four acres of meadow habitat within the RNA burned at a low to moderate severity.

High severity burn conditions are defined as a loss of greater than 70 percent canopy cover and loss of the duff layer. With particular regard to species within the red fir group, most of these

stand ins the RNA were consumed by high severity fires. In adjacent areas, there could also be continued loss of trees over the next three to five years due to insect damage. Re-establishment will in part depend on availability of a see source as well as adequate moisture and shade for germination and seedling development. Furthermore, although cone periodicity is relatively frequent, their yields are commonly low. These low yields are due to a combination of factors including lack of pollinator activity, adverse weather conditions and insect predation. (Young and Young 1992). Seeds of red fir also do not remain viable for longer than one year.
Low to moderate burn effects on meadows may not have unduly altered meadow conditions in the RNA from conditions prior to the fire. From this point, effects to the meadows may have more to do with any added disturbance from livestock grazing. For example, in moderately burned areas of meadows indicating late seral conditions, a shift in composition can occur toward more early successional species than existed before the fire. Livestock grazing in portions of the meadow where vegetation is young and sparse, and where bare ground exists, would exacerbate conditions set in place by the fire, such as a greater shift toward early successional species, including noxious weeds and non-native species.

Fire Occurrence

Reference Conditions

Wildfires have been a major component of the analysis area, as evidenced by the typically dry summer environment, frequent lightning activity and existing vegetation types and seral stage distribution. The predominantly steep topography also adds to the scenario to produce large fires that would be difficult to suppress. Barrett (1935) in his summary of early California wildfires from the days of the early explorers to the creation of the forest reserves states, “Great conflagrations occurred in California during the early days. Records from both the northern and southern part of the state prove that these fires often burned from four to six months and frequently swept over more than 100,000 acres of forest and major watersheds before being extinguished by rain.” A long-term drought in California in the mid to late 1800s (Fritts and Gordon 1980) appears to coincide with these frequent large fires during this period.

Barrett’s (1935) summary has several references related to this analysis area. The Denver Daily Rocky Mountain News (August 23, 1873) reported “A terrific fire has been raging on Trinity Mountain, 25 miles north of Shasta, for a week past and destroying a great amount of timber…There is dense smoke all over the country, making the atmosphere oppressive and hot”. Another reference from the San Francisco Chronicle (August 10, 1887) mentions a fire on Trinity Mountain that had been “raging so fiercely throughout the country for the last month and has destroyed so much timber and property.” R.T. Fischer’s report of September 1901 on the proposed Trinity Forest Reserve mentions fire conditions in the South Fork Mountain area (approximately 15 miles south of the HLMTT area). “The entire tract has been much burned. In the dense Fir Type along South Fork Mountain there are a score or more of fire glades, 50 to 100 acres in extent. In the opener Pine fire has seldom cleared the ground, but has scarred or burned down many trees, killed the reproduction, and brought in brush. In the scrub, fires had burned large areas. Six fires were seen during this reconnaissance, three of which had been set to clear trails, and the rest left by campers”. Interestingly enough, except for the long-term drought weather pattern, this scenario of large, lengthy, intense wildfires was very similar to what occurred during the Megram Fire (which started on August 26, 1999).

As was found for areas north and south of this study area (Keter 1993 and Keter 1995), Native American burning was a widespread component of this landscape due to the long-term existence of Native American tribes in this area and traditional uses of different materials that can be enhanced with fire. Considering the importance of tanoak acorns to many aboriginal people, these hardwood stands were most certainly burned to maintain this important food source. The creeks were also an important means of subsistence for the tribes inhabiting this area. A subsistence lifestyle by most of the people in this portion of the watershed has influenced the development of the landscape. The grasslands as well as the river in this area were also used by aboriginals to gather food.

Ranching became an important land use activity prior to 1850, when the grasslands throughout Humboldt County were discovered to be prime for grazing cattle. Livestock grazing also promoted burning of large areas to provide forage for mobile herds of animals. Although not the only factor, periodic burning by both aboriginal people and Euro-American ranchers maintained the diversity and size of these grasslands on the landscape. Since more and more of these fires were getting out of hand, the first California State Fire Law was enacted in 1872 to prevent the destruction of forests by fire on public lands. Fines not exceeding one thousand dollars or imprisonment not exceeding one year or both were set for fires caused by arson or carelessness which affected "any wooded country or forest belonging to this State, or the United States, within this State, or to any place from which fire shall be communicated to any such wooded country or forest" Barrett (1935). The creation of National Forests and Forest Reserves increased aggressive fire prevention efforts to eliminate wildfires caused by settlers, sheepmen, miners, and Native Americans. Barrett (1935) went on to say "No such conflagrations as these [the large 100,000 acre fires] have destroyed the timber wealth of the state since fire prevention measures have been put into effect by the Forest Service."

Adams and Sawyer (1980) found intervals between fires in Douglas-fir dominated mixed evergreen forests to be 16.2 years for the Lower Trinity Ranger District and 17.2 years for the adjacent Orleans Ranger District. They concluded that the all-aged nature of these stands, infrequent scarring of trees, and frequency of fires strongly suggests that ground fires, as opposed to crown fires, were the common mode of burning. The fire report form for Cedar Creek #1 Fire (1932), which burned 170 acres of Douglas-fir, showed 70 of these acres were in young growth of 21 to 40 years of age (which probably resulted from an earlier fire). A white fir fire history study, using plots within the Orleans Ranger District, showed mean fire-free intervals to be 36.7 years, with a range of 20.1 to 52.2 years (Stuart 1997). In Douglas-fir forests, frequencies averaging 20 years have been found in the eastern Siskiyou Mountains (Atzet et al. 1988), and Agee (1991) has documented a similar fire return interval in the eastern Siskiyou Mountains between 1740 and 1860, before significant European settlement. In the Salmon River watershed on the Klamath National Forest, Wills (1991) found presettlement mean fire return intervals of 10 to 15 years for Douglas-fir/hardwood forests. Within a Douglas-fir dominated landscape in a late-successional forest reserve in the Klamath Mountains, Taylor and Skinner (1998) found median fire return intervals of 14.5 years for the presettlement period (1626 to1849), 12.5 for the settlement period (1850-1904), and 21.5 for the suppression period (1905 to 1992). These studies, combined with the relatively low recorded burned acreages for this watershed before the Megram Fire (Table 3-

32) indicate that at least one to several fire intervals have been eliminated due to very effective suppression and prevention efforts.

Current Conditions

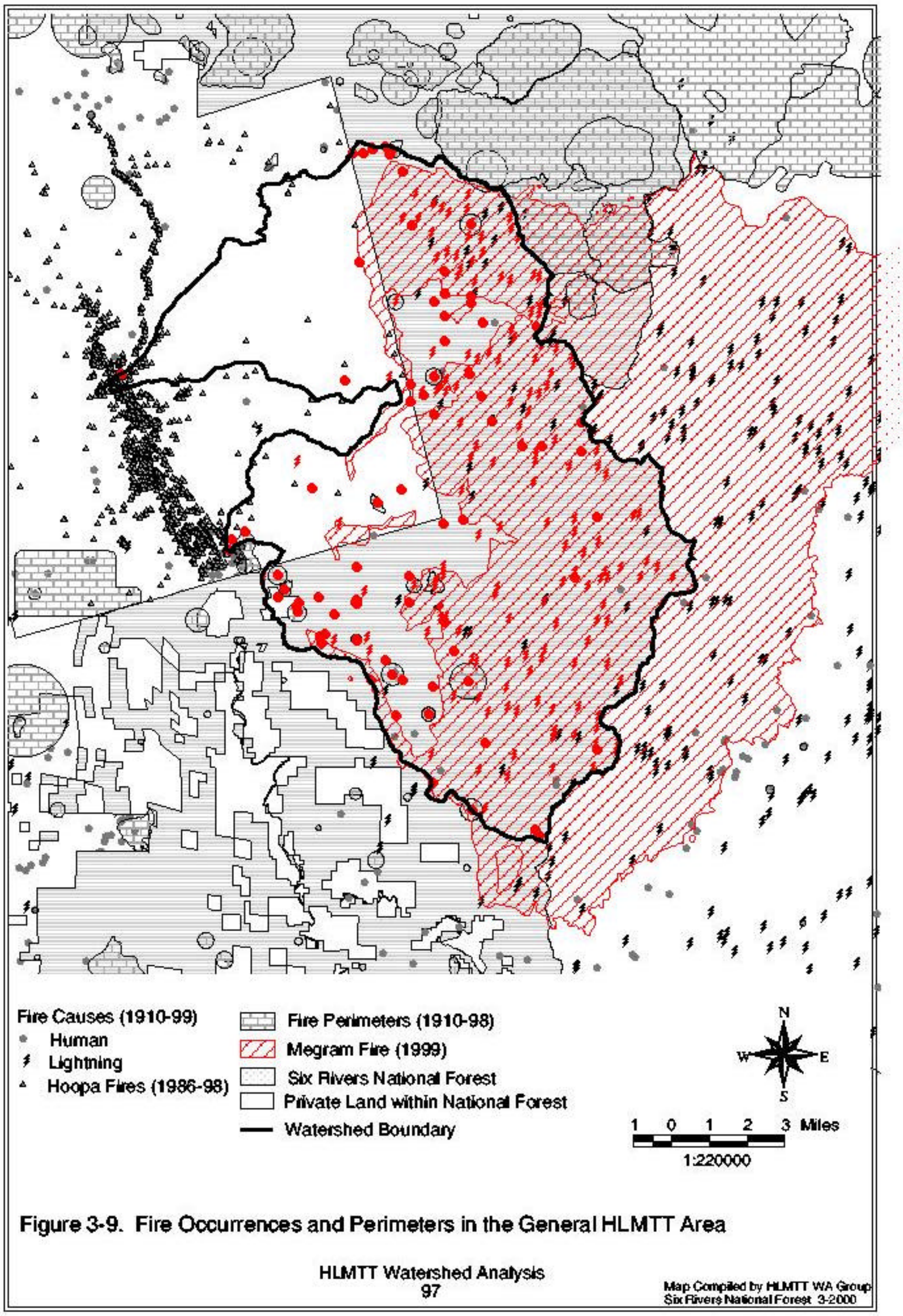
Available Six Rivers National Forest fire report forms for the analysis area go back to 1930. Summary fire data were also available for the Six Rivers portion of the Trinity NF for the years 1911 to 1924. Data locations only were available for the Hoopa Indian Reservation for the years 1986 to 1998. Even though fire causes were not available, it can be assumed that the vast majority (approximately 95 to 99 percent) of the fire causes were human. A total of approximately 284 fires (49,467 acres) occurred within the Six Rivers NF portion of the watersheds between 1911 and 1999 (excluding 1925 to1929, when no data were available). An additional 70 fires occurred on the Hoopa Reservation portion of the watersheds from 1986 to 1998; the highest occurrence year for the Hoopa portion was 1995 with 11 wildfires. Because fire cause data was not specifically included with the Hoopa database, the following summary data do not reflect the Hoopa Indian Reservation. Table 3-32 provides a breakdown of numbers and acres of fires by either decade or designated years and cause for the SRNF portion of the watersheds.

Table 3-32. Number and Acres of Fires on SRNF Lands in the HLMTT Area

Year	Human Number	%	Lightning Number	%	Total Number	Year	Human Acres	%	Lightning Acres	%	Total Acres
1911-19	11	92	1	8	12	1911-19	543	100	0	0	543
1920-24	13	87	2	13	15	1920-29	291	100	1	0	292
1930-39	9	26	26	74	35	1930-39	321	73	118	27	439
1940-49	1	3	31	97	32	1940-49	0	0	85	100	85
1950-59	3	12	23	88	26	1950-59	241	66	123	34	364
1960-69	6	27	16	73	22	1960-69	16	42	22	58	38
1970-79	13	33	27	68	40	1970-79	3	21	11	79	14
1980-89	27	73	10	27	37	1980-89	260	99	3	1	262
1990-99	21	32	44	68	65	1990-99	5	0	49462	100	49467
Total	104	37	180	63	284	Total	1679	3	49825	97	51504

Before the Megram Fire (which burned 49,439 acres within the HLMTT watersheds), the vast majority of the recorded fires on the Six Rivers portion were small in size, with only 7 recorded fires greater than 100 acres. The largest was a 458-acre fire of unknown cause that occurred in 1915; the others were all less than 175 acres. The last large fire before the Megram Fire was in 1987, of unknown cause, that grew to 123 acres. Figure 3-9 shows that four out of these seven fires were along the southern portion of the watershed near Waterman Ridge. Without the Megram burned acreage, and just focusing on the Six Rivers National Forest portion of the watersheds, only approximately 3 percent of the HLMTT area has been burned in the 84 years of record. With the Megram Fire included, this area burned bumps up to approximately 76 percent.

Figure 3-9. **Fire Locations within and Adjacent to SRNF Lands in the HLMTT Area:**



This area shows one of the highest lightning occurrences on the entire Forest; the records showing several lightning “busts”, with up to 12 recorded fire starts within a 24-hour period. Multiple lightning fire starts originated anywhere from May to October, and sometimes were clustered along specific ridges. Overall, the lightning fire starts were evenly distributed throughout the watershed. Focusing on the most recent period (1986 to 1999), the human-cause breakdown was: equipment use (2), smoking (1), campfire (10), debris burning (2), incendiary (16), and unspecified miscellaneous (10) (Figure 3-10). The majority of human-caused fires occurred in August and September, which are high use months for both recreation and hunting.

A larger landscape perspective must be taken to completely assess the current fire occurrence potential for this analysis area. Figure 3-10 shows the more extensive human-caused wildfire concern that exists directly outside the HLMTT boundary. Clusters of human causes are centered along Highways 96 and 299. Adjacent communities (i.e. Trinity Village, Willow Creek, Salyer, Hoopa) and interior or adjacent recreational sites (i.e. Trinity Alps Wilderness, campgrounds at Grove’s Prairie, Happy Camp, Tish Tang, Box Camp, and trailheads at Grizzly Camp, Tish Tang, and Red Cap) also present the potential for future human fire starts. Figure 3-9 also shows adjacent large wildfire perimeters in the Red Cap watershed, including the Red Cap #2 Fire of 1938, which burned approximately 16,775 acres.

The entire Trinity Alps Wilderness is also a part of this larger area perspective, as was shown by the events of the Megram Fire. Large fires (greater than 100 acres) have been documented since the turn of the century in what is now the Trinity Alps Wilderness. Large fires have burned in virtually all areas of the wilderness and have been started by both lightning and humans. From 1900 to 1935, large fires were frequent, with no more than a six year fire-free interval – the largest documented fire being 2,000 acres. Between 1935 and 1975, the wilderness had one large fire every 10 years – with the largest fire at 9,600 acres. From 1975 to 1999 large fires burned every two to four years, with several notable lightning fires: the Hog Fire (1977) burned 46,000 acres; nine fires (1987) burned more than 47,000 acres; and the Megram Fire (1999) burned a total of 125,000 acres. In 1987, there were so many fires burning in the Northwest that firefighting resources were exhausted before any suppression resources could be sent to wilderness fires; these fires were considered low priority because there was no threat to life or structures. These fires burned for two weeks before suppression activities began (Klamath National Forest 1998). A very similar situation occurred on the Megram Fire, which originated in the Trinity Alps Wilderness. No life or structures involved, and there were five higher priority wildfires elsewhere in California. Suppression resources did not arrive at the Megram Fire for two to three days. Although smokejumpers arrived within 48 hours, their suppression actions did not affect perimeter growth.

Figure 3-10. **Human-Caused Fire Starts in the Vicinity of the HLMTT Watersheds :**

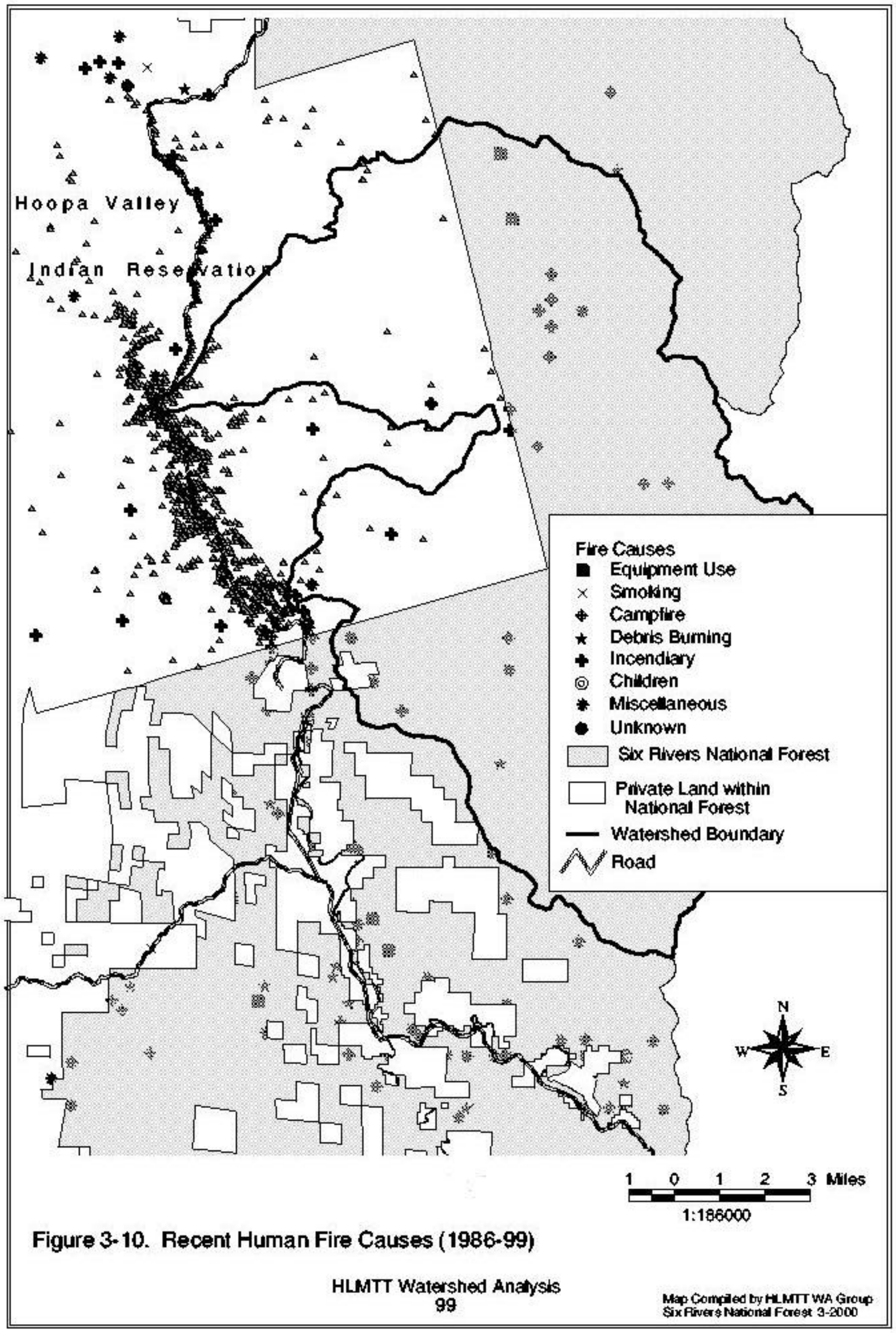


Figure 3-10. Recent Human Fire Causes (1986-99)

Riparian Areas

Riparian area fire histories are of particular interest to the HLMTT area, but very few fire history studies have been done specifically to reflect riparian fire regimes in the Klamath Mountains or the southern Cascades. Agee (1993) suggests that narrower riparian zones will be more likely to have been more frequently disturbed by fire than will wider riparian zones, and that riparian zones in drier areas will probably burn more frequently than those in wetter areas."

Skinner (in preparation) gathered fire history data from four riparian areas along the east side of the Shasta-Trinity Divide in the Klamath Mountains within the Sacramento River watershed north of Lake Shasta. These data were gathered from within the riparian zone, and in summary, the forest type adjacent to all four sites would generally be described as the Klamath enriched mixed conifer type (Sawyer and Thornburgh 1977). Species common to all four sites were willows, western azalea, Port Orford cedar, and various grasses, sedges, and forbs associated with wet meadow systems. Other common species on these sites were spiraea, Sierra laurel, thimbleberry, mountain alder, and California pitcher plant. Elevations ranged from 4600 to 6300 ft. Two sites were on north-facing, gently sloped swales, and two were on steeper south-facing slopes. The sites were all less than 2.5 acres each.

The fire histories, which dated from the mid-1600s, suggest that riparian areas generally have longer and more variable fire return intervals than nearby upland sites. The pre-1850 median fire return interval for north-facing swales were 31 and 36 years (with a range of 9 to 71 years). The time since the last fire scar formed on these sites was 49 and 95 years. The pre-1850 median fire return intervals for the south-facing slopes were 26 and 52 years (with a range of 7 to 65 years). No fires had been recorded in the stumps for 58 and 102 years. Nearby (less than 1650 ft away) upland sites had pre-1850 median fire return intervals of 12 and 15 years (with a range of 6 to 44 years).

On the west side of the Shasta-Trinity Divide, in the watershed of the East Fork of the Trinity River, data were collected for two 2.5-acre sites that were separated by a small creek with a well-developed riparian zone. The Forest types were Klamath enriched mixed conifer with riparian species similar to those described previously. These sites were in the middle third of along north-facing slope at an elevation of approximately 4750 ft."

This fire history, dated from the mid-1500s, suggests that a narrow riparian zone only a few meters wide may have longer and more variable fire return intervals than adjacent upland sites. the pre-1850 median fire return intervals were 13 and 14 years (with a range of 5 to 47 years). Sixty-one years had passed since the last fire scar was formed. A total of nineteen fires were recorded for the period. Of these nineteen fires, only ten (53 percent) were recorded on both sides of the riparian zone. The median fire return interval for the fires recorded on both sides of the riparian zone was 29 years (with a range of 7 to 47 years)."

Fire Hazard

Reference Conditions

Fire hazard pertains to projected fire behavior and subsequent suppression effectiveness once a fire starts. Historic hazard conditions can be inferred from several studies and personal accounts. Barrett (1935) refers to the diary entry of Jedediah Smith from May 10, 1828 near the junction of the South Fork and Main Trinity Rivers, "The traveling was very bad, several very steep, rocky and brushy points of mountains to go up and down with our horses,…we lost 15 on the way in the brush – 2 with loads." Four days later when the party was down in what is now the Hoopa Indian Reservation, the diary says, "The traveling amazingly bad; we descended one point of brushy and rocky mountain, where it took us about 6 hours to get the horses down." The 1873 fire that "raged in the Trinity Mountains" had burned for more than a week, creating "dense smoke all over the country, making the atmosphere oppressive and hot"; another fire on Trinity Mountain in 1887 "raged so fiercely throughout the country for the last month" (Barrett 1935). These historic accounts relate conditions of extreme fire behavior with wildfires raging for long periods of time in the steep terrain.

During the early parts of the 20th century, aggressive fire prevention and suppression kicked in, resulting in stands that are more dense with a greater ladder component (GAO/RCED-99-65, 1999). The Orleans District Ranger Harley recognized the negative impacts of aggressive fire suppression as early as 1918, bemoaning the "thick underbrush, windfalls, and general humus" that now covered the forest. The aforementioned fire frequencies for this general area indicate that fires have played a major role in the ecological development of major species within the watershed. Stuart (1997), as part of his white fir fire history study on the Orleans and Mad River Districts, found that, on average, fires have had 39 to 54 more years to accumulate under the current fire regime than would have occurred under the presuppression fire regime. Without fire suppression, the more frequent fires (either from lightning or Native American burning) probably would have been less intense, but possibly larger in size due to more open canopies. Therefore, rates-of-spread may have still been high under late summer conditions, but flame lengths would probably have been much less severe, except during stand-replacing fire events (i.e. under severe weather and/or extreme fuel conditions).

This area, as part of the Klamath subregion (as defined in the Recovery plan for the northern spotted owl), has a high potential for habitat loss through wildfire (Agee 1993), due to higher fuel loads and more uniform multilayered canopies. This area is also defined as part of an intermediate physiographic province (USDA and USDI FSEIS 1994), which has highly variable fire return intervals and fire severities. Wildfires played an important role in stand dynamics, altering age-class distributions with stand regeneration following wildfires. Wildfires did not always result in complete stand mortality or fuel consumption, with surviving trees, snags, and coarse woody debris becoming important components of developing old growth stands. The coastal fog component would also affect the frequency and intensity of wildfires in the HLMTT area, especially lower in the watersheds.

More current reference fire hazard conditions (pre-Megram Fire) were assessed as part of the Large Area Vegetation Analysis (USDA SRNF 1997) and the Forest-Wide LSR Assessment ((USDA SRNF 1999). Beyond subjective hazard assessments, hazard can be modeled in terms of rates of spread (ROS) and flame length (FL), which are calculated based on inputs of fuel model, slope class, and weather (Andrews 1986). These two critical fire behavior factors, ROS and FL, also affect resistance to control, which must be considered in the assessment of fire hazard for an area the size of a watershed. Implications of resource effects can be made based on flame lengths and the amount of time it takes for a fire to spread over an area. Flame lengths are also related to suppression effectiveness, in terms of whether hand crews, equipment or aerial attack can successfully suppress a wildfire. Fires that require aerial attack would be associated with the greatest potential for larger, more destructive wildfires with extensive crown fires and higher tree mortality.

The process involved fire behavior models and mortality assessments. Fuel models were assigned to all mapped subseries and seral stages on the Forest. (Note: due to incomplete mapping of the blowdown area, fuel models were not revised to reflect blowdown fuel conditions). Fire Behavior fuel models (Anderson 1982) were used with a two fuel model concept (Andrews 1986) to reflect understory conditions. These fuel models were geographically overlaid with standard National Fire Danger Rating slope classes (Deeming and others 1977) and assigned typical June and August weather for input into the BEHAVE fire model (Andrews 1986) which calculated ROS and FL.

Separate ROS and FLs were calculated for each individual fuel model and fuel model combination. For the two fuel model combination, ROS values were weighted by percent cover. Flame lengths were assigned based on the fuel model with the greatest assigned percentage. Table 3-33 displays the June and August weather inputs to typify typical average (50th percentile) and more severe (90th percentile) summer time conditions. Depending on the year's weather, the more severe 90th percentile values and even more extreme values could still exist well beyond August into September and October.

Table 3-33. June and August Fuel Conditions

Weather Parameter	June	August
Midflame windspeed (mi/hr)	5	7
1-hr timelag fuel moisture	6	2
10-hr timelag fuel moisture	8	4
100-hr timelag fuel moisture	14	8
live herbaceous fuel moisture	133	75
live woody fuel moisture	143	100

Note: Fuel moistures are designated by "hour" timelag categories, which correspond to diameter size classes: 1-hour - 0.0 to 0.25 inches; 10-hour - 0.26 to 1.0 inch; 100-hour - 1.1 to 3.0 inches.

For map representation and discussion purposes the groupings for ROS and FL are shown in Table 3-34 with their corresponding suppression effectiveness assessments.

Table 3-34. ROS and FL Groupings with Suppression Effectiveness Assessments

Value	ROS (ft/min)	FL (ft)	Suppression Effectiveness
Low	0-5	0-2	3-person handcrew or engine
Moderate	5.1-11	2.1-4	5-person handcrew or engine
High	11.1-22	4.1-6	engines/handcrews/water tender plus aerial attack
Very High	22.1-33	6.1-8	all above plus dozers/aerial support
Extreme	33.1+	8.1+	beyond initial attack, into extended attack

The modeled fire behavior results showed that varying percentages of the LSR or watersheds exhibited coincident high to extreme ROS (greater than 11 ft/min) and FL (greater 4 feet) (Table 3-35). Note that these figures do not reflect the extreme fuel loadings from the blowdown event.

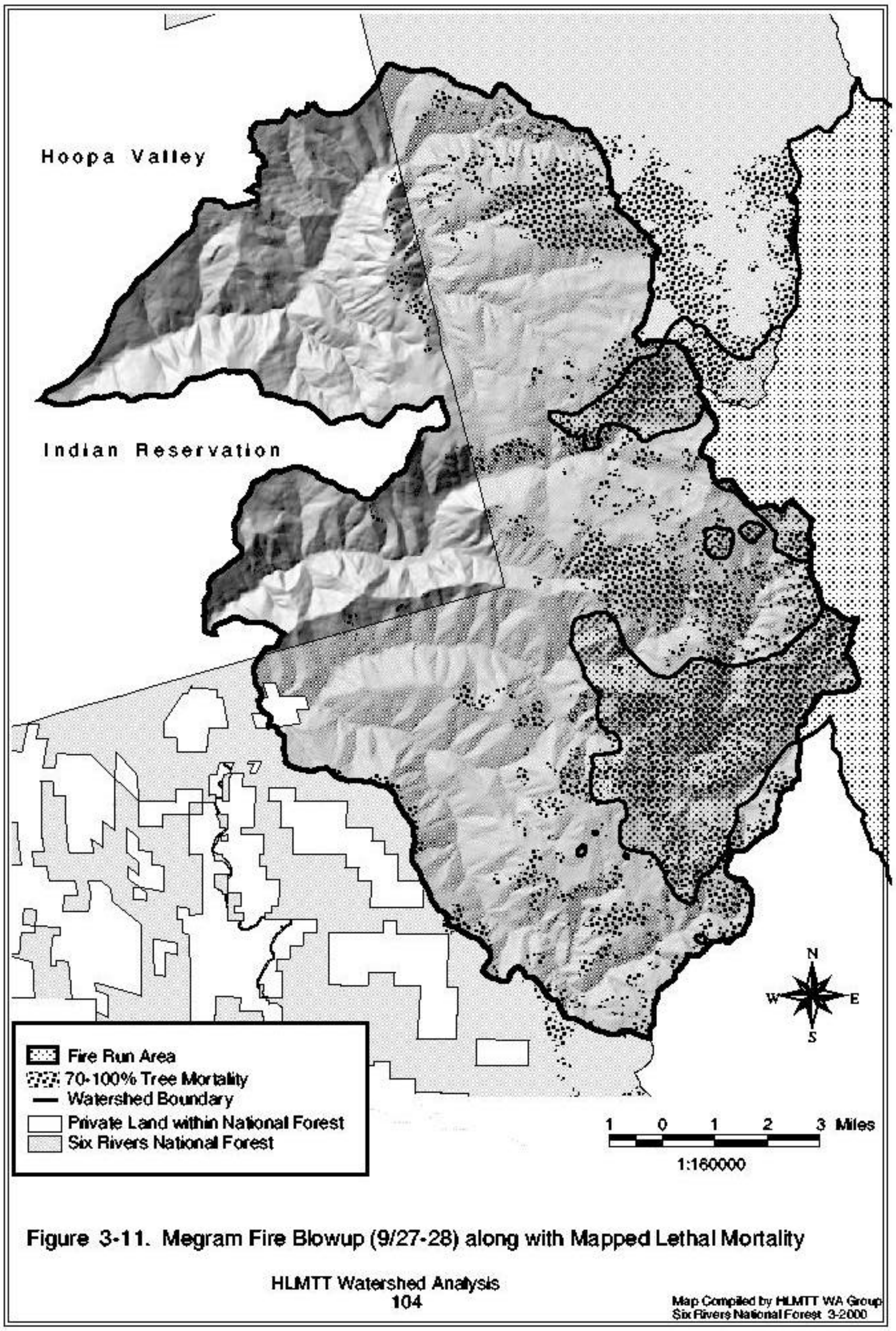
Table 3-35. Percentage of LSR/Watersheds Exhibiting High to Extreme ROS and FL

LSR/Watershed	June	August
Horse Linto Creek	7	48
Mill & Tish Tang Creek	6	39
LSR 305	30	52

Relatively speaking, LSR 305 had the highest percentage for June among all LSRs on the Forest, and the second highest among all LSRs in August. Among all watersheds in the central zone for August conditions, Mill and Tish Tang Creeks had the lowest percentage value, and Horse Linto was within a large midrange group of watersheds (SRNF Large Area Vegetation Analysis 1997).

If fuel models had changed to reflect the blowdown, high to extreme modeled ROS and FL would have resulted throughout the entire blowdown area (SRNF LSRA 1999). This was verified clearly by the fire behavior experienced during the Megram Fire as it burned through the blowdown area on September 27. Extreme fire behavior was exhibited, including 150-foot flame lengths and a 5-mile run in 7 hours through the headwaters of Horse Linto Creek and Tish Tang Creek, with spotting up to a mile ahead of the flaming front (Figure 3-11). Before the blowdown, dead and down fuel loading across the landscape varied considerably. Depending on aspect, stand density, and seral stage development, total pre-blowdown fuel loading ranged from 5 to greater than 50 tons per acre. After the blowdown, total fuel loading ranged from 100 to 300 tons per acre, with many of the fuels propped up as part of jackpots (Hom and Kersh 1996). Figure 3-11 also shows how the September 27 fire run resulted in substantially higher areas of mapped lethal mortality (i.e. greater than 70 percent mortality) compared with surrounding stands. This major run that burned approximately 9,600 acres was due in part to the strong, dry easterly winds and accompanying low humidities (Snook 2000) in addition to the extremely high fuel loadings. Referring to potential wildfire events within the blowdown area Hom and Kersh (1996) predicted: “Under extreme conditions of wind and/or drought, the communities of Denny (on the Big Bar Ranger District), Hoopa, Hoopa Valley Indian Reservation, and Willow Creek could conceivably be at risk, with Denny having a high chance of being cutoff due to limited access”. Ironically, these predictions were very close to what actually occurred during the Megram Fire.

Figure 3-11. **Megram Fire Progression in the Blowdown Area along with Mapped Lethal Mortality:**



Tree Mortality

The Forest-wide LSR Assessment (SRNF 1999) predicted fire-related tree mortality. The First Order Fire Effects Model (FOFEM) was developed to predict the direct consequences of prescribed fire and wildfires (Reinhardt et al. 1997). First order fire effects are the immediate of direct results of a fire. FOFEM was used in the LSR Assessment to predict fire-caused tree mortality based on tree diameters by vegetation type and modeled flame lengths. The current version of FOFEM only includes major vegetation types, so initial modeling used average tree diameters for the Douglas-fir and white fire subseries. For the remaining tree species, a generalized mortality matrix developed by the Klamath National Forest using mortality research accumulated within the Fire Effects Information System (Linfoot 1997). Again, without blowdown conditions reflected, 56 percent of LSR 305 was predicted to experience stand-replacing results (greater than 70 percent mortality) from a wildfire under 90th percentile weather values in August and 54 percent under 50th percentile values in June. [Note: The tanoak series data from the Klamath matrix reflected lethal mortality for all flamelengths. Our tanoak series includes a substantial component of conifers, especially Douglas-fir. Further analysis since this document was completed has resulted in refined values for the tanoak series. Therefore, these quoted results would be reduced with a refined tanoak mortality assessment.] Based on fuel loading assessments within the blowdown area of 100 to 300 tons per acre (Hom and Kersh 1996), these wind-affected areas would have also had the potential to experience lethal, stand-replacing conditions during a wildfire.

Fuel Treatments and Suppression Effectiveness

Of special note within the HLMTT watersheds are two groups of fuel treatments that actually did affect or had the potential to affect suppression effectiveness during the Megram Fire. The first group was a cluster of understory burns that were completed in the late 1980s as part of the Point timber sale (approximately one mile north of Hawkins Bar). Since this area of approximately 400 to 600 acres had been treated, fire suppression tactics took this into consideration when they placed their fireline along the eastern boundary of the treated area. This afforded the firefighters the tactical advantage of an open forest floor to their backs and the potential for reduced intensities if a spot fire had occurred within the treated area. These open areas also allowed for greater mobility for the suppression resources.

The second group of fuel treatments was a series of shaded fuelbreaks that were undertaken within the blowdown area along roads and ridges. A wide variety of fuel treatment prescriptions were undertaken within these units, including large woody debris removal, piling and burning, jackpot burning, and understory burning (see Table 3-29 in the Vegetation section). A small number of units were completed all the way to understory burning, while many more were only partially implemented, and some had no treatment at all. This group of fuelbreaks fit the standard definition of "a strategically located wide block, or strip, on which a cover of dense, heavy, or flammable vegetation has been permanently changed to one of lower fuel volume or reduced flammability (Green 1977). Shaded fuelbreaks are created by altering surface fuels, increasing the height to the base of the live crown, and opening the canopy by removing trees (Agee et al. 1998). Due to the extreme fuel loading from the blowdown, removal of large woody debris already on the ground was also part of the prescription for most of these units.

A total of 1,615 acres had some phase of fuel treatment completed, and essentially all of them were within the Megram Fire boundary, including some spot fires. By overlaying the fuel treatment coverage with the burn severity coverage, an overview of fuelbreak effectiveness can be assessed. (Note: Due to the extreme fire behavior exhibited while the fire was burning through this area, firefighters were not dispatched to this area, but the fire effects were very indicative of potential suppression effectiveness. This relates to the assumption that fuelbreaks are never designed to stop fires, but to allow suppression forces a higher probability of successfully attacking a wildland fire [Agee et al., 2000]). Overall, 30 percent of the treated acres resulted in less than 40 percent mortality even without fire suppression assistance. The best results within these fuel treatments, in terms of highest percentage of acres in the less than 40 percent mortality category, were:

- 68 percent of the 215 acres that had large woody debris removed along with understory burning
- 73 percent of the 119 acres that just had the fuels piled

At the other end of the spectrum the “worst” results in terms of lowest percentage in the less than 40 percent mortality category were:

- 0 percent of the 12 acres that had large woody debris removed with piles burned
- 0 percent of the 18 acres that were logged, piled, and jackpot piles burned
- 0 percent of the 13 acres with just piles burned
- 2 percent of the 429 acres that had large woody debris removed, piles burned and jackpots burned
- 2 percent of the 129 acres that just had large woody debris removed

These percentage results are grouped for the entire list of fuel treatments. When looking at individual units, many stand out as having survived these extreme burning conditions quite well, including Sweet Onion 1, Sweet Onion 8, and Sweet Onion 9. To fully address the underlying reasons why these units did not experience stand-replacing mortality, many factors will need to be assessed, including unit size and width, width of ridge, aspect, orientation compared to the wildfire spread, windspeed and direction, time of day the fire burned through, date of fuel treatment accomplishment, etc. (Note: There is interest by Colorado State University, through the Joint Science Program, to investigate these units in relationship to the Megram Fire results.) Results from these studies and on the ground observations could help refine design criteria for future shaded fuelbreaks.

Current Conditions

As explained earlier, fire hazard can be represented by fire behavior and subsequent fire suppression effectiveness. The same modeling scheme was used to represent fire behavior factors of ROS and FL based on revised fire behavior fuel models that were assigned by the mapped mortality from the Megram Fire. Because of the extent of mortality from the Megram Fire, fuel models were reassigned by subseries and seral stage based on coincident severity levels of high (greater than 70 percent mortality), moderate (25 to 70 percent mortality) and low (less than 25 percent mortality). In addition, fuel models had to be projected into the future due to probable shrub and grass regrowth after the fire along with fuel accumulation due to standing dead trees falling to the ground. This resulted in three representations of projected fire behavior for both June and August weather conditions: year 1, years 5 to 7, and years 10 to 12. Table 3-36 displays the results for these three time periods.

Table 3-36. Percent of SRNF HLMTT Area by Projected Fire Behavior

Projected Behavior	ROS (June)	ROS (Aug)	FL (June)	FL (Aug)
Year 1				
Low	52	24	59	33
Moderate	21	29	12	27
High	13	14	15	7
Very High	3	13	14	6
Extreme	11	20	0	27
Year 5				
Low	23	7	52	29
Moderate	51	28	20	23
High	19	23	13	8
Very High	2	15	5	6
Extreme	4	27	10	34
Year 10				
Low	25	7	57	30
Moderate	36	20	13	27
High	21	30	11	8
Very High	11	18	8	5
Extreme	7	25	11	31

Modeled high to extreme fire behavior potential increases with time after a wildland fire due to increased mortality and an influx of the shrub and grass component where the canopy has been removed. This is especially evident under a typical August weather scenario, with dry, cured fuels. From Table 3-36 it appears that the high to extreme group for either ROS or FL peaks at year 5 and then declines at year 10. The typical scenario is more of a plateau of fire hazard with additional ground fuel being added from standing trees falling over at the same time that fuels in contact with the ground are decomposing. It is also important to recognize that the potential for high to extreme fire behavior will exist well beyond the 10 to 12 years used for this analysis.

For display purposes, only the combined high to extreme August ROS and FL were included for year 1 (Figure 3-12), years 5-7 (Figure 3-13), and years 10-12 (Figure 3-14). Table 3-37 shows the acres and percentage breakdown by year for June and August weather scenarios for all three time periods.

Figure 3-12. **Areas with August High to Extreme Predicted Fire Behavior – Year 1:**

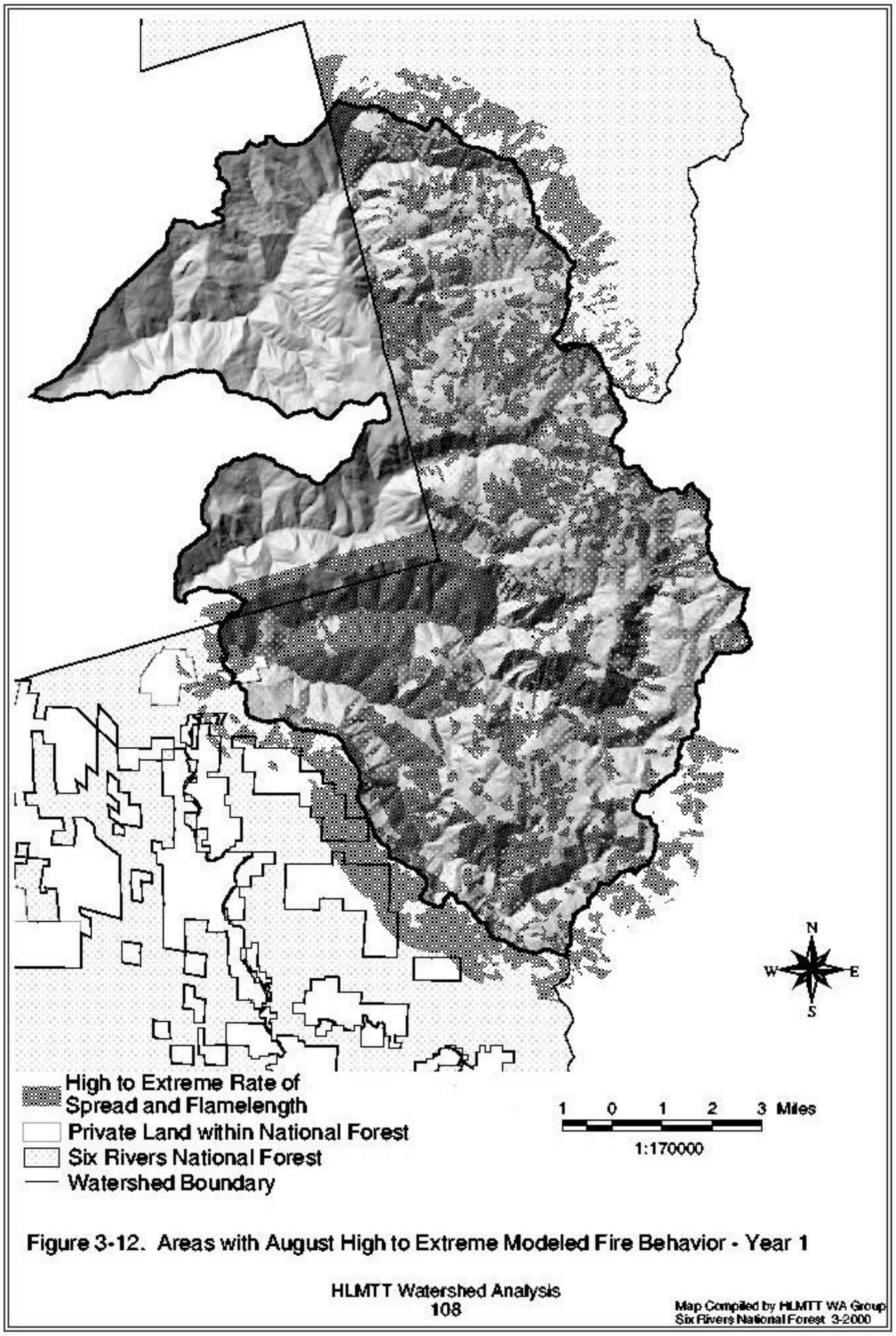


Figure 3-12. Areas with August High to Extreme Modeled Fire Behavior - Year 1

Figure 3-13. **Areas with August High to Extreme Predicted Fire Behavior – Years 5-7:**

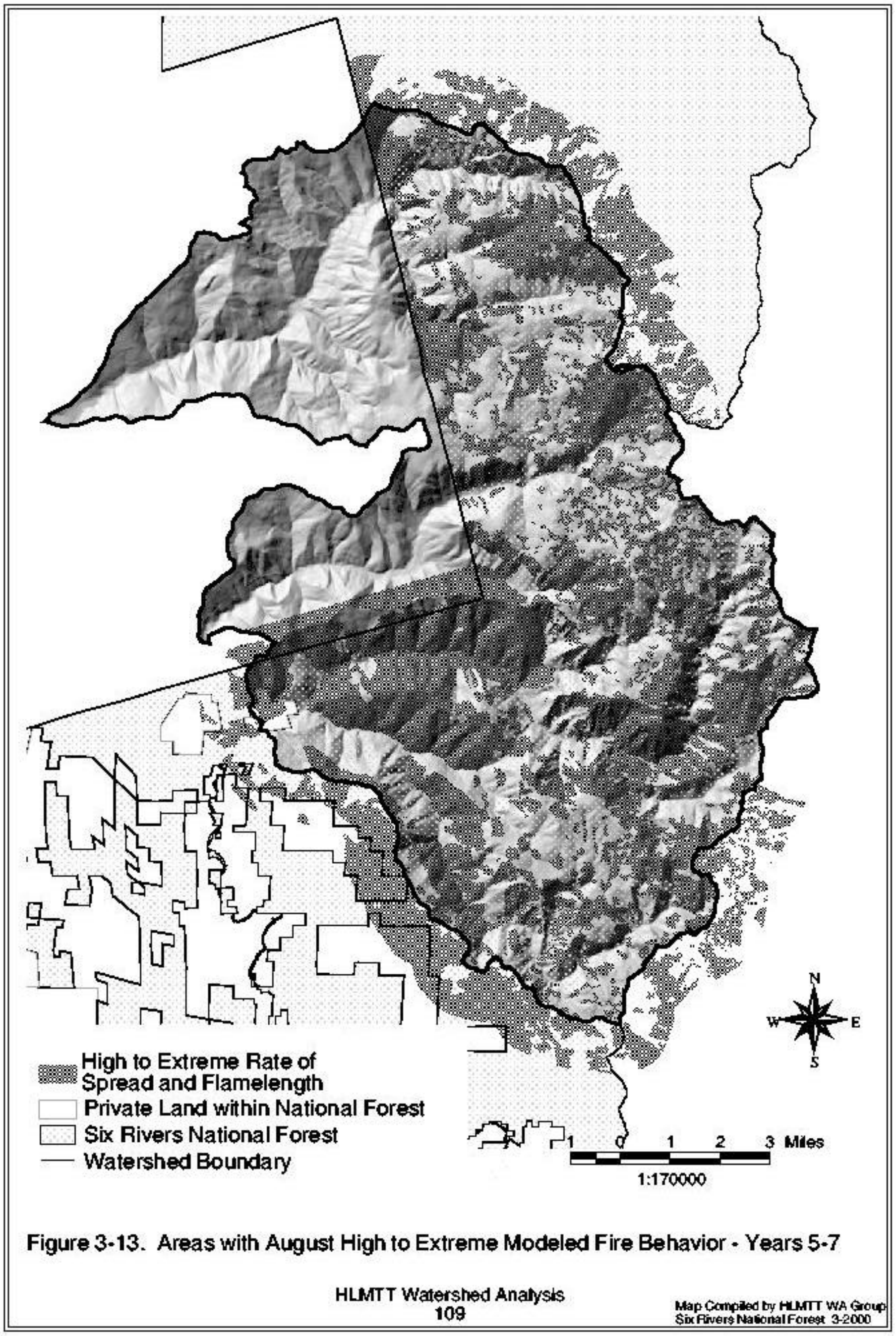


Figure 3-14. **Areas with August High to Extreme Predicted Fire Behavior – Years 10-12:**

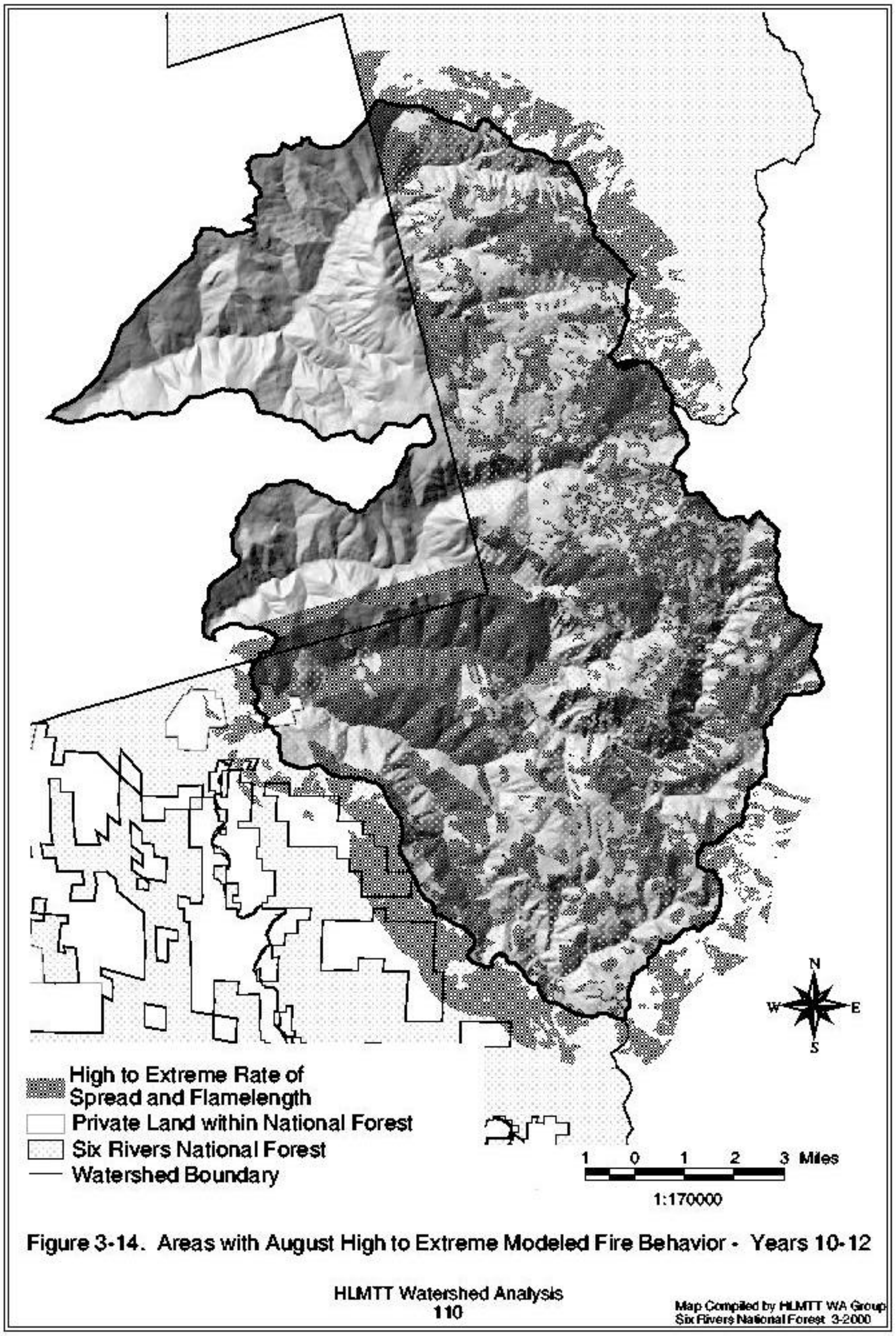


Table 3-37. Acres and Percent of SRNF HLMTT Area with High to Extreme Predicted Fire Behavior

	Year 1		Year 5-7		Year 10-12	
	June	**August**	**June**	**August**	**June**	**August**
Acres	10,875	27,384	10,185	31,394	14,471	28,888
Percent of Area	16	40	15	46	21	43

Of extreme importance to this area is the ongoing threat of wilderness fires both within and adjacent to this watershed. Preserving the "natural character" of the wilderness precludes active fuels management (except through wildland fire use) within the wilderness. The large area burned by the Big Bar Complex in the wilderness both on the Six Rivers and the Shasta-Trinity National Forest will have the potential for high to extreme fire behavior and associated mortality many years into the future.

Tree Mortality

Except for the tanoak series, the same matrix discussed in the "Reference Conditions" Tree Mortality section was used to model mortality for years 1, 5 to 7, and 10 to 12. The tanoak series has a high conifer (mainly Douglas-fir) component. The tanoak species is highly susceptible to mortality even at lower flamelengths because of its thin bark. Douglas-fir, at the same time has a higher resilience to fire due to its thicker bark. Based on this information, we adjusted the mortality rankings associated with the tanoak series to reflect the overall series mortality, using seral stage as the deciding factor (i.e. older trees would need higher flamelengths to kill them). Therefore, these results should not be directly compared with the modeled mortality reported in the reference tree mortality section.

For display purposes three percentage classes of mortality were used: 0 to 25 percent (non-lethal), 25.1 to 70 percent (mixed mortality), and 70.1 to 100 percent (lethal). Table 3-38 displays the acres and percentages that fall into these three mortality categories. Both June and August modeled flame lengths were used to typify early season wildfires (or late spring prescribed burns) and late season wildfires, respectively. Modeled August tree mortality is displayed for years 1 (Figure 3-15), 5-7 (Figure 3-16), and 10-12 (Figure 3-17).

Table 3-38. Percent of Area in Mortality Classes

	Year 1		Year 5-7		Year 10-12	
	June	**August**	**June**	**August**	**June**	**August**
Percent						
non-lethal	64	50	56	44	56	47
mixed mortaltiy	17	18	19	15	19	16
lethal	19	32	25	41	25	37

Figure 3-15. **Modeled August Tree Mortality – Year 1:**

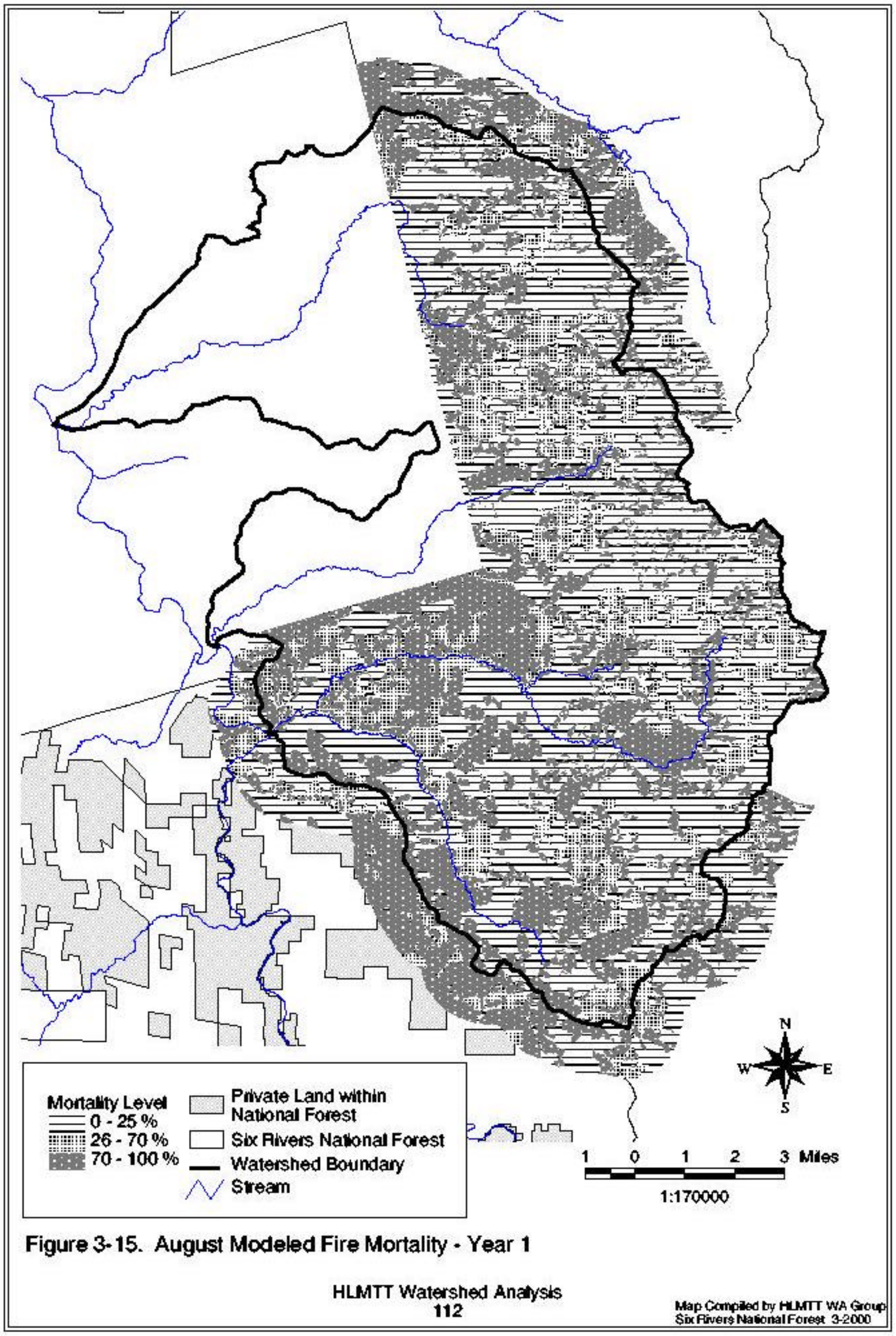


Figure 3-16. **Modeled august Tree Mortality – Years 5-7:**

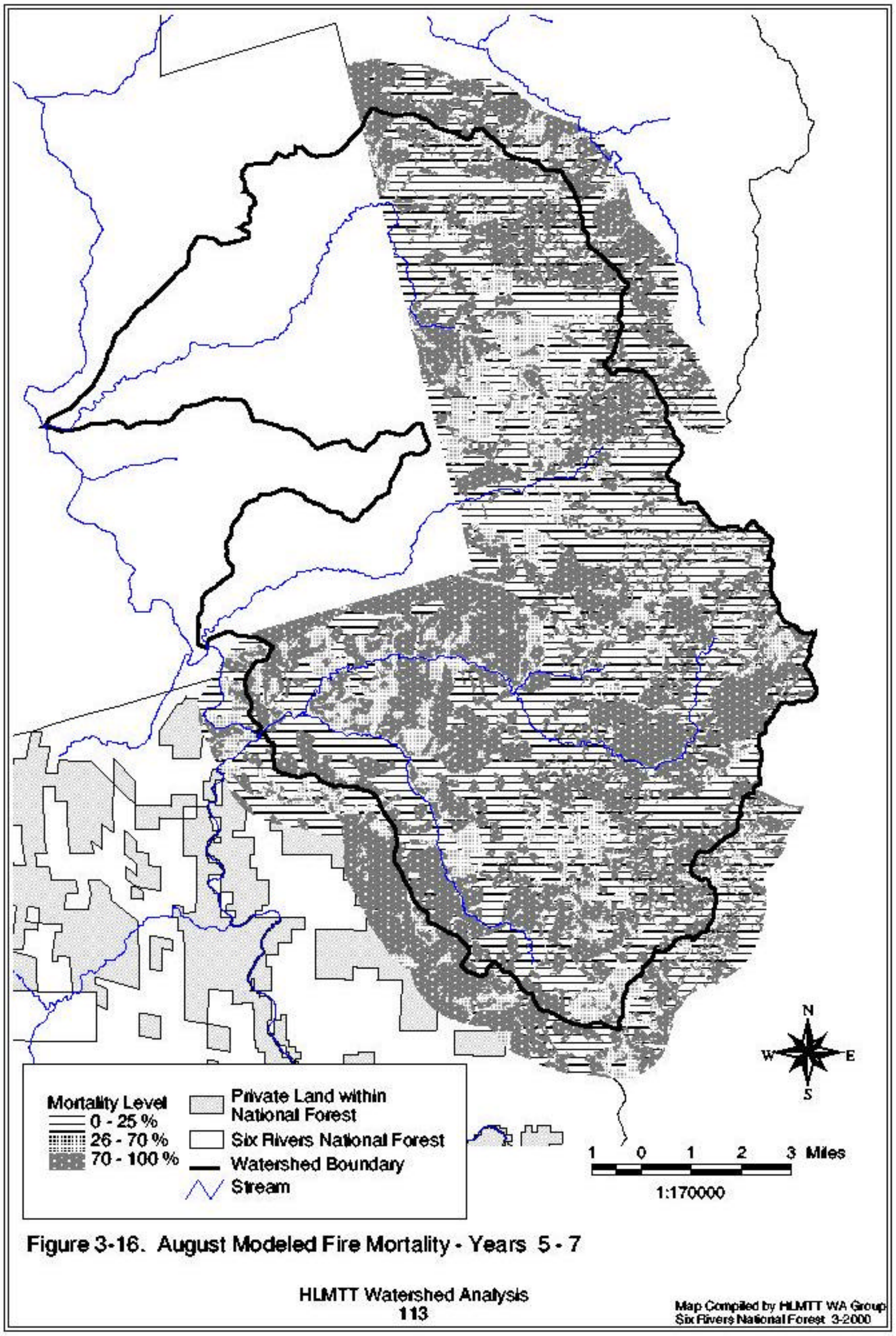
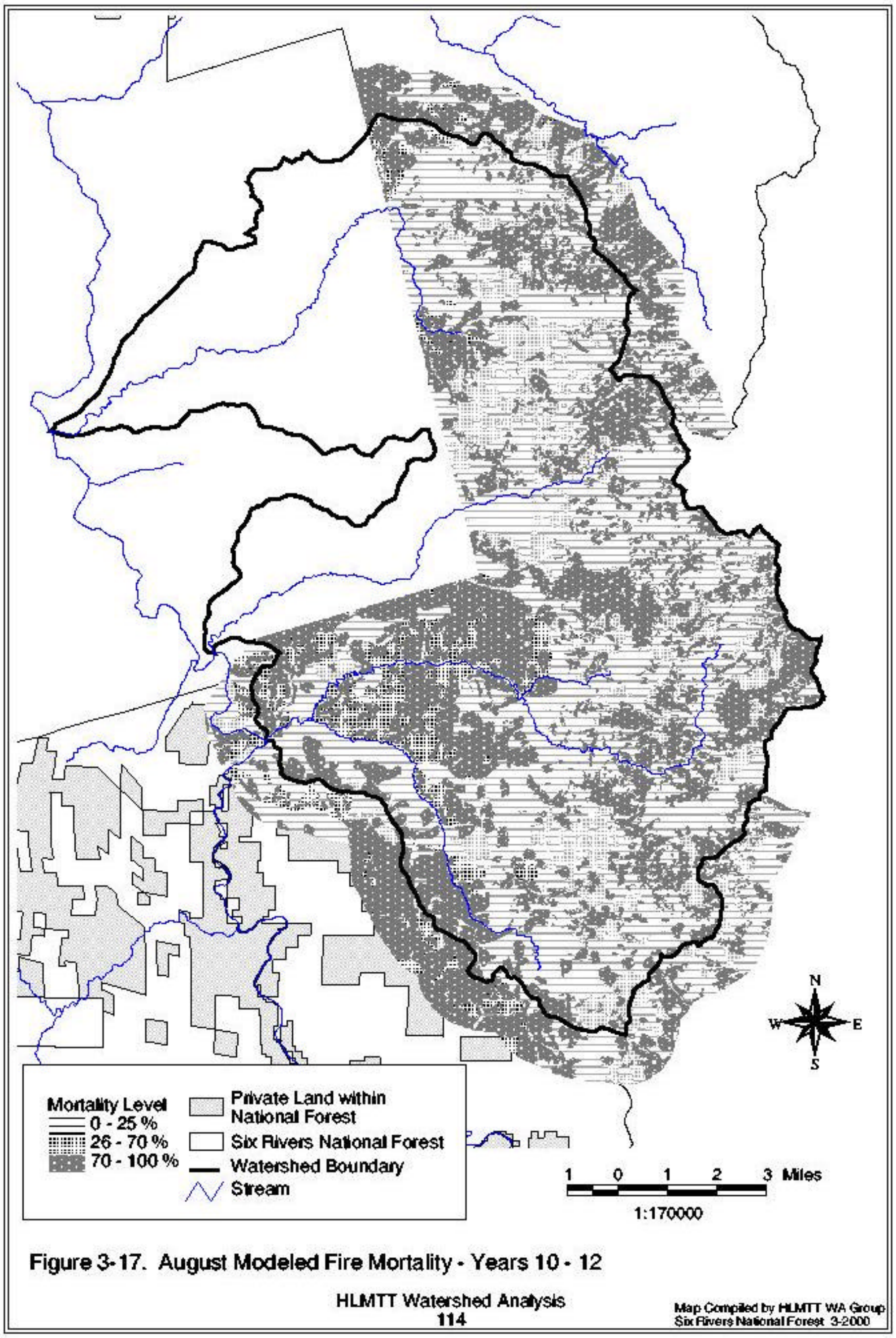


Figure 3-17. **Modeled August Tree Mortality – Years 10-12:**



Suppression Availability

Of equal importance to a hazard assessment and suppression effectiveness is the determination of suppression availability once a fire does start. Suppressing fires while they are still small requires a mix of initial attack resources that is mobile and quickly available. The current organization for the Forest Service and CDF emphasizes ground attack as the primary initial attack resource, with support from aerial forces for extended attack. This area falls within the Lower Trinity Ranger District which has two engines available, with three engines also available from the Hoopa Valley Tribe. CDF would supply crews from High Rock, Alderpoint (1 engine), Trinidad (1-engine), Fortuna (dozer), Thorn, and the Mendocino Ranger Unit. The watershed would also typically receive resources from the Shasta-Trinity NF. Local air support would include Kneeland and/or Scott Valley helicopters and air tankers out of Rohnerville, Redding, and Medford. Numerous volunteer fire departments would also respond.

Due to the mainly rural population of this area, fires within or adjacent to the HLMTT watersheds would have a lower priority when compared to more populated wildland interfaces and intermixes found throughout the state. Since this was the case during the Megram Fire, this will be a continuing significant factor when forces are drawn down past effective levels, possibly resulting in significantly larger and more destructive wildfires. For example, the extremely busy fire season of 1996 resulted in standard resource orders being delayed for two to three days.

Air Quality

Reference Conditions

Related to the issue of fire hazard and cumulative fire effects is the concern for air quality, both from wildfires and prescribed burns. Historic (i.e., pre-Megram Fire) newspaper accounts, personal accounts, and fire report forms relate severe, smoky conditions when wildfires were burning in the HLMTT general area:

- August 23, 1873 – a fire raging in Trinity Mountains produced “dense smoke all over the country, making the atmosphere oppressive and hot” (Daily Rocky Mountain News)
- August 24, 1932 – Salyer Ditch #5 Fire – “This fire was not discovered by crew upon arrival at Salyer Ditch 1,2,3, and 4 fires because of dense smoke in the canyons.”
- August 28, 1932 – Cedar Creek #1 and #2 Fires– “Heavy smoke screen from Hoopa Reservation fires has put our regular lookouts out of commission...visibility very poor.”
- September 16, 1932 – Waterman Fire – “Due to dense drift smoke from Hoopa Reservation fires, this fire could not be seen by Brannon Mt. Lookout.”
- October 1, 1932 – Jim Jam Fire – “Because of smoky conditions lookouts did not locate fire until action had been taken to suppress it by Fireman Fancher.”
- October 6, 1932 – Sharber #3 and #4 Fires – “Smoke was dense over the district.”

Note: This previous series of five fires show smoky conditions existed from August until October of 1932.

- November 17, 1936 - Indian Field Fire – "Large fires on same readings outside the forest, together with heavy smoke prevented detection of fire in its early stages."
- June 27-August 8, 1987 – Horse Linto Fire – this fire along, with the numerous wildfires that burned during the summer of 1987, produced enough dense smoke to see bats flying during the day (Pfister personal communication 2000)

Smoke from wildfires and prescribed burns can be a major contributor of particulate matter smaller than 10 microns (PM10), which is of particular interest to human health. Airborne particles larger than 10 microns are trapped by the body's normal defense mechanisms and are expelled from the body. PM10 bypasses these defenses and remains lodged deep in the lungs. Detrimental health effects of PM10 can include asthma attacks, reduced lung function, aggravated bronchitis, respiratory disease, cancer and possibly premature death. Immediately affected by PM10 emissions are the elderly, children, asthmatics, and people with chronic heart or respiratory disease. Long-term exposure could have more widespread detrimental effects, including affecting healthy people.

Concerning the Megram and Onion Fires, severe air quality impacts occurred due to the long duration of the fires (which burned from August 23 to November 4, 1999), poor dispersion characteristics, and heavy fuel loading. During the 30-day period that air monitoring was conducted for PM10 at Hoopa by the North Coast Air Quality Management District (AQMD), the California Ambient Air Quality Standards (50 ug/m3 as a 24-hour average) were exceeded on 19 days and the Federal Ambient Air Quality Standards (150 ug/m3) were exceeded on 12 days (Herr 2000). The 24-hour average PM10 concentration exceeded 420 ug/m3 (considered hazardous as rated by the Federal Air Quality Index) on 4 consecutive days. Beginning on October 17 the most severe smoke episode started and lasted until October 23. This period saw several days of 24-hour average PM10 levels in excess of 400 ug/m3, and numerous hourly peaks up to 1,000 ug/m3. A mini-vol sampler placed at the mouth of Horse Linto Creek recorded a 5-hour average PM10 concentration of 4,000ug/m3 during the early morning hours of October 21, the highest recorded concentration during the entire fire. High volume samplers placed in Salyer and Willow Creek recorded concentrations at various averaging times of 600 to 800 ug/m3. Due to this hazardous air quality, the governor declared a state of emergency for Humboldt, Napa, and Yuba Counties on October 22, 1999. On the same day, the Office of Emergency Services recommended evacuation of Hoopa. Willow Creek, and all smoke affected areas. This was the first state of emergency declared in California due to air pollution. Smoke plumes from the fires were visible on satellite imagery, extending several hundred miles into Oregon and Nevada and out into the Pacific Ocean parallel to the Monterey Peninsula. Air quality levels at distant monitoring stations (Garberville and Blue Lake) were also elevated, but in no case did the 24-hour average PM10 exceed 100 ug/m3.

Visibility was also severely hampered during these episodes, sometimes down to 20-foot visibility. Several times imaging and suppression aircraft were prevented from flying due to dense smoke. The clear visibility of the Trinity Alps Wilderness was severely degraded throughout the duration of the Big Bar Complex.

Smoke generated from the fuel treatments executed within these watersheds (i.e. pile burning or understory burning) were of short duration, dispersed away from populated areas, and did not produce any nuisance calls to the North Coast AQMD. One of the most important tradeoffs to consider is the substantial increase in smoke production from wildfires versus prescribed fires. Wildfires typically occur when fuels are dry, fuel consumption is greater, and the fuels are consumed during the less efficient smoldering stage. In comparing wildfire versus prescribed burning emission production in eastern Oregon and Washington, Ottmar et al. (1993) found the wildfires to produce approximately twice as much PM10 when compared to the prescribed fires. The fuel loadings described for this study were well within the pre-blowdown conditions. It can be assumed that the extreme fuel loading from the blowdown would have produced much higher than double the PM10 values in the wildfire versus the prescribed burns.

Current Conditions

The HLMTT watersheds fall within the North Coast AQMD. Air quality in this air basin has generally been considered good, except during large wildfires of long duration (e.g. the Megram Fire and the 1987 wildfire events). Except during these extreme events, all Federal standards are consistently achieved (including those for ozone, carbon monoxide, particulate matter, and nitrogen dioxide). The overall area is considered to be in "attainment" by Federal standards; it has previously met and currently meets ambient air quality standards. California state standards for PM10 have not been met for the North Coast AQMD (which has mainly been attributed to sea salt).

Smoke from wildfires, along with prescribed burns, can be a major contributor to impaired air quality. One of the most important tradeoffs to consider is the substantial increase in smoke production from wildfires versus prescribed fires. Wildfires typically occur when fuels are dry, fuel consumption is greater, and the fuels are consumed during the less efficient smoldering stage. In comparing wildfire versus prescribed burning emission production in eastern Oregon and Washington Ottmar et al. (1993) found the wildfires to produce approximately twice as much PM10 when compared to the prescribed fires. The fuel loadings described for the Ottmar study were well within the pre-blowdown conditions. It can be assumed that the extreme fuel loading created by the blowdown would have produced much higher than double the PM10 values in the wildfire versus the prescribed burns. Within the blowdown treated units, the yarding of unutilized tops (10 feet or more in length), which was specified for all units (Hostler personal comm. 2000) would have also reduced the amount of fuel that was available to burn. Using air quality models from the Prescribed Fire Information Reporting Systems (PFIRS), the estimates of fuel loading for the pre (5 to 50 tons/acre) and post blowdown (100 to 300 tons/acre) event (Hom and Kersh 1996), and assuming complete consumption, Table 3-39 shows the modeled results for PM10 production in tons/acre based on tons/acre of fuel consumed.

Table 3-39. PM10 Production by Tons/Acre of Fuel Consumed

	Tons Per Acre Consumed			
	5	50	100	300
Wildfire	.07	.68	1.35	4.05
Mixed conifer	.05	.51	1.03	3.08
Dozer piled slash	.03	.31	.62	1.86
Hand piled slash	.06	.64	1.28	3.84

These numbers seem somewhat close in value regardless of situation, but it must be remembered that wildfires could easily consume more acres than were planned in a prescribed burn. Also, wildfires are not planned, with little opportunity to employ mitigation techniques except to suppress the fire as quickly as possible. The smoke generated will be directed and concentrated according to the prevailing wind and atmospheric stability. This will often occur during the summer months when fuel moisture is low, fuel consumption and smoke production is high, and stable atmospheric conditions may persist. Managed ignitions or wildland fire use can be planned for a time when:

- Smoke will disperse quickly
- Smoke will avoid sensitive airsheds
- Less fuel will be consumed or fuel will consume more efficiently and produce less smoke
- Fuels have been removed or reduced, eliminating the need to burn piles or jackpots

Effective smoke management means maintaining desired air quality by avoiding unacceptable combinations of concentration, duration, and dispersal of smoke. The central principle of smoke management is to promote dispersion of smoke and other pollutants that have the potential to cause health and visibility impacts. This is especially the case in the vicinity of communities and major highways where the best available predictive models and strategies would need to be used to minimize the negative impacts on the area and its visitors.

Wildlife Species

Reference and Current Conditions

The watershed analysis area provides habitat for a wide variety of terrestrial and riparian dependent species. Based on existing survey information, species range maps, the Lower Trinity District incidental wildlife sighting reports, and the California Wildlife Habitat Relationships database, there are 16 amphibian, 17 reptile, 120 bird, and 60 mammal species likely to occur within the HLMTT area. Species distribution and habitat has been differentially affected by the Megram Fire. Depending on the species and burn intensity, the effects could be detrimental (short or long term) or beneficial. The loss of late-seral attributes within the high intensity burn areas has impacted late-seral dependent species to a high degree. However, these stands will also in the near future provide habitat for a large array of early-seral dependent species. This section provides an overview of the suitability of wildlife habitat conditions both before and after the Megram Fire.

Threatened, Endangered and Proposed Species

Preliminary guidelines for evaluating federally threatened, endangered and sensitive species (TES) through watershed analysis were provided in a memo from the U.S. Department of Interior and U.S. Department of Agriculture, June 13, 1994. The Endangered Species Act includes provisions for "a means whereby the ecosystem upon which endangered species and threatened species depend may be conserved (and) to provide a program for the conservation of such endangered species and threatened species..." Watershed analysis provides an avenue to assess habitat conditions for listed and candidate species. This information is then available for use in planning and subsequent Section 7 consultation.

There are three federally threatened wildlife species that are known or suspected to occur within or contiguous to the analysis area; the bald eagle, northern spotted owl (NSO), and the marbled murrelet. The northern spotted owl is the only federally threatened species known to nest within the analysis area. There are recorded sightings of the bald eagle within the analysis area; however, no recorded nest territories have been located and no suitable nesting habitat has been designated within the analysis area. Although critical habitat for the marbled murrelet has been designated within the HLMTT area, surveys associated with the Marbled Murrelet Range and Distribution Study have yielded no detections for this species within the area.

The U.S. Fish and Wildlife Service (USFWS) has designated critical habitat for the northern spotted owl and the marbled murrelet within the analysis area. Additionally, a large portion of the analysis area is within LSR 305, which is designated to maintain a functional late-successional and old growth forest ecosystem for late-successional dependent species.

There are also eight of the nine Forest Service (Region 5) sensitive species that are likely to occur within the HLMTT area. The great gray owl is not likely to occur in the watershed analysis area.

Northern Spotted Owl

The first segment of this analysis focuses on the habitat conditions for the NSO prior to the Megram Fire. Current population information is from surveys conducted from 1977 through 1997. The analysis area contains portions of the Northern Spotted Owl Willow Creek Demographic Study Area, which has been in existence since 1985, and has been intensively surveyed annually by Alan Franklin, Humboldt State University. Suitable spotted owl habitat is referred to as nesting and roosting (NR) habitat.

Habitat selected by NSOs typically exhibits moderate to high canopy closure with a multi-layered, multi-species canopy that is dominated by large overstory trees, a high incidence of large trees with large broken tops and other indications of decadence, numerous large snags, heavy accumulations of logs and other woody debris on the forest floor, and considerable open space within and beneath the canopy. These attributes are usually found in old growth, but they area sometimes found in younger forests, especially those that contain remnant large trees or patches of large trees from earlier stands (USDA and USDI 1994).

Acres of suitable NR habitat for spotted owls was queried using the tanoak, white fir and Douglas-fir series that contained trees at least 21 inches in diameter at breast height (DBH) and with at least 60 percent canopy cover.

Prior to the Megram Fire, there were approximately 33,215 acres (36 percent) of NR habitat within the HLMTT area. Foraging habitat comprised approximately 11,843 acres (13 percent) of the habitat within the analysis area. Specific to the SRNF land base, NR habitat comprised approximately 49 percent of the HLMTT area and 18 percent of the area was classified as foraging habitat. Capable (e.g. foraging and dispersal) habitat is defined as stands with the capability of becoming suitable habitat. Specific to the SRNF land base, 52,172 acres (80 percent) of the HLMTT area is capable habitat. Table 3-40 displays the NSO habitat by type and ownership.

Table 3-40. Northern Spotted Owl Habitat Prior to Megram Fire within the HLMTT Area

Habitat Type	SRNF	Hoopa	Private
Foraging	11,570	233	40
Nesting/Roosting	32,282	834	99
Unsuitable	21,685	25,085	159
Total NSO Habitat	43,852	1,067	134
Total Acres	65,689	26,152	297

Approximately 50,830 acres of the HLMTT area is within LSR 305. Prior to the Megram Fire, the portion of LSR 305 within the analysis area provided approximately 26,780 acres of NR habitat and 9,750 acres of foraging habitat for northern spotted owls (Figure 3-18). Within the analysis area, approximately 50,830 acres are designated as critical habitat for the northern spotted owl (CHU CA-30).

There are 33 known NSO activity centers within the HLMTT area. Surveys have been conducted in select portions of the watersheds for timber sales and prescribed underburning projects between 1977 and 1999. Surveys prior to 1991 may not have been to protocol.

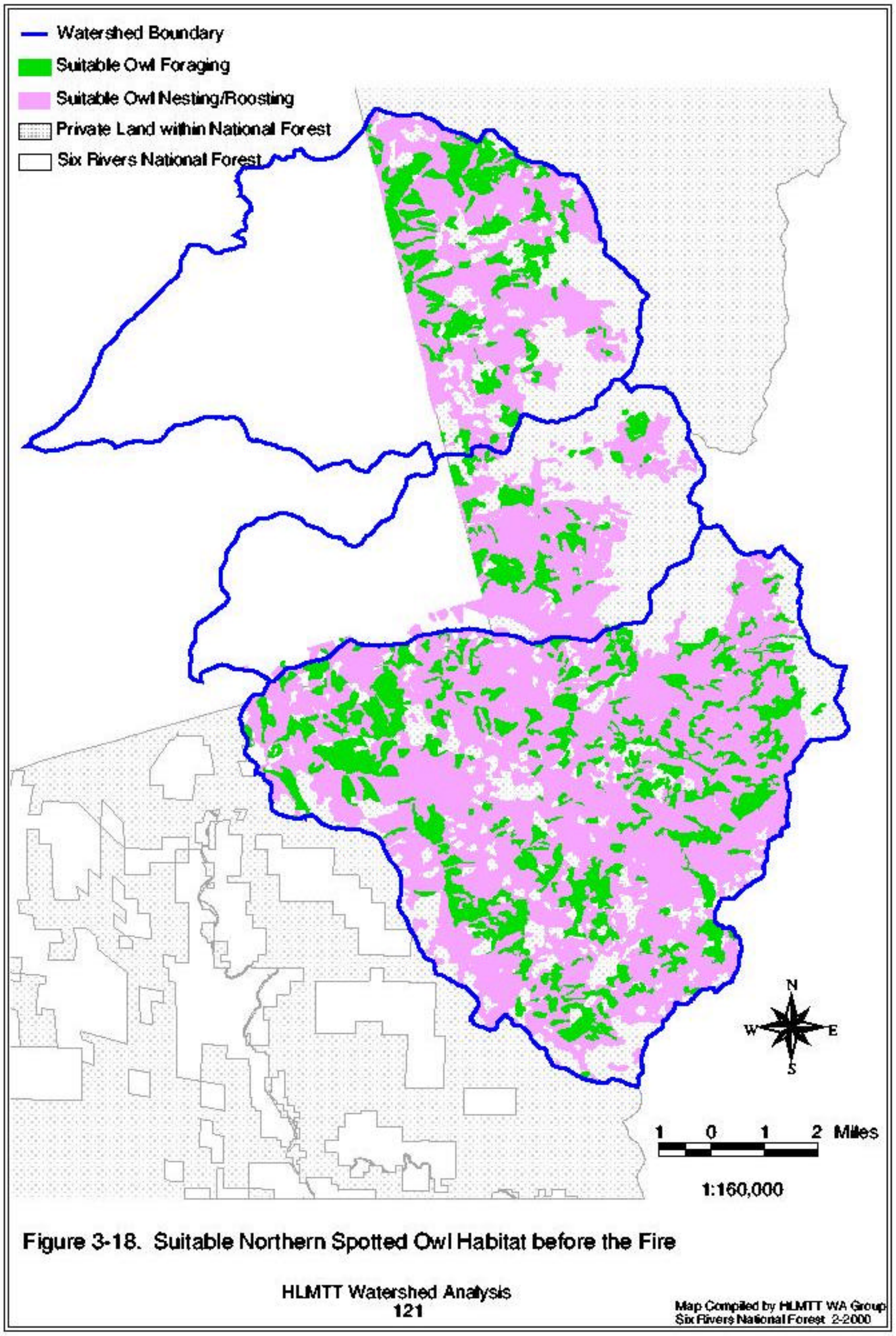
The USFWS considers an owl territory to be “taken” when the amount of nesting, roosting, and foraging (NRF) habitat drops below 500 acres within 0.7-mile radius around the activity center and 1,340 acres within a 1.3-mile radius circle. Table 3-41 displays results of the preliminary take assessments for the 33 activity centers located within the watershed analysis boundary prior to the Megram Fire.

Table 3-41. Assessment of NR and NRF Habitat for NSO Activity Centers (AC) within the HLMTT Area Prior to the Megram Fire

Total Number of ACs	# AC > 500 acres NR within 0.7 Miles	# AC > 500 acres NRF within 0.7 Miles	# AC > 1,340 acres NR within 1.3 Miles	# AC >1,340 acres NRF within 1.3 Miles
33	16	30	25	31

In the past, the Forest was required to analyze dispersal habitat for NSO using the “50-11-40” rule. This rule stated that 50 percent of each quarter township (9 square miles) must have forest conditions equivalent to 11-inch dbh trees with 40 percent canopy closure or better for adequate spotted owl dispersal. Although the 50-11-40 rule is no longer required, preliminary assessments indicate that the area was not deficit in dispersal habitat prior to the Megram Fire. There were approximately 49,055 acres of dispersal habitat for the NSO in the HLMTT area.

Figure 3-18. **Suitable NSO Habitat before the Fire:**



Prior to the Megram Fire, the preliminary take assessments for the activity centers located within the HLMTT area determined that 17 activity centers were below the “take” threshold within the 0.7-mile radius and 8 activity centers were also below the “take” threshold within the 1.3-mile radius. One activity center is deficient only in the 1.3-mile radius. Fifteen activity centers are above the “take” threshold completely. Table 3-42 summarizes the NSO assessment of suitable habitat within activity centers.

Table 3-42. Acres of Suitable NSO Habitat within 0.7 and 1.3 Miles of Known Activity Centers in the HLMTT Area Prior to the Megram Fire

Owl Number	Territory Name	NR Acres 0.7 Mile	F Acres 0.7 Mile	Total NRF Acres	NR Acres 1.3 Mile	F Acres 1.3 Mile	Total NRF Acres	Status P: Pair T:Single
106	NF Mill Creek	545	303	848	1,428	1,009	2,437	P
107	Mill Crk Gap	523	51	574	1,258	521	1,779	T
108	Middle Fork	214	68	282	1,356	168	1,524	P
113	Mill Creek	445	70	515	1,030	374	1,404	P
114	Tish Tang Pt	200	132	332	800	348	1,148	P
115	SF Tish Tang	662	68	730	2,281	418	2,699	T
116	Tish Tang East	807	50	857	2,242	545	2,787	P
117	Tish Tang C	473	219	692	1,418	521	1,939	P
118	C Lone Pine	641	243	884	1,719	1,042	2,761	T
119	W Lone Pine	521	283	804	1,613	903	2,516	P
120	McKay Mdws	347	14	361	1,149	195	1,344	T
121	Ladder Rock	622	178	800	1,828	540	2,368	T
122	Grizzly Camp	348	247	595	1,209	535	1,744	P
123	EF Horse Linto	483	208	691	1,547	682	2,229	P
124	E Lone Pine	419	371	790	1,982	718	2,700	T
125	Cedar Creek	541	200	741	1,882	574	2,456	P
126	Groves Prairie	439	287	726	1,530	832	2,362	P
127	E Cedar Creek	624	196	820	1,977	737	2,714	P
128	S Cedar Creek	386	352	738	1,342	705	2,047	P
130	N Waterman	393	306	699	1,336	1,149	2,485	P
131	Horse Range C	711	166	877	2,240	428	2,668	P
132	Horse Creek	561	88	649	2,250	321	2,571	P
133	W Maple Sprg	328	296	624	1,222	1,367	2,589	T
134	E Waterman	460	237	697	1,644	543	2,187	P
135	Horse Range	478	309	787	1,712	987	2,699	P
136	C Waterman	438	78	516	1,403	514	1,917	P
137	S Waterman	665	71	736	1,655	593	2,248	P
273	Corral South	590	174	764	2,345	451	2,796	T
274	Corral North	639	168	807	1,914	472	2,386	T
275	Bear Hole	214	27	241	1,018	266	1,284	P
319	G Praire Crk	406	288	694	1,477	805	2,282	T
335	Horse Linto	721	160	881	2,289	560	2,849	T
358	W Horse Rg	652	59	711	2,123	466	2,589	T

Habitat conditions have been altered greatly by the recent Megram Fire, and this next section will focus on post-fire conditions. The current habitat conditions have been derived from aerial photograph interpretation and a limited amount of field verification. The fire severity mapping was utilized to assess the impacts to spotted owl habitat post Megram fire. A description of the severity mapping categories is displayed within this chapter under “Fire Effects to Vegetation” within the section entitled “Fire Severity. Basically, habitat that is in burn severity categories 3, 4a and 4b is classified as unsuitable due to canopy closure losses of 60-95 percent. However, where moderate severity occurred (2a), within nesting/roosting habitat, the habitat was reclassified as foraging due to the effects of 40 to 60 percent canopy loss. Within the 0–2 severity categories, which experienced 0-40 percent canopy loss, nesting, roosting and foraging habitat remains as classification prior to the Megram fir. The acreages of habitat degraded by the Megram Fire are expected to change as future mortality occurs and with ground validation. This analysis is intended to be utilized as a tool to capture the conditions as they presently exist.
After the Megram Fire, there are approximately 20,241 acres (22 percent) of NR habitat within the analysis area, which represents a reduction of 14 percent due to the fire. Foraging habitat comprises approximately 14,883 acres (16 percent) of the habitat within the analysis area, which represents an increase of 3 percent (degraded NR habitat now qualifies as foraging habitat). Specific to the SRNF land base, NR habitat comprises approximately 29 percent of the HLMTT area and 22 percent of the area is classified as foraging habitat. Table 3-43 and Figure 3-19 display NSO habitat post-Megram Fire. Table 3-44 displays the “take” assessment for the activity centers in the analysis area post-Megram Fire.

Table 3-43. Northern Spotted Owl Habitat Post-Megram Fire within the HLMTT Area

Habitat Type	SRNF	Hoopa	Private
Foraging	14,611	232	40
Nesting/Roosting	19,317	825	99
Total NSO Habitat	33,923	1,057	134
Unsuitable	31,609	25,095	159
Total Acres	65,689	26,152	297

Figure 3-19. **Suitable NSO Habitat after the Megram Fire:**

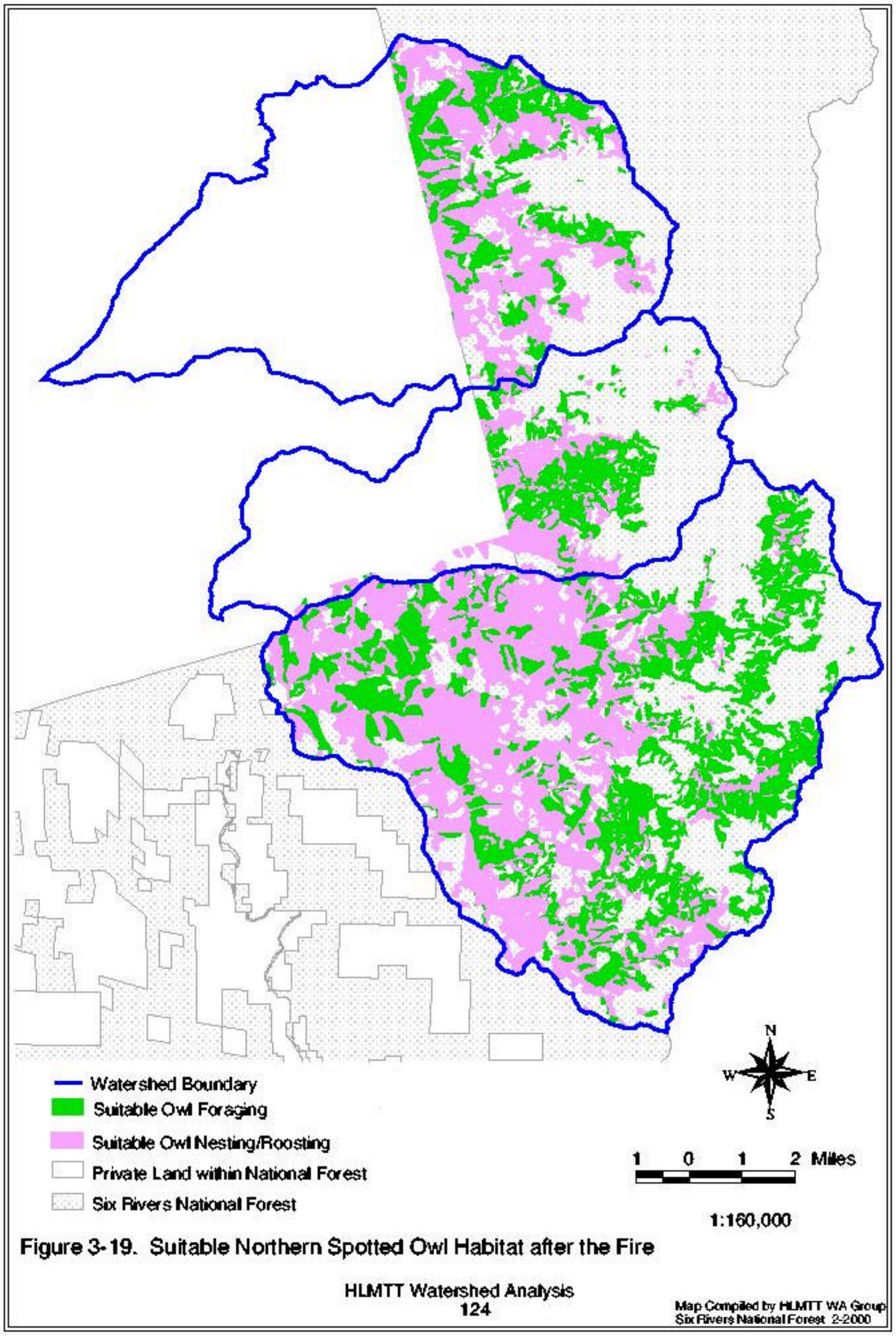


Figure 3-19. Suitable Northern Spotted Owl Habitat after the Fire

Table 3-44. Acres of Suitable NSO Habitat within Known Activity Centers in the HLMTT Area after the Megram Fire

Owl Number	Territory Name	NR Acres 0.7 Mile	F Acres 0.7 Mile	Total NRF Acres	NR Acres 1.3 Mile	F Acres 1.3 Mile	Total NRF Acres	Status[1]
106	NF Mill Creek	360	349	709	895	943	1,838	P
107	Mill Crk Gap	513	51	564	1,213	519	1,732	T
108	Middle Fork	214	68	282	957	441	1,398	P
113	Mill Creek	445	70	515	1,030	374	1,404	P
114	Tish Tang Pt	160	145	305	714	333	1,047	P
115	SF Tish Tang	509	126	635	1,600	560	2,160	T
116	Tish Tang East	807	50	857	2,180	596	2,776	P
117	Tish Tang C	472	219	691	1,412	520	1,932	P
118	C Lone Pine	641	243	884	1,714	1,042	2,756	T
119	W Lone Pine	521	282	803	1,610	902	2,512	P
120	Mckay Mdws	32	253	285	163	740	903	T
121	Ladder Rock	97	239	336	362	795	1,157	T
122	Grizzly Camp	0	108	108	20	422	442	P
123	EF Horse Linto	4	323	327	166	851	1,017	P
124	E Lone Pine	177	583	760	751	1,263	2,014	T
125	Cedar Creek	222	390	612	822	991	1,813	P
126	Groves Prairie	260	395	655	783	1,283	2,066	P
127	E Cedar Creek	404	269	673	978	968	1,946	P
128	S Cedar Creek	337	353	690	995	841	1,836	P
130	N Waterman	386	306	692	1,324	1,151	2,475	P
131	Horse Range C	711	166	877	2,209	443	2,652	P
132	Horse Creek	514	118	632	2,004	305	2,309	P
133	W Maple Sprg	327	297	624	1,216	1,371	2,587	T
134	E Waterman	458	237	695	1,603	520	2,123	P
135	Horse range	434	306	740	1,217	1,073	2,290	P
136	C Waterman	428	80	508	1,375	472	1,847	P
137	S Waterman	640	69	709	1,576	556	2,132	P
273	Corral South	572	186	758	1,890	546	2,436	T
274	Corral North	348	152	500	1,133	528	1,661	T
275	Bear Hole	84	93	177	311	618	929	P
319	G Prairie Creek	392	279	671	1,333	843	2,176	T
335	Horse Linto	175	183	358	641	920	1,561	T
358	W Horse Ridge	619	84	703	1,997	468	2,465	T

[1]Reproductive Status; T=Territorial single; P=pair

After the Megram Fire, the preliminary take assessments for the activity centers located within the analysis area have determined that 23 activity centers are below the “take” threshold within the 0.7-mile radius, and 21 activity centers were also below the “take” threshold within the 1.3-mile radius. Only one activity center is deficient in the 1.3-mile radius. Nine activity centers are above the “take” threshold completely. Dispersal habitat was also determined utilizing the 50-11-40 rule. Presently there are approximately 37,557 acres of dispersal habitat for the NSO within the analysis area. Although the 50-11-40 rule is no longer required, preliminary assessments indicate the analysis area is not deficient in dispersal habitat post Megram Fire. Table 3-45 summarizes the NSO assessment of suitable habitat within activity centers for both pre- and post-fire habitat conditions.

Table 3-45. Comparison of NR and NRF Habitat for NSO Activity Centers (AC) within the HLMTT Area Pre- and Post-Megram Fire

Time Period	Total # AC	# AC > 500 acres NR within 0.7 Miles	# AC > 500 acres NRF within 0.7 Miles	# AC > 1,340 acres NR within 1.3 Miles	# AC > 1,340 acres NRF within 1.3 Miles
Pre-Megram	33	16	30	25	31
Post Megram	33	10	25	11	27

Bald Eagle

There have been recorded observations of bald eagles within the analysis area. However, there are no historic nest sites and no bald eagles are known to be utilizing habitat for nesting within the watersheds.

Marbled Murrelet

There have been no detections of marbled murrelets in the HLMTT watersheds. Marbled murrelet habitat structural elements consist of large diameter nest trees with large lateral branches, decadent trees with mistletoe, deformations, and moss on limbs (Hammer and Nelson, 1995). These elements are typically found in mature forest stands, including mid to late successional and old growth stands.

Approximately 99 percent (64,976 acres) of the SRNF land in the analysis area lies within marbled murrelet Zone II (approximately 40 to 47 miles from the coast). A small portion (59 acres) lies within marbled murrelet zone I (coast to 40 miles inland). Approximately 35,300 acres have been designated by the USFWS as critical habitat within the analysis area (CHU CA-30). Intensive surveys have been conducted since 1998 in the HLMTT watersheds. In 1998 and 1999, extensive surveys were conducted in the analysis during Phase II of the Marbled Murrelet Range and Distribution Study. The study is in the final phase of completion and is focused on late-mature and old growth tanoak forest on the Lower Trinity and Orleans Ranger Districts, as well as portions of the Klamath National Forest and the Hoopa Valley Indian Reservation. The study yielded no detections of marbled murrelets within the analysis area or the entire study area.

Prior to the Megram Fire, the watersheds contained approximately 27,730 acres of suitable habitat for the marbled murrelet, with 14,648 acres on SRNF lands (Figure 3-20). The Megram Fire reduced the quantity of suitable habitat within the watersheds by approximately 5 percent, and 26,234 acres now remain suitable. Specific to the SRNF land base, there are currently 13,066 acres of suitable habitat, which represents a reduction of 11 percent. Figure 3-21 displays the distribution of suitable marbled murrelet habitat after the fire.

Forest Service Sensitive Species

U.S. Forest Service sensitive species, which include the northern goshawk, American marten, fisher, foothill yellow-legged frog, and the southern torrent salamander, are known to occur in the watershed analysis area. There are three known and three suspected goshawk territories in the analysis area. Singing males (willow flycatcher) have been reported within the analysis area, however, nesting has not been confirmed for this species on the Forest. While many of the streams contain willow and alder habitat, the wet meadow systems are not present in sufficient quantities to probably support this species. The large wet meadow systems needed by the great gray owl are not present within the analysis area, but are present to the west within the Trinity Alps Wilderness. It is unlikely that this species is present within the analysis area. Additional information on these species can be found in Appendix E.

Survey and Manage Species

A number of survey and manage and/or wildlife protection buffer species are known or suspected to occur in the analysis area. Known occurrences include the Del Norte salamander, Oregon shoulderband snail, Klamath shoulderband snail, Church's sideband snail, Pressley hesperian snail, papillose tail-dropper snail, and one ROD Protection Buffer Species – *Ancotrema voyanum*. Surveys for the following species are required within the analysis area:
Del Norte salamander, Oregon shoulderband snail, Pressley hesperian snail, Tehama chaparral snail, Shasta chaparral snail, and the Papillose tail-dropper snail. Locations have been determined primarily by surveys associated with proposed management activities. The specific extent of the above species' range within the analysis is currently unknown. The high burn severity categories are representative of areas which canopy closures have been reduced by 70 to 95 percent. Within these areas, the micro habitat conditions needed by S&M species have been removed and/or altered to a significant degree. The midstory and overstory canopy components have been lost which protected animals from extreme fluctuations in temperature and humidity. The exposure to hot and dry conditions as a result of the loss of forest canopy and the loss of micro habitat conditions greatly reduce the probabilities for species persistence and population viability. The majority of the above listed S&M species are vulnerable to wildfire even at low intensity levels. The effect of the Megram Fire on these species as of this time is yet to be determined in the absence of monitoring data after the fire. It is expected that species were consumed in the areas of high fire intensity; however, species may have survived in adjacent areas of unburned habitat or areas with low to moderate burn intensities.

Bats

Many species of bats are suspected to occur in these watersheds. There is little information on caves or mine shafts within the HLMTT watersheds, and limited information on abandoned buildings or bridges that may provide suitable breeding or roosting sites. No surveys for bats

Figure 3-20. **Suitable Marbled Murrelet Habitat before the Megram Fire:**

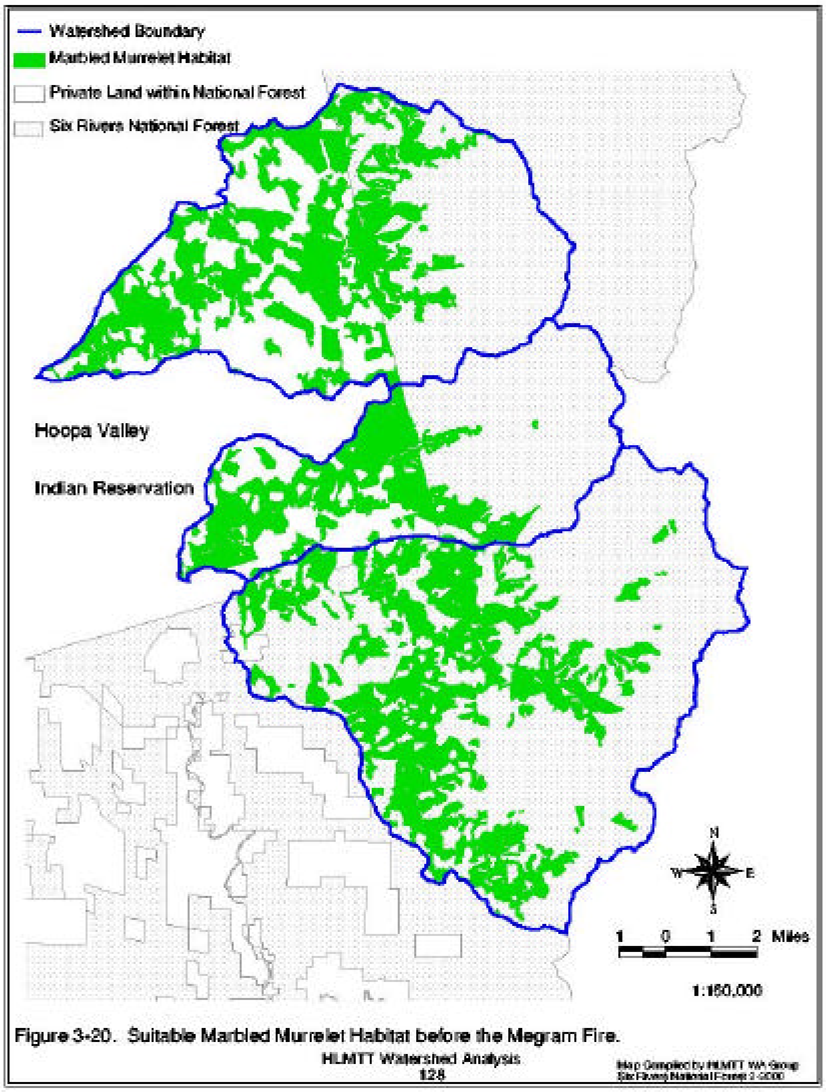


Figure 3-20. Suitable Marbled Murrelet Habitat before the Megram Fire.
HLMTT Watershed Analysis
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Figure 3-21. ***Sui*****table Marbled Murrelet Habitat after the Megram Fire:**

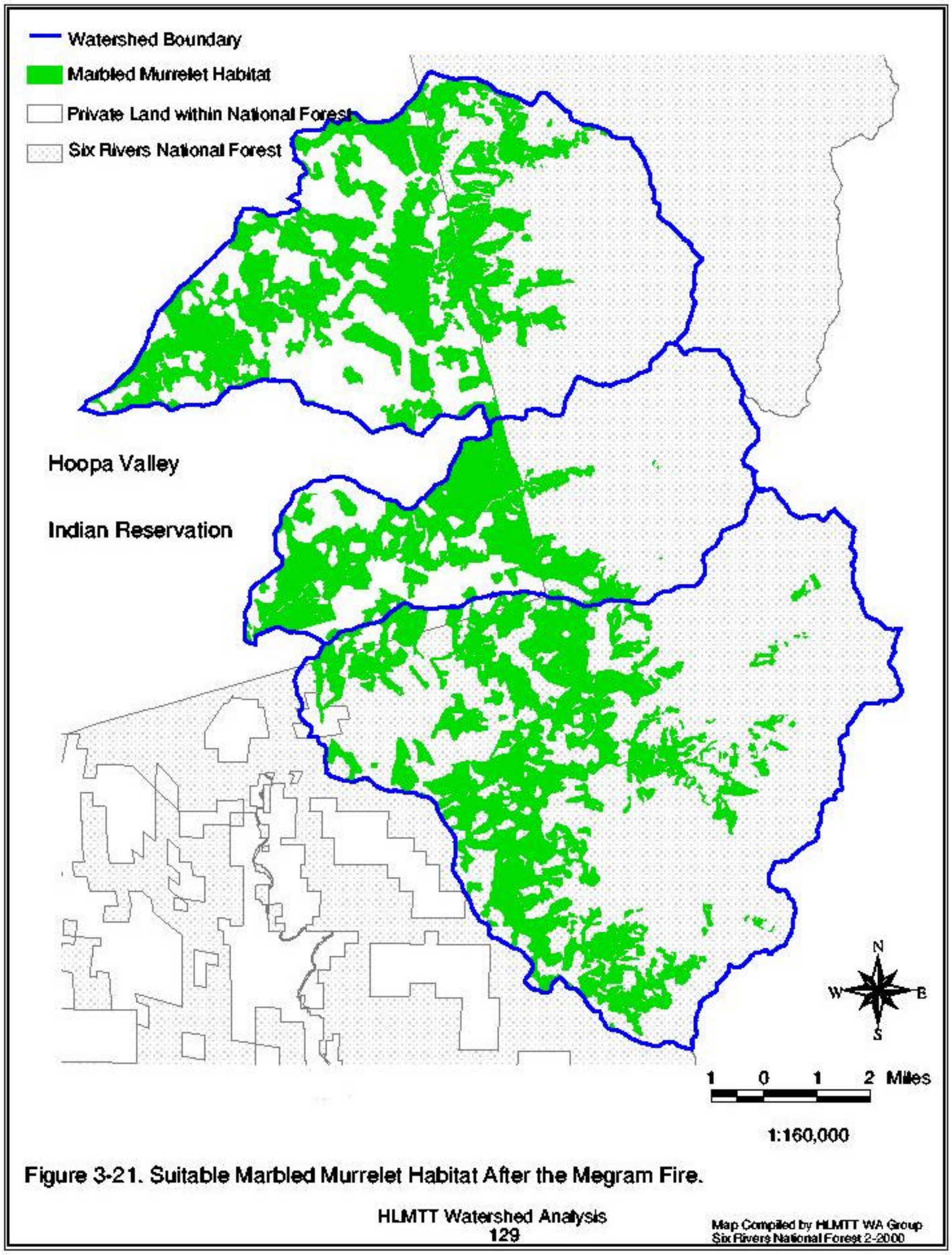


Figure 3-21. Suitable Marbled Murrelet Habitat After the Megram Fire.

have occurred within the analysis area. Snags probably provide the primary bat roosting habitat in these watersheds. See Appendix E for life histories and habitat discussions.

Herpetofauna

There are known occurrences of the foothill yellow-legged frog, southern torrent salamander, and the Del Norte salamander in the watershed analysis area. Other special status species listed in Appendix E are suspected in the watersheds. In addition, the Pacific Southwest Redwood Sciences Laboratory has monitored several populations of Del Norte salamanders since the early 1980s. Due to the recent wildfire, riparian vegetation needed by frogs, salamanders and pond turtles has been reduced to a high degree in localized areas that burned with high intensities.

Harvest Species

The Redwood Creek black-tailed deer herd utilize habitat within the watershed analysis area. The summer range is generally characterized by habitat over 4,000 feet in elevation. Key fawning areas include portions of the Horse Linto, Mill Creek and Tish Tang Creek drainages. No key deer areas have been identified within the analysis area. The Le Perron Peak Key Deer Area lies approximately two to three miles north of the analysis area. Only one wintering area has been identified within the analysis area. The Tish Tang deer wintering area lies within the southeast corner of the Hoopa Valley Indian Reservation and portions of this wintering area lie within the SRNF boundary. The Tish Tang wintering area was not affected by the Megram Fire. Due to the fire, an abundance of early seral-stage habitat will be available for forage in the near future. Currently the Redwood Creek herd has been in a slow decline in population since the mid to late 1970s.

There have been several incidental sightings of Roosevelt elk in recent years. The analysis area is within close proximity to several established herds (Marbled Mountain Herd, Trinity Alps Herd, and the Lewiston Herd) and expansion of the herds within the area is the near future is probable. Black bear, quail (California and mountain), blue grouse and band-tailed pigeons are also hunted in the watershed analysis area.

Special Habitats

Many special habitats occur within the HLMTT watershed analysis area (Figure 3-22). These include wetlands, springs, ponds, meadows, cliffs, talus slopes, and hardwood stands. These habitats may support endemic or rare wildlife species in the watershed. However, little is has been done to adequately survey these areas. Therefore, the status of these sites and potentially associated species is unknown.

In 1991, the Six Rivers National Forest wildlife department mapped the location of many special habitats across the Forest from aerial photographs (Figure 3-22). Many small areas such as bogs and springs may not have been visible, and are most likely underrepresented. Additional information on these assemblages can be found in Appendix E.

Figure 3-22. **Special Habitats in the HLMTT Area:**

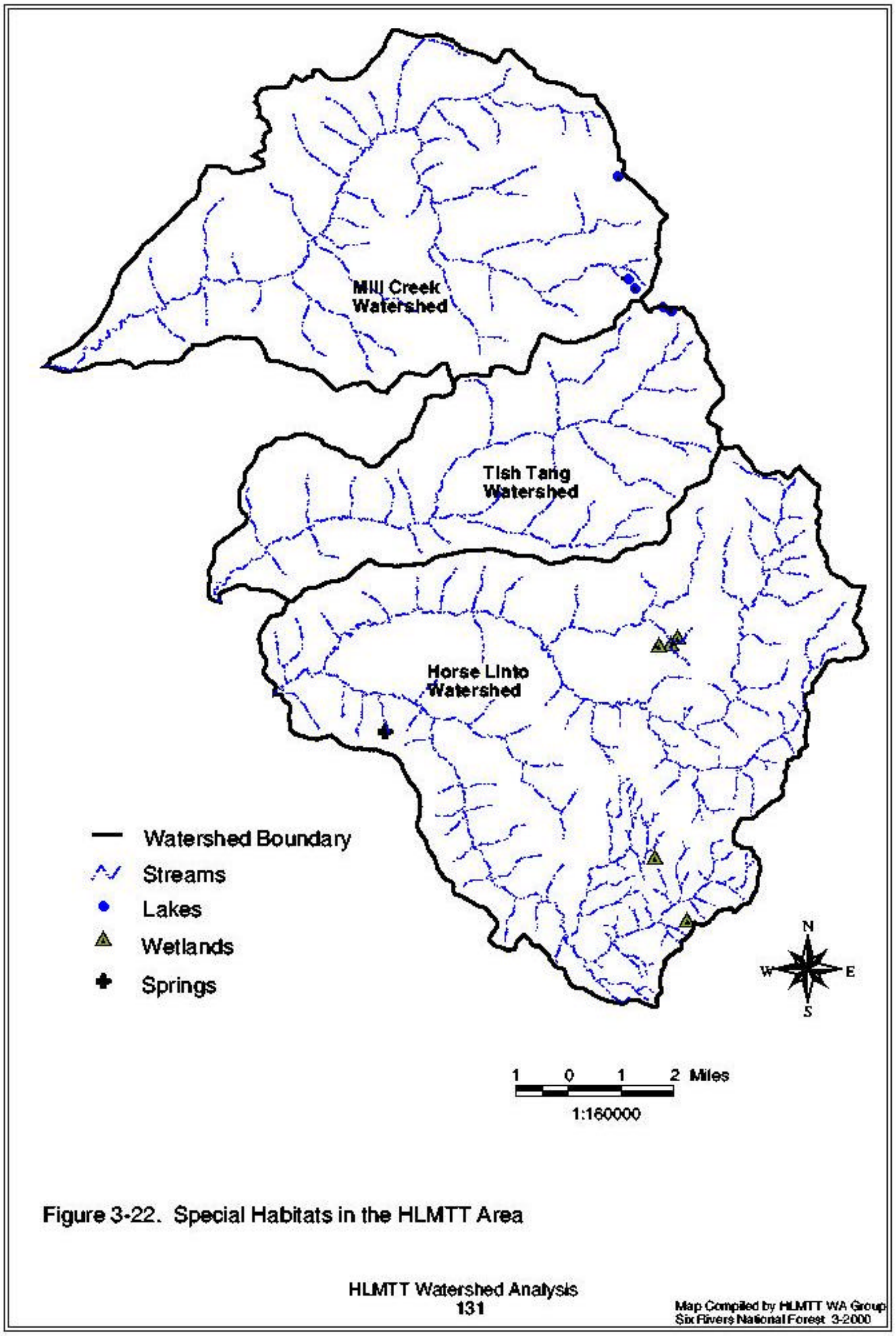


Figure 3-22. Special Habitats in the HLMTT Area

Riparian and Aquatic Systems

This section addresses water quality, riparian and aquatic habitat quality, and the species dependent on this habitat, as well as how these values are affected by erosion processes and other disturbance regimes. **R*eference conditions*** describe riparian and aquatic conditions within the probable range that existed prior to current land management activities. Estimating the full range or reference variability of those conditions can be very important in making informed land management decisions. The following descriptions of reference conditions are often derived from qualitative professional judgment where quantitative data about the analysis area are lacking. The discussion is often based on anecdotal information, general knowledge of ecosystem processes and function, general knowledge of the affected species, and visual evidence from old aerial photos. ***Current conditions*** are based on the best available data for the analysis area, including direct knowledge of relevant physical and biological functions and the affected species.

Hydrologic Context within Klamath-Trinity River Basin

The Klamath-Trinity Basin has experienced considerable land use change during the last 135 years. Mining and logging have affected streams throughout the basin. Hydraulic mining drastically altered channels and floodplains in many areas. Pulp mill effluent created additional water quality impacts. Irrigated agriculture, grazing and hydropower development also have occurred in the basin over the last 50 years. All of these disturbances represent a significant departure from conditions that existed prior to European settlement.

Natural flow regimes in the Klamath-Trinity Basin began to be altered with the construction of large dams on both mainstems in the early 1960s. Large inter-basin diversions from the Lewiston Dam on the mainstem Trinity River have significantly influenced its flow regime and consequently impacted the aquatic community, particularly anadromous fish populations. These impacts are most evident near the dam where natural flows have been greatly altered in terms of volume and timing. In contrast to the Trinity River, flows in the Klamath River have been altered primarily in terms of seasonal duration rather than total annual discharge. The altered flow regimes in both the Trinity and Klamath Rivers have affected seasonal stream flows and water temperatures. These changes have altered habitat conditions within the river and are thought to have affected both downstream and upstream migration of anadromous salmonids.

Erosion Processes

The landscape of the analysis area is typical of the Klamath Mountains, although somewhat unusual for the Six Rivers National Forest in that about one-third is an upland surface that has been glaciated and gradually eroded, while the lower two-thirds of these watersheds has been dissected by deep stream canyons. This is largely due to contrasting bedrock characteristics in the upper and lower watersheds. The present erosion regimes also differ considerably between the upper and lower watersheds, with sediment delivery being much higher in the lower watersheds due to mass wasting.

Geologic Setting

There are two major geologic units plus a third minor unit that underlie the HLMTT analysis area. The distribution of geomorphic units over the bedrock geology is also shown in Figure 3-23, and the units are described below. The geomorphology of the analysis area was interpreted and mapped from 1:24,000 color aerial photos. Geomorphic units are defined in terms of process types and landforms (Haskins et al., 1998). The mapping area covered Horse Linto, Tish Tang and upper Mill Creek, but geomorphology was not mapped in lower Mill Creek on the Hoopa Valley Indian Reservation.

Bedrock Units

Galice Formation metasedimentary rocks (principally slate and phyllite) underlie 37 percent of the analysis area in the lower watersheds. This unit comprises a somewhat greater proportion of Mill Creek and a lesser proportion of Tish Tang Creek. Galice terrane contains extensive ancient landslide deposits (19 percent of its area) and is susceptible to debris slides and accelerated gully erosion.

Igneous rock (principally diorite) underlies 60 percent of the analysis area in the upper watersheds. It appears to be relatively massive with moderate jointing and tends to support rugged terrain in the upper river canyons and uppermost glacial headwall areas. Old landslide deposits are much less common than in the Galice (only 3 percent of the diorite area) while steep headwalls and rockslide areas are much more common (16 percent of its area). About three percent of the diorite terrane is mantled by glacial deposits (moraines and outwash) that are relatively coarse grained and well drained. Dioritic terrane appears to be much less susceptible to historic landsliding, but its deeply weathered, non-cohesive soils tend to be very erodible even on moderate slopes.

Western Hayfork Terrane metasedimentary and metavolcanic rocks underlie three percent of the analysis area in a narrow zone along the Orleans Thrust Fault and in upper Horse Linto Creek. They are somewhat less prone to mass wasting than Galice rocks, but this unit does contain extensive older landslide deposits and headwall basins and is moderately erodible.

Geomorphic Units

Alluvium includes stream-deposited sediment within the active channel and floodplain.

Stream terrace deposits consist of older alluvium outside or above the present-day active channel that may be subject to erosion and remobilization during peak flows.

Alluvial fan deposits are localized at the mouths of some steep tributaries that have been subject to high mass wasting rates. Altogether, alluvial deposits cover about one percent of the analysis area, principally in the middle and lower sections of Tish Tang and Horse Linto Creeks.

Inner gorge is composed of steep slopes (generally >65 percent) adjacent to incised streams that are produced by coalescing debris slides. This tends to produce a noticeable break-in-slope at the top of the inner gorge. This landform was differentiated where it overlaps colluvial deposits. It includes about 3.5 percent of the mapping area.

Landslide deposits are translational types in the analysis area consisting of disrupted rock and soil. More coherent landslide masses are differentiated as block slides.

Landslide toe zones include the lowermost part of landslide deposits that are considered more susceptible to secondary mass failure due to their proximity to streams and typically more saturated condition.

Other colluvial deposits were mapped in the lower sections of headwall basins. Such deposits also tend to be more susceptible to secondary mass failure than the adjoining hillslopes. Altogether, unstable colluvial deposits cover about 6.2 percent of the mapping area.

Talus deposits were mapped below rockslide/rockfall areas. These areas are typically more stable than other colluvial deposits and comprise less than one percent of the mapping area.

Headwall basins are steep, generally concave slopes in the upper parts of some tributaries that have been formed by prolonged shallow mass wasting, in many cases inferred to be from a former, more intensive erosion regime. However, they are considered more susceptible to landsliding than comparably steep adjacent slopes. They comprise about 8.6 percent of the mapping area.

Rockslide/rockfall areas* and *rockslide/headwalls were mapped where very steep slopes and generally competent bedrock were exposed. These areas are fairly stable and do not produce much fine-grained sediment. They comprise about 4.3 percent of the mapping area.

Glacial headwalls are found along the Trinity Summit area. Most are comprised of steep, craggy exposed diorite. They comprise about 1.9 percent of the area.

Glacial deposits include moraines and outwash, and were mapped below most of the glacial headwall areas. They are comprised of poorly to moderately sorted sand, gravel and boulders that were deposited by glacial ice or meltwater, and cover about 1.9 percent of the mapping area.

Eroding hillslopes include the remaining terrain of the analysis area. These variable slopes are subject to sheetwash erosion, creep and minor localized mass movement. Their susceptibility to landsliding and erosion generally increases with slope steepness.

Landscape Evolution and Disturbance Regimes (Reference Conditions)

This landscape of deep canyons, steep slopes, relatively high energy streams, and widespread mass wasting has evolved over millions of years during which it has undergone catastrophic changes with long intervening periods (hundreds to thousands of years) of relative stability. Both large and small-scale physical disturbances have been an integral part of this evolution. During earlier glacial epochs, the terrain experienced especially intense erosion and mass

Figure 3-23. **Geomorphic Units and Bedrock Geology:**

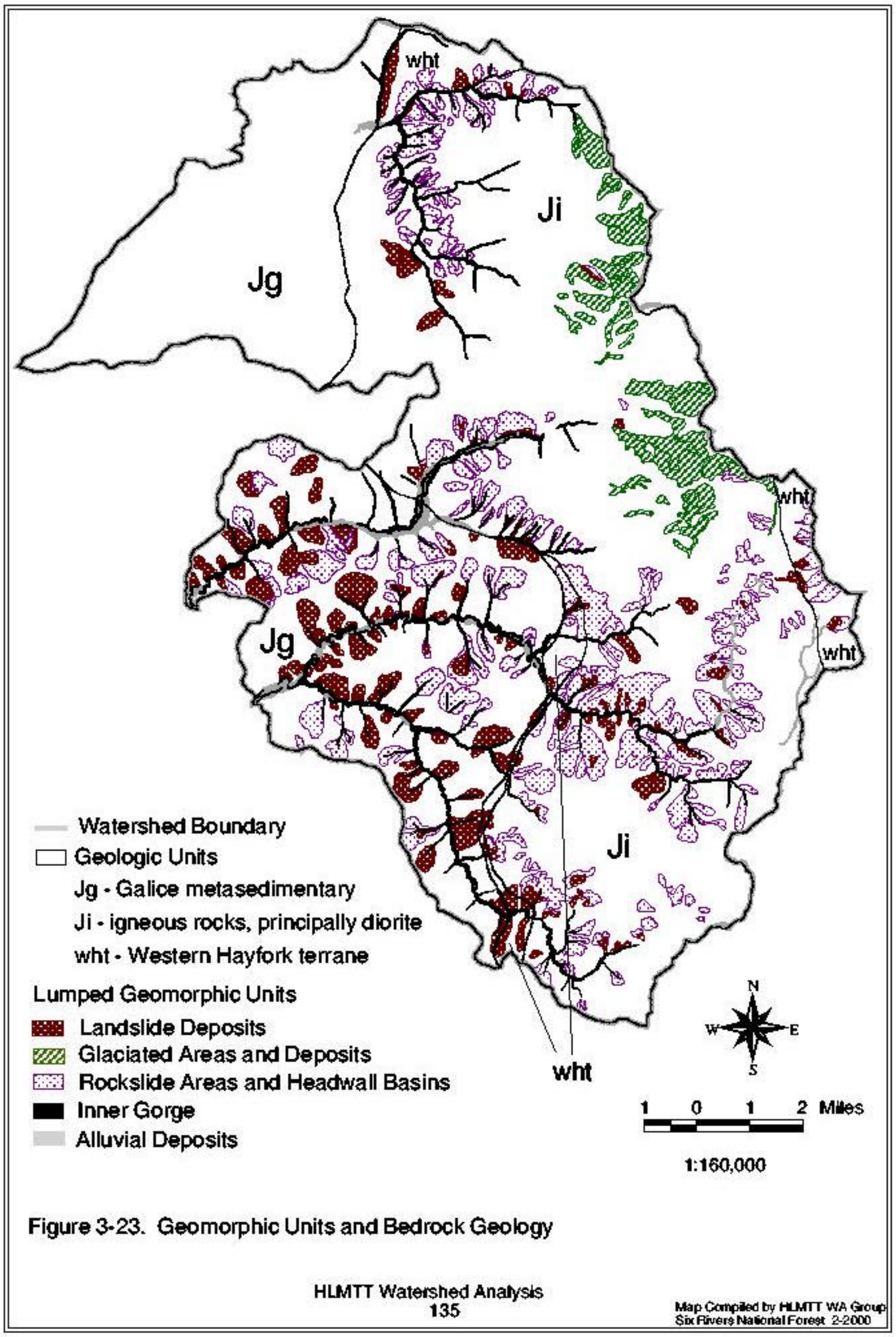


Figure 3-23. Geomorphic Units and Bedrock Geology

wasting which have left their imprints on the landscape as headwall basins and massive landslide scars.

Our short historical window only provides a limited sample of the full spectrum of disturbance. Two catastrophic, landslide-producing floods occurred during the historical period in 1861 and 1964, but other floods have also caused substantial erosion and mass wasting. Floods even greater than 1861 or 1964 undoubtedly occurred in prehistoric times; such extreme flood events are believed to have occurred in 1750 and 1600. Clearly, the reference condition for this region includes landsliding and sedimentation that were occasionally very widespread and caused drastic changes in riparian and aquatic ecosystems.

However, prehistoric conditions also would have included long intervals with relatively less active geomorphic processes. This would have been accompanied by relatively low sedimentation rates from landslides and erosion, and therefore would have provided long periods for riparian and aquatic systems to recover from catastrophic events. The distribution of disturbance would have been affected by variation in geologic and geomorphic sensitivity, because different bedrock units and landforms would have responded differently to extreme natural events.

Surface erosion has probably varied greatly across this landscape because of differences in soil and parent material, slope steepness and position, and vegetative cover. Mass wasting processes tend to accelerate erosion processes by abruptly altering all three of these conditions. In a geologically active setting such as this, the average rate of soil formation is probably only somewhat faster than natural erosion rates. On some sites such as old landslide benches and gentle uplands, deep soils have time to form and are protected from erosion, while on other sites such as old landslide scars, erosion persists and little or no soil development occurs. Wildfire has been a second complicating factor in the erosion history of the analysis area because it alters or removes the vegetation cover to some extent, and if very intense, may alter physical soil properties that cause short-term increases in surface erosion from rilling and gullying. Since intense fires have likely occurred in this area for millenia, locally high rates of erosion have occurred here prior to any human disturbance of the landscape.

Riparian and aquatic communities have adapted to these disturbance regimes and erosion processes. For extended periods, stable riparian and aquatic conditions would have resulted in high productivity and integrity of dependent communities, while at other times, these communities would have been struggling to recover from recent disturbances.

Pre-Management Conditions

The 1944 aerial photos predate most human disturbance of the area and show relatively unaltered landscape conditions with respect to erosion processes. Prior to 1944, the area was occupied by Native Americans and turn-of-the century miners. Their use of these lands probably had relatively minor impacts on erosion processes. Forest Service road construction and timber harvest did not begin until the 1950s.

Recent landslide scars constitute the principal evidence of erosion on the 1944 aerial photos. Only the Horse Linto and Tish Tang watersheds were inventoried for landslides. However, landslide occurrence in Mill Creek is probably very similar to that in Tish Tang Creek (Pacific

Watershed Associates, 1990 and 1995). A total of 164 features (132 in Horse Linto and 32 in Tish Tang) were present of which 58 percent were smaller than one acre while 9 percent were larger than 3 acres. Active landslides were estimated to cover about 220 acres or 0.4 percent of the analysis area. Slides were most common along the middle to lower mainstem of both creeks and predominantly in lower slope (inner gorge) positions. Half of the slides in Tish Tang Creek and 85 percent of those in Horse Linto had delivered sediment directly to streams and could have had some adverse effects on aquatic or riparian habitats. Most of these slides also appeared to be ongoing sources of sediment from surface erosion, but this was probably only a small fraction of the sediment delivered by the original slope failure.

Many dormant landslide features were present in the analysis area since prehistoric times and also can be seen on the 1944 aerial photos. They are more numerous and cover more area than the historically active landslides, indicating that prolonged landsliding has shaped the landscape. Active landsliding is often spatially associated with older landslide deposits because the colluvium typically forms less competent slopes and more readily entrains water during major storms that favors slope failure. Although only one-sixth of the active slides observed in 1944 were associated with older landslide terrain, they accounted for 43 percent of estimated total sediment delivery up to that time.

Dormant landslide deposits underlie about seven percent of the analysis area (ranging from 3.5 percent in Mill Creek to 9 percent in Horse Linto Creek). Dormant shallow landslides (including many headwall basins) are more widespread throughout the steeper terrain of these watersheds, ranging from 12 percent of Mill and Tish Tang watersheds to 17 percent of Horse Linto. Shallow landsliding has probably been a more common mass wasting process in these watersheds than current mapping indicates because smaller debris slides are more quickly obscured by vegetation. Over long time frames, deep-seated landsliding may have a more profound effect on the total landscape, but shallow landsliding is a more effective and frequent mechanism for delivering sediment and debris to stream channels.

Current Conditions for Erosion Processes

Extensive areas of resistant bedrock as well as other areas of relatively unstable and erodible terrane underlie the analysis area. Therefore, erosion rates are also quite variable across this landscape. Total erosion rates are a combination of surface erosion and mass wasting processes. Based on previous erosion studies in northwest California, it can be assumed that mass wasting processes have been far more important volumetrically than surface erosion in most of this analysis area over the long term. However, the recent Megram Fire represents an extreme short-term change in erosion rates for a substantial fraction of the Horse Linto watershed and a moderate fraction of the Tish Tang and Mill Creek watersheds.

Surface Erosion

Surface erosion involves the removal and downslope transport of soil particles from the soil surface by sheet or rill erosion. The highest surface erosion rates have probably been associated with active gullying in finer-grained or weakly cohesive units including some of the Galice metasediments and deeply weathered diorite, as well as steep headwall areas and poorly revegetated landslide scars. Surface erosion rates before and after the Megram Fire were calculated for the three watersheds using the Universal Soil Loss Equation (USLE) with the Order III Soils coverage. Pre-fire surface erosion estimates are shown in Table 3-46.

Table 3-46. Estimated Pre-Fire Surface Erosion Rates

Watershed	Surface Erosion (tons/year)	Erosion Rate (tons/acre/year)
Horse Linto	1180	0.03
Tish Tang	371	0.02
Mill Creek	495	0.02

The Horse Linto watershed contains the more erodible soils, which is reflected in the higher background surface erosion rate. It also has the largest area, resulting in a predicted background delivery rate of 1180 tons per year.

Mass Wasting

Storm events and land management have had important erosion effects in the analysis area. Three large storm/flood events occurred between 1960 and 1975, including the 1964 flood that caused widespread landsliding throughout Northern California, as well as lesser storms in 1972 and 1975. These disturbances had dramatic impacts throughout the analysis area. Prior to and during this period, road building and timber harvesting had occurred throughout the lower watersheds. When the storms occurred, slopes that had been clearcut or on which roads had been constructed were more susceptible to mass wasting processes than other undisturbed slopes. Previous sedimentation studies for the Hoopa Tribe Forestry Department (Pacific Watershed Associates, 1990 & 1995) provide a wealth of data on road-related mass wasting in Tish Tang and Mill Creeks.

An inventory and chronology of historically active landslides was prepared for this watershed analysis to evaluate sediment volumes mobilized by mass wasting. The entire watersheds of Tish Tang and Horse Linto Creeks were included, while Mill Creek was omitted. The analysis consisted of examining 1944, 1960, 1975, 1990 and 1998 aerial photos that bracket the major floods that have most affected the area. The following attributes were recorded for each identified landslide:

- estimated size in acres
- landslide type (shallow or deep-seated)
- management influence (Forest or County road, harvest, cumulative or natural)
- hillslope position (upper, midslope or streamside)
- apparent or inferred percent delivery to streams
- notable aggradation response downstream
- change from previous airphoto year, including estimated enlargement

Volumes of each slide were calculated from the estimated area by adapting a relationship developed in Grouse Creek for shallow debris slides. Sediment delivery in tons was then calculated from the estimated percent delivery and a density conversion factor of 1.6 tons per cubic yard (cy). These estimates, especially when summed for the various categories discussed below, are considered accurate to ±30 percent. A number of conclusions can be drawn from the resulting data.

General Trends and Management Influences

As noted earlier, there were 164 active landslides within the two watersheds in 1944. By 1998, 385 additional landslides had occurred, all but 31 of which had appeared by 1975. Total sediment delivered from all 549 landslides was estimated at 7,877,000 tons (Table 3-47). Approximately 17 percent (1,346,100 tons) was delivered before 1944, which is a smaller proportion than has been found in other watersheds on the Six Rivers where landslide inventories have been done. Large fractions of total sediment delivered by landslides occurred during the period 1960-1975, including 60 percent of the total in Horse Linto Creek and 82 percent in Tish Tang Creek. Sediment delivery from landslides appears to have been much lower since that time, despite the occurrence of several large winter storms including the January 1997 storm. Of the 6,531,000 tons delivered after 1944, about three-quarters was the result of new landslides and one-quarter was due to enlargement of older slides.

Table 3-47. Landslide Trends and Estimated Sediment Delivery in Tish Tang and Horse Linto Creeks. Bold entries denote first appearance; other entries denote enlargement.

Tish Tang Creek: Total = 3,021,000 tons

Present in 1944		Appeared or Enlarged 1960		Appeared or Enlarged 1975		Appeared or Enlarged 1990		Appeared or Enlarged 1998	
Count	**Tons**	**Count**	**Tons**	**Count**	**Tons**	**Count**	**Tons**	**Count**	**Tons**
32	**251,700**	3	42,300	6	288,400	0	0	0	0
		16	**214,600**	6	71,200	1	900	0	0
				124	**2,111,900**	0	0	0	0
						8	**39,600**	**0**	**0**
32	**251,700 (8%)**	**16 /** 3	**256,900 (9%)**	**124 /** 12	**2,471,500 (82%)**	**8 /** 1	**40,500 (1%)**	**0 /** 0	**0**

Horse Linto Creek: Total = 4,856,000 tons

Present in 1944		Appeared or Enlarged 1960		Appeared or Enlarged 1975		Appeared or Enlarged 1990		Appeared or Enlarged 1998	
Count	**Tons**	**Count**	**Tons**	**Count**	**Tons**	**Count**	**Tons**	**Count**	**Tons**
132	**1,094,400**	5	132,300	30	541,700	3	132,000	1	800
		26	**472,900**	11	265,300	0	0	0	0
				188	**2,108,500**	1	7,500	0	0
						23	**93,400**	1	7,600
								0	**0**
132	**1,094,400 (22%)**	**26** / 5	**605,200 (12%)**	**188** / 41	**2,915,500 (60%)**	**23** / 4	**232,900 (5%)**	**0** / 2	**8,400 (<1%)**

A large majority of these landslides delivered some of their volume to a stream channel; the average estimated delivery rate was 78 percent. Approximately 38 percent of all active slides after

1944 were directly or indirectly related to management activities, based on aerial photo interpretation (i.e., proximity), while the remaining slides appeared to be due solely to natural causes. However, the patterns of occurrence and sediment delivery to stream channels were substantially different in the two watersheds. As shown in Tables 3-48 and 3-49, a much greater percentage of slides and tons of delivered sediment were associated with management in Tish Tang Creek than in Horse Linto Creek. This is also the case for sediment delivery after 1960, as well as after 1975 when management practices are thought to have improved.

Table 3-48. Landslide Delivery by Management Influence.

1944-98	Tish Tang Creek		Horse Linto Creek	
Influence	**Number**	**Tons Delivered**	**Number**	**Tons Delivered**
Mgmt-related	80 (55%)	1,870,800 (68%)	76 (28%)	704,700 (19%)
Natural	65 (45%)	897,000 (32%)	192 (72%)	3,057,200 (81%)
TOTAL	**145**	**2,767,800**	**269**	**3,761,900**

Table 3-49. Landslide Delivery by Management Influence and Year.

Tons Delivered	Tish Tang Creek		Horse Linto Creek	
Influence	**1960-98**	**1975-98**	**1960-98**	**1975-98**
Mgmt-related	1,769,600	26,500	677,900	100,700
Natural	742,200	14,900	2,471,600	122,300

Landslide occurrence and sediment production have also varied among the different geologic units in the analysis area. Overall, about half of the 437 slides that were active after 1944 and half of the sediment they delivered originated from Galice metasediments. The next most prolific landslide source terrane was colluvium, which accounted for a third of the sediment delivery from only one-fifth of the landslides. Colluvium has had a somewhat higher sediment delivery rate (tons/ac) than Galice metasediments in Tish Tang Creek and a much higher rate in Horse Linto Creek (Tables 3-50 and 3-51). Landslide incidence and sediment delivery was considerably lower throughout areas underlain by diorite and Western Hayfork Terrane. These data suggest that recognizing dormant landslide terrain as highly susceptible to shallow landsliding can have important benefits to reduce the adverse effects of management activity on sedimentation.

Table 3-50. Active Landslides by Geologic Unit in Tish Tang Creek, 1944-98

Geologic Unit	Acres in watershed	Number of Slides	Total Cu.Yds.	Cu.Yds. per acre	Tons Delivered	Tons per acre	tons/ac/yr
Colluvium	1,340	26	384,000	287	512,300	382	**7.1**
Galice metased	5,286	84	1,412,200	267	1,837,500	348	**6.4**
Diorite + W.Hayfork Terrane	12,533	45	375,700	30	418,900	33	**0.6**
TOTALS	**19,159**	**155**	**2,171,900**	**113**	**2,768,700**	**145**	**2.7**

Table 3-51. Active Landslides by Geologic Unit in Horse Linto Creek, 1944-98

Geologic Unit	Acres in watershed	Number of Slides	Total Cu.Yds.	Cu.Yds. per acre	Tons Delivered	Tons per acre	tons/ac/yr
Colluvium	3,705	56	1,595,400	431	1,718,800	464	**8.6**
Galice metased	12,338	121	1,235,400	100	1,550,000	126	**2.3**
Diorite + W.Hayfork Terrane	26,027	105	396,100	15	493,100	19	**0.4**
TOTALS	**42,070**	**282**	**3,226,900**	**77**	**3,761,900**	**89**	**1.7**

Pre-1944 slides were most abundant in the diorite and Western Hayfork Terrane, although nearly all the largest delivered volumes originated from Galice metasediments and colluvium. After 1944, both the majority of slides and the bulk of delivered sediment were associated with the latter two units.

Effects of the Megram Fire on Erosion Processes

Fire is a natural and important part of the disturbance regime in forested ecosystems, but scientists disagree about the nature and degree of both its beneficial and adverse effects on watershed condition and health. The effects of fire on erosion principally result from the destruction of ground cover that exposes mineral soil that is then subjected to increased overland flow and raindrop impact. Severely burned areas typically experience higher rates of soil erosion, increased peak runoff, greater duff reduction, loss of soil nutrients and soil heating. If the organic layers are consumed by high intensity fire and mineral soil is exposed, soil infiltration and water storage capacity are reduced and water repellent conditions (hydrophobicity) may result. These impacts may persist for weeks or decades, depending on the fire's severity and intensity, any remedial measures that are implemented, and the rate of vegetative recovery (Robichaud &Winter, 2000). Erosion from burned areas typically declines in subsequent years as the site stabilizes, but the recovery rate varies depending on the fire severity.

Soils are a critical component of hydrological processes. Sediment production and hydrologic response to wildfire often depend on fire severity and the occurrence of hydrologic events. Burning reduces the amount of rainfall interception by the forest canopy and reduces evapotranspiration. This may in turn contribute to increased runoff and peak flows. When a large storm follows a severe wildfire, impacts can be substantial. Increased runoff, peak flows and sediment delivery can adversely affect fish populations and their habitat. Suspended sediment concentrations in stream flow can increase several-fold due to the addition of ash and fine soil particles [Rinne 1997].

Fire severity typically varies spatially, making erosion potential from burned hillslopes variable also. Robichaud and Monroe (1997) found that a high severity burn upslope from a low severity burn commonly produced about 50 percent more sediment because the rilling initiated in the upper burned area continued down through the lower severity burn. Table 3-52 summarizes burn severity by slope position for the three watersheds. In the Horse Linto watershed, 67 percent of the burned acres are in middle or upper hillslope positions, indicating a greater potential for hillslope erosion.

Table 3-52. Burn Severity by Slope Position (Percentages are of the Whole Watershed)

Watershed	Burn Severity	Upper Slope	Mid-Slope	Lower Slope
		Acres/Percent	**Acres/Percent**	**Acres/Percent**
Horse Linto	High	3550 (8%)	4430 (10%)	1917 (5%)
	Moderate	4482 (11%)	7516 (18%)	7450 (18%)
	Low-None	2395 (6%)	5623 (13%)	4725 (11%)
Tish Tang	High	900 (5%)	1078 (6%)	775 (4%)
	Moderate	2445 (13%)	2942 (15%)	2737 (14%)
	Low-None	1757 (9%)	3524 (18%)	3000 (16%)
Mill	High	1007 (3%)	934 (3%)	452 (1%)
	Moderate	1930 (6%)	2859 (9%)	2596 (8%)
	Low-None	5195 (17%)	312 (1%)	6890 (22%)

The potential for increased surface erosion following the fire can be estimated better by examining burned severity acres relative to slope steepness as well (see Table 3-53).

Table 3-53. Burn Severity by Slope Class (percentages are of the whole watershed)

Watershed	Burn Severity	<20% Slope	20-35% Slope	35-65% Slope	>65% Slope
Horse Linto	High	967 (2%)	2279 (5%)	4969 (12%)	1683 (4%)
	Moderate	2791 (7%)	3814 (9%)	9153 (22%)	3689 (9%)
	Low-None	375 (9%)	1561 (4%)	9237 (22%)	1570 (4%)
Tish Tang	High	451 (2%)	1076 (6%)	1056 (6%)	169 (1%)
	Moderate	1666 (9%)	2753 (14%)	2564 (13%)	1142 (6%)
	Low-None	714 (4%)	1198 (6%)	5143 (27%)	1227 (6%)
Mill	High	222 (1%)	1295 (4%)	858 (3%)	144 (1%)
	Moderate	807 (3%)	2183 (7%)	2632 (9%)	1767 (6%)
	Low-None	2639 (9%)	4421 (14%)	11,666 (38%)	2104 (7%)

If slope steepness and position are considered together, a clearer picture of increased erosion potential results. Conceptually, highest risk is associated with severely burned, steep slopes; moderate risk is associated with severely burned, moderately steep middle or lower slopes, as well as moderately burned, steep upper or middle slopes; and least risk is associated with moderately burned, less steep slopes. Based on these assumptions, Table 3-54 shows percent acres considered to be at risk of increased erosion, while Figure 3-24 shows their distribution in the analysis area.

Table 3-54. Estimated Increased Erosion Risk in Burned Areas (Percent of Watershed)

Erosion Risk	Horse Linto	Tish Tang	Mill
High	30%	18%	18%
Moderate	18%	19%	10%
Low	22%	20%	5%
Little or no burn	30%	43%	67%

Estimated surface erosion rates by burn severity were also calculated using the USLE with a 2-year, 6-hour rainfall, as shown in Table 3-55. A considerable range of surface erosion is expected for the range of burn severity. Soils specialists documented extensive rilling and gullying during site visits in high elevation granitic terrain after the first fall rains, and recommended doubling the surface erosion rates predicted by the USLE for these soils. Nevertheless, the data shown below have not been revised to reflect higher erosion rates on high elevation granitic soils because the USLE model is thought to over-predict soil erosion rates. Therefore, these estimates may be somewhat conservative.

Table 3-55. Estimated Surface Erosion Rates, Post-Fire

Watershed	Burn Severity	Acres	Predicted Surface Erosion (tons/yr)	Predicted Erosion Rate (tons/ac/yr)
Horse Linto	Low	1,300	1,000	0.8
	Medium	50	40,400	2.1
	High	9,900	50,800	5.1
	TOTAL/AVG	30,650	92,200	3.0
Tish Tang	Low	9	7	0.9
	Medium	8,120	12,200	1.5
	High	2,750	11,200	4.1
	TOTAL/AVG	10,890	23,400	2.2
Mill	Low	440	200	0.4
	Medium	7,380	9,200	1.2
	High	2,520	7,000	2.8
	TOTAL/AVG	10,340	16,400	1.6

Post fire surface erosion rates are predicted to be greatest in the Horse Linto watershed, followed by the Tish Tang and Mill Creek watersheds. A greater proportion of the Horse Linto watershed was subjected to moderate and high severity burns on steeper slopes, and this translates to higher predicted surface erosion rates and amounts.

Pre- and post-fire surface erosion estimates are compared in Table 3-56. The data suggest that dramatic increases in surface erosion should be expected over background or pre-fire rates.

Figure 3-24. **Burned Areas with Increased Erosion Risk:**

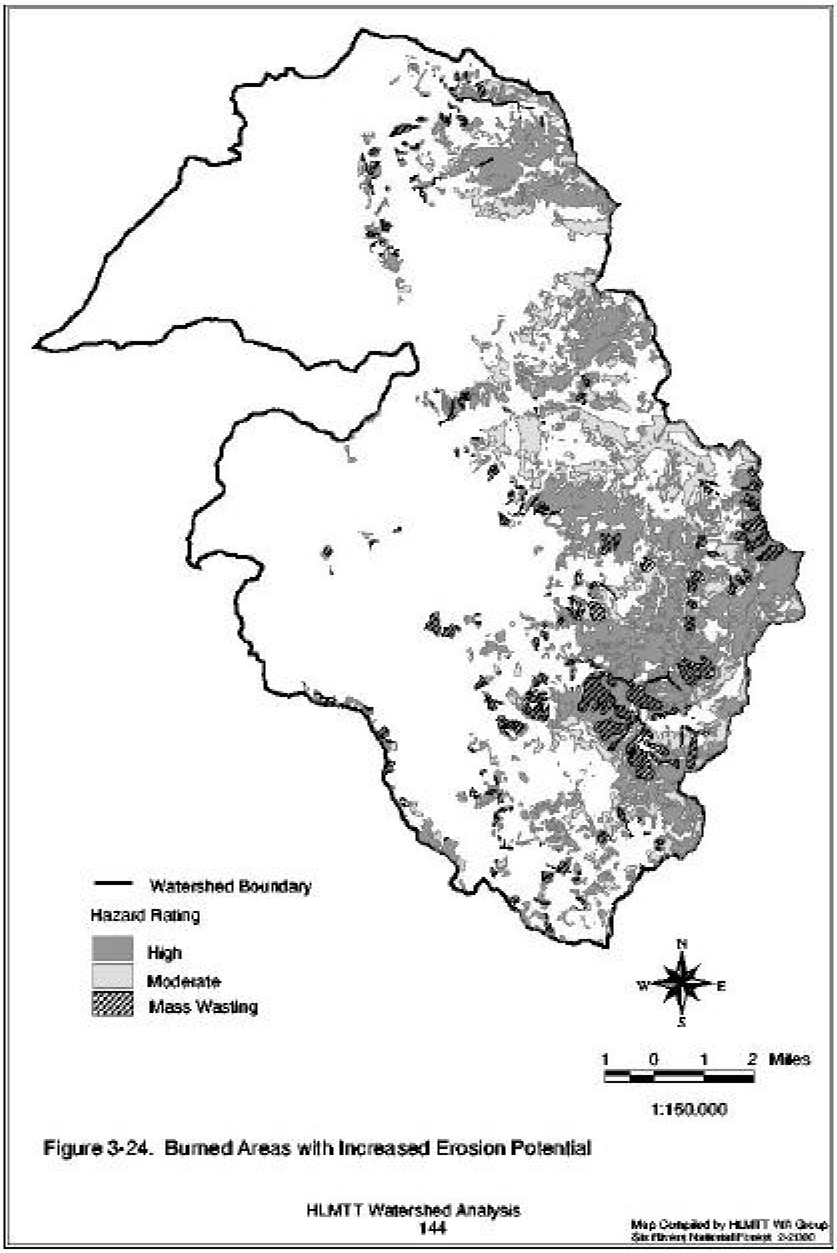


Figure 3-24. Burned Areas with Increased Erosion Potential

The greatest predicted changes are anticipated to occur in Tish Tang and Horse Linto watersheds, followed closely by Mill Creek watershed. These inflated erosion rates are likely to attenuate within a few years to perhaps a decade on the most intensely burned areas.

Table 3-56. Pre- and Post-Fire Surface Erosion Estimates

Watershed	Pre-Fire Surface Erosion Rate (tons/ac/yr)	Post-Fire Surface Erosion Rate (tons/ac/yr)
Horse Linto	0.03	3.0 (100-fold increase)
Tish Tang	0.02	2.2 (110-fold increase)
Mill Creek	0.02	1.6 (80-fold increase)

Based on some rough assumptions about likely rates of attenuation in areas of different burn severity, and using the first year estimated yields from Table 3-56, the total short-term increases in surface erosion as a result of this fire were estimated as follows: Horse Linto – 198,000 tons; Tish Tang – 49,000 tons; Mill Creek – 34,000 tons.

It is more difficult to estimate the potential increase in sediment delivery from *mass wasting* as a result of the Megram Fire because landslides tend to be randomly distributed in time and space and strongly dependent on major storms coinciding with a period of vulnerability such as this. One approach is to consider past patterns of landslide occurrence relative to certain terrain and geologic types as an indicator of future patterns. Based on those relationships discussed earlier, areas with burn severity of 3 or greater on slopes over 50 percent or on sensitive geomorphic terrains (landslide deposits, headwall areas and inner gorge) could experience higher than normal landslide frequencies *if* a major storm occurs in the next 5 to 10 years. To estimate the acres in each watershed that meet those criteria, it was assumed that roughly half of slope class 35 to 65 percent is steeper than 50 percent (the midpoint).

Table 3-57. Estimated increase in mass wasting sediment delivery from Megram Fire

Watershed	Burn class ≥3 Slopes >50% (acres)	Burn class ≥3 Sensitive terrain (acres)	Total acres (% of watershed)	Possible increased sediment delivery from landslides (tons)
Horse Linto	4,730	1,590	6,330 (15)	50,000
Tish Tang	660	180	840 (4)	8,000
Upper Mill	530	170	730 (5)	6,000
TOTAL	**5,930**	**1,940**	**7,870 (10)**	**64,000**

The last column in Table 3-57 was calculated using a delivery rate that is comparable to the long-term rate observed on sensitive terrains in the active landslide study (7 to 8 tons/ac/yr). This is a very speculative value to apply to burned areas, and actual delivery could vary substantially up or down. However, it is probably the right order of magnitude.

These two estimates of increased sediment delivery are combined in Table 3-58 and compared to the historic delivery of sediment from mass wasting during the period 1960-1975 (tons/year for the Megram Fire is based on a presumed five-year duration of those effects.) The results suggest that the Megram Fire could have a noticeable short-term effect on sedimentation rates in Horse Linto Creek (roughly one-quarter of the sediment delivery), but a substantially smaller relative effect in Tish Tang Creek and probably Mill Creek as well. However, a significant difference between these two events is that the floods and landsliding of 1960-1975 delivered a large fraction of coarse material, whereas the Megram Fire is likely to produce a much larger fraction of fine-grained material which could have more adverse effects on fish populations and habitat.

Table 3-58. Comparison of sediment delivery from floods of 1960-1975 and estimated delivery from the Megram Fire.

Watershed	Sediment delivery from mass wasting, 1960-1975	tons/year	Estimated increased sediment delivery due to Megram Fire	tons/year
Horse Linto	2,915,500	194,400	248,000	49,600
Tish Tang	2,471,500	164,800	57,000	11,400
Upper Mill	unknown		40,000	8,000

Water Quality and Hydrologic Processes

Reference Conditions

Water quality parameters important to the analysis area include temperature, sediment, and turbidity. These parameters and associated water quality objectives for streams and tributaries are outlined in the North Coast Basin Plan. This plan also lists specific conductance, dissolved oxygen, pH, hardness, and Boron as parameters. The former water quality parameters (temperature, sediment and turbidity) are the most critical water quality parameters for beneficial uses within the analysis area since they can be modified by land management activities, such as timber harvesting and road construction. The latter water quality parameters are not sensitive to land management activities, but rather apply to drinking water standards and are of more concern in urban or agricultural settings where these parameters can be greatly modified.

Very little information exists with respect to historical water quality conditions within the three watersheds. Presumably, the sedimentation rates within the mainstem streams were low due to the limited extent of inner gorge landslides evident in the 1944 aerial photographs. Given the nearly pristine appearance of tributary watersheds in 1944, ambient conditions in riparian areas are inferred to have included cool, moist air and filtered light, providing good habitat for riparian species. Likewise, summer stream temperatures were probably at the low end of their historic range, presumably below 65^{o}F, thereby providing good conditions for aquatic species. Given the small number and size of active landslides visible along tributaries on the 1944 aerial photos and the general absence of channel widening commonly associated with excessive sediment loads, it is likely that sediment was moving through tributary stream channels in a manner that was not disruptive to aquatic communities in the long term. In addition, the abundant conifers visible in the riparian canopy suggest that there was sufficient large woody debris available for recruitment, and by inference, incorporated in the channel. Sediment routing through the tributaries was probably efficient because of the steep channel gradients.

Current Conditions

Temperature

Temperatures below 15C (59°F) are considered optimum for rearing anadromous salmonids, while temperature above about 26°C (78°F) are considered lethal. Horse Linto Creek has low water temperatures ideal for anadromous fish rearing. Continuous stream stage and temperature have been recorded since the stream gage was installed in 1993 in lower Horse Linto Creek. Average maximum summer temperature at this site ranges between 65°F to 68°F in Horse Linto Creek. Summer water temperatures are also monitored at a number of sites higher in the anadromous portion of the watershed and the temperatures are, as would be expected, even lower. Temperature monitoring on Mill Creek and Tish Tang Creeks did not begin until 1998. Fisheries biologists from the Hoopa Tribe state that summer stream temperature in Tish Tang Creek is high during summer months when solar radiation is high and flows are low. Summer water temperature in Mill Creek is considered an impaired condition that places fish at risk (personal communication, James Wrobell).

Effects of the Megram Fire on Temperature

A significant percentage of the intermittent and ephemeral stream network within all three watersheds, but particularly in Horse Linto, was impacted by moderate and high fire severity. Increased stream temperature is expected in perennial stream channels within or downstream of intensely burned areas and will persist until riparian canopy cover is re-established. It is not known whether these increases in headwater stream temperatures will alter stream temperatures on the mainstem channels of the three watersheds. A slight increase is possible.

A temperature gage (hobo monitor) was installed on the uppermost reach of the mainstem Tish Tang Creek on the Hoopa Reservation to track changes in stream temperature. The gage was installed in January 2000, so pre-fire temperatures at this location are not known. Temperature gages also exist in Horse Linto and Mill Creek (three hobo gages), so changes in stream temperature in the mainstem can be tracked in the future.

Sediment

Sediment levels can be inferred in the three watersheds on the basis of the erosion history and appearance of riparian corridors. Of the three watersheds, Horse Linto has the least sedimentation problems while Mill Creek has the most. Horse Linto was severely impacted by the 1964 flood and experienced extensive channel adjustment, particularly in the lower reaches. Since the 1964 flood, there have been very few new significant sediment sources, thereby allowing the watershed to recover.

Redwood Sciences Lab personnel sampled the V* parameter in pools on Horse Linto Creek. V* measures the amount of sediment stored in a pool and is an indicator of sediment levels and aquatic habitat quality. Overall, V* for Horse Linto Creek was 0.12. A channel with a V* equal to or less than 0.1 is considered to have a low sediment load (Lisle and Hilton, 1999). There are no V* data for Mill Creek and Tish Tang Creeks.

In contrast to Horse Linto Creek, Mill Creek is considered sediment impaired by Hoopa fisheries biologists (personal communication, James Wrobell). The 1964 flood resulted in widespread inner gorge landsliding and channel aggradation along the entire mainstem. Subsequent road building and harvesting exacerbated the impacts of the flood, particularly in the upper half of mainstem Mill Creek on Hoopa lands where tractor skid roads and harvesting occurred within the inner gorge (personnel communication, Greg Blomstrom). The resulting excess sedimentation in the stream channel is still visible on recent aerial photos. It is estimated that approximately half of the sediment generated by the 1964 flood and subsequent logging has flushed out and that it will take another 40 years for the watershed to recover to pre-1964 sediment levels (personnel communication, Greg Blomstrom).

Tish Tang Creek has moderate sedimentation concerns. Most sediment originates from tribal lands as a result of past logging and road related operations. Less than one percent of the eroded sediment in Tish Tang Creek is generated from Forest Service lands (Pacific Watershed Associates, 1995). If the current level of sedimentation is reduced, there is a good chance that the stream would flush out the excess fines and sand. Landslides and erosion rates are naturally high in the Tish Tang watershed. Landslides represent the single largest source of past and future erosion and sediment delivery. In summary, even the moderate sediment levels in Tish Tang Creek place aquatic habitats at risk (Wrobell, 1999, unpublished).

Effects of the Megram Fire on Sediment

Sedimentation of stream channels within and downstream of burned areas is expected to occur in all three watersheds, particularly given the extent of moderate and severely burned acreage and the number of miles of perennial, intermittent and ephemeral watercourses impacted (see riparian reserve discussion). The extent of sedimentation and associated downstream impacts are not yet known. Sedimentation of stream channels within severely burned areas and closely downstream is expected to be high. Preliminary field visits by specialists after the first rains following the fire documented extensive surface erosion, particularly in high elevation granitic terrane. It is expected that a significant portion of this erosion will reach stream channels and cause sedimentation. Sedimentation of stream channels is anticipated to be greatest in Horse Linto, followed by Mill and Tish Tang Creeks.

Turbidity

Turbidity is an important water quality parameter that indicates the suspended sediment load. Turbidity is higher in streams carrying greater concentrations of fine particles. Continuous turbidity data in the Horse Linto and Tish Tang watershed have only been gathered since the Megram Fire. Grab samples for turbidity measurements have been collected over time in these watersheds which provide enough information to suggest that pre-fire turbidity levels in Horse Linto and Tish Tang Creek were low and moderate respectively, with occasional higher turbidity levels associated with high flows from storm events. The Mill Creek watershed is used as a domestic water source by the reservation. However, due to high turbidity levels during high flows, the water supply is periodically shut down for water quality reasons.

Effects of the Megram Fire on Turbidity

In November 1999, a turbidimeter was installed at the stream gage in Horse Linto Creek near the Horse Linto campground. Preliminary information from this gage indicates that there has been no significant increase in turbidity associated with the fire as of mid-January 2000. Turbidity measurements are mostly in the 5 to 10 NTU range, with occasional spikes of 40 to 80 NTUs during higher flows. High readings in the range of 200 to 400 NTUs have not been seen yet. Possible reasons for the lack of higher NTU readings are: 1) fine-grained sediment and ash from the fire have not yet reached the lower mainstem channel; or 2) the fire effects will never influence the lower mainstem significantly due to dilution and distance from the source. Nevertheless, continued monitoring of turbidity in Horse Linto will occur for the foreseeable future.

Turbidity measurements began in Tish Tang Creek in January 2000 but it is too early to demonstrate any real data. A continuous turbidimeter has been installed in the Mill Creek watershed but it has yet to be calibrated and has not been providing useable data as yet.

Hydrologic Regime

The hydrologic characteristics of the three watersheds have only just begun to be assessed. Stream gages were installed in Horse Linto Creek in 1993 and in Mill and Tish Tang Creeks in 1998. At present, there is very little data with which to assess changes in peak flows associated with land management activities. However, inferences can be made based on extent, type and location of land management activities such as timber harvesting and road building. A pristine forested watershed has a low surface run-off rate due to the ability to infiltrate precipitation into the ground that is later slowly released to adjacent stream channels. Road building can increase the rate of delivery of subsurface water to surface waters. Timber harvesting decreases evapotranspiration rates making more water available for runoff. Both management activities have the potential to increase peak flows during storm events.

In Horse Linto watershed, timber harvesting and road building has not been very extensive. Average road density is low (2.4 miles/square mile) and most roads are located on mid to upper hillslopes. Over the past 40 years, clearcut harvest has occurred on approximately 12 percent of the watershed. A minor amount of selective cut harvest has also occurred. Overall, it is unlikely that peak flows have changed from historic levels. There may have been short- term increases associated with peak flows on small perennial stream channels adjacent to clearcut units, but these peak flows would not have increased the peak flows in the main tributaries or mainstem of Cedar or Horse Linto Creek.

In Mill Creek, road density is higher and many of the roads were built in inner gorges and lower hillslope positions. Clearcuts have occurred on approximately 29 percent of the watershed, and 84 percent of the clearcut acres are on the Hoopa Reservation. Based on the extent of historic land management that has occurred in Mill Creek, peak flows may be somewhat higher than historic peaks.

In Tish Tang Creek, clearcut timber harvest has occurred on 21 percent of the watershed with 84 percent of the harvest occurring on Hoopa lands. Road density is high and roads have been constructed on inner gorge slopes along the main channel of Tish Tang Creek and its major tributaries. Hydrologists and fisheries biologists from the Hoopa Tribe believe that the hydrology of the watershed has changed, affecting infiltration and transportation of water in and out of the watershed. As a result, peak flows are thought to have changed from historic conditions.

Effects of the Megram Fire on Peak Flows

Moderate and high burn severity impacted most of the intermittent and ephemeral stream channel network, as well as many miles of perennial streams, in the headwaters of Horse Linto, Tish Tang, and Mill Creek watersheds. Because of the drastic loss of vegetation, evapotranspiration rates will be reduced considerably for several years, allowing more groundwater flow to reach the stream network. Therefore, total runoff and summer base flows will probably increase in these watersheds somewhat, especially Horse Linto where the proportion of high and moderate severity burning was greatest.

Table 3-59. Pre- and post-fire flows for 2 and 10-year recurrence intervals

Watershed	Acres subject to increased runoff	Pre-fire 2-year recurrence interval flow (cfs)	Post-fire 2-year recurrence interval flow (cfs)	Percent increase from pre-fire	Pre-fire 10-year recurrence interval flow (cfs)	Post-fire 10-year recurrence interval flow (cfs)	Percent increase from pre-fire
Horse Linto	29,300	3,890	4,440	14	8,830	10,100	14
Tish Tang	10,900	1,840	2,050	11	4,320	4,810	11
Mill	7,190	3,320	3,540	7	7,190	7,650	6

Estimates of pre-fire and post-fire peak flows are shown in Table 3-59. The projected increase in post -fire peak runoff for a 10-year recurrence interval storm ranges from 6 to 14 percent. These values are based on preliminary estimates of burn intensity acreage for BAER and assumptions about reduced infiltration due to burning effects on the soil. Based on the data shown in Table 3-59, changes in peak flows are not likely to be apparent in the mainstem channels of the three watersheds. The slight change in peak flow occurrence that this represents is very unlikely to produce significant geomorphic change in mainstem channels. However, localized increases in peak flow are expected to be more substantial in headwater streams that drain a large proportion of severely burned acres. The projected changes could be on the order of 25 percent, which could result in modest channel adjustments such as downcutting, gullying and bank erosion.

Megram Fire and Other Water Quality Parameters

The influx of ash from the fire into stream channels is expected to result in a short-term change in pH and conductivity. In addition, increase in nutrient loading is anticipated. These effects may last from one to two seasons as seasonal rains flush the ash and nutrients through the system. These changes are natural and a result of the fire. (Fredriksen 1971; Scrivener, 1982).

Watershed Restoration

Effects of Roads on Erosion Processes

Roads are generally recognized as the principal land management influence on erosion and sedimentation rates. The most common problems associated with roads are: (1) improper locations of road cuts and fills on unstable or erodible terrain; (2) improper design or construction of stream crossing fills; (3) undersized or improperly installed culverts; and (4) inadequate or improper road maintenance. Since one-third of the active landslides and 29 percent of the associated post-1944 volume of sediment identified in the aerial photo inventory can be directly or indirectly linked to roads or landings, identifying and correcting the remaining problem sites should promote the recovery to a more "normal" sediment regime. This has been the focus of watershed restoration on these lands, as described in a following section.

Most Forest Service system roads in the analysis area are located on the upper 2/3 thirds of hillslopes. The average road density is relatively low on NFS lands, but roads are concentrated in some sub-areas and on the Hoopa Reservation. The relatively low densities are unlikely to alter hillslope hydrology significantly, but areas with extensive inboard ditches that intercept groundwater flow and convert it to surface flow can increase the likelihood of increased erosion and sedimentation.

Culvert density reflects the extent to which roads have modified the channel network, as well as the potential risk associated with failure of drainage structures and subsequent sediment delivery. Culvert failures may have a variety of consequences within riparian corridors. Minor failures may introduce sediment volumes that exceed the transport capacity of the channel, causing the channel to aggrade and widen, followed by fluvial adjustments that may take many years to complete. Sudden mass failure of stream crossings also may generate debris flows that entrain much additional sediment as they move downstream. Stream crossings in steep terrain with a lot of organic debris upstream that could plug the culvert during large storms have the highest debris flow potential. Maintenance, storm proofing, or decommissioning are high priorities in such areas. Improvement activities include removal of culverts or other drainage structures and associated fills, reshaping a stable channel, and ripping and partially outsloping the roadbed.

Stream diversions also pose significant risks in terms of off-site sedimentation. Diversions occur when a culvert plugs and the stream flow follows the roadbed instead of crossing the road and returning to the original channel. When the stream flow eventually crosses the road, it may create a new channel on the hillslope with considerable erosion consequences.

It has become widely accepted that road restoration can be one of the most effective, long-term means of erosion control and prevention. Funding for maintenance of Forest Service roads has been declining dramatically and in the absence of timely road maintenance, minor road problems can become more damaging to aquatic habitat and may persist for decades.

Extensive inventories on Forest Service roads were conducted throughout the analysis area. The objective of the inventories was to gain a better understanding of current conditions of the transportation system and determine what opportunities existed for road restoration and upgrading. Storm-proofing is the improvement of a road drainage system to withstand large storm events without appreciable on-site or off-site damage. It can be accomplished in several ways. The most common methods are increasing culvert sizes to accommodate larger flows, modifying inlet geometry to accommodate organic debris better, and correcting stream diversion potential. These types of corrective measures are gradually being applied to the road network within the analysis area as time and funding permits.

A transportation strategy for Horse Linto, Tish Tang and Mill Creeks was drafted in 1997. It outlined road restoration activities that would reduce the total road network and allow more roads to be regularly maintained with limited available funds. Other restoration work completed in the analysis area includes landslide treatments, road upgrading and instream structures. Figure 3-25 displays the locations of all restoration on federal lands in the analysis area.

Horse Linto

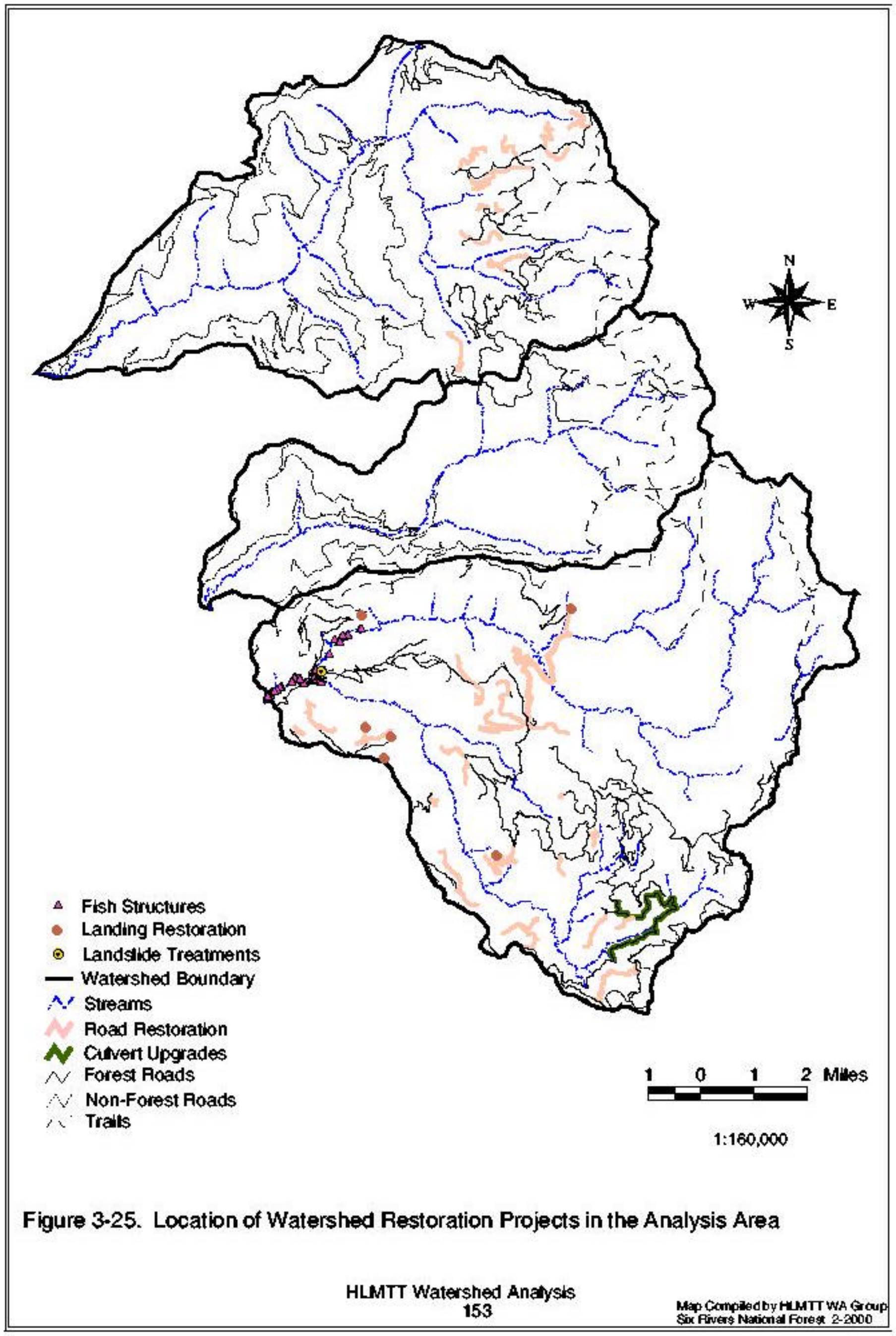
The Forest Service manages 90 percent of the roads in the watershed, of which 75 percent are located on upper and middle hillslope positions. A total of 23 miles of road (19% of the total system) have been decommissioned or placed in a hydrologically maintenance-free condition. Both classifications had the same on-the-ground treatments, but some roads were not permanently taken off the transportation system. In either case, all stream crossings were removed and stream channels returned to original grade and configuration. All road fill was removed and placed in a stable location. Drainage dips and outsloping were added where needed to disperse overland flow along the road, thereby restoring more natural drainage patterns. Road surfaces were de-compacted by ripping the upper 36 inches to improve infiltration and promote natural revegetation. Some roads were planted with native species.

All landings in Horse Linto watershed were evaluated for their potential to deliver sediment into streams. Of all the landings in the watershed, only seven were identified as high priority treatment sites. Approximately eight acres of landings were restored, which accounted for about 3,500 cubic yards of material that was removed and stored in a more stable location. Landing treatments removed fill from the outside edges and blended it back into the cutslope. All treatment areas were planted with native species.

A large slump-earthflow located about one-quarter mile upstream from Cedar Creek had been very active and delivered considerable fine-grained sediment to Horse Linto Creek since the 1950s. An ambitious stabilization project on this natural feature was implemented in the early 1980s to reinforce the toe zone of the slide and divert much of the slide debris away from the stream and onto the adjoining stream terrace. This $400,000 project has been highly successful since construction in reducing the delivery of fine sediment to spawning and rearing habitat in the lower reach. Five smaller landslides also were identified and replanted successfully to reduce erosion.

In 1991, the Ridge Tie slide occurred along a major road that accessed the upper headwaters of Horse Linto Creek. The slide was adjacent to the mainstem of Horse Linto. Because of the high level of instability, a sediment trap was constructed below the slide to capture additional material and prevent it from entering the stream. In addition, it was decided not to reopen the road but to upgrade an existing jeep road that would serve as a bypass route.

Figure 3-25. **Location of Watershed Restoration Projects in the Analysis Area:**



The most recent restoration work in Horse Linto watershed occurred along route 7N04, a major system road with long sections parallel to Cedar Creek. All stream crossings were assessed in terms of condition, hydraulic capacity, and diversion potential. Six of the sites were high priority for upgrading. At two sites, existing culverts were removed and replaced with larger ones. At three sites, additional overflow culverts were installed, and at one site, the inlet configuration was modified. All treatment sites had drainage dips installed to limit diversion potential.

Table 3-60. Road Restoration Summary in the Horse Linto Creek Watershed

Miles of Road Restored	Miles of Upgrading	Acres of Landings Restored	Total Fill Removed (yd^3)	Cost per mile	Cost per yd^3
20.5	4.5	8	39,900	$6,500	$3,500

Table 3-60 summarizes restoration accomplishments to date. The remaining restoration work in Horse Linto will focus primarily on upgrading system roads to meet current Standards and Guidelines in the Aquatic Conservation Strategy (as outlined in the Six Rivers Land and Resource Management Plan).

Currently, there are approximately 124 miles of road in the watershed, 95 percent of which are on Forest Service lands. The average road density is low, but some areas outside Forest Service lands have a higher density. Generally, road density in the watershed is not high enough to alter hillslope hydrology. Table 3-61 summarizes information on the current transportation system. Approximately 90 percent of the Forest Service roads in Horse Linto watershed are in a maintenance level 1 or 2 category. Roads placed at these maintenance levels generally do not receive annual maintenance, and therefore are considered a high priority for upgrading.

Table 3-61. Current Road System Miles and Density in the Horse Linto Creek Watershed

Jurisdiction	Road Miles	Acres	Area in Square Miles	Road Density (mi/sq.mi)
Hoopa	9.84	1,005	1.57	6.27
SRNF	113.58	40,786	63.73	1.78

Tish Tang

Pacific Watershed Associates conducted an extensive inventory throughout this watershed in 1995. The purpose of the inventory was to identify road-related sediment production. Roads were singled out primarily because the network provides ready access for heavy equipment to reach potential work sites. The Hupa Tribe has implemented all high priority sites identified in the inventory (personnel communication, Greg Blomstrom).

One of the major findings of the inventory was an abandoned segment of Forest Service road 8N10 located in the Trinity Alps Wilderness. Many of the stream crossings were old log-stringer bridges and the road was no longer being maintained. The decision was made to remove all the stream crossings and convert the road into a trail. This work is under contract and is scheduled for completion in the fall of 2000. Table 3-62 lists restoration accomplished to date.

Table 3-62. Road Restoration Summary in the Tish Tang Creek Watershed

Jurisdiction	Miles of Road Restored	Total Fill Removed (yd^3)
SRNF	5.7	5,000
Hoopa	4.6	2,465

Currently, the Forest Service manages approximately 30 percent of the road system, the majority of which is located on upper and middle hillslope positions. Several miles of road were transferred to the Hoopa Reservation after the recent boundary adjustment was made. Of the 32 miles on Forest Service lands, approximately 50 percent are in a maintenance level 1 or 2 category. The average road density is relatively low, but some areas have a higher concentration of roads than others. Table 3-63 summarizes road density by land ownership.

Table 3-63. Current Road System Miles and Density for the Tish Tang Creek Watershed

Jurisdiction	Road Miles	Acres	Area in Square Miles	Road Density (mi/sq.mi)
Hoopa	68.00	8365	13.07	5.20
SRNF	32.58	10794	16.87	1.93

Mill Creek

Pacific Watershed Associates completed a comprehensive field inventory of this watershed in 1990. The objective was to identify road-related sedimentation and develop a priority list for treatment. The Forest Service began implementing road restoration projects in 1998. None of the restored Forest Service roads were classified as decommissioned; rather, they were downgraded to a maintenance level 1 category and made hydrologically maintenance free. The restoration treatments were the same as in Horse Linto, but the roads were not completely removed from the transportation system. The Hupa Tribe has completed all high priority sites identified as a result of the PWA inventory (personnel communication, Greg Blomstrom). Table 3-64 lists all restoration work accomplished to date.

Table 3-64. Restoration Summary for the Mill Creek Watershed

Jurisdiction	Miles of Road Restored	Total Fill Removed (yd^3)
SRNF	10.5	7,465
Hoopa	16.5	60,863

The current road system that is managed by the Forest Service accounts for approximately 43 percent of the roads in the watershed. Of these, 86 percent are located in upper and middle hillslope positions. Table 3-65 lists road density by ownership.

Table 3-65. Current Road System Miles and Density in the Mill Creek Watershed

Jurisdiction	Road Miles	Acres	Area in Square Miles	Road Density (mi/sq.mi)
Hoopa	157.00	16782	26.22	5.99
SRNF	54.08	13957	21.81	2.48

Watershed Restoration following the Megram Fire

Figure 3-26 shows the locations of high and moderate burn severity areas relative to existing and decommissioned roads. Stream crossings and ditch relief culverts that exist within moderate or high severity burn areas may have a greater chance of becoming plugged by debris or sediment. All roads and stream crossings within these areas need to be evaluated for possible treatments. Fortunately, a substantial proportion of Forest Service roads in the moderate to high severity burn areas were decommissioned prior to the Megram Fire.

Fireline Rehabilitation

All known bulldozer and hand lines constructed on the Six Rivers during the Megram Fire were evaluated in terms of their potential to erode and deliver sediment into streams. Rehabilitation of the control lines consisted of machine or hand placed waterbars, covering exposed soils with slash or straw mulch, and pulling berms created by bulldozers back from riparian areas. Table 3-66 summarizes most of the fire line rehabilitation. Of all the road restoration completed throughout the analysis area, approximately two miles of road and three stream crossings in Horse Linto were re-opened during the fire. Six Rivers specialists supervised 90 percent of all rehabilitation activities, including the rehabilitation of the roads that were opened during the fire.

Table 3-66. Summary of Suppression Rehabilitation Activities

Activity	Unit of Measure	No. of Units
Waterbar Firelines	Miles	62
Firelines Seeded	Miles	14
Firelines Mulched	Miles	25
Firelines Slashed	Miles	8
Safety Zones Treated	Acres	25

Burned Area Emergency Rehabilitation (BAER)

The interim BAER report for the Six Rivers and Shasta-Trinity National Forests outlines what has been accomplished this year and what remains to be treated next spring. The majority of the work outlined is located on the Six Rivers. Erosion control treatments on hillslopes and in channels have been initiated in the Mill and Horse Linto watersheds. The Tish Tang watershed was not considered for work in the winter of 1999/2000 due to adverse weather conditions, safety concerns and access problems.

Figure 3-26. **High and Moderate Burn Severity Areas in Relation to the Road System:**

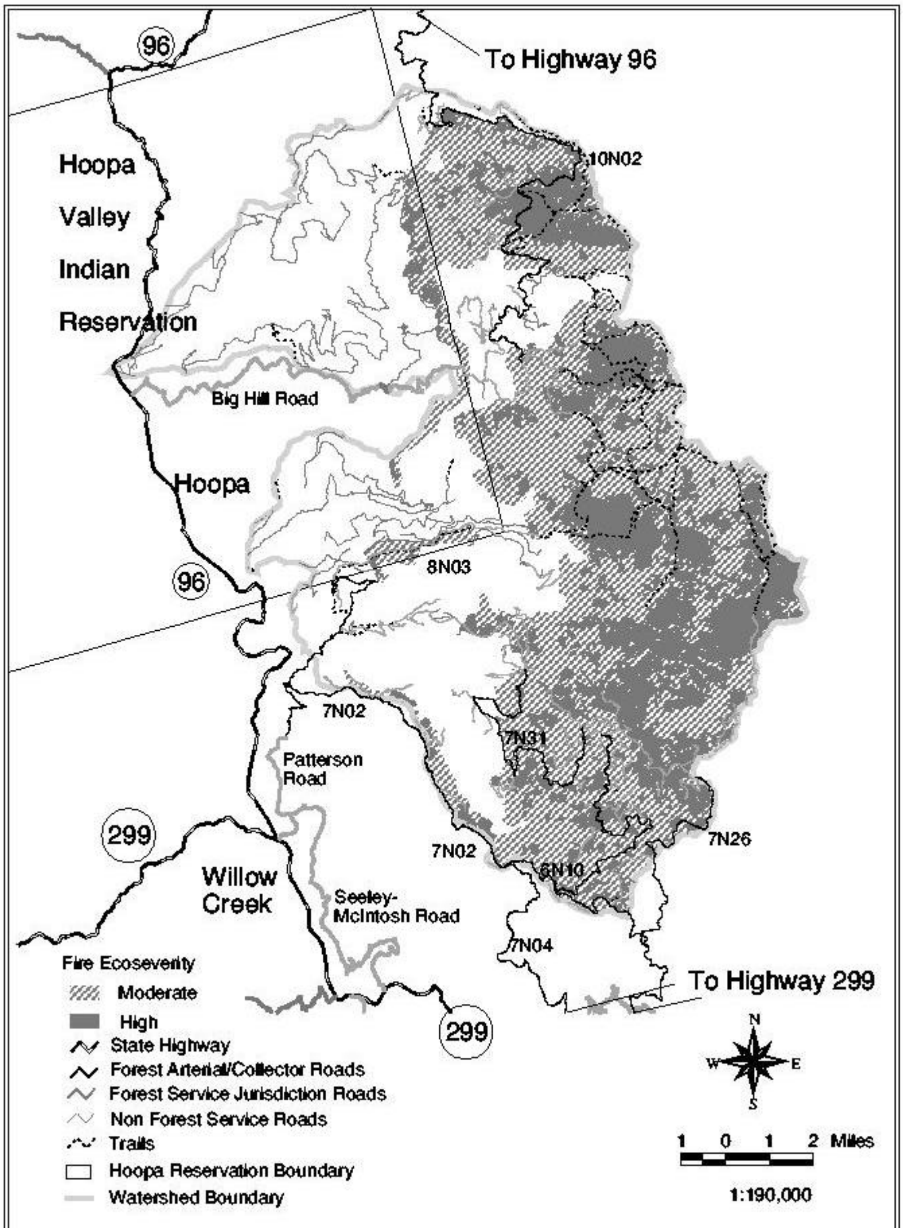


Figure 3-26. High and Moderate Burn Severity Area in Relation to the Road System

Riparian Corridor Conditions

Reference Conditions

The condition of riparian and aquatic habitats in the analysis area has varied through time, primarily as a result of channel changes caused by mass wasting and sedimentation during major floods. In the first few decades after a major flood, there would be numerous fresh landslides adjacent to channels, considerable secondary erosion from landslide scars, widespread accumulation of sediment and debris in most stream channels, and increased exposure of the channel due to loss of riparian cover. This would have caused elevated water temperatures, reduced aquatic habitat quality, and reduced stream productivity for salmonids. During longer and more stable recovery periods, large conifers would have dominated riparian areas and provided dense shade and occasional inputs of large woody debris to the channel. A large proportion of the aquatic habitat would have been highly suitable for salmonids, with cool water temperatures and complex instream structure. Erosion, sediment production and sediment transport would have been roughly in balance over the watershed, providing abundant clean substrate for spawning and rearing of salmonids.

Little direct information exists regarding prehistoric conditions, processes and functions under which the riparian and aquatic ecosystems of the analysis area evolved. However, useful inferences can be drawn from aerial photographs taken in 1944 since relatively little land management had occurred by 1944. The aerial photos reveal extensive riparian cover, much of it old-growth conifer. The flood of 1861 reportedly had widespread impacts in the region, but very little evidence of those effects is visible on these older aerial photos. Much of the flood effects could have been erased in the intervening 83 years, however.

Inferences about other riparian and aquatic processes and functions can be drawn from the extent and density of this riparian cover. Stream temperatures were probably low where there was substantial shading along most tributary streams. It is also reasonable to infer from the few active landslides and other sediment sources visible in 1944 that aggradation and channel widening were fairly minimal in any of the three watersheds. Although extensive sedimentation is not apparent in 1944, considerable sediment could be stored in these channels but concealed by riparian vegetation. Total sediment storage in the watersheds might have been comparable to the present, but much of it was probably well stabilized by vegetation and channel structural elements such as logs and boulders. Hence, it is inferred that less sediment was available for transport during high flows compared to the present.

Current Conditions

Sequential aerial photos (1944, 1960, 1975 and 1998) reveal extensive riparian corridor and stream channel changes in tributary drainages. In the 1944 photos, riparian areas along main tributary streams in the analysis area had such a dense coniferous riparian canopy that they were only discernible through stereographic relief. The majority of the tributary channels were not directly visible. Small openings were evident next to scattered inner gorge landslides. There were very few landslides within tributary watersheds, and nearly all were attributable to natural causes. The tributaries appear pristine with little or no land management activity. Ridge-top roads existed in some parts of the watersheds, but no erosion impacts associated with these roads were evident. A large flood occurred in 1861 that reportedly had a large impact on many Trinity River tributaries. Effects of this flood in the analysis area are not very evident in 1944, although some older dormant debris slides are visible that could have resulted from 19th century floods. It is possible that the 1861 flood did not produce as much landsliding and resultant damage to riparian areas as the 1964 flood and that most of those areas had fully healed by 1944. Given the extent of the riparian conifer coverage visible in 1944 and the time that it takes for the conifers to mature (75 to 120 years), it is reasonable to conclude that these tributaries had not experienced a major disturbance capable of altering sediment routing and large woody debris recruitment for many decades, or perhaps since the 1861 flood.

In 1960, there were a few inner gorge landslides scattered among the Horse Linto, Tish Tang and Mill Creek watersheds that created riparian canopy openings and downstream channel adjustment. These channel adjustments appeared to be fairly minor and did not appear to have had significant riparian or aquatic impacts. These landslides and the resultant canopy opening were probably a result of the 1955 flood.

The most dramatic change in riparian canopy and stream channel conditions was visible in the 1975 aerial photos. All three mainstems experienced flood damage of riparian areas ranging from severe localized impacts to complete removal of riparian canopy along the stream corridor. Horse Linto and Mill Creeks experienced the greatest riparian disturbance with extensive inner gorge landsliding and resulting channel aggradation, although Tish Tang experienced extensive channel adjustment in the middle section.

The 1998 aerial photos reveal that much of the coniferous riparian canopy that was disturbed by floods between 1960 and 1975 has been replaced by dense deciduous vegetation. While the long-term woody debris recruitment potential may have been set back, the shade component has been re-established through encroachment of alders and other riparian species. Channel openings remain along most tributaries, but riparian canopy conditions overall have substantially recovered since 1975. Impacts to riparian corridors associated with the Megram Fire are discussed in the Interim Riparian Reserve section after the following descriptions of specific watershed conditions.

Horse Linto Creek

The lower section of Horse Linto Creek below Cedar Creek experienced extensive channel changes in the 1964 flood, including loss of all coniferous riparian canopy, channel aggradation, and loss of sinuosity. By 1998, deciduous riparian vegetation had returned and now covers much of the channel. The creek appears to have cut down through the aggraded sediment and partly re-established the pre-1964 meanders. The middle reach of Horse Linto Creek also lost much of its riparian vegetation and experienced extensive landsliding, but it did not undergo the degree of channel adjustments that occurred in the lower section. By 1998, riparian vegetation fully covered the channel and the effects of the flood were no longer visible. Upper Horse Linto Creek and the East Fork have shown much less channel adjustment over time.

Cedar Creek is a steep, narrow and incised channel that was dominated by mature conifer cover in 1944 and 1960. Its middle section is similar to that of Horse Linto Creek, with extensive inner gorge landslides associated with the 1964 flood. It appears to have since fully recovered in terms of riparian vegetative cover. In the uppermost sections of Cedar Creek, most of the slides in 1944 were old debris avalanche chutes that have changed little in historic times.

Riparian habitat elements such as large woody debris, pool character and quality, stream bank condition and floodplain connectivity are all considered to be functioning properly. Despite land management activities associated with harvesting and road building, riparian condition has not been significantly impacted beyond that caused by natural flood events.

Tish Tang Creek

The riparian corridor along lower Tish Tang Creek had some inner gorge landslides in 1944. The 1964 flood stripped the riparian vegetation, caused extensive inner gorge landsliding, but did not result in appreciable channel widening. These landslides had fully recovered with deciduous vegetation by 1998. The middle section of Tish Tang Creek had very few landslides in 1944 and 1960 and was dominated by conifers. This area was heavily managed and was hardest hit by the 1964 flood. Channel widening was substantial in this section. By 1998, most of the landslides and the riparian corridor had been significantly revegetated. This reach seems most vulnerable to future mass wasting due to the presence of mid-slope roads. The North Fork was subjected to extreme sedimentation in the 1964 flood. This area has moderately recovered from the flood as evident by the riparian canopy. The South Fork is the most stable channel in the watershed with few landslides within the riparian corridor despite harvest activities on Forest Service lands. The riparian canopy is still dominated by conifers.

Extensive ground disturbance associated with timber harvesting and road building has occurred without protection buffers along the tributaries and mainstem of Tish Tang Creek inside the reservation. These land management activities have resulted in excessive sediment along the main channel and degradation of fish habitat. The lack of streamside vegetation in some areas has contributed to a rise in water temperature, bank instability, and loss of instream habitat. Floodplain connectivity and associated riparian vegetation has been affected. Large woody material is generally low or lacking in the channels. Past timber salvage operations in smaller tributaries and along the main channel have removed most of the large woody material that was present. Recent restoration work on roads has only marginally enhanced the recovery of the watershed and stream channels (Hoopa, 1999).

In summary, riparian habitat characteristics considered not properly functioning are large woody debris, pool character and quality, riparian reserves and off-channel habitat. Stream bank condition and floodplain connectivity are also considered at risk (Hoopa, 1999).

Mill Creek

Prior to the 1964 flood, Mill Creek riparian areas were characterized by a dense coniferous canopy and few inner gorge landslides. The stream channels were not visible on the aerial photos. The 1964 flood resulted in extreme channel changes throughout the watershed due to aggradation resulting from streamside landslides. This aggradation was so extensive that the floodplain was used as logging access for inner gorge harvesting that occurred after the 1964 flood. Considerable inner gorge and riparian corridor harvesting has occurred within the upper half of Mill Creek on the Hoopa reservation (personal communication, Greg Blomstrom). This logging exacerbated the sedimentation and impacts to riparian areas from the 1964 flood. The riparian corridor of the upper half of Mill Creek is composed mostly of deciduous vegetation. The 1964 flood and subsequent inner gorge logging and road building significantly reduced the long-term potential for large woody debris recruitment.

The lower half of Mill Creek also experienced extensive riparian impacts associated with the flood, including extensive aggradation and channel widening. The lower mile of the creek has been channelized with log crib walls. Riparian cover is dominated by deciduous vegetation that has grown since the 1964 flood. The conifer component along the inner gorge is better in the lower half of the mainstem than in the upper reach as little inner gorge logging occurred within this lower reach. Hence, the long-term large woody debris recruitment potential is slightly better (personal communication, Greg Blomstrom).

When viewed in its entirety, the riparian corridor of mainstem Mill Creek is considered at risk. Roughly half of the inner gorge has been logged. The combined flooding, road building and harvesting within the watershed has resulted in significantly reduced in-channel large woody debris, large woody debris recruitment, and stream bank and floodplain function (Hoopa, 1998).

Interim Riparian Reserves

Interim Riparian Reserves (IRRs), as defined by the Northwest Forest Plan and the Six Rivers Land and Resource Management Plan, are derived by buffering fish-bearing streams and non-fish-bearing perennial, intermittent and ephemeral streams, as well as including unstable lands. These interim riparian reserves are based on a crenulated stream coverage, which extends the stream network shown as blueline streams on USGS maps into topographically defined indentations. Many of these indentations are first- and second-order stream channels. The interim riparian reserves have been developed for all streams within the three watersheds for this analysis, although they technically apply only to National Forest lands. Nevertheless, for the purposes of this analysis, the reserves will be analyzed for all lands.

As described in a previous section, the condition of the riparian network varies among these watersheds. Table 3-67 shows the extent of past harvesting within currently defined IRRs. It is important to note that IRRs are not based on site-specific criteria but are modeled from map data. Many IRRs are found to exceed the geomorphic breaks-in-slope when field verified, and hence have excessive acreage compared to field-defined riparian reserves.

Table 3-67. Extent of Past Harvesting within IRRs

Watershed	Jurisdiction	IRR Acres	IRR in Past Harvest Units (acres)
Horse Linto	Six Rivers	11,568	758
	Hoopa	160	29
	Total	11,846	788 (6.7%)
Tish Tang	Six Rivers	2,616	159
	Hoopa	2,210	783
	Total	4,825	942 (19.5%)

Mill Creek	Six Rivers	3302	203
	Hoopa	4314	1997
	Total	7,616	2,220 (28.9%)

Data from Table 3-67 indicate that the extent of total riparian reserves modified by past harvest activities varies among the three watersheds with Mill Creek having the most harvest in riparian reserves and Horse Linto Creek the least. One can assume that in most cases, past harvesting activities did not have riparian buffer protection widths as defined by the Northwest Forest Plan and may have adversely impacted riparian areas.

Effects of the Megram Fire on Interim Riparian Reserves

The full effects of the recent Megram Fire on riparian reserves have yet to be verified; however, some inferences can be made from aerial photo analysis and preliminary ground visits. The fire covered extensive headwater areas of all three watersheds. Table 3-68 summarizes the extent of riparian reserves affected by different burn severity.

Table 3-68. Burn Severity within Interim Riparian Reserves

Watershed	Burn Severity	Burned Acres	% of Total Riparian Acres
Horse Linto	none	3,184	26.9
	low	330	2.8
	moderate	6,099	51.5
	high	2,333	18.8
	SUBTOTAL	**11,846**	**100**
Tish Tang	none	2,226	46.1
	low	9	0.2
	moderate	2,055	42.6
	high	535	11.1
	SUBTOTAL	**4,825**	**100**
Mill Creek	none	4,899	64.3
	low	120	1.6
	moderate	2,178	28.6
	high	419	5.5
	SUBTOTAL	**7,616**	**100**

Based on the data above, IRRs within the headwaters of Horse Linto appear to have the greatest proportion of total riparian reserves acres (74 percent) impacted by the Megram Fire compared to Mill and Tish Tang watersheds. Furthermore, the majority of the burned riparian reserve acres in Horse Linto Creek are in the moderate and high severity categories. Horse Linto also has the largest proportion of acres in both the high and moderate burn severity categories compared to Mill and Tish Tang Creek watersheds. Tish Tang watershed had 54 percent of total of riparian reserve acres burned, mostly in the moderate and high severity categories. Mill Creek had approximately 36 percent of total of riparian reserve acres burned. Both Tish Tang and Mill Creeks also had extensive moderate and high burn severity acres within IRRs.

The extent of perennial and intermittent/ephemeral streams impacted by the fire is shown in Table 3-69. The miles of perennial and intermittent/ephemeral streams affected by the fire could alter such watershed processes as peak flow, channel erosion and sedimentation. The greater the number of perennial streams burned, the greater the likelihood of increased channel erosion and sedimentation. Perennial channels have a greater likelihood of sediment delivery and routing due to greater stream power to mobilize sediment. However, the intermittent and ephemeral stream network is more extensive and they probably store more sediment subject to remobilization. Many crenulated channels are only debris avalanche chutes in headwalls that deliver little sediment principally by mass wasting, not fluvial transport. Thus, the miles of burned intermittent/ephemeral stream channel are likely overestimated.

Approximately 73 percent of the total stream miles in Horse Linto were moderately or severely burned. The greatest amount of the stream channel network burned was in the intermittent/ephemeral category, and of these channels, the majority were in the moderate to high burn severity (239.5 miles or 61.4 percent). The majority of Horse Linto watershed perennial stream channels were moderately or severely burned (44.6 miles or 66.9 percent of the perennial streams). In the Tish Tang watershed, 69.2 percent of perennial stream channels experienced moderate and high burn severity. In addition, a large number of miles of intermittent/ephemeral streams were in the moderate and high burn severity category (75.4 miles). Approximately 58 percent of the total stream network in Tish Tang is in moderate and high burn severity categories with the majority in the moderate category. The Mill Creek watershed has the least number of stream miles that were impacted by high and moderate fires in the perennial (11 miles or 4.5 percent) and intermittent/ ephemeral streams (70.7 miles or 29.1 percent).

These figures are only estimates and must be field verified. It is difficult to estimate the condition of a stream channel from aerial photos, particularly in the moderate category since site conditions can be so variable. Nevertheless, the impact of the Megram Fire on the stream network has the potential to be highly significant, particularly at the local scale. The extent of the potential impact on stream channels is largely weather dependent, but the stage has been set for extensive stream channel erosion, sedimentation, and adjustment in the headwaters of each watershed, and particularly in Horse Linto Creek. The downstream impact of these conditions is not yet known.

Table 3-69. Perennial and intermittent/ephemeral stream miles by burn severity

Horse Linto Creek

Stream Type	Burn Severity	Miles	% of Total Miles
Perennial	none	20.8	5.3
	low	1.3	0.3
	moderate	38.9	10
	high	5.7	1.5
Intermittent/ephemeral	none	75.5	19.3
	low	8.5	2.2
	moderate	170.2	43.6
	high	69.3	17.8
	TOTAL	**390.2**	**100**

Tish Tang Creek

Stream Type	Burn Severity	Miles	% of Total Miles
Perennial	none	10.9	6.3
	low	0	0.0
	moderate	23.6	13.7
	high	0.9	0.5
Intermittent/ephemeral	none	61.4	35.7
	low	0	0
	moderate	57.4	33.3
	high	18.0	10.5
	TOTAL	**172.2**	**100**

Mill Creek

Stream Type	Burn Severity	Miles	% of Total Miles
Perennial	none	31.8	13.1
	low	1.1	0.5
	moderate	11.0	4.5
	high	0	0
Intermittent/ephemeral	none	125.2	51.4
	low	3.3	1.4
	moderate	58.3	24.0
	high	12.4	5.1
	TOTAL	**172.2**	**100**

Riparian Species and Habitats

Reference Conditions

In the distant past, many riparian areas were characterized by an overstory of old-growth conifers presumably with an understory mix of shade tolerant, deciduous trees or shrubs such as big-leaf maple, various willow species, Pacific dogwood, vine maple and thimbleberry. Riparian corridors were well distributed across the landscape, allowing for habitat connectivity for mosses that more often rely on asexual reproduction via fragmentation than sexual reproduction, the former limited in dispersal distance. Before logging and road building fragmented the landscape and before wildfire suppression, riparian areas were subject to periodic disturbance across the landscape primarily in the form of flood events. Periodic disturbances would have fostered a mosaic of conditions within the riparian areas, thereby promoting epiphytic diversity, abundance and persistence.

Current Conditions

Riparian habitat was greatly affected by the 1964 flood and past management actions such as road building and logging. Substantial riparian corridor recovery has occurred during the last few decades, so that prior to the Megram Fire, riparian areas provided good connectivity for bryophytes, lichens, and vascular plants and for wildlife dispersal. The fire allowed the majority of the true riparian vegetation, such as dogwood and willow, to survive the fire, but the overstory canopy trees were killed or damaged along many miles of stream corridors in the headwaters of the analysis area. This change may alter the microclimate and habitat values along those streams for many years, thus altering the quality of riparian habitats and affecting the vascular and non-vascular species that rely on those habitats.

Vascular Plants

Of the vascular plants of concern within the analysis area, only bensoniella (*Bensoniella oregana*) is considered riparian-associated. Although specifics about bensoniella's habitat are not well known, suitable habitat is characterized as moist zones along the edge of streams in the true fir zone. Partial shade and adequate moisture are important habitat variables. Large coarse woody debris appears to provide micro-site shading and moisture retention.

Reference conditions for bensoniella can only be addressed in terms of potential habitat. Habitat for bensoniella occurring in true riparian areas (as compared to meadows) would be characterized by low gradient stream conditions, presence of scattered large coarse woody debris, and partial (not dense) overstory shade. Disturbance agents historically operating in riparian areas include flood and mass wasting events. These agents influenced habitat variables important to bensoniella including a change in canopy closure and recruitment of coarse woody debris. As is the case with most dynamic systems, the influence of disturbance on habitats varied temporally and spatially so at any one time, suitable habitat would have been present within the analysis area.

Potential habitat for bensoniella was affected by loss of the shade canopy. Loss of overstory conifers in severely burned areas will also reduce recruitment of large woody debris — a structural habitat element often associated with bensoniella. The effects relative to bensoniella are only based on potential habitat. Changes in shade, moisture and bank stability discussed below in relation to epiphytes can be applied to bensoniella as well.

Non-Vascular Plants

Many bryophytes (i.e. *Kurzia makinoana*) and certain lichens (ie. *Leptogium saturninum*), require moist, shady micro-habitat conditions that riparian areas provide. Furthermore, the deciduous tree and shrub component of riparian areas contributes to the diversity and cover of species in these groups. Both bryophytes and lichens lack roots; most of their water and nutrients are acquired from the atmosphere; therefore, maintenance of micro-climate and micro-habitat conditions are critical to these species.

Mosses in particular are commonly associated with deciduous trees in riparian areas. Epiphytic mosses (meaning attached to other plants) depend on transfer of water and nutrients from the atmosphere via stem flow. The orientation of deciduous tree branches directs the flow to the main stem or bole of the tree as compared to the typical downward-oriented branches of conifers that direct water toward the branch tips. Moss mats in the path of the flow capture and accumulate the nutrients and water. Nutrients are leached from the mosses during heavy rains and subsequently enter the soil (Norris 1993).

Given their reliance on adequate moisture, nutrient/mineral contribution and shade, mosses are very sensitive to changes in their environment, even on a micro-scale. Fires can be lethal to epiphytes, which rely on moisture and nutrient uptake from the atmosphere, due to either direct consumption of the substrate or to smoke levels. Fire effects varied across the analysis area with the Horse Linto watershed experiencing the most extensive moderate to high severity burning. In areas that burned severely, mosses would be directly affected by consumption of their substrate or indirectly affected by reduced canopy cover. In regard to bank stability and riparian vegetation associated with these immediate stream environments, the greater the extent of intense burning in perennial streams the increased likelihood of subsequent channel erosion within the burn area and downstream.

Although the Megram Fire certainly affected the riparian associated epiphytic flora in these watersheds, the significance of these effects is not known. Pre-requisites for recovery of epiphytic organisms in riparian areas affected by moderate to high intensity burning include: suitable substrate availability (primarily deciduous trees or shrubs); available parent material for dispersal; and adequate shade to ensure proper humidity and temperature levels within the riparian area.

Meadows

Meadow habitats in the analysis area provide habitat for an array of native species and plant species of concern including Klamath gentian (Gentiana plurisetosa, CNPS rare), coast checkerbloom (Sidalcea oregana var. eximia, SIS), and nodding semaphore grass (Pleuropogon refractus, CNPS rare). Discussion of reference and current conditions for these meadow species is discussed under the Terrestrial Sections within “Plant Species of Concern”. Current conditions in the meadows have most likely changed from reference conditions with regards to the shift in the species composition of meadows to include non-native plant species, with livestock being the most likely vector for non-native introductions. Fire may have, in specific areas subject to moderate burning, favored a shift in composition toward early successional and non-native species. However, it is expected that continued livestock grazing in these particular meadows will only exacerbate the trend.

Northwestern Pond Turtle

Northwestern pond turtles are often concentrated in low velocity and low gradient sections of creeks and rivers, especially in sloughs, side channels, and backwater areas. They prefer creeks that have deep, still water and sunny banks. Hatchlings are small and cryptic, and require shallow edgewater areas with minimal currents. Adults concentrate in deep-water pools with lots of underwater debris. For nesting and overwintering, turtles require an adjacent terrestrial area (within 500m of the watercourse) with uncompacted soil and a duff layer (Jennings et al. 1993).

Although pond turtles have been eliminated from an estimated 30-40 percent of their historic range, habitat conditions and population trends are largely unknown in the HLMTT watershed analysis area. Major threats to this species are loss or alteration of habitat (including wetland reclamation, water diversions, dams, and grazing), fragmentation of habitat, over-exploitation, and spread of exotic species (especially bullfrogs and bass) (Jennings et al. 1993).

There are no records of western pond turtles within the analysis area. Surveys for this species have occurred within several of the streams and lakes within the analysis area but no detections have been made. However, this species is a habitat generalist and is very likely to occur in some of the pools associated with low gradient streams within the analysis area.

Red-Legged Frog

Northern red-legged frogs require ponds, pools in slow streams, marshes, or reservoirs with submerged vegetation for egg attachment, a depth greater than 1 meter to accommodate singing males, and a maximum stream width greater than 2 meters. This frog is found in coniferous/mixed hardwood forests with greater than 50 percent canopy closure, and with downed logs in and out of water. It requires cool water, having the lowset upper (21 degrees Celsius) and lower (4 degrees Celsius) lethal embryonic temperature of any North American ranid frog (Licht 1971).

Threats to this species are similar to those discussed under the northwestern pond turtle (e.g. loss, fragmentation, or alteration, of habitat resulting in increased water temperatures, decreased pool depths, or decreased riparian vegetation, and introduction of exotic fishes or bullfrogs. Riparian reserves are expected to provide adequate protection for these species. There are no known records for red-legged frogs within the watershed analysis area.

Foothill Yellow-Legged Frog

Foothill yellow-legged frogs inhabitat rocky, higher gradient, shallower streams with less vegetative streamside cover than red-legged frogs. Both species require partially submerged rocks and logs for basking and cover. The yellow-legged frog population is considered stable in the north coast area. Surveys for this species have been accomplished in many of the streams associated with anadromous fish surveys. Yellow-legged frogs have been recorded in the watershed analysis area, specifically within Horse Linto Creek and its drainages.

Southern Torrent Salamander

Southern torrent salamanders reside in headwaters, springs, seeps, and first to third order streams with high canopy closure. This species is an aquatic obligate, sensitive to desiccation, increased sedimentation, and habitat alteration. Torrent salamanders require cold water temperatures that consistently range from 8-12 degrees Celsius in summer. Their headwater stream habitat has declined substantially due to extensive logging. There are three records of the southern torrent salamander within the analysis area, all of which are located within the Horse Linto drainage.

Aquatic Species and Habitats

The current known range of salmonids within the analysis area is shown in Figure 1-7. Fisheries information for these three watersheds prior to the 1960s is primarily anecdotal. There is general agreement among fisheries biologists and the general public that the abundance of anadromous fish and the quality of their habitat declined severely in these three watersheds following the 1964 flood.

A decline also took place throughout most of California and beyond. There are many causes for the general decline of anadromous salmonids in California, and not all scientists agree as to which causes are most responsible for declines of the different fish stocks. Although it is recognized that many problems exist at larger scales than the analysis area, it is beyond the scope of this document to focus on fisheries problems beyond the analysis area. However, it is important to remember that anadromous salmonid populations have declined throughout the western continental United States.

Historically, if a catastrophic event eliminated a salmonid population in some watersheds for a decade or even a century, the watershed would eventually be re-colonized from adjacent watersheds. Such colonization was possible due to the presence of diverse and abundant stocks of fish spread out over many, presumably healthy watersheds. Due to dwindling fish populations, fish stocks, and limited properly functioning habitat, it is much less likely that fish populations can rebound as they formerly did.

The decline of anadromous salmonids, coupled with a desire to conserve anadromous salmonids for future generations, led to the designation of Horse Linto Creek and other watersheds as key watersheds. Federal policy dictates that the key watersheds are to be managed as refugia for at-risk fish species. The protection of fish habitat is central to the management of all watersheds, and especially key watersheds.

Extensive data about anadromous fish and their habitat in the Horse Linto key watershed is available from the 1970s to present. This Horse Linto data are available in a stream report (Fuller, 1991) and anadromous monitoring reports. The most recent monitoring report encapsulates past monitoring through 1999 (Six Rivers National Forest, 1999). The California Department of Fish and Game (CDFG) assisted the 1999 to 2000 monitoring in Horse Linto Creek via a grant agreement funded by Senate Bill 271.

The known anadromous habitat in the Mill and Tish Tang watersheds is all on the Hoopa Valley Indian Reservation, although steelhead may sometimes ascend Mill Creek beyond tribal lands. The Hoopa Valley Tribe (HVT) assisted this analysis by providing information about fish and fish habitat on tribal lands.

Coho Salmon

Coho salmon *(Oncorhynchus kisutch)* and their habitat have been listed under the Endangered Species Act (ESA). All three watersheds contain designated critical habitat for the threatened Southern Oregon/ Northern California Evolutionary Significant Unit (ESU) of coho salmon. General information about coho can be found in the Forest-wide Reference Document (Six Rivers National Forest, 1997). We know the following specifics about coho within the analysis area.

Coho numbers in the analysis area are extremely low. The numbers in the Horse Linto watershed have been especially low since 1995 (Boberg, 1996 and Six Rivers National Forest, 1999). In that time, we have seen a few coho adults and/or juvenile coho in the Horse Linto watershed each year, but the numbers have been so low that it appears that very few pairs of coho return each year to spawn. However, it should be noted that our current method of salmon and steelhead juvenile monitoring couldn't be implemented early enough in the year to count the majority of coho yearlings due to the high flows when they out-migrate.

Juvenile coho have been seen in Mill Creek for most of the past decade in limited numbers. Little information is available on coho within Tish Tang Creek, except that they are occasionally present.

Some scientists wonder whether any of the coho in the analysis area are truly native. It is likely that coho were never common in the analysis area since the available habitat is dissimilar from what coho normally prefer. It is also likely that the coho within the analysis area have some amount of hatchery stock in their genetic makeup because hatchery coho have been planted in Horse Linto and other nearby watersheds including on the Hoopa Valley Indian Reservation. In addition, over half of the coho carcasses recovered by the Lower Trinity Ranger District in 1998-1999 in a condition allowing verification, showed a maxillary clip denoting they were from the Lewiston hatchery (Six Rivers, 1999). Coho strays have also been recovered from Oregon hatcheries.

Chinook Salmon

Chinook salmon *(Oncorhynchus tshawytscha)* and their habitat within the analysis area have not been listed under the ESA. All three watersheds contain habitat for the Upper Klamath and Trinity River ESU of chinook salmon. General information about these chinook can be found in the Forest-wide reference document (Six Rivers National Forest, 1998). We know the following specifics about chinook within the analysis area.

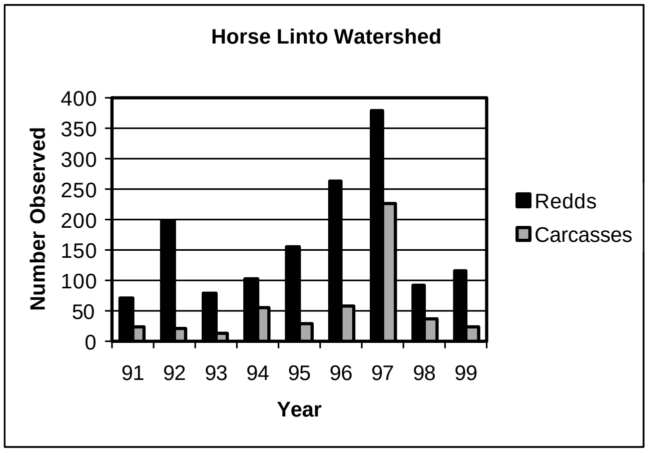
All chinook in the analysis area are fall-run fish; spring-run chinook have not been found. Horse Linto chinook are considered a late-fall-run stock since peak spawning occurs from late November to early December, with some chinook continuing to spawn into mid to late January. It is believed that this timing was the norm for the chinook within the analysis area for many centuries due to natural selection. A late-fall run fits the hydrology of the watershed; fish do not benefit from returning to spawn until flows increase sufficiently to allow them to spawn efficiently. Recognizing the importance of local chinook adaptations to local conditions was a central facet of a small-scale cooperative chinook hatchery that operated in Horse Linto from 1984 to 1994.

While historical numbers of chinook are unknown, the habitat could have easily supported many thousands of spawners and runs could have been that large in normal to good years. However, spawning surveys in the late 1970s documented very low numbers of returning adult fall chinook (less than a dozen per year were located in some years). As a result, a small hatchbox rearing project was initiated in 1981 to augment the spawning population. The project was discontinued in 1983. Spawning surveys continued to find very low numbers of chinook adults returning to the Horse Linto Creek watershed.

A small, streamside chinook salmon production facility was developed in Horse Linto Creek in 1984, through a cooperative agreement between Six Rivers National Forest, the California Department of Fish and Game, the Hoopa, Karuk, and Yurok Tribes, the Pacific Coast Federation of Fishermen's Association, US Fish and Wildlife Service, and Humboldt State University. The facility was designed to increase returning chinook spawners to a level that would no longer require augmentation. Returning Horse Linto chinook spawners were trapped, spawned, reared to fingerling and/or yearling size, coded-wire tagged at the facility and released back into Horse Linto Creek (Halemeier & Farro, 1995). During the early years of the project, very few fish were artificially spawned, since the project also had to allow for escapement of some chinook to spawn naturally. As returns grew, a greater number of adults were available from which eggs could be collected. Between 1984 and 1994, as many as 75,000 juvenile chinook salmon were tagged and released annually from the Horse Linto facility. As a result of this effort, fall chinook spawning in Horse Linto and Cedar Creeks increased to over 200 pairs annually, while the facility was in operation. The facility has been idle since 1994 to test the viability of the augmented spawning population over time.

The project appears successful to date. Horse Linto Creek currently has the largest naturally spawning chinook population in the lower Trinity River. Figure 3-27 shows the number of redds and carcasses located within the approximately 5.5 miles of habitat in the lower watershed that are regularly surveyed. The highest number to date was in 1997 when the last four-year-old Horse Linto hatchery fish were returning. While natural variability, such as flooding, can impact how many juvenile chinook survive to outmigrate, monitoring has shown a steadily improving trend in naturally produced chinook juveniles from 1993 through 1997 (Six Rivers National Forest, 1999).

Figure 3-27. **Redd and Carcass Totals from 1991 to 1999 for Horse Linto Watershed :**



Chinook are present within the Mill and Tish Tang watersheds, and their numbers are increasing from the very low numbers seen after the 1964 flood. These streams also benefited to some degree from the Horse Linto hatchery, since carcasses of Horse Linto tagged strays have been recovered in those watersheds.

Steelhead

Steelhead *(Oncorhynchus mykiss)* and their habitat within the analysis area have not been listed under the ESA. All three watersheds contain habitat for the Klamath Mountain Province ESU of steelhead. General information about steelhead can be found in the Forest-wide reference document (Six Rivers National Forest, 1997). We know the following specifics about steelhead within the analysis area.

All steelhead in the analysis area are winter-run fish; summer-run steelhead are not known to be present. Steelhead spawning in Horse Linto Creek has been observed between January and early May.

Steelhead populations in Horse Linto Creek appear to be at a stable level, within probable natural variability. Population surveys and monitoring of downstream migrants began in 1990. From 1990 through 1996, the entire anadromous reach of Horse Linto Creek was surveyed annually by snorkel divers to count and identify juvenile anadromous salmonids. These surveys found a well-stocked array of quality habitats and well balanced year-class distributions for juvenile steelhead (Boberg, 1996). The downstream migrant trapping is continuing annually. Data compiled from the traps also indicate a strong recruitment of young-of-the-year steelhead and healthy numbers of out-migrating smolts in Horse Linto Creek (Six Rivers National Forest, 1999).

Steelhead are present within the Mill Creek and Tish Tang Creek watersheds and their numbers appear to be increasing from the very low numbers seen after the 1964 flood.

Resident Trout

Two species of resident trout are found within the analysis area, rainbow trout *(Oncorhynchus mykiss)* and brook trout (*Salvelinus fontinalis*). The brook trout are not native to California but were introduced within the headwaters of the analysis area beginning as early as the 1930s. Streams within the analysis area were formerly planted with both brook trout and rainbow trout by the California Department of Fish and Game, but that effort ceased decades ago. Upstream portions of the analysis area contain healthy populations of both species. Resident trout may be found within the anadromous waters, but their primary range is upstream of natural barriers. It is unclear what the historic range of rainbow trout was prior to fish planting. Some of the rainbow trout above current natural barriers are likely descended from steelhead that were able to access farther upstream when passage conditions were different.

Resident trout are found in one lake within the analysis area. Mill Creek Lake is located in the Wilderness in the headwaters of the Mill Creek watershed. The lake contains both brook and rainbow trout, which are stocked by the California Department of Fish and Game. It is believed that the Megram Fire had little effect on the fishery in Mill Creek Lake.

Fish Habitat Availability and Condition

These three watersheds are believed to have provided healthy fish habitat prior to European settlement. The analysis area has experienced assorted human activities, including Native American burning to manage vegetation, more recent active fire suppression, mining, road building, and logging. Within the last 100 years, several large flood events have significantly altered aquatic habitat conditions, as noted in preceding sections. Most of the fish habitat within the analysis area has experienced some level of recovery from the 1964 flood. Stream habitat quality ranged from fair to excellent condition for anadromous and resident salmonids prior to the Megram Fire.

While no human-caused anadromous fish barriers are present within the analysis area, it is believed that resident fish passage may be blocked at several stream crossings along roads 7N04, 7N53 and 10N02. These stream crossings and the fish habitat upstream from them should be inspected for fish passage improvement needs.

Environmental baselines that characterize the health of each watershed prior to the Megram Fire relative to anadromous species are shown in Table 3-70. These baselines are used to summarize the habitat values of a watershed for anadromous fish. The methodology used to arrive at these baselines is found in “Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale” (NMFS, 1996). A combination of fisheries and hydrologic field data, GIS data and professional judgment were used to rate the three watersheds. Horse Linto Creek was deemed to be a properly functioning refugia, while Mill and Tish Tang Creeks were judged not to be properly functioning refugia.

Figure 3-28 displays fish habitat within the analysis area relative to the Megram Fire. The fire overlapped both anadromous and resident fish habitat, but it did not directly affect the habitat equally. Most of the anadromous habitat was left unburned. Generally, the fire burned hottest in headwater reaches that contained no fish or only resident fish. However, it is certain that some degree of indirect effects will occur in all anadromous and resident fish habitat where the

Figure 3-28. **Fish Habitat and the Megram Fire:**

Table 3-70. Environmental Baselines for Anadromous Fish Habitat before the Megram Fire

	Horse Linto Creek			Mill Creek			Tish Tang Creek		
	ENVIRONMENTAL BASELINE			ENVIRONMENTAL BASELINE			ENVIRONMENTAL BASELINE		
	Properly Functioning	At Risk	Not Properly Functioning	Properly Functioning	At Risk	Not Properly Functioning	Properly Functioning	At Risk	Not Properly Functioning
WATER QUALITY									
Temperature	■				■			■	
Sediment/Turbidity	■				■			■	
Chem.Contamination	■			■			■		
HABITAT ACCESS									
Physical Barriers	■			■			■		
HABITAT ELEMENTS									
Substrate	■				■			■	
Large Woody Debris	■					■			■
Pool Frequency	■					■			■
Pool Quality	■					■			■
Off-channel Habitat	■					■			■
Refugia	■					■		■	
CHANNEL CONDITION & DYNAMICS									
Width/Depth Ratio	■				■			■	
Streambank Cond.	■				■			■	
Floodplain Connect.	■				■			■	
FLOW/HYDROLOGY									
Peak/Base Flows	■					■			■
Drainage Network Increase	■					■		■	
WATERSHED CONDITIONS									
Road Density & Loc.	■					■		■	
Disturbance History	■					■			■
Riparian Reserves	■				■			■	

upstream headwaters experienced high or moderate intensity wildfire. All anadromous fish habitat had such fire effects in the riparian reserves upstream. It is expected that the chief effects to anadromous habitat will be related to erosion, sedimentation and water quality. Resident fish habitat is expected to have the same problems, plus the direct alteration of habitat along the stream corridor where downed wood was burned and living trees and other vegetation were killed or damaged. The Megram fire likely impacted environmental baselines related to riparian reserves, sediment/turbidity and refugia function in all three watersheds, but additional field analysis will be needed to update the current baseline conditions.

It is likely that the Megram Fire will affect anadromous fish and their habitat for at least a decade. It is not possible to quantify the magnitude of future effects of the fire on anadromous fish habitat or to predict the maximum duration of these effects. The effects on fish habitat will depend to a great degree on the weather in the next decade and natural recovery processes. Large rain-on-snow events such as occurred in 1964 would be much more damaging to anadromous fish habitat than "normal" weather patterns considering the current erosion potential in the analysis area. Erosion will probably remain elevated until the intensely burned hillsides and stream courses are vegetated and stable again. Sediment that moves into a headwater stream course may take several years to reach anadromous habitat, however.

Several years of monitoring are probably necessary before we can estimate the long-term effects of the Megram Fire on anadromous habitat or predict likely long-term effects if similar large, catastrophic fires occur in the future. The Six Rivers National Forest fisheries program has been monitoring habitat conditions including stream flows and water temperatures in lower Horse Linto Creek for a number of years. Stream Condition Inventory (SCI) sites were established in Horse Linto Creek and a tributary to Tish Tang Creek prior to the Megram Fire. These sites will allow us to monitor changes in habitat condition over time.

Horse Linto Creek

The Horse Linto watershed contains about 14 miles of fish habitat where anadromous fish are present and another 33 miles of habitat where only resident trout are present. Horse Linto Creek and its major tributary Cedar Creek comprise the majority of the anadromous habitat. The stream channels are predominantly bedrock controlled and deeply incised. There is good habitat diversity including primary pools and coarse woody debris. Water quality is good with no temperature problems. There are only minor problems with excess fine sediment adjacent to and immediately downstream of small natural landslides.

After the 1964 flood, the anadromous habitat had been greatly simplified, causing some fisheries biologists to liken the creek to a bowling alley. Post-flood salvage logging and wood removal to "protect the fisheries" was generally detrimental to aquatic habitat. Large woody debris is now recognized as an important component of healthy aquatic habitat. The shade canopy had been restored in most of the anadromous reaches of Horse Linto and Cedar Creeks by the late 1980s. Large woody debris has become common throughout the anadromous reach within the last few years due to recruitment from adjacent riparian reserves. Current conditions provide high quality, diverse habitat.

Instream enhancement projects were initiated in 1979 in Horse Linto and Cedar Creeks to develop additional spawning areas and increase habitat diversity through the placement of log and boulder structures. Most of the structures in Horse Linto and Cedar Creeks have performed as designed and are assisting greatly in the sorting and storage of bedload sediment, providing cover for juvenile and adult fishes, and enhancing habitat quality overall.

Horse Linto Creek was a properly functioning refugia with good to excellent habitat conditions for anadromous salmonids prior to the Megram Fire. Approximately 64 percent of the Horse Linto watershed fishery habitat burned in the fire. However, only about seven percent of the Horse Linto anadromous stream corridor was burned. About 2.1 miles of anadromous stream corridor burned at moderate severity and less than 0.1 mile burned at high severity. Stream corridors containing only resident fish burned much more extensively. About 12.8 miles of resident stream corridor burned at moderate severity and about 4.3 miles burned at high severity.

The lower 0.9 miles of Horse Linto Creek are on private land. The now inactive Horse Linto hatchery is located on that private land. The private landowner is working with Six Rivers National Forest, California Department of Fish and Game, and other cooperators to complete projects to benefit anadromous fish. The latest habitat projects were the addition of LWD and planting conifers near the stream to provide more long-term shade and large woody debris. The Megram Fire did not directly affect fish habitat on private land.

Mill and Tish Tang Creeks

Mill and Tish Tang Creeks were not designated as key watersheds, but both streams have important fisheries values to the Hoopa Valley Tribe. The known anadromous habitat lies on the Hoopa Reservation. Neither Mill nor Tish Tang Creeks were thought to be properly functioning refugia prior to the Megram Fire. Tish Tang is the healthier of the two watersheds. There is a much higher road density and more extensive management disturbance in the Mill Creek watershed than in Tish Tang Creek. Table 3-70 shows the environmental baselines for a number of factors that affected anadromous fish habitat prior to the Megram Fire (Frank Lake, 1998 and 1999).

Anadromous fish are found only in the lower 2.8 miles of Tish Tang Creek and resident trout are present in about 15.5 miles of stream. Mill Creek contains about 6.7 miles of anadromous habitat that has been historically occupied, but salmon are currently confined to the lower 2.6 miles of habitat. Forest Service fish surveys have suggested that steelhead could not reach habitat on National Forest lands. The Hoopa Valley Tribal Fisheries staff believe that some steelhead are currently able to ascend Mill Creek at least to the reservation boundary, so that steelhead habitat probably encompasses 10 or more stream miles (personal communication, James Wroble). There are about another eight miles of habitat on National Forest lands where only resident trout are known to be present.

Prior to the Megram Fire, resident fish habitat in upper Mill and Tish Tang watersheds was generally in good condition. This habitat had experienced the same kinds of problems and subsequent recovery that occurred in Horse Linto Creek.

Mill Creek fisheries habitat received less direct impacts from the fire than the other two watersheds. Approximately 19 percent of the fish-bearing stream corridors in Mill Creek burned in the Megram Fire. However, none of the anadromous stream corridor was burned. About 3.3 miles of resident stream corridor burned at moderate severity and none is thought to have burned at high severity. It should be noted that about 34 percent of the riparian reserves in Mill Creek were burned in the Megram Fire at a moderate to high severity, so indirect post-fire fisheries problems are still likely to affect resident and anadromous fish habitat.

Approximately 50 percent of the fish-bearing stream corridors in Tish Tang Creek burned in the Megram Fire. However, none of the anadromous stream corridor was burned. Stream corridors containing only resident fish burned fairly extensively. About 8.5 miles of resident-only stream corridor burned at a moderate severity and about 0.6 miles burned at a high severity.

CHAPTER 4

SYNTHESIS AND INTERPRETATION

This step of the analysis process is designed to synthesize and interpret information collected in the previous steps. Emphasis is placed on understanding ecosystem processes and functions as they relate to the issues and key questions in Chapter 2, and on identifying opportunities to close the gap between current and desired conditions.

This chapter is designed to follow the format of Chapter 2 (Issues and Key Questions) in order to address the issues and answer key questions. Thus, the major sections of this chapter correspond with those in Chapter 2. As the intent of this chapter is to synthesize the information gathered during the analysis and integrate different disciplinary perspectives, many of the issues and key questions are simultaneously addressed in these discussions. For example, some of the opportunities identified to achieve RMRs (key question 1.3) would also reduce the risk of future fires (key question 3.4), help recover habitat for plant and wildlife species of concern (key questions 2.3 and 2.6), contribute to local economies (key question 5.1), and reduce the threat from future wildfires to Tribal trust resources (key question 5.5). It is therefore impractical to respond to each key question separately. Instead, headings for the discussions that follow identify the relevant key questions in parentheses. Some of discussions pertain to only one key question; in these cases, the question precedes the discussion.

Terrestrial System

Issue 1: Long-Term Health and Recovery of Vegetation

Vegetation Management

Historic Range of Variability (1.1, 2.4, 2.5)

The recent HRV analysis performed for the central zone (see Chapter 3) shows the combined effects of past logging and the Megram Fire. Past harvests between 1960 and 1990 had the most impact on the old growth seral stage in the tanoak and Douglas-fir series. Before the fire, both of these vegetation types were below the recommended management range (RMR) for the old growth seral stage, and near or below the HRV. The fire exacerbated this situation by further reducing the number of mature and old growth acres. Before the fire, the white fir and red fir series were within the RMRs for most seral stages, but high severity fire converted many acres to the shrub/forb seral stage. As a result, the late mature and old growth seral stages are now below the RMRs for these vegetation series.

Although fire is a natural event that affects successional development, the large scale and severity of the Megram Fire appears to be outside the historic range of variability for fires in the Klamath

Mountains (Skinner, personal communication). The Megram Fire was the fifth largest fire in recent history in California, and the largest fire in conifer forest lands (California Department of Forestry, 1999). Historically, median fire return intervals ranged from 12 to 19 years in Douglas-fir-dominated forests, with a median fire size of 860 acres (Taylor and Skinner, 1998). Although fires were frequent, they typically burned with a low to moderate severity, with small patches of high severity stand-replacing fire. "Frequent fires of mixed low and moderate severity killed some overstory trees, initiated recruitment, and thinned or killed understory trees. These mixed-severity fires created multi-aged stands where tree establishment was associated with more severe fires that killed parts of the canopy. Large, severe fires were uncommon" (Ibid). Fire suppression over the last century has altered natural successional patterns, lengthening the interval between fires and thus creating higher fuel levels than expected in a "natural" system. The 1995-1996 blowdown event added more fuel to stands, which already had a higher than "natural" stand density due to past fire suppression. These unusually high fuel levels helped to fuel the Megram Fire, with an atypically high percent of high severity stand-replacing fire.

After the Megram Fire, the combined effects of human and natural disturbance have reduced the four primary vegetation series (tanoak, Douglas-fir, white fir and red fir) below the minimum value for both the HRV and the RMR for the late seral stages in the central zone. This is particularly important in light of the fact that these three watersheds contributed the majority of the late seral vegetation to the zone. In addition, the acreage of mature seral stage vegetation has decreased in the Douglas-fir, white fir and red fir series. Because the mature seral stages provide potential in-growth for late seral vegetation, this loss could influence the attainment of a balanced seral stage distribution that is within the RMRs for many decades.

Recommended Management Ranges (1.3, 2.3, 2.5, 2.6, 3.4, 4,6, 5.1,5.5)

The Forest LRMP provides overall vegetation management direction for the Forest and the central zone. It describes the desired vegetation conditions for vegetation types and seral stages in the RMRs. The Forest-wide LSR Assessment (LSRA) provides management recommendations for LSR 305, which covers most of the analysis area. The LSRA emphasizes the maintenance and promotion of late seral conditions to the maximum amount sustainable over time. "It is expected that the acreage of each LSR in the mid-mature, late mature, and old growth seral stages will be at the upper end, or even exceed, its relative contribution to the RMRs for the zone in which the LSR is located…" (Six Rivers National Forest LSRA, 1999). The Megram Fire has significantly reduced the amount of mature and old growth vegetation within the analysis area, and there is a large gap between current conditions and the desired conditions described in both the LRMP and the LSRA. We therefore look toward the LRMP and LSRA for management direction.

When vegetation is outside the RMRs for a specific vegetation series and seral stage in any zone, the LRMP directs that all vegetation management activities should be aimed at returning vegetation within the RMR for the zone. The LSRA directs that management activities promote or maintain late seral vegetation.

To meet both of these objectives and achieve the RMRs, two opportunities are outlined here:

1. Protect remaining mature and old growth stands from catastrophic loss
2. Accelerate the development of late mature habitat:
    - Move early and mid mature low and moderate burn severity acres into the late mature seral stage
    - Reforest high severity burn areas and reduce fuel concentrations
    - Reforest burned plantations

Opportunities for Moving Vegetation toward RMRs

1. Protect Remaining Mature and Old Growth Stands from Catastrophic Loss

Within these watersheds, stands that suffered a loss of 60 percent or more of their pre-fire canopy closure total over 17,000 acres (Table 3-23). Losses of this magnitude re-set the successional clock and changed the seral stage distribution (Table 3-14) in the HLMTT area, as well as the central zone of the Forest. It is imperative to maintain remaining stands into the foreseeable future to provide late-successional habitat within the LSR and move vegetation toward the RMRs for the late mature and old growth seral stages.

Mature and late successional stands with moderate and low severity burn effects experienced both individual tree and group mortality; mortality in these stands is expected to increase as trees are stressed by cambium and crown loss. Over time, these trees will add significantly to the fuel loading and hazard in the area, far exceeding desired fuel levels. Reducing the fuel loading, while maintaining the desired snag and log levels identified in the LRMP and LSRA, will add to the likelihood that these stands will survive another fire. “Given the continued alteration of fire regimes and our lack of ability to control tree densities on a landscape basis, untreated post-fire stands could have the future combination of elevated dead and down and also elevated tree densities. This future condition could be a serious concern for both suppression and adverse fire effects from the increased fire intensity. Basically, fires in altered forest systems may not have reset the environmental clock, but set a biological time bomb in the future…” (Everett 1995).

2. Accelerate the Development of Late Mature Habitat

The following options would accelerate the development of late mature habitat within these watersheds.

- Move Early and Mid Mature Low and Moderate Severity Burn Acres to the Late Mature Seral Stage

Between 1996 and 1999, 1,580 acres within the fire area were harvested and treated to reduce fuel loadings and hazard that resulted from the storm events during the winter of 1995-1996. These treatments were designed to reduce fuel levels, and did not include structural treatments based on silvicultural prescriptions to enhance development of late seral characteristics. During the Megram Fire, the majority of these treated acres (Table 3-28) suffered lower burn severities than similar untreated areas. Due to the success of these treatments in reducing burn severity, we believe that a combination of fuel reduction and silvicultural treatments would be beneficial. A two-fold benefit can be achieved; to enhance stand structure development and reduce stand density to accelerate the movement of mature stands toward late seral conditions, and reduce hazard and increase survivability in the event of another fire.

Many of the stands that burned with a low to moderate severity contain fire-killed or severely stressed trees, and can be expected to have further insect-related mortality (Furniss and Carolin 1977, Wagener 1961, Weatherspoon 1988). Trees with low vigor are most likely to die in the near future; characteristics include cambium loss, low crown ratio, thinning or fading crowns, defects, and insect evidence. This mortality creates high levels of large and fine fuels, putting the remaining functional mature stands at substantial risk for future loss. This risk can be reduced by implementing fuel reduction projects in stands that burned with a low to moderate burn severity. A combination of fuel reduction and silvicultural treatments can alter structure within these stands both vertically and horizontally, thereby shortening the period of time needed to attain late seral characteristics (Jimerson and Jones. 1993). Within small gaps or patches created by fire and insect mortality, tree removal will reduce fuels and in many locations provide conditions conducive to regeneration of a new age class of trees and other vegetation, providing both vertical and horizontal diversity. In other portions of these stands, density reduction by removing low vigor trees will allow the remaining trees to more fully utilize the site resources that will maintain or enhance diameter and height growth. Trees removed under these circumstances would generally have less than 25 percent live crown, or would have lost greater than 65 percent of their pre-fire canopy volume. These treatments will retain desired levels of snags and downed wood and not remove large remnant trees (predominants) that were survivors from stand-replacing fires in the late 1800s or early 1900s, which are important stand components for snag recruitment, coarse woody debris and wildlife habitat. Treatments are expected to accelerate movement into later seral stages. The highest priority stands for treatment are those located in the mid to upper one-third slope position that had a moderate burn severity, because these are the stands that are most likely to burn severely in future stand-replacing fires.

- Reforest High Severity Burn Areas and Reduce Fuel Concentrations

Of the approximately 17,000 acres of high severity burn, about 10,500 are located outside the wilderness, mostly in the white fir and Douglas-fir series. Stands in the high severity burn category have been converted to the shrub/forb seral stage, and will be rapidly occupied by fire-adapted shrub species such as snowbrush (*Ceanothus velutinus),* deer brush (*Ceanothus intergerrimus*), bitter cherry (*prunus emarginata*) and manzanita (*Arctostaphylos sp*). The combination of both fine fuels and large dead fuels presents a significant hazard for re-burning at high severity. The ability of these stands to naturally regenerate depends on numerous factors, including the proximity of a conifer seed source, periodicity of seed crop, predation of seed, germination and survival of seedlings and the effects of vegetative competition and animal browsing (Nyland 1995). Naturally regenerated stands will be impacted by the large number of dead trees as they decay and fall, which can crush or damage new growth. These falling trees can reduce the number of surviving seedlings and saplings. The growth and movement (succession) of stands into later seral stages under these conditions can be expected to take 20 to 25 years or longer than with artificial regeneration, assuming future fires do not set them back to the shrub/forb stage repeatedly.

Artificial regeneration of high burn severity stands, where possible, will provide multiple benefits. The large numbers of snags and logs that would contribute to high intensity re-burns would be reduced to desired levels. The remaining surviving green trees and predominants, as well as snags and logs, would provide the structure and habitats needed to bridge to later seral stages as the stands develop. Reforestation will reduce the period of time in the shrub/forb seral stage and speed recovery of the LSR in the long term. Follow-up treatments such as release and precommercial thinning will also accelerate stand development. Early seral vegetation is highly susceptible to loss in a fire. Treatments that reduce the time that stands are in these seral stages should reduce the risk of loss in the future.

By reducing the risk of re-burns, artificial regeneration can reduce impacts to soil productivity in high severity burn areas. Soil productivity in these areas may have been reduced, and subsequent fires would further impact the soils in these stands.

The white fir and red fir series are found at higher elevations within the burn area. Development of unmanaged stands will be slower due to shrub competition, seed source availability and the limitation of high elevation growing seasons, which are typically short. Development of the pole seral stage will likely take up to 30 years in white fir stands, and 30 to 50 years in the red fir series. Late successional conditions may not appear for 140 to 180 years, thus affecting the timeframe to meet the RMRs for the late mature and old growth seral stages. Surviving stands (low to moderate burn severities) that are adjacent to high severity burned stands are at an increased risk of burning in the event of another large fire.

- Manage burned plantations as needed to re-establish healthy conifer stands

Plantations are the result of past forest management, primarily following harvest. Of the approximately 7,000 acres of plantations on national forest lands in these watersheds, between 2,500 and 3,500 acres were destroyed in the fire and burnout operations (Table 3-22). These stands are in a variety of conditions following the fire. Many were 25 to 35 years old and have standing dead trees between 6 and 16 inches in diameter. Younger stands have sapling-sized material standing, while very young stands were burned relatively clean of woody material. Timber values are not recoverable in these stands due to their small tree size and rapid decay. Decay will render them unmerchantable by the time a recovery project could be implemented.

Reforestation efforts of high severity burn plantations would begin replacement of these stands and speed the recovery of the LSR. These efforts could not begin until the spring of 2001 due to the unavailability of site-adapted seedlings. It takes a minimum of 16 to 28 months to obtain a seedling following placement of an order. Reforestation of plantations would depend on seedling availability and implementing necessary site preparation treatments to provide access and reduce the amount of dead fuel.

Plantations that burned at a moderate or low intensity will need to be field evaluated during the summer and fall of 2000. It is expected that additional mortality will occur from cambium and crown loss and increased insect activity. Plantations that have additional mortality that leave fewer trees per acre than deemed adequate to meet long term LSR objectives would be reforested.

Those with high fuel loading would be treated. To minimized potential erosion, hand cut, hand pile and burn or lop and scatter would be utilized. Concern is that additional fire in these stands has the potential to adversely impact soil productivity.

15 Percent Retention S&G (1.1)

One of the standards and guidelines (S&Gs) in the LRMP addresses the retention of late-successional stands at the fifth field watershed level. The S&G states that if the federal forest land within a fifth field watershed is currently comprised of 15 percent or less late-successional forest, all remaining late-successional forest should be protected. The Horse Linto, Mill, and Tish Tang Creek watersheds are fifth field watersheds. A directive dated September 14, 1998 outlines implementation procedures and field guidance for this S&G. The following assessment is based on the steps and procedures outlined in this draft directive. The directive states that the 15 percent S&G will be interpreted and implemented in the context of an assessment at the watershed scale.

The FSEIS ROD defines late-successional stands as forest seral stages that include both mature and old growth age classes. The definition for mature stands is “A mappable stand of trees for which the annual net rate of growth has peaked. Stands are generally greater than 80-100 years old and less than 180-200 years old…” This definition of a mature stand does not coincide with the description of the early mature seral stage on the Forest (which generally range from 71 to 110 years in age). Late-successional characteristics begin to develop about halfway through the mid-mature seral stage. The scale of the Forest vegetation mapping cannot identify these stand-level characteristics, so half the acreage in the mid-mature seral stage was used to proxy for late-successional forest in this assessment. In addition, both the late mature and old growth seral stages are considered late-successional forest.
The amount of late-successional habitat remaining after the Megram Fire was determined by assuming that stands which burned with a moderately high to a high fire severity (greater than 60 percent of the canopy cover killed) reverted to the shrub/forb seral stage. The total acreage and percent of early and late-successional forest in each watershed are shown in Table 4-1. All watersheds are well above the 15 percent threshold in both matrix and reserved lands.

Table 4-1. Acres and Percent of Late-Successional Forest after the Megram Fire

Land Allocation	Early Successional Acres	Early Successional Percent	Late-Successional Acres	Late-Successional Percent	Total Acres
Horse Linto					
Matrix	0	0	0	0	0
LSR	17,067	54	14762	46	31,829
Wilderness	6,159	69	2,798	31	8,957
Total	23,226	57	17,560	43	40,786
Mill					
Matrix	404	44	507	56	911
LSR	6,297	57	4,749	43	11,046
Wilderness	1,106	55	894	45	2,000
Total	7,807	56	6,150	44	13,957
Tish Tang					
Matrix	0	0	0	0	0
LSR	4,200	53	3,752	47	7,952
Wilderness	2,023	71	819	29	2,842
Total	6,223	58	4,571	42	10,794

The late-successional forest acres shown in Table 4-1 are further broken down by seral stage in Table 4-2. In each of the watersheds, the old growth seral stage comprises a large proportion of the late-successional habitat, which reinforces the finding that these watersheds carry a large portion of the late seral habitat in the central zone of the Forest.

Table 4-2. Late-Successional Forest Acres by Seral Stage after the Megram Fire

Seral Stage	Matrix Acres	Reserve Acres	Total Acres
Horse Linto			
mid mature	0	3,451	3,451
late mature	0	6,385	6,385
old growth	0	7,724	7,724
Total acres	0	17,560	17,560
Mill			
mid mature	63	1,353	1,416
late mature	191	1,711	1,902
old growth	254	2,581	2,835
Total acres	508	5,645	6,153
Tish Tang			
mid mature	0	526	526
late mature	0	1,309	1,309
old growth	0	2,738	2,738
Total acres	0	4,573	4,573

The September 14, 1998 directive outlines successive levels of assessment to implement the 15 percent S&G. These levels are provided below.

Level 1 Assessment: Are all federal forest lands within the watersheds designated as either congressional withdrawal, LSR, or other reserved land?

All of the lands in the Horse Linto and Tish Tang Creek watersheds are designated as either LSR or congressional withdrawal (wilderness), so no further assessment is required. A small portion of the Mill Creek watershed is matrix land (7 percent), so additional assessment for this watershed is required.

Level 2 Assessment: Are management actions planned or proposed on federal forest lands in the Mill Creek watershed that would reduce the acreage of 80-year-old and older forest (this assessment uses half of the mid-mature as well as all of the late mature and old growth stands)?

Most of the land in the Mill Creek watershed is in either LSR or wilderness, and there are no proposed management actions in these land allocations that would reduce the acreage of late-successional forest. Within the 911 acres of matrix land in the watershed (of which only 48 acres burned), there could be management actions that would reduce the acreage of late-successional forest, so additional assessment is required.

Level 3 Assessment: Is the percentage of federal forest lands within the Mill Creek watershed currently comprised of 15 percent or less 80-year-old and older forest (late-successional)?

The answer to this questions is no; the watershed is currently comprised of 44 percent late-successional forest. Additional assessment is required.

Level 4 Assessment: Does an assessment of federal forest land within the Mill Creek watershed indicate that planned or proposed management actions would reduce 80-year-old and older (late-successional) forest to the 15 percent level?

The answer to this question is no. Most of the watershed is either LSR or wilderness; silvicultural treatments are precluded in wilderness areas, and are directed at maintaining and protecting late-successional habitat in LSRs. Therefore, no treatments in these land allocations will reduce the amount of late-successional habitat. Management actions in matrix lands could reduce the amount of late-successional habitat, but only by one or two percent due to the small acreage in matrix land. Under the Forest Plan, vegetation management in the watershed is aimed at moving vegetation toward the recommended management ranges for the central zone; these recommended management ranges are much more restrictive than the 15 percent S&G. The zone is currently at or below the minimum RMR for the late mature seral stage and below the minimum RMR for old growth in the primary vegetation series. Therefore, management actions in these seral stages will be limited in order to maintain and increase the acreage of late seral stands over time.

Snags and Logs (1.1, 1,3, 2.1, 2.4, 3.4)

Snag and log densities have increased significantly as a result of the fire. These increased densities far exceed the recommended densities displayed in Table 3-30 and contribute to elevated fuel levels and risk of future fires. Possible management practices to meet the opportunities described here and in Chapter 5 should be designed to reduce fuel levels while maintaining the desired densities of snags and logs across the landscape.

Pests

1.4 Has the fire increased the risk of pest infestation?

For this issue, pests are categorized into two groups; diseases and insects. Weed pests are discussed below. Tree diseases will not spread outside of the fire perimeter. Decay fungi are going to be a large factor in the determination of value and salability of logs from potential salvage and fuel reduction areas within the burn. Trees vary in their susceptibility and rate of decay by species and by tree size. Many of the recommended recovery and fuel reduction activities will be dependent on how quickly the dead and severely damaged trees can be removed. They are expected to remain sound enough to be merchantable for two to four years following the death of the tree. Following that period, their economic value rapidly declines and therefore fuel reduction will not be feasible. Large areas with high numbers of rotting trees make prescribed fire difficult if not impossible. Burning under these conditions is hard to control and would do substantial soil damage when large logs are consumed.

Insects will increase in activity and will cause widespread additional mortality inside the burned areas. Mortality will vary from scattered single trees, to groups not expected to exceed 5 acres in size. This will add to the fuel loadings and exacerbate fire hazard. Once dead, these trees fall into the same conditions and scenario described above for diseased trees.

Meadow Communities

High Elevation Meadows associated Riparian Areas (1.5, 2.1, 2.3, 4.5, 4.6, 5.13)

Riparian habitats and montane meadows have been altered by historic grazing. In dry meadows, past grazing has resulted in an increase in bare ground (average 28 percent) and an increased cover of disturbance-tolerant species such as bracken fern (*Pteridium aquilinum*), which alters soil acidity thus influencing species composition in these areas. Cattle are noted vectors for the introduction of non-native species (Bedunah 1992), species that presently occur in both dry and wet meadows in the analysis area

Fire lightly burned a number of the meadows in the analysis area. Light burns would not be expected to unduly affect meadow conditions. Certain riparian reaches, particularly in the upper one-third headwater streams, were subject to high severity fires, which resulted in complete loss of riparian vegetation. The direct effects of fire-caused damage to riparian areas and wet meadows need further investigation. For the most part, fire's direct effects on meadow habitats are considered inconsequential; however, it is probable that these habitats could be indirectly affected by displacement of cattle use. Roughly 30 percent of the Trinity Summit allotment (an allotment that contains wet meadows) burned under severe fire conditions, with 65 percent burning at moderate severities. Burn pattern and severity could influence livestock movement due to loss of available forage or improved access to water in riparian areas subject to severe burning. Assessment of grazing patterns needs to occur to ensure that displacement of cattle use due to the fire doesn't lead to overgrazing in certain meadows and riparian areas. Overgrazing, with its associated shift in composition toward early successional (disturbance-tolerant) and non-native species as well as compaction and potential soil erosion, could lead to long-term destabilization of meadow communities.

There are concerns about continuing grazing in meadows and riparian habitats in an immediate post-fire environment. High elevation meadows in particular are important reservoirs of biodiversity. These communities provide habitat for such rare plant species as Klamath gentian and coast checkerbloom. The recovery of riparian areas is important to wildlife species that use riparian areas as travel corridors and foraging habitats, as well as to anadromous fish populations that rely on these areas for critical stages in their life history.

The specifics of livestock use after the fire requires further investigation. In general, grazing in meadows and riparian areas has the potential to direct successional, compositional and erosional trends in these habitats (e.g. shift toward non-native species, loss of vegetation, increased erosion). Within riparian areas, concentrated grazing can locally prevent vegetation from developing to a mature state. To assess the potential impacts due to cattle use, specialists should visit the meadows and riparian areas before cattle are turned out. Specialists should assess 1) the potential for streambank erosion and soil compaction caused by cattle concentrating in areas void of vegetation and 2) whether turnout will delay the re-establishment of vegetation. Management options should be developed based upon findings. See the "Grazing" section for more information.

Noxious Weeds

Reduce the Risk of Noxious Weed Introduction and Spread (1.6, 1.7)

Non-native species and noxious weeds readily become established and spread in exposed, disturbed areas. Prior to the fire, non-native and noxious weeds were documented in the analysis area; however, their extent is not accurately known. Activities related to wildfire suppression, particularly the use of equipment for suppression and fuel break construction, could have provided both a vector and a suitable setting for weeds. Wind-born seeds of noxious weeds can travel considerable distances. The fire itself created an environment suitable for weed establishment (disturbed ground and reduced canopy). Equipment and other material (erosion control) used in recovery efforts can also promote weed introductions.

In keeping with LRMP standards and guidelines (LMP IV 20-16 to19), efforts should be made to reduce noxious weed introductions and spread. The best prevention for introduction and spread of noxious weeds is the removal of satellite populations (localized, small populations) once detected. This tactic is also the most cost-effective control method. The fire and activities related to wildfire suppression could have favored noxious weed introduction and establishment. There is an opportunity to reconnaissance roadside settings or any setting disturbed by the construction of fuel breaks (especially those constructed with a bulldozer) to determine if any satellite populations exist. This reconnaissance is especially important within the first post-fire growing season to reduce the chances of seed bank development and for ease of removal. This reconnaissance effort would also provide useful baseline information for assessing risk of noxious weed introduction related to subsequent activities proposed in the area.

Relative to grazing and noxious weeds in meadow habitats, historic livestock use has influenced the composition and extent of noxious weeds in the analysis area. As cattle move from one area to another, they can transport seed of noxious weeds (e.g. seed attached to hair or trapped in mud) to areas previously uncontaminated. Noxious weed effects are most noted in "open" habitats that include meadows—a setting where cattle tend to concentrate. An approach to reduce the risk of noxious weed introduction and spread related to cattle use is addressed in the "Meadow Communities" and "Grazing" sections.

Issue 2: Long-Term Health and Recovery of Terrestrial TES Species and Species of Concern

Plants

Plant species of concern that are known or have the potential to occur in the analysis area were addressed in terms of their respective habitat groups, which include rocky or outcrop habitats, riparian areas and meadows, and late seral conifer forest. Most of the plant species of concern are within habitats associated with the Ironside Batholith, composed primarily of diorite parent material. The white fir, red fir and Shasta red fir series are coincident with the batholith at high elevations (upper one-third slope position) in the eastern half of the analysis area.

Species respond differentially to fire. Early successional rare species such as Tracy's lupine and robust false lupine (*Thermopsis robustus*, Forest sensitive) could benefit from the fire and potentially colonize burn areas. In moderate to low severity burn areas, certain species may have benefited from the mosaic pattern of burning. Geophytes (i.e. *Lilium* sp., *Iris* sp.) can flourish after a fire; as the fire stimulates above-ground growth. A mosaic burn pattern can reduce inter-specific competition and create canopy gaps necessary for regeneration. Species such as lady's slipper orchids are considered gap tolerant, meaning they can survive small disturbances if micro-site conditions are not significantly altered (Nelson 1999).

While fire effects may have benefited certain species of concern, high severity burn areas resulted in the loss of considerable late successional and old growth habitat in the analysis area; this habitat is far more limiting across the landscape than early successional environments.

Mature Conifer Forest Habitats (2.1)

Late-seral conifer forest was the habitat most directly affected by the fire, with specific reference to those areas with a high burn severity. Fire severities were high near the ridge top position, settings dominated by true fir forests. Suitable habitat for such late seral species as mountain lady's slipper, fascicled lady's slipper and *Ptilidium californicum* (a liverwort) will be lost in these areas for decades. Lady's slipper orchids possess various life history traits and habitat requirements (i.e. presence of mycorrhizal fungi and partial shade) that limit their establishment and survival. These species are considered poor survivors of disturbance and poor recruiters after disturbance. Survey and manage species highly associated with white fir include *Ptilidium californicum* (a liverwort) which grows specifically at the base of mature white fir trees and *Polyzellus multiplex* (a fungus) which grows in association with true fir roots. According to the vegetation analysis presented earlier in this chapter, 50 percent of the white fir series in the central zone and contains the highest amount of late mature and old-growth habitat in this zone. Within these watersheds, 36 percent of the white fir acres burned at high severities, which converted about 40 percent of the acres in the mid, late and old-growth seral stages to the shrub/forb and pole stages.

Before the fire, management activities (residential development, logging, and road construction) on public, tribal and private lands within and surrounding the analysis area had already affected mature conifer forest habitat. The loss of suitable habitat resulting from these management practices has reduced the extent, size and distribution of late seral stage conifer forests. Furthermore, a tradition of wildfire suppression that has placed late-seral stands within and beyond the analysis area at risk, imparts a cumulative effect on those species associated with this habitat.

Logging of mature stands and road construction on lands outside of the Forest Service's jurisdiction will continue in the foreseeable future. Specific to the Forest, mature white fir stands within the central zone are below the recommended acres (RMRs); therefore, the Forest would not prescribe to intensively manage within these stands under the current Forest Plan; however, the threat of intense fire due to unnatural fuel loads will prevail.

Meadow and Wetland Habitats (2.1, 1.5)

Although not unduly affected by the fire, meadow habitats that support such rare species as Klamath gentian and coast checkerbloom could be indirectly affected by the displacement of livestock use from high severity burn areas to moderate severity burn areas. Fire's effects on meadow habitats that support plant species of concern are further discussed under Issue 1 in the "Meadow Communities" section.

Maintain Habitats for Species of Concern during Recovery Efforts (1.5, 2.2, 3.2, 4.6, 5.12, 5.13)

Within stands that burned with a low to moderate severity and are still considered suitable habitat, recovery efforts should consider maintenance of habitat elements necessary for establishment and survival of certain plant species of concern. Habitat variables include structural diversity, partial shade, presence of large coarse woody debris and minimal ground disturbance. Activities that disrupt these elements across the stand would deter maintenance and recovery of species of concern.

In riparian areas (particularly perennial streams) where much of the overstory was consumed, substrate and micro-climate conditions have been affected by the fire. Various moss species including *Buxbaumia viridis* (S&M) depend upon maintenance of humid conditions. Perennial stream courses provide important habitat for these species. Meadow habitats are discussed under Issue 1 in the "High Elevation Meadows" section.

Opportunities to Benefit or Enhance Habitat Conditions for Species of Concern (1.5, 2.3, 4.4, 5.7)

Concern rests over the future fire risk to mature stands, especially late mature and old growth stands within the true fir vegetation types. This concern certainly extends beyond the analysis area since continuity of habitat may be very important to such species as mountain lady's slipper having dispersal limitations and generally small population sizes. Development and implementation of a prescribed burn program with associated fire effects monitoring would be an important action. A baseline burn program would initially reduce fuels in areas of unnatural fuel accumulations and with an ongoing program would likely create an opportunity to sustain habitat conditions for species of concern within mature forests.

With the exception of fuel reduction activities or prescribed burning and efforts to reduce erosion in the conifer stands, other recovery activities are not expected to benefit or enhance habitat conditions for species of concern. In any activity occurring in the forest habitats, it is important to minimize ground disturbance, maintain stand structural components and provide partial shade—conditions needed by late-seral associated species.

Meadow habitats within the analysis area are the most vulnerable to increased grazing pressure (due to the possible displacement of use from other areas subject to intense fires), trampling and the introduction or spread of non-native species and noxious weeds. The conditions needed for cattle turn out are discussed under Issue 1 in the "Meadow Communities" section.
Riparian-dependent and associated species (with particular reference to bryophyte species) would benefit from recovery efforts focused on active planting of deciduous hardwood species on those perennial reaches most affected by high severity fires.

Wildlife

2.4 How has the fire altered habitat conditions for TES and special status species in these watersheds?

The Megram Fire altered habitat conditions for many of the TES wildlife species dependent on late-successional habitat. There were approximately 28,950 acres in the late mature and old growth seral stages within the tanoak, white fir, red fir and Douglas-fir vegetation series prior to the fire; the Megram Fire reduced the amount of late mature and old growth habitat by 21 percent, to 22, 890 acres. Before the fire, shrub/forb habitat comprised approximately 4,560 acres; after the fire, this seral stage now comprises approximately 18,610 acres, an increase of over 400 percent.

Threatened, Endangered, and Proposed Species

Northern Spotted Owl: The fire reduced the amount of nesting and roosting habitat for the northern spotted owl by approximately 20 percent. Of the 33 activity centers within the analysis area, 25 were above the "take" threshold prior to the Megram Fire; only 11 are now above the “take” threshold at the 1,340 acre level for nesting and roosting habitat. Before the fire, 84 percent of the acres capable of supporting suitable habitat were suitable habitat; currently, only 65 percent of the capable area is suitable. Future reductions in suitable habitat may be expected through additional conifer mortality from insects and fire related stress.

Marbled Murrelet: Extensive surveys were conducted within the analysis area during Phase II of the Marbled Murrelet Range and Distribution Study. The study has yielded no detections of marbled murrelets within the analysis area. The Megram Fire reduced the amount of suitable habitat for this species by approximately 11 percent on SRNF lands within the analysis area. Even though the fire reduced the amount of suitable habitat for this species, the effects to individual species are probably negligible.

Bald Eagle: Within the analysis area there are no historic or known nesting territories for the bald eagle. Therefore, there are no known impacts from the fire on any bald eagle nesting territories within the analysis area.

Other Species of Interest

Marten and Fisher: The fisher occupies habitat similar to that used by the marten and the northern spotted owl. As a result of the Megram Fire, potential habitat for the fisher was reduced to 33,903 acres, which reflects a reduction of 23 percent from pre-Megram Fire habitat assessments. Before the fire, approximately 25,720 acres of the analysis area were classified as suitable for the marten. The fire reduced the amount of potentially suitable habitat for the marten by approximately 31 percent, to 17,850 acres. The majority of the suitable marten habitat affected by the fire was in the higher elevation white fir and red fir communities.

These two species also utilize riparian corridors to a high degree for travel and foraging. Over 74 percent of the riparian reserves within the Horse Linto watershed were affected by moderate to high fire severities. Riparian reserves in the Mill and Tish Tang watersheds were impacted at the 36 and 54 percent level by moderate and high burn severities. The impacts to the riparian reserves have the potential to alter the travel corridors and foraging habitats for these two species.

Northern Goshawk: The general habitat for this species in the watershed analysis area consists of Douglas-fir and white fir in the mid mature, late mature and old growth seral stages. Prior to the Megram Fire, there were approximately 43,850 acres of suitable habitat for this species. After the fire, there are currently 33,930 acres of suitable habitat within the analysis area (represents a 23 percent loss due to the fire). There are four known and two suspected territories in the watershed analysis area. The Ladder Rock and the Horse Trail territories were extensively impacted by the loss of habitat by high severity wildfire. The South Fork Mill Creek, Tish Tang East, Tish Tang West, and the Groves Prairie territories were affected by a combination of low to moderate burn severities. Future reductions in suitable habitat for this species may be expected through additional conifer mortality from insects and fire related stress.

Willow Flycatcher: The willow flycatcher utilizes willow and alder dominated wet meadow systems. Suitable habitat exists within the analysis area in several high elevation meadow systems near the Trinity Summit area and the adjacent meadow complexes found in the Trinity

Alps Wilderness Area. Surveys for willow flycatchers within the Trinity Summit area have not yielded any detections; however, not all suitable habitat has been surveyed. The effects of the Megram Fire on willow flycatcher habitat are currently unknown. Limited field reconnaissance has occurred in suitable habitat to validate the effects of the fire on this species habitat.

Peregrine Falcon: There are two historic peregrine falcon territories within the analysis area, which include the Mill Creek and Horse Linto territories. The Horse Linto territory was extensively impacted by a combination of moderate and high burn severities. The foraging habitat within the Mill Creek territory was affected to a lower degree given the lower level of burn severities that occurred within this territory. The areas within and adjacent to the existing territories may offer a unique guild of prey species in the future for this species.

Herpetofauna and other riparian-dependent species: Within the analysis area, the following species are known to occur; the foothill yellow-legged frog, southern torrent salamander, and the Del Norte salamander. Surveys for the western pond turtle and the northern red-legged frog have not yielded detections for these species. However, suitable habitat within the analysis area exists for these two species. The specific impact of the Megram Fire on herpetofauna and riparian-dependent species is currently unknown. However, given the level of impacts to riparian reserves discussed in the section for marten and fisher, it is probable that the impacts on the habitat attributes needed by these species may be significant given the level of fire severities within riparian reserves.

Survey and Manage Species: The analysis area provides habitat for an number of survey and manage and protection buffer species. The known occurrences include the Del Norte salamander, Oregon shoulderband snail, Klamath shoulderband snail, Pressley Hesperian snail, papillose tail-dropper snail, and one protection buffer species – *Ancotrema voyanum.* Surveys are required for the above listed species as well as the Tehama chaparral snail and the Shasta chaparral snail. The majority of the survey and manage species that are predicted to occur within the analysis area are vulnerable to fire even at low burn severities. The effect of the Megram Fire on these species has yet to be determined in the absence of limited monitoring data after the fire. It is expected that in the areas of high burn severity, species were consumed and the area is no longer considered habitat, however species may have survived in adjacent areas of unburned habitat or areas with low to moderate burn severities.

2.5 Within the LSR, how has the fire altered the habitat conditions for the northern spotted owl and how has the fire affected functionality of the LSR?

The Draft Recovery Plan for the northern spotted owl predicted that LSR 305 would support 20 Current Projected Federal Owl Pairs and the 25 Future Projected Federal Owl Pairs. Given the habitat conditions after the Megram Fire, LSR 305 does not meet the level of suitable habitat needed to provide for 20 Current Projected Federal Owl Pairs nor the 25 Future Projected Owl Pairs as per the Draft Recovery Plan. The Megram Fire reduced the amount of nesting and roosting habitat by approximately 20 percent and the amount of foraging habitat by 10 percent. Currently, only 72 percent of the capable spotted owl habitat within LSR 305 is classified as suitable. The preliminary “take” assessment exhibits that LSR 305 is providing suitable habitat that is above the “take” threshold in only 11 of the 37 activity centers.

As identified within Table 3-25, the highest frequency of affected acres for all intensities was in the old growth seral stage. This is unfortunate given the importance of the old growth seral stage in providing habitat for late seral dependent species. Approximately 27 percent of the old growth seral stage burned with a high severity. Stands in the high severity burn category had greater than 70 percent mortality, which reset the seral stage to shrub/forb. This represents a significant loss of late seral habitat, one of the key features of the LSR system. The mid mature and late mature seral stages also suffered from high severity wildfire, with 29 and 26 percent of their extent reset to the shrub/forb seral stage. These two seral stages are very important to the old growth seral stage, since they are the source of in-growth. In light of the above data, it is doubtful that LSR 305 is adequately functioning at the landscape level in providing late-successional habitat for the northern spotted owl and other late seral dependent species.

2.6 What possible management practices, if any, are needed to facilitate the recovery of habitat for these species?

The desired condition within LSRs is to provide late-successional forest in which structure and composition is consistent with site conditions and ecological processes. Management objectives within LSRs are designed to protect and enhance conditions of late-successional forest ecosystems, which serve as habitat for late-successional dependent species such as the northern spotted owl (USDA, USDI 1994). Protection includes reducing the likelihood of large-scale disturbances, including stand-replacing fire, insects, and disease epidemics, and major human caused activities. Enhancement includes silvicultural treatments designed to accelerate the development of late-successional stand characteristics.

Given the significant impacts of the Megram Fire on late mature and old growth habitats, it is critical that emphasis is placed on maintaining and protecting these habitats for late-successional dependent species. The HLMTT area is currently below the RMRs for the late mature and old growth seral stages. This triggers the next focus, which is an emphasis on accelerating the growth of early mature and mid mature stands toward late mature and old growth habitat conditions. By emphasizing the acceleration of these two seral stages, late-successional habitat will be achieved sooner for late-seral dependent species such as the northern spotted owl.

The amount of shrub/forb habitat also greatly increased due to the effects of the Megram Fire. Management activities should focus on reforestation within these areas for development into late mature and old growth habitat. Expedient reforestation is critical for providing habitat for late-seral dependent species as well as increasing the functionality of the LSR in the long term. Given the extreme fuel loadings within areas of high intensity, management emphasis should focus on reducing fuels to reduce the hazard and future risk to adjacent habitats. Many of these stands have fuel loadings in excess of 100 to 400 tons per acre. By reducing fuels within these areas, fire risk will be further reduced within the new stand, and impacts to seedlings as dead trees decay and fall will be minimal.

The Forest-wide LSRA identifies strategies for a system of shaded fuelbreaks throughout LSR 305. Opportunities exist for utilizing prescribed underburning in concert with a strategically developed system of shaded fuelbreaks to reduce the effects of future wildfires. Using these two management tools at the landscape level would provide a significant benefit to the LSR by providing a higher level of protection for late seral habitats. An equally critical benefit would be the enhanced protection of mature seral stage habitats that provide the in-growth for late mature and old growth habitats.

Issue 3: Fire, Fuels, and Air Quality

Fire Risk

3.1 What is the trend of fire risk within and adjacent to the HLMTT watersheds?

Lightning has been the cause of the majority of fires within and just east of the Six Rivers portion of the HLMTT watersheds, accounting for 97 percent of the acreage burned and 63 percent of the wildfires. The Megram Fire, which spread to the Forest from the east, ignited as part of an onslaught of nearly 300 lightning fires during a single storm on August 23, 1999. This area has had one of the highest lightning occurrence rates on the SRNF. Lightning strikes somewhat follow ridges, but overall seem to fit a random pattern of occurrence.

Human fire occurrence is relatively low within these three watersheds, but a high incidence of fire starts is "clustered" along Highways 96 and 299, directly west and southwest of the HLMTT area. Private inholdings southwest of Waterman Ridge and on the Hoopa Valley Indian Reservation provide the locale for potential future human-caused wildfires.

The average number of fires per year has remained essentially the same within the analysis area, with a noticeable increase during the period from 1990 to 1999, mainly due to a high lightning rate in 1990 and 1991. Before the Megram Fire, most fires were kept to small acreages due to the following factors:

- extensive initial attack coverage from several crew bases within relatively close proximity
- good access to locations of frequent fire starts
- good detection coverage from local residents and lookouts
- local volunteer fire departments that contributed to the fire fighting efforts

The effects of the Megram Fire could have a substantial impact on future fire statistics. Extensive areas of dead and dying trees and shrubs (which are easier to ignite than living fuels) are now interspersed across a landscape that already had higher than historic densities and fuel loadings. In addition, a tremendous number of snags has been created and will continue to be created within the severely burned areas as trees are killed by insects and burn-related stresses. This extensive snag component, in combination with the relatively high lightning occurrence in the area, and a hazardous fuel situation, presents the possibility of increased lightning ignitions and potentially large stand-replacing wildfires.

In some areas (e.g. ridgetops), leaving snags may increase the risk of spotting during a wildfire, especially under extreme weather events. If this happens during resource drawdown periods, when firefighting forces are not readily available, the wildfire could become larger and produce greater damage. Firefighter safety would also be a concern in areas with a large number of snags. During an ongoing wildfire, all snags that occur along proposed suppression control lines and pose potential safety or spotting problems would be cut down.

Future Risk

To assess past fire occurrence trends and expected future fire occurrence, a risk rating is calculated using a standard formula. This standard risk formula is based on the number of fire starts, the number of years of historical information, and the number of acres involved:

$$\text{Risk rating} = [(x/y)*10]/z$$

where x = number of starts recorded for the chosen area
y = number of years records cover
z = number of acres analyzed, displayed in thousands (65.54)

Risk ratings and ranges of values used in this assessment are shown in Table 4-3.

Table 4-3. Fire Risk Ratings and Values

Risk	Values	Interpretation
Low	0 - .49	At least one fire expected every 20 or more years per thousand acres
Moderate	.5 - .99	At least one fire expected in 11-20 years per thousand acres
High	> 1.0	At least one fire expected in 0-10 years per thousand acres

Table 4-4 shows the risk values and ratings for the Six Rivers portion of the watershed to provide a sense of the trend in risk for various periods of time between 1911 to 1999.

Table 4-4. Risk Values and Ratings for the SRNF Portion of the HLMTT Area

Period	Number	Number of Years	Risk Value	Risk Rating
1911-19	12	9	0.20	low
1920-24	15	5	0.46	low
1930-39	35	10	0.53	moderate
1940-49	32	10	0.49	low
1950-59	26	10	0.40	low
1960-69	22	10	0.34	low
1970-79	40	10	0.61	moderate
1980-89	37	10	0.56	moderate
1990-99	65	10	0.99	moderate
1911-99	284	84	0.52	moderate
1911-49	94	34	0.42	low
1950-99	190	50	0.58	moderate
1970-99	142	30	0.72	moderate

The moderate risk rating since 1970, which indicates at least one fire expected in 11 to 20 years per thousand acres, coincides with increased access, detection, and recreation activities on the National Forest. The substantially higher risk rating for the 1990s (almost in the high category) is mainly due to a high number of lightning fires during this period, including 24 reported lightning fires in 1991. The high human-caused fire occurrence immediately adjacent to the HLMTT watersheds (within the Hoopa Indian Reservation and along Highways 96 and 299) combined with the frequency of lightning strikes on the adjacent Shasta-Trinity wilderness area would increase the overall “risk rating” associated with this analysis area. In addition, as mentioned earlier, the fuel structure created by the Megram Fire (i.e. tremendous number of snags, large expanses of standing dead fuels, future in-growth of grass and shrubs, and large areas that will not be treated within the wilderness) could result in higher ignitions and larger wildfires in the future. Given all these factors, this area is expected to experience a high risk rating in the future, (i.e. at least one fire in the next 10 years per thousand acres). This risk potential, in combination with the state of the fuels within and adjacent to these watersheds, would present a substantial threat to local communities and the Hoopa Indian Reservation.

Opportunities for Reducing Wildland Fire Risk

Management efforts can be instrumental in reducing human-caused wildfire risk. These strategies would include increased prevention and focused fuel treatment efforts to deter human-caused fire starts and transportation planning to determine the benefits vs. costs of road closures during periods of high fire danger.

Accelerated prevention efforts and transportation management strategies could help reduce the human-caused risk both within and adjacent to the HLMTT watersheds. Prevention efforts could include local educational campaigns and increased patrols. Local educational efforts may not reach recreationists, other visitors who are passing through the area, or arsonists. Increased patrols during periods of high visitor use or high fire danger may instead be more effective with these groups. Public awareness programs should be accelerated through fire prevention and vegetation management program efforts, especially before and during high visitor usage periods (e.g., hunting season).

Road closures (both permanent and seasonal) could assist in eliminating some human-caused fires. A Transportation Plan is necessary to address the tradeoffs of access for fuel treatments and fire suppression versus road closures that eliminate certain human-caused ignitions or would help reduce sedimentation. Roads that pass through or are within burning proximity of a high hazard area should be considered for seasonal closure during periods of high fire danger and possibly hunting season. Proper signing and education of users would be critical to explain the purpose of closures.

Especially in areas where road closures are not feasible, fuel treatments along roads should be pursued in high risk and value areas (e.g., near communities, within and adjacent to LSRs and activity centers), with regular maintenance schedules to keep the fuel loadings in check. The risk of wildfires burning onto or from inholdings and tribal lands could be reduced with strategically placed fuels treatments (e.g., fuelbreaks and/or prescribed burns) and through well-maintained defensible spaces around residences. In these areas cooperative fuels treatment, involving private landowners, the Hoopa Tribe, and the California Department of Forestry and Fire Protection, would be critical to make these fuel treatments effective on a landscape scale.

Fire Hazard and Mortality (3.2, 3.3)

Aggressive prevention and suppression efforts over the past 80 years have lengthened fire return intervals, resulting in higher fuel loadings and densities. Even before the Megram Fire, large portions of the HLMTT watersheds had the potential for high to extreme fire behavior, especially late in the summer when recreation, traffic and lightning occurrence are typically at their highest levels. The Megram Fire has compounded this situation due to the extensive, contiguous areas of stand-replacing and mixed mortality fire effects across the vast majority of the HLMTT area (see Figures 3-12 through 3-17). The potential for re-burning in these areas is high solely due to the inherent factors associated with these watersheds (i.e. steep slopes, frequent lightning occurrence, and summertime drying). In addition, the extensive amounts of killed and stressed trees that resulted from the Megram Fire will provide extremely high levels of standing and surface dead fuel available to burn during the next series of wildfires. Initially, finer fuel (needles and small branches) will prevail over much of the ground in the burned area, but in three to five years, more trees will fall over and extensive carpets of shrubs will grow back due to the removal of canopy. Modeling of current fire behavior (year 1) shows that 40 percent of the HLMTT area has the potential for high to extreme ROS and FL in August. The highest continuous concentrations of this immediate projected threat are in the lower reaches of Horse Linto Creek, outside the Megram Fire area. Within a one-mile buffer of the HLMTT watershed, a continuous area just southwest of Waterman Ridge also displays the potential for high to extreme fire behavior in August. This area is steep and is comprised of predominantly pole and shrub stands, which typically would display this hazardous fire behavior. Modeled future fire behavior shows that this late summer, high to extreme hazard would exist for approximately 46 percent of the watershed area in 5-7 years, and 43 percent in 10 to 12 years. There is not much spatial difference in the location of this potentially hazardous fire behavior between these three time periods, with the highest continuous concentrations in the lower Horse Linto Creek watershed and the area just outside the southwest boundary of the HLMTT area. It can be projected that similar hazardous conditions will continue well beyond the next 12 years until a substantial overstory component has been reestablished. Even the June high to extreme fire behavior results increased over time in this modeling period, from 16 percent in year 1 to 21 percent in the 10 to 12 year period.

When the next wildfire occurs in this area, the extremely large (one to three miles in length and width in some places) continuous patches of standing dead trees could easily extend further into the adjacent low to moderately burned areas. Modeled mortality from future wildfires is also quite extensive in all three time periods, with the highest extent in years 5-7 with 41 percent of the area in the lethal, stand-replacing category. Adjacent areas of untreated fuels in neighboring private inholdings, the Hoopa Valley Indian Reservation, or within the Trinity Alps Wilderness, roadless areas, or the Shasta-Trinity portion of LSR305 add to the equation of an extensive and continuous hazardous fuels situation at a landscape level. The east-west orientation of most major drainages in this area also presents the scenario of dry easterly winds pushing a fire towards the Hoopa Indian Reservation or private inholdings to the southwest of the Horse Linto watershed.

Since this area recently experienced a large catastrophic wildfire event, active management will be just as critical to reduce the risk of even more detrimental effects from the next wildfire. Areas that have been treated within the watersheds (and survived the wildfire) can provide some discontinuity in these expanses of homogeneous high to extreme fuel loadings. Fire behavior during Megram Fire showed which ridges and roads were strategically located to benefit suppression efforts. All of these areas need to be used and built on as much as possible to break up this continuity of hazardous conditions and to assist future suppression efforts.

During suppression resource draw-down (e.g. fire season 1996 and 1999), this area would again have a lower priority than more populated watersheds, which could result in larger more intense wildfires. Therefore, access for initial attack is critical to locate and fight potentially damaging fires when they are small. Permanent road closures could negatively impact access both for suppression and fuel treatment activities.

Riparian Areas (3.2, 3.3, 4.4, 4.6)

Aggressive past fire suppression and prevention efforts in addition to mortality from the Megram Fire has produced high levels of fuel accumulations in some riparian areas. A continuous concentration of heavy fuels along this linear chimney path from the bottom of the drainage to the top creates the potential for future crown fires and increased tree mortality and riparian habitat degradation. The affected riparian area will recover over time due to its shading pattern and moisture conditions, but in the meantime sediment load to the streams will probably be increased.

The LRMP states “In Riparian and Late-Successional Reserves, the goal of wildfire suppression is to limit the size of all fires.” This strategy, which was traditionally called “the 10-acre policy”, is counter to the complaints aimed at five to eight decades of aggressive fire suppression which has resulted in “significant increases in accumulated fuels” (FSEIS ROD B-7). Lightning fire occurrences and traditional burning techniques used by local Native Americans indicate that fire has been and will be a major player in virtually every ecosystem on the Forest. Skinner's study (in preparation) shows that fire is also a frequent player in riparian areas on the west and east side of the Shasta-Trinity Divide in the Klamath Mountains. Even though their fire return intervals are longer and more variable, certain conditions (e.g. long-term droughts, south or west-facing slopes) could make fires behave in a similar fashion to nearby upland sites.

Rather than limiting the size of all fires within riparian areas, a more realistic and achievable goal is to minimize the negative impacts of wildfires that might burn into and through Riparian Reserves. Fuel treatment practices, which include fuelbreaks, understory burning, and fuel removal, can assist this goal by reducing excess fuel loadings and vertical and horizontal fuel continuity. Fuel treatment and fire suppression “strategies should recognize the role of fire in ecosystem function and identify those instances where fire suppression or fuels management activities could be damaging to long-term ecosystem function” (FSEIS ROD C-35). Fuels management that attempts to isolate an area by only treating outside it could be even more damaging by leaving continuous and higher fuel loadings within the area of concern. This is especially true of Riparian Reserves, which are linear features that go from the bottom of the slope to the top of the ridge - an excellent wick to carry the fire.

“In LSRs in the Klamath Province, silviculture aimed at reducing the risk of stand-replacing fires may be appropriate. Treatments may include thinning and underburning. Due to fire suppression, some forests have become quite dense and multistoried, primarily from the invasion of shade-tolerant species. Density reduction in mid-level canopy layers by thinning may reduce the probability of crown fires” (ROD, B-7). In Riparian Reserves, it does not appear that shade tolerant species are the problem, since these areas have typically had denser canopies. What appears to have changed is the density and continuity of ground fuels within these corridors. With more “natural” fire frequencies, a more typical mosaic pattern of succession and recruitment would have occurred and the multistory, ladder situation would not have been so extensive.

Opportunities to Reduce Fire Hazard (1,3, 2.5, 3.4, 3.5, 5.5)

In the Recovery Plan for the Northern Spotted Owl, Agee and Edmonds (1992) found that a “hands-off” policy was not recommended for any of the areas associated with the northern spotted owl. Active management was deemed “particularly necessary” in the Klamath subregion due to its high catastrophic risk level from wildfires: “Fire suppression in this region has helped to create a broader landscape pattern of multiple-canopied stands with thick understories, thought to be suitable for northern spotted owl habitat. The forest protection strategies recommended here (i.e. fuelbreaks and underburning) will reduce some of that habitat to more effectively protect the rest. Such forests, in their present condition, are also more likely to be catastrophically disturbed because of higher physiological stress, caused by increased tree density, higher fire hazard, and higher horizontal and vertical fuel continuity. Recommendations to reduce owl habitat in order to save it may seem a paradox. We believe that such implementation will, in the long run, better protect owl habitat than a more short-sighted attempt to continue total protection. Active management in some areas to reduce the probability of large-scale catastrophic events is the most rational management direction…Fuel and fire specialists in the vicinity of each Designated Conservation Areas (DCA) [the precursor to LSRs] are the best qualified to develop the fuel management strategies. There is no reason to expect the strategy to be the same in each DCA. The expected result of any strategy will be a temporary to permanent reduction in preferred owl habitat within the manipulated area, with a higher probability of control of potentially catastrophic wildfires over the larger area.” (Agee and Edmonds 1992). The overall objective is to employ fire scientifically to realize maximum, long-term net benefits at acceptable damage and cost levels.

Vegetation management and/or natural fuels reduction needs to be considered throughout the watersheds, taking into consideration existing and potential risk, hazard, and values. Brackebusch (1973) emphasized the importance of developing hazard reduction plans for large areas that incorporate a variety of strategies. He suggested that combinations of fuelbreaks, vegetation mosaics, and project-level treatment on a landscape scale would be more cost effective than project-level treatment alone. Due to the extensive effect of the Megram Fire within these watersheds, fuel treatments and wildland fire use need to be investigated with the goal of returning to more "natural" fire regimes of frequent, low intensity fires.

Resource management activities should be designed and implemented so that the wildfire hazard level of the surrounding area is not increased to an unacceptable level. Concentrations of fuels created by management activities (e.g. slash from road clearing) should be reduced to acceptable levels and arrangements based on the site-specific wildfire risk and the needs of other resources. The selected treatment methods should consider resource values and environmental limitations (for example, topography, accessibility) as well as costs.

The effectiveness of any fuel treatment program within the LSR will depend on its spatial distribution, the number of acres treated per year, and the duration of the beneficial effect of that treatment. Realistically, fuel treatment opportunities within this LSR may be difficult to accomplish because of the constraint realities of funding, weather, survey requirements, the environmental restrictions of air quality and burning during nesting periods, and competition from other high priority treatment areas outside the HLMTT area. The burning windows for prescribed burns may be extremely short, with unpredicted weather shutting down a planned burn for an entire year. Spring burning is typically preferred because of reduced resource damage (air quality, soil, consumption of coarse woody debris) due to lower intensity burning, but the associated smoke may impact nesting wildlife. Helicopter ignitions are often preferred for large area ignitions in steep terrain, but helicopter noise is a concern in LSRs during the nesting period. Project planning and consultation with U.S. Fish and Wildlife Service and National Marine Fisheries Service must address the short-term vs. long-term effects and benefits of fuel treatments (especially burning) within and adjacent to LSRs.

Fuelbreaks

Fuelbreak construction includes those activities necessary to permanently modify a strip of heavy, hazardous fuels with dense stand characteristics to a lighter, more open fuel type along a strategically located ridge, natural land feature, or road. "Compartmentalized landscape units of reduced fuel allow safe access for fire suppression crews and provide strategic locations for efficient fire suppression. Stands are manipulated to reduce continuity of canopies, boles are pruned on residual trees and significant quantities of understory fuels are removed" (ROD, B-7). Fuelbreak construction would entail manipulation of live vegetation by thinning young conifers, limbing larger trees and cutting brush. This activity may be done be manual and/or mechanical means, with prescribed burning as a key component in removing the fine fuels that carry a ground fire and the ladder fuels (e.g. low branches) that can carry the fire into the crown. Jackpot fuels (i.e. concentrations of natural or activity fuels) that increase the chance of high intensities, spotting, and torching are also reduced or eliminated during the construction of a fuelbreak. As was shown in the existing fuelbreaks within the Megram Fire, reducing canopy cover and snags also decreases the chance of a crown fire continuing throughout a stand and spotting into an adjoining drainage. Snags left within a fuelbreak could hamper suppression effectiveness. Therefore, if snags are left within the fuelbreak and a wildfire occurs within or downslope from the fuelbreak, all snags that could present safety or spotting problems would be cut down in a control suppression strategy.

This strip of land on which the vegetation has been modified to a lower fuel loading and more open canopy is used for the purposes of:

- breaking up expanses of continuous heavy fuels into smaller blocks which are more manageable from a fire suppression standpoint
- providing safe access to suppression forces during fire control operations
- providing a prepared line and anchor points from which fire suppression forces can backfire to remove hazardous fuels ahead of an oncoming wildfire
- minimizing adverse resource impacts of control strategies and the need for intensive rehabilitation efforts in the event of a large, intense wildfire (e.g., wide dozer firelines)
- providing the infrastructure necessary for adjacent, large area, landscape level prescribed burns to be implemented

Shaded fuelbreaks could also be used to help isolate high-risk areas where understory burning is not desired or practical (e.g., plantations, adjacent to communities, Botanical Areas). In addition fuelbreaks allow fire control forces to conduct backfiring operations even with the bulk of forces deployed elsewhere (Agee et al., 2000). Individual examples of this occurred during the Megram Fire (Hostler pers. comm. 2000).

Fuelbreaks often include “safety islands” (strategic areas where personnel and their equipment can be located safely if a fire is spreading all around them) and improved sources of water. Because of environmental dynamics and the long-term use and strategic nature of fuelbreaks a maintenance and reburn schedule is necessary to keep fuel loading and canopy closure at required standards. “Indefinite maintenance of the fuelbreak in low fuel condition is essential. In the Klamath subregion, the occurrence of sprouting hardwoods with substantial regrowth potential (Tappeiner et al. 1984) suggests maintenance intervals of a decade or less for fuelbreaks” (Agee and Edmonds). Subsequent treatments should be relatively easy and much less costly because the majority of ladder fuels and jackpots have already been eliminated. Under low to moderate weather conditions future wildfires would respond in a similar fashion to a prescribed burn, with resulting low to moderate fire severity.

Prescribed Burning

Prescribed fire is any fire ignited by management actions to meet specific objectives, and it includes understory burning (or underburning), pile burning, and jackpot burning. Due to the magnitude of hazard within and adjacent to the fire affected area, large area underburning is a landscape-level option that needs to be considered within the HLMTT watersheds. Regarding LSRs in the Klamath Province “Underburning can be used to reduce fuel loading and vertical fuel continuity. Wildfires in stands that are managed using underburning are generally less severe, and fire suppression is aided. To increase effectiveness, underburning should be implemented over large areas” (FSEIS ROD, B-7).

Understory burning involves the application of prescribed fire to natural or management produced (e.g. thinning) fuels under an overstory canopy to reduce fuel loading and vertical fuel continuity. Conditions of weather, fuel moisture, soil moisture, and staffing are chosen that will allow the confinement of the fire to a predetermined area. At the same time prescriptions are designed to produce fire intensities and rates of spread required to accomplish certain planned benefits to one or more objectives of hazard reduction, silviculture, wildlife management, grazing, etc. Since underburning is an area treatment that eventually reduces total dead fuel loads and vertical fuel continuity (Agee and Edmonds 1992), “wildfires entering such stands under most conditions have less severe overstory scorch and allow direct control of the fire. To be effective, underburning must be implemented over wide areas...Underburn sites can be keyed into fuelbreaks to expand fuel-reduced areas. The underburning need not be done at historic return intervals. Monitoring of burned areas where owls exist should be done to determine what effects underburning has and how long they last.”

Large area burns should be the norm (both for economic and ecological efficiency), but at the same time underburning includes some inherent risks. Burning large areas will involve some Riparian Reserves. Large areas may burn in mosaics with varying fire intensity and severity. While this may mimic natural underburning, there are risks associated with retaining coarse woody debris and preserving remaining trees and snags. The likelihood for reburning, spotting, and the killing of some trees is increased as is the possibility for a prescribed burn to escape the planned burn area. The mortality of standing trees would primarily involve younger, thinner barked, or fire intolerant tree species, which, in turn, can contribute to future snags and coarse woody debris. However, it is anticipated that by prescribed burning under appropriate weather conditions, subsequent detrimental wildfire effects may be reduced by decreasing the amount of available fuel and breaking up the fuel ladder. To prevent further resource damage in the areas of moderate to high mortality within the Megram Fire area it would be important to remove as much excess heavy dead fuel material as possible before understory burning was undertaken. Piling and burning created fuels and burning natural concentrations of fuels (jackpots) would also be important in this removal effort.

Fire Suppression

Beyond fuel treatments that strategically address hazard reduction throughout the landscape, certain other strategies can help improve overall suppression effectiveness. Due to the dramatically increased hazard in this area, increased initial attack and detection forces would be critical for suppression effectiveness in future fire seasons. This increase would not be excess of the annual calculated MEL (Most Efficient Level) as determined by the fire budgeting program, NFMAS (National Fire Management Analysis System). During periods of high fire danger or multiple fire starts throughout the state, prepositioning of crews and equipment could help decrease arrival times. With reductions in fire hazard over time, this staffing increase would revert to current levels in approximately 15 years.

Wildland fire use is the management of naturally ignited wildland fires to accomplish specific pre-stated resource management objectives in predefined geographic areas outline in Fire Management Plans (NPS et al., 1998). As designated in the LSRA (1999) the entire LSR complex was designated as a candidate for wildland fire use. The Wildland Fire Implementation Process will be used real-time to determine where wildland fires in the LSR would help to achieve resource benefits. Wildland fire use should be considered under the right weather and staffing parameters as a way to reduce the long term hazard for this area. This strategy should especially be considered in areas that have already been designated as good candidates for large area understory burns.

Other suppression strategies that should be considered for use under the right weather and staffing parameters include the Minimum Impact Suppression Tactics (MIST) (Appendix H) which were developed in Region 1 primarily for use in wilderness areas, proposed wilderness, or other lands with similar land management objectives. The intention of these tactics was to reduce fire suppression or holding impacts on resources while insuring the actions taken were timely and effective. These low impact tactics for suppression, logistics, aviation, hazardous materials, rehabilitation, and demobilization should be considered throughout the watershed and carried out if at all possible in the LSR and wilderness and any other areas with significant resource concerns (e.g., near landslide areas), except during extreme burning periods when the need to aggressively suppress the wildfire overrides the resource concern. These low impact suppression actions 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.

Of special importance to this area is cooperative wildland fire management between the Forest Service and federally recognized tribes as indicated in the MOU between Federally Recognized Tribes sited within the Six Rivers National Forest and the USDA Forest Service, Six Rivers

National Forest (2000): “Such cooperation will benefit natural resources, the parties, and the public, and will provide a foundation for formal and informal consultation on a government-to-government basis and, more specifically, will assure that Tribal concerns are effectively addressed by those managing incidents within areas of concern, and to do so in manners which, at a minimum, do not compromise firefighting safety and effectiveness, and which demonstrate a high regard for cost efficiency.” On extended attack fires, Tribal representatives will participate in both planning and implementation levels of the Incident Management Organization, and interact with all relevant resources.

Considering the risk and hazard within this watershed, pre-attack planning should also be addressed and pursued to determine the need and placement of water sources, helispots, communication links, etc. It is known that access to water sources is deficient in this watershed and need to be developed. Pre-attack planning could also incorporate areas of special tribal management consideration regarding cultural or spiritual sites or attributes.

Air Quality (3.4, 3.5)

The social data indicates that the local communities have immense concern regarding the potential long-term impacts to individual health from lengthy exposure to wildfire smoke. Community safety during future fires in the analysis area was a concern that crossed the broad range of community views.

The community strongly believes that the analysis area poses a threat to community safety and health due to a high risk for potential future fires resulting from fuel build-up after the Megram Fire. They believe that exposure to heavy smoke for long periods should not be a probable consequence of any future management activity or wildfire. Air quality as it relates to wildfires is directly related to the duration of fire, dispersion characteristics, and fuel loading. Local communities believe that removal of large amounts of fuel build-up will reduce the threat of future health-related risks from prolonged exposure to smoke.

In terms of air quality, large, stand-replacing wildfires (as was shown by the Megram Fire) produce significantly greater amounts of pollutants than prescribed burning, with the potential for greater health impacts to residents and visitors during the summer months. Due to the duration and extremely high amounts of pollutants from the Megram Fire, health variables may have been affected for local residents who stayed within the impacted area for the duration of the fire. Repeated exposure to high levels of pollutants would only exacerbate the problem for these local residents.

The extensive amounts of fire-killed and stressed trees provide extremely high levels of dead and down fuel available to burn during the next series of wildfires. This could potentially generate particulate levels equivalent to that produced when the Megram Fire burned through the blowdown area. This will be especially true in three to five years when the standing dead trees will fall over and be interspersed with extensive carpets of shrub and tree regrowth.

Opportunities to Reduce Negative Air Quality Impacts

3.5 What possible management practices could reduce the potential for extended exposure to smoke from wildfire?

Fuel treatments designed to reduce the overall fuel loading and the ladder component can decrease the amount of fuel available to burn in wildfires and break up the continuity of the fuels. Shaded fuelbreaks along roads and ridges, in combination with understory burning downslope from these areas, can also provide the infrastructure needed to more successfully keep wildfires confined to smaller areas.

When implementing prescribed burning, the following smoke reduction practices should be considered for use to minimize negative impacts to nearby residents:

- Remove or yard fuels in excess of resource and habitat requirements
- Limit size of burn or fuel consumed each day.
- Favor backing fires whenever possible.
- Burn when fuel moisture is low for better combustion.
- Burn minimal amounts of green material.
- Burn with a high atmospheric mixing height.
- Burn when conditions are not stagnant.
- Limit smoldering combustion especially at night.
- Be aware of other burning activities in the area.

If possible, biomass utilization should be promoted in the local communities to reduce the amount of slash left on the ground and the resultant smoke that is generated during the prescribed burning. Firewood collecting opportunities should also be pursued and encouraged, especially along roads within shaded fuelbreaks as another way to remove excess fuels.

Priorities for Treatment

The Six Rivers portion of these watersheds provides several opportunities and challenges for implementing broad fuels treatment and fire prevention programs, with focused and cooperative efforts having the greatest chance for success. By following the Megram Fire with strategic, large area fuel treatments, negative impacts from future fires can be somewhat lessened. Initial fuel treatment focus should be directed along major roads and ridges, especially those that were effectively used during the Megram Fire, including Waterman Ridge and Packsaddle Ridge. Adjoining south and west facing slopes in the upper 1/3 slope position are also of highest benefit from treatments. As stated in the Federal Wildland Fire Management Policy, “Firefighter and public safety is the first priority in every fire management activity” (USDI and USDA 1995). Due to the extensive potential for future wildfires with high to extreme fire behavior, fuel treatments related to community and reservation protection are of the highest priority. Since a high number of plantations that were burned in this fire are also in close proximity to adjacent private land, treatment focus needs to include plantations, especially where they coincide with strategic fuelbreaks. Opportunities for cooperative fuel treatment projects exist and should be aggressively pursued along the border between public, tribal, and private lands, as a buffer between ownerships (i.e. the western and southwestern portion of the watershed).

As mentioned in the LSRA (1999), treatments along frequently used roads and strategic ridges (Waterman Ridge, Packsaddle Ridge, Tish Tang a Tang Ridge, and Lone Pine Ridge), along the

Reservation Boundary (Figure 4-1) and in the vicinity of both developed and dispersed camp sites (Groves Prairie, Happy Camp, Tish Tang, Box Camp, hunter camps) and wilderness trailheads (Grizzly Camp, Tish Tang, Red Cap) should be seriously considered. Due to the high human-caused fire occurrence along Highways 299 and 96, these would also be prime candidates outside the HLMTT watersheds for further fuel modification, including shaded fuelbreaks.

Public awareness and fire prevention efforts should be accelerated within and around the communities of Willow Creek, Hoopa, Hawkins Bar, and Trinity Village, including reemphasizing the benefits of fuels treatments on private and tribal land. Developed and dispersed recreation sites, including hunter camps, would also be good sites for increased public fire awareness. Community participation and involvement should be encouraged as a mutually beneficial activity.

There is an opportunity to develop a Community Safety Plan in partnership with the Forest Service, CDF and other organizations to assist communities in reducing private property risks from wildfires. As an alternate opportunity, implement the “Firewise” program developed by the National Wildland/Urban Interface Fire Protection Program. The concept is of providing workshops to communities using GIS mapping, role-playing and simulated exercises to develop a firewise community plan that would enable people to survive wildfire without using fire agencies.

Riparian and Aquatic System

Issue 4: Long-Term Health and Recovery of Riparian and Aquatic Systems and Species

This section summarizes trends in erosion processes and their effects on water quality parameters, and particularly how the Megram fire may exacerbate those processes and conditions. The interactions between erosion processes and management in these watersheds are examined, including possible cumulative effects and the benefits of watershed restoration work. Finally, the likely consequences to aquatic and riparian species over both the short and long term are addressed.

Erosion Processes and Water Quality

4.1 How have natural and human-caused disturbances (floods, landsliding, fire & resource management) affected erosion processes in the watershed? What parts of the watershed have been most affected?

Figure 4-1. **Potential Proposed Fuel Treatment Areas:**

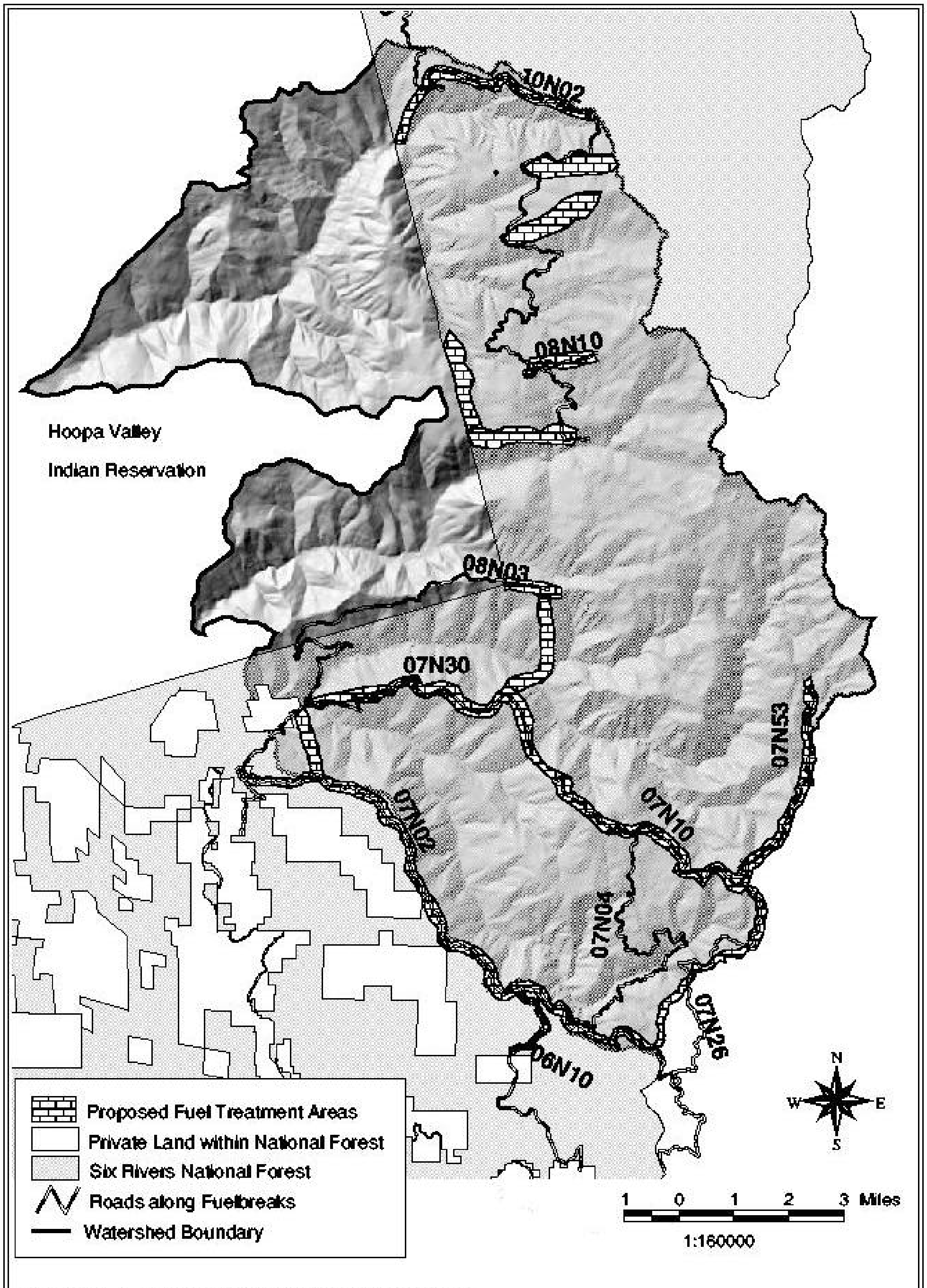


Figure 4-1. Proposed Fuel Treatment Areas

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Erosion processes have been driven primarily by major storm/flood events, and historic sediment delivery to streams has resulted principally from mass wasting and secondarily from surface erosion. A large proportion of delivered sediment has been fine-grained, due to the geologic substrate of these watersheds, and it has had some adverse effects on water quality and fish habitat, especially following the 1964 flood. Before management began in the 1950s, mass wasting was comparable in the upper and lower watersheds, and surface erosion may actually have been somewhat higher on the diorite terrane underlying the upper watersheds. In contrast, the large pulse of sediment resulting from three large storms between 1960 and 1975 originated largely from Galice terrane and older landslide deposits within the lower watersheds. Wildfire has probably had a moderate effect on erosion and sedimentation over the centuries, but there is little direct evidence of its historic role. In the recent past, aggressive fire suppression has greatly reduced the role of wildfire as an erosion agent until the recent Megram Fire, where elevated fuel levels are likely to have increased erosional effects.

Parts of the lower watersheds had been intensively managed during the 1960s and 1970s, and this management probably resulted in disproportionately higher landslide delivery rates and total erosion. Resource management appears to have played a much larger role in sediment production in Tish Tang and Mill Creeks than in Horse Linto Creek. Two-thirds of sediment delivered by landslides in Tish Tang Creek but only one-fifth of sediment delivered in Horse Linto Creek can be attributed to management. Roads have definitely been associated with more sediment production and delivery from landslides than timber harvest.

The Megram Fire has left extensive parts of all three watersheds vulnerable to accelerated surface erosion on steep slopes and to increased mass wasting on sensitive terrain, including headwalls, inner gorge and old landslide deposits. The greatest threat of accelerated erosion is in the Horse Linto watershed because of the greater proportion of high and moderate severity burned areas on steep, erodible slopes underlain by diorite. The current erosion potential in burned areas could have been exacerbated by the century of fire suppression that preceded the fire and left unnaturally high fuel levels. Erosion levels will gradually attenuate over the next 5 to 10 years due to surface armoring, accumulation of organic debris and natural revegetation.

The potential for increased mass wasting as a result of the fire is considered less, since the upper watersheds that experienced most of the severe fire effects have not experienced as much mass wasting historically as the lower watersheds. Moreover, acreage susceptible to mass wasting is less extensive than that at risk of accelerated erosion. However, the outcome with regard to mass wasting depends largely on whether a landslide-producing storm occurs during the next 5 to 15 years of higher vulnerability, when root strength is diminished and groundwater levels are raised. Possible landslide initiation sites that burned with moderate to high severity appear to be more widespread in Horse Linto watershed than in Tish Tang or Mill Creeks.

Extremely high fuel levels are expected to result from the Megram Fire on many thousand acres of high and moderate burn severity. Future wildfires in these areas will tend to burn with high severity again, and that would increase the likelihood of future accelerated surface erosion and possibly mass wasting delivering sediment to fish-bearing streams.

4.3 To what extent are cumulative effects (as defined by the Environmental Protection Agency) evident in these watersheds? How may future management actions in response to the Megram Fire contribute to the level of cumulative effects?

The effects of management activities on water resources can be cumulative. A cumulative impact results from the incremental effect of an action when added to other past, present and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. While a watershed analysis is not the same as a cumulative effects analysis, it can provide most of the information on which to base a cumulative effects analysis and show what characteristics and processes the analysis should emphasize. Cumulative effects analysis is intended to evaluate whether or not a given proposed action may result in cumulative effects. Critical components include a description of what the past was like, how changes have occurred, and what the future may be like (Reid, 1998). A key part of watershed analysis is to characterize the *cumulative disturbance* (both natural and management-related) that has occurred and assess its bearing on future natural or human-caused disturbances. Thus, an understanding of past trends is critical in forecasting future trends in watershed processes.

The preceding descriptions of erosional history and riparian and aquatic conditions indicate the relative contributions of natural and management-related sediment, the downstream impacts to aquatic habitat and beneficial uses, and the implications of the recent Megram Fire to hillslope erosion and its possible effects on the aquatic system. The Horse Linto watershed did not appear to be experiencing cumulative watershed effects (in terms of excessive sediment loads or high summer water temperatures) prior to the Megram Fire, and therefore was recovering well from past disturbances. Due to the vast extent of the fire in this watershed, however, downstream cumulative impacts to beneficial uses from future management activities in burned areas are possible and need to be evaluated in project design and mitigated where appropriate.

In the Tish Tang and Mill Creek watersheds, cumulative watershed effects (including excessive sediment loads, high summer water temperatures, and low levels of existing and potential large woody debris) existed prior to the Megram Fire. Although the extent of burned acres is less in these two watersheds, additional cumulative watershed effects could result from management actions in burned areas.

Prolonged fire suppression itself has had a cumulative effect on erosion processes by replacing the natural regime of frequent, moderate to low intensity fires with infrequent, high intensity fires like the Megram event that tend to have more serious erosional consequences. The post-fire potential for accelerated erosion and mass wasting has almost certainly been exacerbated by past fire suppression strategies. Consequently, allowing the area to recover without any intervention to reduce fuel levels or mitigate erosion resulting from the fire should not be construed as maintaining a natural condition in terms of watershed processes. Given the post-fire ground conditions in the upper parts of these watersheds, the ***threshold of sensitivity*** for cumulative effects has most likely been lowered. Therefore, future management activities should be designed with greater caution than would be appropriate had the fire not occurred to prevent adverse effects on downstream beneficial uses.

The following critical processes and attributes need to be addressed in future cumulative effects analysis for proposed actions. The factors that could influence these processes are storm events, wildfire and land management activities.

1. Sediment delivery from potential mass wasting and surface erosion
2. The likelihood of this sediment impacting downstream water quality and beneficial uses
3. The condition of riparian corridors in terms of cover and large woody debris recruitment and how these elements might affect downstream beneficial uses

Riparian and Aquatic Species and Habitats

4.4 How have the abundance and distribution of riparian and aquatic species and their habitats changed as a result of natural and human-caused disturbances?

Some riparian and aquatic species are thought to have declined greatly from their historical abundance due to declines in habitat quality. Coho are listed under the ESA, while steelhead and chinook are designated as sensitive species due to their overall decline in the Trinity Basin. The 1964 flood is thought to be primarily responsible for the decline in habitat quality, but management that occurred before and after the flood very likely contributed to the decline. Different levels of recovery had occurred in the three watersheds prior to the Megram fire.

Condition Trends in Horse Linto Creek

Historic and recent data for the Horse Linto watershed indicate that riparian and aquatic habitats were recovering well from the extensive impacts that resulted from landsliding and sedimentation associated with the 1964 flood, as well as from sediment delivery associated with intensive timber management in the 1970s and 1980s. Both aerial photo analysis and stream surveys of habitat conditions document general recovery since about 1975. Very little sediment delivery from landslides has occurred in that time to threaten the recovery trends. In addition, extensive watershed restoration has treated the most critical landslide, road and landing sedimentation problems through stabilization, upgrading or decommissioning. The environmental baseline matrix also indicates that critical indices of aquatic health were functioning properly within the watershed. Horse Linto Creek was considered one of the best key watershed refugia on the Forest in terms of watershed condition and anadromous populations.

Condition Trends in Tish Tang and Mill Creeks

Historic and recent data for Tish Tang and Mill Creek watersheds indicate that they were severely impacted by floods between 1960 and 1975, and that management-related sedimentation has played a more dominant role than in the Horse Linto watershed. Aerial photo analysis indicates that Tish Tang and Mill Creeks have only partially recovered from the 1964 and later floods. The environmental baseline matrix shows that critical aquatic health indices are at risk in Tish Tang Creek and are not functioning properly in Mill Creek. Excessive sediment loads continue to be a problem for both Tish Tang and Mill Creeks, despite road-related restoration to reduce those problems. Riparian areas have been recovering slowly in terms of deciduous canopy that provides some shading, but the potential for large woody debris recruitment has been seriously reduced over the short and long term due to extensive inner gorge harvesting along many stream channels. The large sediment loads still present in these systems suggest that significant cumulative watershed effects may be attributable to land management activities. The identified problems in the Mill and Tish Tang watersheds are predominately not related to USFS management, however. Improved land management practices, as well as current restoration efforts on the Hoopa reservation, should help to improve riparian and channel conditions, but full recovery will probably take many decades.

4.5 How did the Megram Fire affect critical habitat components for the maintenance, protection and recovery of anadromous salmonid populations? What additional risks has the fire created for riparian and aquatic species and habitats?

Impacts to watershed health resulting from the Megram Fire (in term of sediment, temperature, aquatic habitat and riparian reserves) are expected in all three watersheds. Because of prolonged and aggressive fire suppression during the last century in the analysis area, future high intensity burns will likely result in higher erosion rates than would have occurred under the natural fire disturbances regimes.

Seventy-three percent of the Horse Linto watershed was burned (27 percent at high severity), 57 percent of the Tish Tang watershed was burned (17 percent at high severity), and 34 percent of the Mill Creek watershed was burned (9 percent at high severity). The fire likely increased surface erosion potential and landslide susceptibility substantially on about one-third of the Horse Linto watershed, one-quarter of the Tish Tang watershed and one-fifth of the Mill Creek watershed where steep headwater slopes and other sensitive terrain burned with moderate to high severity. It is estimated that as much as 250,000 tons of additional fine-grained sediment could be delivered to streams over the next 5 to 10 years in Horse Linto Creek, mostly from surface erosion rather than landsliding. This level of increased sedimentation could temporarily set back the recovery of riparian and aquatic habitat in Horse Linto Creek. The projected levels of increased sediment delivery in Tish Tang and Mill Creeks are 57,000 and 40,000 tons respectively. While not as extreme as projections for the Horse Linto watershed, these impacts would further delay recovery of these watersheds and add to existing cumulative watershed effects. Elevated summer stream temperatures are also anticipated in the headwaters of all three watersheds because of the extensive reduction in riparian canopy along perennial streams and anticipated microclimate changes. Only through future monitoring will we know the extent of the subsequent effects, if any, on summer stream temperatures in downstream anadromous habitat.

Effects to other riparian and aquatic species and habitats include alteration and loss of travel corridors and foraging habitats used by such species as fisher. Habitat attributes for herpetofauna were also altered by burning in riparian reserves. Many bryophytes (mosses and liverworts) and certain lichens require micro-habitat conditions that riparian areas provide. Mosses in particular are commonly associated with deciduous trees in riparian areas and humid micro-climate conditions. Along stream reaches in high severity burn areas, substrate for non-vascular plant species were completely consumed. Due to their reliance on moisture and nutrient uptake from the atmosphere, smoke levels may have also deleteriously affected these species.

Increases in peak flow and base flow are also anticipated in headwater channels, particularly in the most severely burned areas due to lowered infiltration and reduced evapotranspiration losses. The projected changes could be as much as 25 percent, which could result in modest channel adjustments such as bank erosion or downcutting.

On-site sedimentation increases could be substantial, given the miles of perennial and intermittent/ephemeral streams that burned with moderate to high severity (73 percent of IRRs in Horse Linto Creek, 54 percent of IRRs in Tish Tang Creek, and 36 percent of IRRs in Mill Creek). Sedimentation of streams will depend on the percentage of hillslope erosion that remains stored on hillslopes. In this terrain with predominantly granitic soils, it could be as much as a third, which would reduce the estimated tons cited above substantially. Nevertheless, surface erosion is expected to be the dominant process in burned areas and will tend to deliver mostly sand-sized and smaller particles.

Short-term increases in large woody debris recruitment should be considerable and will result in excessive fuel loads in riparian corridors. On the other hand, long-term recruitment may be limited for many decades because of the rapid deterioration of true fir after it falls and the delay until new trees can reach maturity. Nearly all large woody debris resulting from the fire is expected to remain on site rather than being transported downstream. Headwater streams in the burned areas are generally not capable of transporting large wood, and historic evidence suggests that the debris flow potential in this terrain is low.

Off-site effects are more difficult to gauge because of the complex hydraulic relationships involved. The texture (size distribution) of sediment mobilized from hillslopes and the extent of woody debris remaining both on hillslopes and in channels will determine the magnitude and duration of downstream impacts to a large extent. The smallest size fractions are likely to move through the system rapidly as suspended load, and turbidity monitoring will be able to track this impact. On the other hand, much of the coarsest material should remain in headwater reaches except during very high flows. The intermediate size fractions (including sand and fine gravel) are the most likely to produce aggradation in fish-bearing streams. These impacts will almost certainly affect resident habitat within the three watersheds and may also affect downstream anadromous habitat.

The rate of sediment delivery downstream cannot be predicted with any confidence. The most likely scenario is that a substantial fraction of sediment delivered to streams in the burned areas will be stored in those headwater streams for an extended time, rather than being rapidly transported into the main fish-bearing streams. Peak flows are not predicted to increase sufficiently to increase stream power significantly, and most headwater streams do not appear to have experienced high sediment transport in the recent past. As noted above, the predominant downstream impact is expected to be periodic increases in turbidity rather than large sediment loads and blanketing of aquatic habitat as occurred with the 1964 and other floods. In summary, downstream impacts associated with the fire are likely, particularly in the Horse Linto and Tish Tang watersheds, but the degree and timing of the impacts are not yet known and will have to be tracked through monitoring.

The longest lasting effect will probably be the loss of conifers along perennial stream reaches that burned severely enough to kill most of them. The overstory canopy within and near riparian areas contributes to microclimate regulation by providing adequate shade, thus affecting humidity and temperature conditions. There are only about 10 miles of perennial stream in this condition, but there are another 70 miles that experienced moderate loss of riparian conifers. Recovery of an effective canopy and its associated microclimate will likely take decades, while recovery of late seral conditions and renewed recruitment of large woody debris could take a century or more. Riparian and aquatic species and their habitat are faced with years of effects from this fire and the additional risk of similar problems in the future if another catastrophic fire occurs.

The Megram Fire has also increased future fire risk, particularly in moderate to high severity burned areas where residual fuel loads will be very high for decades. Future wildfires in these heavy fuels could be very detrimental to beneficial uses in all three watersheds, perhaps even surpassing the effects of the Megram Fire. Areas that experienced lower severity burning are less susceptible to re-burning because they burned in a patchy mosaic. These lightly burned areas are also less sensitive to ground disturbing management activities in terms of potential water quality impacts because damaged riparian areas and sensitive soils are less extensive.

Opportunities to Benefit Water Quality and Restore Riparian and Aquatic Habitats

4.6 What possible management actions or practices are needed to facilitate recovery of habitat for riparian and aquatic species? What factors need to be considered when proposing activities in response to the fire, especially in riparian areas?

The Forest Plan and LSR assessment provide direction on desired conditions for fisheries habitat in general. In light of the likely effects of the Megram Fire on sedimentation processes, the following should be emphasized for this analysis area in particular:

- maintain the Horse Linto watershed as a properly functioning refugia in the short and long term
- continue to manage USFS lands in the Mill and Tish Tang watersheds to contribute towards obtaining properly functioning refugia

It is important to identify and evaluate key processes and functions operating within riparian areas when assessing potential impacts of land management activities on beneficial uses.
Key processes to consider include:

- the likelihood of increasing peak flows at the site;
- the role of large woody debris both in the channel and downstream
- the influence of canopy cover on microclimate
- stream channel stability and sediment delivery potential
- unique riparian vegetation that indicates an elevated water table
- nutrient cycling and retention

It is very difficult to quantify the magnitude of future effects of the Megram Fire on anadromous habitat or to predict the maximum duration of those effects. Sediment loads that move into a headwater stream may take several years to reach anadromous sections. At least several years of monitoring are probably necessary before we can gauge the long-term effects of sediment delivery from the fire on anadromous habitat, as well as other riparian and aquatic habitats. However, this uncertainty about the fire's effects on riparian and aquatic species, their habitat or water quality should not preclude implementation of ***reasonable*** management actions within the analysis area.

Any management strategy applied to these severely burned areas poses some future risk to riparian and aquatic resources. If no fuel reduction projects are implemented, future fire intensity and erosional consequences could be extreme in areas with fuel loads far in excess of conditions prior to the Megram Fire. On the other hand, logging practices to remove excess fuels from moderate to high severity burn areas could have some erosional consequences. It is our judgment that the former risk is collectively much greater than the latter. The elevated fuel conditions will be a long-term and potentially self-reinforcing liability, whereas log removal to reduce those fuels would be a short-term impact. In addition, about 3,000 acres of intensive timber management has occurred in Horse Linto Creek in the past 35 years, yet aquatic and riparian habitats do not appear to have suffered; the watershed is still considered to be functioning properly for key ecological indicators of health. Historic evidence strongly suggests that cumulative watershed effects result largely from poorly located or constructed roads and from imprudent logging practices on steep slopes, but not from timber harvest in general.

Postponing actions designed to reduce fuel loads and future erosional consequences could preclude some remedial options for logistical or economic reasons. The Forest's responsibility for management of the LSR, achieving ACS objectives, and protecting Tribal resources would be best served by pursuing some fuels reduction and erosion prevention projects immediately that could directly or indirectly benefit riparian and aquatic values in burned areas.

Within the analysis area, the Horse Linto watershed has the greatest current value as an anadromous refugia; it is also the watershed most affected by moderate to high severity fires within perennial reaches. Projects designed to improve or protect habitat for fish and other riparian associated species would probably have the greatest benefits if pursued in Horse Linto Creek. However, work could still be of value in the other two watersheds, even though they do not currently qualify as refugia.

Projects that are likely to benefit riparian and aquatic habitat fall into several categories:

- reduction of erosion, sedimentation and turbidity where feasible
- addition of downed woody debris to perennial channels where it is lacking and expected to be lacking in the short or long term
- protection of stream corridors from future high severity wildfire at such a large scale, especially existing habitat that remains in those reaches that were burned at low to moderate severity
- decommissioning, upgrading or relocating roads that pose a risk to fish and water quality, especially valley bottom roads (such as the end of 7N53)
- establishing monitoring sites and a methodology to assess effects of livestock grazing within these watersheds through interdisciplinary field discussions prior to livestock turnout
- planting deciduous and conifer species along stream reaches in high severity burn areas

All activities in and adjacent to riparian areas should be planned to avoid the risk of measurably increasing erosion, since there are already short-term problems as a result of the fire. Fuel reduction goals should be balanced against the need to maintain some woody debris across the landscape, especially along perennial stream corridors. In addition, the needs of woody debris available on the ground in the IRRs should be balanced against the potential for future recruitment from standing dead trees. Retention of large standing snags (rather than falling these to provide immediate recruitment of wood) may be especially important in some areas because LWD recruitment from new live trees may be delayed for more than a century.

4.2 How can restoration efforts following the Megram Fire influence erosion processes and benefit water quality, thereby protecting the domestic water supply in Mill and Tish Tang watersheds and enhancing the values that make Horse Linto a key watershed? How long will it take for the effects of restoration to be evident?

Only a portion of planned BAER treatments were implemented before winter rains and snowfall restricted access into higher elevations. The types and locations of future treatments are somewhat uncertain because a majority of the burned area will have gone through one rainy season without any rehabilitation. The extent of future treatments and where they will be effective needs to be evaluated in the field. However, given the extent of riparian areas that were impacted by the Megram Fire, it is certain that some hillslope and channel treatments will occur in FY 2000. Treatments such as aerial seeding, contour felling, strip mulching, grade control structures and road-stream crossing improvements are planned, and steps to accomplish the restoration work are underway. These kinds of treatments applied in severely burned areas can effectively reduce erosion and sedimentation locally.

Some of the severely burned areas have been identified as susceptible to debris flows because of lost root strength and increased groundwater levels. It is probably not practical to treat these sites to reduce the debris flow potential, but any road-stream crossings on steep drainages below these sites are vulnerable to plugging and failure. If they haven't failed already this winter, these crossings could be evaluated for upgrading to reinforce the crossing, increasing the culvert capacity or efficiency, reducing diversion potential, or decommissioning the road in the near future.

Part of watershed restoration is to re-establish a more natural fire regime of frequent, lower intensity fire. Overall fuel reduction and breaking up fuel continuity are the principal means of accomplishing this goal. Some fuel reduction treatments will require logging systems to remove heavy fuels. The literature suggests that post-fire logging on steep slopes and sensitive soils may exacerbate erosion. Given the extent and severity of the fire and the erodibility of soils in burned areas underlain by diorite, beneficial uses could become degraded to a moderate degree in all three watersheds merely as a result of the fire. Therefore, caution is certainly warranted in designing or implementing most land disturbing activities to restore burned areas. In terms of post-fire watershed restoration, the desired condition is to leave sufficient organic material on sensitive hillslopes to anchor the site through recovery without leaving an undesirable fuel load that could re-burn at high intensity.

Potential impacts of log removal in high and moderate severity burned areas could be reduced in a variety of ways, such as minimizing construction of new roads, ensuring that any new roads are in stable locations, and applying conservative standards in designing logging systems even for moderate slopes. In addition, logging residue could actually decrease erosion in post-fire logged sites by impeding overland flow, particularly if additional contour felling occurred in riparian areas and on steeper hillslopes.

It is difficult to predict how long it will take for restoration efforts to be evident due to differences in the purpose of the treatments, when they're implemented and site conditions. The emergency, post-fire rehabilitation work that was completed has reduced the amount of erosion caused by the fire and fire-fighting activities. Additional erosion control treatments will likewise have immediate visible benefits, yet erosion and subsequent negative effects to water quality and fisheries habitat could remain elevated in these watersheds for a decade or more. Projects designed to reduce the risk of another large catastrophic fire would take several years to implement and be fully effective at the site scale. Fully implementing complementary fuels projects across all three watersheds will likely take a number of years.

Social System

Issue 5: Human Uses, Values, and Expectations

Human Values and Expectations

Trends

The local communities have strong views regarding how their economic viability depends on the landscape around them. They have concerns that not managing the LSR through salvage and appropriate timber harvesting would result in a landscape that is susceptible to catastrophic events, particularly fire. They believe that such events cause great social and economic impacts and stress to communities that last longer than the event itself.

Another view held by community members is that managing with a light hand allows natural processes to govern and thus allows the landscape to recover more quickly.

Recreational fishing within the region and local area is a major attraction that contributes to the local economies. A concern is the potential for sediment flow from the burned areas into the creeks and ultimately into the Trinity River, affecting fish populations.

People have fears and concerns regarding the health-related impacts of prolonged exposure to high PM10 levels and poor air quality during the Megram Fire. An immense concern is the potential for long-term impacts to individual health due to the lengthy exposure to smoke.

Some people believe that the community suffered economically due the media coverage and the poor air quality. The normal inflow of recreationists was disrupted, and low visitation to the affected the annual income of several businesses.

Synthesis and Interpretation

Social data for this assessment were gathered from written comments and from input provided at public meetings in Willow Creek, Hoopa and Eureka. People were asked why the HLMTT watersheds were important to them, what resources they valued in the watersheds, what activities they wanted to be implemented, and what activities they did not want to be implemented? These questions seemed to focus the discussion around economics, salvage, fuel loading and public safety. Discussions at the Eureka meeting surfaced differences among participants whose natural resource management values were often diametrically opposed to each other. Two main perspectives were voiced: some people did not want the Forest to undertake management activities is the fire area, and believed that it was better to allow for purely natural recovery from the fire on the landscape; others believed that recovery from the fire should include management activities such as salvage. Many considered these two perspectives as trading one value for another, with each value being exclusive of the other.

Many people in the local communities believe that management of the natural resources maintains a healthy environment. Timber harvest and salvage are considered as tools that can create a healthy forest and local economy. The communities support an active rehabilitation program for the analysis area that considers the local economic needs along with the landscape needs for a viable healthy ecosystem.

To a number of participants in the Eureka public meeting, the intrinsic values of the ecosystem are more significant to the environment, and thus to potential tourism, than the opportunity of short-term economic gains from timber harvesting. They view timber harvest, including salvage, as achieving only economic objectives, not as a tool for achieving environmental or landscape management objectives. A strongly held value is that the overall management goal must be to preserve and to re-establish fire and other disturbance regimes that maintain ecological systems and processes, while protecting human life and property.

Recreation and associated tourism play a major economic role in the communities along the Trinity River. The analysis area does not play major economic role, but rather serves as a backdrop for the economic viability of recreation and tourism in the area.

The analysis area contributes to the fisheries of the Trinity River. Fishing is part of the rural community lifestyle and yearly subsistence. This activity has a high value among the local people and those visiting the area. Tribes, communities, organizations, and state/federal agencies have focused on the Trinity River fisheries and have invested a lot of work in recent years in both in research and rehabilitation efforts. There are concerns about the impacts of the fire on these efforts.

Fears and concerns about community safety from future fires occurring in the same area crossed the broad range of community views. Non-community members expressed the view that the role of the Forest Service is to assist communities in making their private property safe, but not to utilize public lands to fire safe communities. The local communities believe strongly that the Forest Service has the responsibility to protect the local communities from the effects of catastrophic wildfires that start on or have the risk of starting on National Forest lands.

The Forest Service needs to work with local communities to address their fears and concerns regarding health issues related to air quality from burns and wildfires. The scope and importance of these issues will increase as humans continue to populate wildlands, thus expanding the wildland/urban interface. As populations increase, firefighting efforts will focus on the protection of private property, dwellings and communities at the potential expense of natural resources on

National Forest lands. These competing priorities increase the complexity of fire fighting within the framework of environmental, social, political, and safety concerns.

Local Community Economies

5.1 How do these watersheds contribute to the economies of local communities? What fire recovery efforts might contribute to local economies?

Synthesis and Interpretation

The local communities experienced economic loss during the lengthy Megram Fire and desire to regain some of that loss through economic opportunities generated from rehabilitative or restoration efforts. One community point-of-view is that a rehabilitation strategy for the analysis area needs to be active and consider the potential economic benefits to local communities. Another community point-of-view is that the landscape should be left to recover on its own with either no or a very light hand in managing that effort.

Within the analysis area, approximately 98 percent of the land outside wilderness is designated as LSR. Management activities within the LSR must serve to maintain, protect and restore late successional and old growth habitat. Therefore, economic benefits are a byproduct, not a driver, of management activities. Given this, local communities do not expect the analysis area to produce a regular, dependable source of commodity outputs. Rather, the analysis area serves as a backdrop to the local communities' recreational economic base, with the Trinity River itself as the primary attractant. Although not designed for economic purposes, some of the opportunities identified in this chapter could contribute to local economies.

Opportunities to Contribute to Local Economies

Vegetation Management/Fire and Fuels

There are several vegetation management opportunities that could contribute to local economies on the North Coast. However, it is difficult to predict how much fire recovery efforts would contribute to local communities. Economic benefits depend on which of the recommendations in Chapter 5 are implemented, the extent to which they are implemented, when and where the actions would occur, and who does the work. Therefore, this section presents the potential benefits that could occur should a given management recommendation be implemented to the fullest extent possible. Benefits are presented in terms of commercial value (i.e. harvest volume), or contractual values (i.e. service contracts). The following economic opportunities are linked to the opportunities identified in the "Vegetation Management" and "Fire, Fuels, and Air Quality" sections of this chapter.

Opportunity: Reforest high severity burn areas and reduce fuel concentrations

Possible management practices associated with this opportunity include removal of high fuel concentrations through salvage harvesting, planting conifer seedlings in harvested areas, and subsequent release and precommercial thinning of the new stands. This analysis focuses on salvage opportunities in the LSR, as vegetation management is prohibited in the wilderness, and there is little salvage opportunity in either the General Forest or Partial Retention management area allocations.

The Six Rivers LRMP and Forest-wide LSR assessment outline the conditions under which salvage may occur in the LSR. In general, volume from large-scale events that result in mortality surplus to reasonably predictable late-successional habitat needs is intended to be available for salvage. Salvage harvest, for the purpose of this analysis, is defined as a regeneration type of stand treatment. Opportunities for salvage exist where high severity fire severely damaged mature and old growth timber stands, effectively returning these stands to the shrub/forb seral stage. According to the Forest-wide LSRA, salvage may occur where:

- The stand has been severely damaged by an event such as wind, fire, insect infestation, or disease
- Canopy closure has been reduced below 40 percent
- The size of area below 40 percent canopy closure is a contiguous 10 acres or larger
- For LSRs larger than 5,000 acres, no more than 10 percent of the LSR acreage is salvaged
- For disturbance events larger than 1,000 gross acres, no more than 35 percent of the area of disturbance is salvaged

Of the 50,830 acres of LSR in the analysis area, 35,890 acres were burned during the Megram Fire. According to the 35 percent guideline, up to 12,560 acres could be available for salvage. However, a maximum of 5,083 acres could be salvaged under the 10 percent guideline for LSRs greater than 5,000 acres in size.

Approximately 7,590 acres of potentially commercial stands were severely damaged in the Megram Fire. This acreage occurs in high severity burn areas (fire severity ratings of 3, 4a, and 4b) and includes early mature, mid-mature, late mature, and old growth stands within the Douglas-fir, tanoak, white fir, and red fir vegetation series. Table 4-5 presents a comparison of the estimated net salvage volume and value associated with these stands over a 10-year period of time. Note that the table presents estimates for the entire 7,590 acres and also pro-rates that volume and value to the maximum 5,083 acres allowed under current guidelines.

Table 4-5. Comparison of Salvage Value and Volume over Time

		Prior to fire		1 year after fire		2 years after fire		3-5 years after fire		6-10 years after fire	
Watershed	**Acres**	**Net MBF**	**Value (MM$)**	**Net MBF**	**Value (MM$)**	**Net MBF**	**Value (MM$)**	**Net MBF**	**Value (MM$)**	**Net MBF**	**Value (MM$)**
Roaded											
Horse Linto	3,071	90,905	21.23	74,363	11.70	23,373	4.07	12,393	2.40	7,438	1.55
Mill Creek	903	27,871	6.31	22,589	3.51	6,256	1.06	2,872	0.54	1,543	0.32
Tish Tang	228	7,059	1.52	5,660	0.86	1,314	.20	412	0.07	133	0.03
Total Roaded	4,202	125,836	29.06	102,612	16.07	30,943	5.33	15,676	3.01	9,114	1.90
Roadless											
Horse Linto	1,673	49,862	5.52	40,235	1.68	10,477	0.66	4,406	0.44	2,189	0.31
Mill Creek	591	18,368	3.95	14,635	2.27	3,016	0.47	641	0.10	00.0	0.00
Tish Tang	1,123	33,466	7.73	27,147	4.33	7,633	1.31	3,478	0.66	1,870	0.39
Total Roadless	3,387	101,697	17.20	82,017	8.28	21,126	2.44	8,525	1.20	4,058	0.70
Total of Potential Treatment Areas	7,590	227,533	46.26	184,629	24.35	52,069	7.77	24,201	4.21	13,173	2.60
Total Prorated to Maximum Acres	5,083	152,378	30.98	123,645	16.31	34,870	5.20	16,208	2.82	8,822	1.74

Post-salvage opportunities exist in the form of new stand establishment activities. These activities are typically implemented under service contracts. Table 4-6 presents the estimated total contractual value of these activities and the time frame in which they would likely occur.

Table 4-6. Potential Post-Salvage Opportunities

Activity	Maximum Acres	Estimated Contractual Value per Acre	Estimated Total Contractual Value	Time Frame
Planting	5,083	$120.00	$609,960	Within 0-2 years of harvest
Release for Survival	5,083	$175.00	$889,520	Within 2-5 years of planting
Precommercial thin/release for growth	5,083	$250.00	$1,270,750	Within 10-15 years of planting

Opportunity: Maintain remaining early mature and mid mature stands that burned with a low to moderate severity and accelerate their development into the late mature and old growth seral stages.

Possible management practices associated with this opportunity include mechanical removal of high concentrations of fuels (dead fuels and live trees that will die in the next 10 years), thinning to improve stand health and vigor where appropriate, and slash and prescribed fire treatments to reduce ground fuels.

There are approximately 11,734 acres in the low to moderate severity burn areas (fire severity ratings of 1, 2, and 2a), within the early mature and mid-mature stands within the Douglas-fir, tanoak, white fir, and red fir vegetation series. Table 4-7 presents the estimated potential maximum volume and value that could be derived if all these stands were treated. Volume estimates are based on pre-fire conditions, given that mortality varies considerably within these stands. Value is estimated based on the assumption that, on average, roughly 75 percent of the volume removed would be dead with the remainder predicted to die within 10 years.

Table 4-7. Estimated timber volume and value associated with fuels reduction treatments

Watershed	Acres	Estimated Net MBF	Estimated Value
Roaded			
Horse Linto	4,015	23,517	$ 4,944,000
Mill Creek	2,355	15,499	$ 2,930,600
Tish Tang	354	2,752	$ 438,200
Total Roaded	6,724	41,768	$ 8,312,800
Roadless			
Horse Linto	1,154	7,237	$ 709,100
Mill Creek	2,565	17,197	$ 3,226,100
Tish Tang	1,291	7,929	$ 1,324,100
Total Roadless	5,010	32,363	$ 5,259,300
Total	11,734	74,131	$ 13,572,100

Subsequent fuels treatments could include the cutting and piling of sub-merchantable live and dead trees to reduce ladder fuels, and piling of cut materials and existing fuels. The contractual value of fuels treatments over the 11,734 acres is estimated at $500.00 per acre for a total of $5,867,000.

Opportunity: Manage burned plantations, based on burn severity, as needed to reestablish healthy conifer stands.

There are 6,960 acres of plantations within the analysis area. It is estimated that 4,630 acres were burned in the fire. Approximately 2,760 acres suffered a high degree of mortality due to high severity fire. Moderate and low degrees of mortality occurred on 690 and 1,180 acres respectively. Reestablishment of plantations would include site preparation, planting, release for survival, and precommercial thinning for growth.

It is expected that all of the plantations within the high severity category will need to be re-established. Of these, an estimated 80 percent (2,200 acres) would require some site preparation prior to planting. It is unknown at this time how many acres in the moderate severity category will require site preparation and/or planting. No treatment is expected in the plantations within the low burn severity category. Table 4-8 presents the estimated maximum total contractual value of reestablishment activities and the time frame in which they would likely occur.

Table 4-8. Plantation Re-establishment Opportunities

Activity	Estimated Acres	Estimated Contractual Value per Acre	Estimated Total Contractual Value	Time Frame
Site Preparation	2,200	$250.00 - $500.00 (depending on treatment)	$550,000 - $1,100,000	Within 1-5 years of fire
Planting	2,760	$120.00	$331,200	Within 1-5 years of fire
Release for Survival	2,760	$175.00	$483,000	Within 2-5 years of planting
Precommercial thin for growth	2,760	$250.00	$690,000	Within 10-15 years of planting

Opportunity: Construction of Shaded Fuelbreaks

Approximately 90 miles (3,610 acres) of shaded fuel breaks could be constructed within the analysis area. Activities associated with this recommendation include thinning, cutting small ladder fuels such as brush, seedlings, saplings, and poles, pruning, piling ground fuels, and prescribed burning. Some of these activities were accomplished during the Megram Fire. The economic value associated with this recommendation is similar to that of fuels reduction and stand maintenance in early and mid-mature stands. If implemented, it is estimated that thinning within the fuel breaks would produce an average of 6 MBF per acre at a value of $200 per MBF, for a total commercial value of $4.3 million. The contractual value of subsequent ground fuels treatments is estimated at $575.00 per acre for a total of $2.1 million.

Other Opportunities

Burned Area Emergency Rehabilitation Efforts

Ongoing Burned Area Emergency Rehabilitation (BAER) activities present opportunities for short-term economic benefits to local communities. Approximately $2.7 million worth of fire rehabilitation work has been planned. Some of this work was completed in the fall of 1999, with the remainder expected to occur in the spring and summer of 2000. A wide variety of activities are planned to reduce fire-induced short-term negative impacts to upslope areas, stream channels, roads, and trails, much of which can be accomplished through service contracts.

Ecotourism

Local communities could see increased tourism if people come to see first hand how the landscape recovers from the Megram Fire. Concerns have been raised that Forest Service fire recovery and rehabilitation activities could negatively impact the potential for increased ecotourism.

The Six Rivers, for the most part, could be called a “backyard” forest. Most of the recreation use on the Forest is by local people. Although people may stop within the Forest on their way to other locations, the Forest is not a typical destination point for non-local recreationists. Therefore, it is unlikely that natural recovery within the Megram Fire area would lead to the large increases in tourism seen at Yellowstone, Mt. St. Helens or other destination locations where large catastrophic events have occurred in the past.

While significant increases in tourism are not expected, an opportunity does exist for local entrepreneurs to develop interpretive programs that may draw non-local recreationists to the area. Given the size of the fire area, the complexity of management direction, resource and public concerns, and limited funding, management activities would be limited within the fire area. As a result, a large percentage of the fire area would remain untreated. Interpretive programs could compare and contrast the progress and results of managed versus natural fire recovery within the Megram Fire area.

Recreation

5.2 What recreational opportunities were impacted by the Megram Fire? What possible management practices could be implemented to restore or maintain these opportunities in areas that were affected by the fire?

Synthesis and Interpretation

- The mountain ecosystem was identified by local businesses as the second greatest recreational asset after the Trinity River. Visitors liked best the river, the climate (heat/sun), and the beauty, scenery, and solitude.

- Twenty-three recreation activities were identified as occurring within the analysis area. Hiking, hunting, fishing, relaxing or hanging out in the outdoors and driving for pleasure are the most common activities in the analysis area.

- The analysis area receives the highest concentration of trail use on the district because of the trail network and access to the Trinity Alps Wilderness. Still, trail use is low compared to use in other areas of the Trinity Alps. Trails are important for historic, tribal cultural and spiritual values. They also provide access to some special places.

- Research conducted in large-scale burned wilderness areas concerning recreationists' preferences indicated that fire has very little impact on peoples' recreation choices. There is a tendency to view fire as a component of the natural environment. The greatest effects to recreationists occurred when the fire was burning, i.e. smoke, blocked access to roads and trails.

- People are curious about the damage to some of their special places and the trail system. Several expressed the desire to visit the burned area as soon as conditions allow.

- Local citizens' attitudes towards the fire's impacts on recreation opportunities ranged from no impact to long-term impacts to certain activities. Both positive as well as negative benefits were identified.

- The greatest fire impacts on recreation opportunities are to the trails (34 miles affected) and to wilderness values.

- The greatest impact to the 56-mile trail system is in the high intensity burn class (approx. 14 miles) and in the moderate intensity burn class (approx. 20 miles). All trails have not been surveyed for damage. Surveys need to be completed this summer.

- Short-term impacts to recreation included loss of hunting grounds, firewood cutting, fishing guide business opportunities due to loss of access, smoke and air quality among overall loss of recreation opportunities during the suppression period. Some trails may need to be posted and closed due to hazardous trail conditions. Impacts to the wilderness were caused by fire suppression activities: fire crew camps, fire lines may be mistaken for trails, etc.

- There may be opportunities to reroute trail segments that were damaged and that were previously causing resource impacts, i.e. trail through a meadow.

- Longer-term impacts are potential loss of trail mileage due to obliteration by fire and low priority for restoration due to funding availability and low use.

- Local citizens' recommendations for managing the large fuel buildup resulting from the Megram fire ranged from using chainsaws and salvage operations in the wilderness to doing nothing and allowing natural processes to occur.

- Wilderness users expressed a desire that visual qualities of the wilderness be maintained and suggested that the fire, by opening up the landscape, gave the opportunity to recognize historic trails, thereby giving the Forest Service the opportunity to compensate for the road closures that have taken place there.

- Concern was expressed regarding safety for individuals, family, and pack stock.

- Local residents were also concerned with trail repair, hazard tree removal along trailheads and trails. Concerned that hazard tree removal along trails will not have as high a priority as along the road system.

Conclusions

- Need to focus rehabilitation efforts on restoring wilderness attributes and values that were impacted by suppression efforts.

- Trail rehab priority needs to be on National Recreational Trails and high use trails in high intensity burn areas. Other recreation facilities such as signs and SSTs damaged by the fire need to be replaced or repaired.

- There needs to be an education and awareness effort of local communities concerning the role of fire in wilderness and wildlands, management efforts, and natural restoration processes to gain understanding and support of our efforts.

- Chainsaw use authority for wilderness work may be needed to clear trails of hazard and downed trees due to season limitations and worker and visitor safety.

- There are short-term efforts that need to be done to rehab the damage caused by the fire; longer-term efforts that may not be as high a priority, but would be considered for long-term tourism and recreation benefits also need to be identified.

- Trail work needs to be appropriate for the type and amount of use received.

- There may be opportunities to reroute trail segments that were damaged and that were previously causing resource impacts, i.e. trail through a meadow.

Trends and Opportunities

- Recreation use in the HLMTT is relatively low, but intrinsic values such as scenery, solitude, and remoteness are important to local communities and residents.

- More group activities are occurring in the HLMTT area.

    Opportunity: The fire has possibly cleared historic trails that were previously covered by vegetation. This might present an opportunity for a Passport-in-Time project that would enhance historical resources.

- The community of Willow Creek is increasingly interested in developing and enhancing recreation opportunities in the area.

    Opportunity: Identify potential projects for development in partnership with the community.

- Can probably expect an increase in visitor use during the first season after the fire due to curiosity about the fire's damage in general and to special places.

    Opportunity: Visitor curiosity and desire for information presents an education opportunity. This could be addressed with information posted at trailheads, around town where people buy supplies, and forest offices.

- Use of the internet is becoming increasingly widespread and a common method for accessing information.

    Opportunity: Develop fire information for the Forest web site. Photos, project descriptions and progress, rehabilitation methods, fire's role and forest recovery are just some of the topics that could be available to the public.

Tribal Trust Resources

5.3 How has the Megram Fire affected the Hoopa and Yurok Tribes' federally reserved rights in the Trinity and Klamath fisheries?

The known anadromous habitat in the Mill and Tish Tang watersheds are all within Hoopa Valley Indian Reservation lands, though steelhead may sometimes ascend Mill Creek beyond tribal lands. The Hoopa Valley Tribe assisted in this analysis by providing information about the fish and their habitat.

It is likely that the Megram Fire's effects on anadromous fish and their habitat will last at least a decade. The stream habitat quality ranged from fair to excellent condition for anadromous and resident salmonids prior to the Megram Fire. Both Mill and Tish Tang creeks were judged to not be properly functioning refugia prior to the fire while Horse Linto was a properly functioning refugia. The fire effects in headwater riparian reserves are expected to trickle down to the anadromous habitat. The most deleterious effects to anadromous fish are expected to be erosion, sedimentation, and water quality. Headwater riparian reserve health is the fisheries environmental baseline factor that is expected to take longest to recover.

Mill Creek fisheries habitat received less direct impacts from the fire than the other two watersheds. Approximately 19 percent of Mill Creek watershed fish-bearing habitat was burned. However, none of the anadromous stream corridor was burned. Thirty-four percent of the riparian reserves were burned at a moderate to high severity, so indirect post fire fisheries problems are likely to occur to resident and anadromous fish habitat.

Approximately 50 percent of the Tish Tang watershed fish-bearing habitat was burned; however, none of the Tish Tang anadromous stream corridor was burned.

The Hoopa Valley Tribe manages the lower basin lands of Tish Tang and Mill Creek watersheds while the upper basin lands are managed by the Forest Service. In 1990 and 1995 Pacific Watershed Associates prepared watershed assessments for both Tish Tang and Mill Creek for the Hoopa Tribe and Six Rivers National Forest. The results of their inventory identified that most of the current erosion was closely associated with past land use and road construction. Less than 1% of the past eroded sediment was generated from National Forest lands, located in the upper Tish Tang Creek basin. The preponderance of past erosion in lower basin areas was due to more extensive logging and road building on Hoopa lands, as well as the occurrence of steeper, more unstable hill slopes areas in the basin. (Pacific Watershed Associates 1995:I)

Mill Creek watershed ownership is similarly situated. Most of the current erosion is closely associated with past land use and road construction. Five percent of the eroded sediment was generated from National Forest lands, located in the upper Mill Creek basin. (Pacific Watershed Associated 1990:I)

The Yurok Tribe's Reservation is on the Klamath River, to which the Trinity River is a tributary. Effects to the Yurok Tribal fisheries are distant to non-existent based on current information.

5.4 How may degraded water quality resulting from the fire affect federally reserved water rights of the Hoopa and Yurok Tribes with respect to domestic use and subsistence fishing?

The Hoopa Tribe depends on Mill Creek for domestic water supply for the eastern portions of the Reservation with approximately 280 metered service connections (Hoopa Valley Tribe 1997:31). Due to high turbidity levels during high flows, the water supply is periodically shut down for water quality purposes.

Tish Tang Creek is under an engineering feasibility and design study for use as domestic water supply. Currently their Water Quality Plan identified a goal to reduce turbidity during high flows on Reservation domestic water supply streams that lead to unacceptable water quality problems during the winter months on Mill Creek and Tish Tang Creek.

A significant percentage of the intermittent and ephemeral stream network within the analysis area was impacted by moderate and high burned fire severities. It is anticipated that increases in stream temperatures in perennial stream channels within or downstream of burned areas will occur and persist until riparian cover is re-established. Mill Creek currently has the highest sedimentation among of the watersheds in the analysis area; it is considered “sediment-impacted” by Hoopa Tribal staff.

Sedimentation of stream channels within the burned areas and downstream of burned areas on all three watersheds is expected to occur, particularly given the extent of moderate and severely burned acreages and number of miles of perennial, intermittent and ephemeral watercourses impacted.

5.5 How can the Forest minimize the threat from future wildfires and pest infestation to Tribal trust resources?

The threat to Tribal trust resources from future fires can be minimized through the opportunities identified to reduce fire hazard; fuelbreaks, prescribed burning and fire suppression. Refer to the discussion under “Forest Hazard and Mortality” provided on pages 4-20 to 4-28.

Pest infestation is restricted to insects. Insect infestation is expected to occur, but not reach epidemic levels; rather, it will be related to individual trees and small group mortality. Insects will spread to trees under stress from fire damage; these trees will likely succumb to insects. It is not expected that insects will leave the fire area in large numbers and impact nearby unburned stands. The biggest risk from insect infestation is that “long after trees are killed by fire or insects, snags invite lightning and can increase the cost, difficulty, and danger of controlling the resulting fire. Fire kills or stresses trees that breed insects and insects can help set the stage for another fire” (Furniss & Carolin 1977). Refer to the discussion under “Pests” provided on page 4-9.

Tribal Spiritual and Traditional Uses

5.6 What are the effects to contemporary spiritual locations used by Hupa traditionalists in the Trinity Summit area and along the Trail of the Blue Sun? What possible management practices could be implemented to mitigate adverse impacts?

Traditional Cultural Properties (TCP) represent sites that contain both tangible and non-tangible properties. That is, there may be artifacts or features present, but natural and environmental attributes such as viewsheds, natural rock features, or isolation may be more critical and of significant importance to the TCP.

The De-No-To District is a TCP on the National Register of Historic Places and is identified as a critical cultural resource from the National Forest perspective as well as from the Hoopa Tribe perspective. The Forest has developed a treatment program to identify what values of the TCP would be at risk due to the deteriorated watershed associated with the Megram fire.

The inventory phase includes consultation with traditional practitioners and members of the Hoopa Tribe to identify if any values of the TCP are at risk from the deteriorated watersheds, and what measures, if any, need to be implemented to protect those values. It is conceivable that the inventory and consultation may result in the formulation of treatment measures.

5.7 What are the short and long-term effects of the fire on the availability and quality of culturally significant vegetation and animals? What possible management practices could be implemented to mitigate adverse impacts?

A significant use of the analysis area is for gathering of native plants to sustain cultural life ways of the Hupa. Subsistence gathering and hunting are major human uses of the analysis area and the most consistent use over the years. Large numbers of Hupa, and some Tsnungwe, continue to gather in this area as their ancestors did within their aboriginal territories. This activity is rooted in the past for Indian cultures and will likely continue into the future.

The Hoopa Tribe has completed field investigations which included the identification of what they refer to as Traditional Hupa species which were designed as such due to their historical and ceremonial use, and because today, their abundance has declined significantly. The Forest Service has extensive ethnographic data that included information on gathering for this analysis area. The Tribe's work identified specific habitat conditions needed for some of the species of concern. The following are from field investigations that located these species on reservation lands adjacent to National Forest lands in the analysis area:

- Some traditional Hupa species have narrow light and moisture requirements. *Polypodium californicum* and *Woodwardia fimbriata* are such species. Other species, such as *Polystichum munitum*, appear to thrive in shady areas with a more mesic regime.
- All of these species would be directly impacted by the removal of substantial canopy cover. Appropriate edaphic conditions are moderate to extensive canopy, low-density shrub layer and accumulations of organic duff/litter layer.
- Some species appear to respond favorably to disturbance. *Corylus cornuta var. California* produces better shoots for basket weaving following a burn and was traditionally burned to

encourage good shoot formation. *Vaccinium ovatum* reportedly responds well to disturbance and/or partial pruning, and bears more heavily following such disturbance.

The fire has directly affected culturally significant vegetation. In order to answer this question, further fieldwork and consultation with traditional users and a botanist is needed to document the normal plant community succession pattern and potential for introduction of invasive species. Consultation with the traditional gatherers is needed to identify what resource values will be lost if invasive species out compete these critical ethnobotanical resources and prohibit the reestablishment of these critical resources. The Forest's strategy is to conduct an ethnobotanical inventory and a resource value inventory to identify any treatment measures for potential implementation.

In areas where habitat decreased due to the removal of a high amount of canopy, it may be necessary to thin out the shrub layer in moderate canopy areas to encourage species establishment. (Theiss 1992:28).

Heritage Resources

5.8 What effects did the fire have on known cultural resource properties located within these watersheds? What kinds of fire recovery efforts might contribute to conserving the values of these sites?

Heritage resources were a priority throughout the Big Bar Fire Complex. The Hoopa Valley Tribe, its representatives and resource managers were involved throughout the fire. Reasonable efforts were made to protect cultural resources, to assess fire and fire suppression damages to these resources and to address all incident-related damages (USDI-BAER 1999:76). There were coordinated efforts to protect previously documented cultural resources as well as resources that were undocumented due to cultural sensitivity. Additionally, cultural resources maintained a high priority for both the USDA and USDI BAER rehabilitation mission and tasks.

Subsequent to the fire, heritage resource staff mapped the locations of all known cultural resources sites within the burn area. Using GIS fire intensity maps, each site was evaluated for potential effects resulting from the fire based on whether it was located within a no burn, low, moderate, or high intensity burn area. The results are shown in Table 4-9.

Table 4-9. Megram Fire Burn Severities for Cultural Resource Sites

Watershed	no burn	low/moderate	moderate/high	high
Horse Linto	2	1	9	5
Mill	2	4	12	1
Tish Tang	1	0	20	2

Effects to known cultural resource properties cannot be determined at this time. The field inventory phase will include consultations with traditional practitioners and the Hoopa Tribe to identify if any values or cultural resources are at risk from the deteriorated watersheds, and what measures, if any, need to be implemented to protect those values.

The Forest has developed a treatment program, which includes mitigation of effects from fire suppression activities and an inventory program to identify what Traditional Cultural Property values of the De-No-To National Register District could be at risk due to the deteriorated watershed within the analysis area.

Access

5.9 Has the Megram fire altered the conclusions of the Lower Trinity Access and Travel Management (ATM) Plan?

Most of the ATM's proposed actions – which listed specific roads to be upgraded, decommissioned, or put into maintenance level 1 (ML1) status and made hydrologically maintenance-free -- had been completed prior to the Megram Fire. During the fire, several decommissioned roads were temporarily reopened in order to provide emergency access for firefighting and, in one case, medical evacuation. After the fire, various Forest resource specialists were consulted to determine whether the plan's conclusions are still valid under current conditions. The review suggested that only minor adjustments to the plan are needed, some of which are unrelated to the fire.

In brief, it is suggested that two roads proposed for decommissioning be left open temporarily that may be necessary to facilitate fire rehabilitation access, and four short spur roads proposed for ML1 closures be left open indefinitely. Specifically, Forest roads 7N04R and 7N04S were proposed for decommissioning. These roads, which are currently ML2 roads, are located in the south end of Groves Prairie in the Horse Linto watershed. Road 7N04R follows relatively flat terrain and has two culverts that would be removed if decommissioned. Road 7N04S also stays on relatively flat ground and terminates on a flat ridge about one-quarter mile above Cedar Creek. These roads total about 2.49 miles in length. Decommissioning should be deferred on both of these roads, as use of the roads may be necessary to facilitate access for fuel treatment and other post-fire restoration efforts. The long-term disposition for these roads should be analyzed in any Environmental Assessment covering fire rehabilitation and fuel treatment work in the area. Depending on the quantity and duration of such activities, it may be preferable to retain these as ML2 roads, or possibly ML1, rather than decommission them.

Roads 7N04G, 7N04M, 7N04N 7N04P are located in Groves Prairie, and were proposed for downgrading to ML1 status. They are currently ML2 roads, totaling approximately 1.24 miles in length. Only one of the roads, 7N04G, has culverts which would be removed. These are low impact roads due to their location on the flat, and are needed to access existing dispersed recreation sites in Groves Prairie. These four roads should be kept open and retained in ML2 status to allow continue public access into Groves Prairie. The recommended change is not related to the Megram Fire.

As mentioned above, several decommissioned roads were reopened to provide emergency access during the fire. Although this could be interpreted as evidence that the roads should not have been decommissioned in the first place, the original premises for closing the roads remain intact: 1) the Forest does not have sufficient funding to adequately maintain all of its existing roads; 2) road decommissioning can result in long-term reductions in sedimentation; and, 3) the ATM team determined that these particular roads were no longer needed; they were constructed to support commercial timber harvest, which is no longer a primary management objective for this area. Though decommissioning may increase initial attack response times (and resulting fire sizes), these trade-offs are weighed against the potential benefits of such actions before the decision to decommission is made. In some cases, potential fire access may be an overriding factor in keeping a road open. In this area, emergency conditions warranted reopening the roads temporarily. Such actions were entirely appropriate under the circumstances, but they do not alter the original conclusions set forth in the ATM plan.

5.10 Which roads pose the greatest threat for failure and erosion if inadequately maintained?

There are two categories of threats related to failure and erosion of roads: the first involves the function, condition and ultimately the maintenance of the road and related structures. The second comes from off-site influences that are not necessarily related to road maintenance. Though this latter category falls outside the scope of this key question, this type of threat could potentially have far greater consequences in the aftermath of the Megram Fire.

The first category described above, and the key question itself, addresses the threat for failure and erosion of roads due to inadequate maintenance. Erosion problems on roads may occur on the running surface, fill slopes, cut slopes, ditches, or areas immediately below the road. More than two-thirds of the Forest roads in these three watersheds have some type of improved surface (pit run, aggregate, chip seal, or asphalt); it is the native surfaced and, in some cases, pit run surfaced roads, that are of prime concern in regards to the running surface, particularly due to the presence of decomposed granite soils. These unimproved surfaces can rut badly if driven in wet weather and if not properly maintained. Approximately 3.5 miles of road 7N04 is of concern since it contains a section of granitic “pit run” which has since broken down. Road 7N53, a native surfaced road, is also of concern, as are the remaining short spur roads with native surfaces. We have a data gap as to the condition of many of these lower standard roads and whether or not gates are present; these roads need to be reviewed in the upcoming field season. In general, all of the native surfaced roads and some of the pit run surfaced roads may offer a threat of erosion if driven in wet weather. These roads need to be bladed as needed to provide proper drainage. Drivable dips or other drainage devices should be installed where needed. Gates or other closure devices may be needed on some roads as to restrict wet weather use.

Ditches need to be maintained on all roads in the area. Culverts and inlets need to be kept clean, and all drainage structures maintained. These practices will minimize the erosion and failure potential to the degree that these events are controllable by road maintenance. However, as mentioned above, offsite influences may play an even greater role in influencing erosion and failure of roads in the burned area. Logs and woody debris may enter ditches, culverts and inlets in far greater quantities than was normal in pre-fire conditions. Such obstructions increase the likelihood of culvert plugging or ditch blockage, which could result in diversions or culvert failure. Similarly, slugs of sediment may plug culverts and ditches with the same potential adverse effects. These off-site influences are likely to be greatest where roads pass through or below areas of high or moderate burn intensity. Such affects were analyzed and addressed under the “Riparian and Aquatic System” heading, which should be referenced for the locations of primary concern. Culvert inlet basins at these stream crossings may need to be oversized to accommodate debris and increased sediment loading. Extra diligence should be used to frequently inspect ditches and inlet basins in these areas to insure they are cleaned whenever required. Hazard tree felling operations should insure that all logs and woody debris are removed from ditches and stream channels. All road maintenance activities that were identified earlier as fire-related or suppression-caused damage should be completed as soon as ground conditions permit.

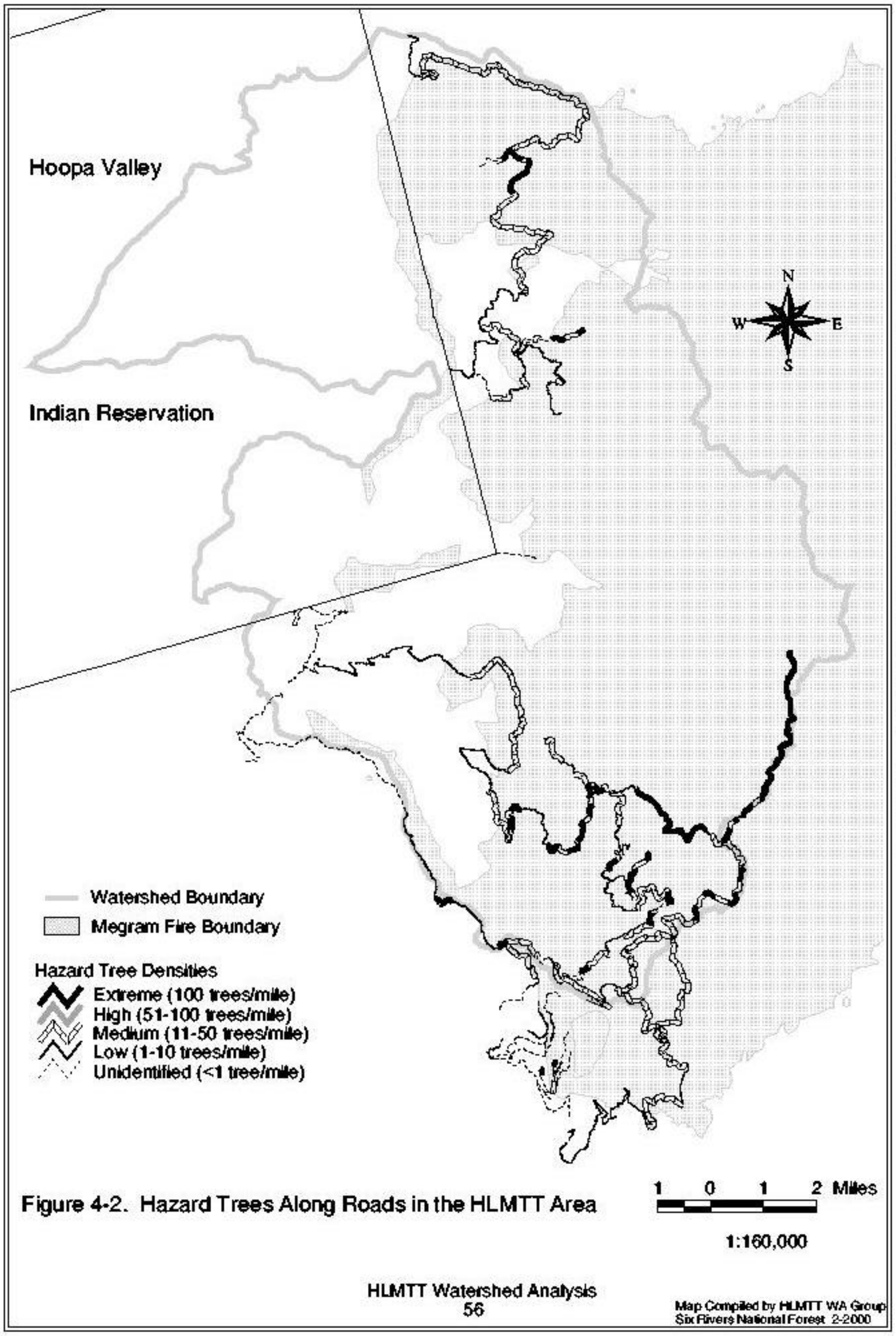
5.11 Where is the potential hazard to the public and Forest employees from fire-damaged trees falling on Forest development roads? How should these trees be removed to reduce this hazard in a manner that minimizes potential impacts to other resources?

An initial inventory of hazard tree densities was completed. Figure 4-2 shows which road segments have hazard trees, including the density of trees per mile. In general, the highest potential hazard to road users is in areas where roads cross through moderate to high burn severities. However, there is some degree of hazard anywhere in the burn area, especially where there are dead and dying trees within close proximity to the road (one tree length, or more where tree is upslope from the road). The safety risk is increased for persons traveling the roads during felling and removal of the hazard trees. Hazard tree treatment operators should post signs and lookouts along affected roads if complete road closure is not necessary. Some roads may need to be closed to public use prior to hazard tree felling if hazard tree conditions make road use inherently unsafe.

The scoping document for the hazard tree EA states that "All heavy equipment would operate only within existing roadways, landings, and other previously disturbed clearings. End-lining or winching for distances up to 150 feet may be necessary to retrieve all portions of hazard trees that are required to be removed." These activities may serve to reduce resource impacts on the ground, but at the cost of increased road damage. In order to minimize such damage, the use of tracked vehicles should be prohibited on paved surfaces; rubber-tired equipment should be used.

All logs and woody debris resulting from hazard tree felling or removal should be cleaned out of stream channels, culvert inlet basins, and ditches. Any damage to the road prism, culverts, or other drainage structures caused by felling or skidding operations should be repaired or replaced immediately.

Figure 4-2. **Hazard Trees along Roads in the HLMTT Area:**



Roadless

5.12 What factors should be considered when evaluating possible management practices within the remaining portions of the Roadless Area?

When evaluating possible management practices within the roadless area, consider the effects of the proposed activities on: 1) the six roadless characteristics and wilderness features (natural integrity, apparent naturalness, solitude, remoteness, special/unique features, manageability/boundaries); 2) special places and special values; and 3) the cumulative roadless environment.

These effects may: 1) eliminate the potential for the area to be considered for future wilderness designation; 2) change the roadless area's size, characteristics and wilderness features; or 3) have no effect on the area's roadless characteristics and wilderness features.

It is anticipated that the Chief of the Forest Service will soon be making a decision that may influence management activities within remaining roadless areas. This decision is commonly referred to as the "Roadless Rule" or "Roadless Initiative". The results of this decision must be considered and applied when evaluating possible management practices within the roadless area.

Grazing

5.12 What criteria for resuming grazing will prevent adverse impacts to high elevation meadows and riparian areas that were affected by the Megram fire?

The following key has been developed to assess high elevation meadows and riparian areas affected by the fire to determine if grazing can be resumed.

CATTLE TURN OUT KEY

1) Forest land adjacent to areas grazed by cattle not damaged to extent where cattle wandering onto it will cause adverse effects: soil erosion, impede revegetation (natural or artificial), etc.

Yes Go to 2

No Consider keeping cattle in another portion of the unit or off the allotment until healing has occurred. If not possible, go to 6

2) Stream channels leading into and out of areas grazed by cattle still vegetated.

Yes Go to 3

No Consider fencing to restrict cattle access to stream channel. If not possible, go to 6

3) Meadows not affected by fire or have recovered from effects of fire.

Yes Go to 4
No Consider keeping cattle in unaffected meadows. If not possible, go to 6

4) Range readiness inspection shows meadows are ready for cattle.

Yes Go to 5
No Consider offering alternative allotment area to permittee, if available. If not possible, go to 6

5) Cattle can be turned out.

6) Keep cattle off allotment unit.

Adaptive Management

5.13 What are the opportunities to learn from the fire?

There are numerous opportunities to learn from the Megram Fire. These opportunities can be built as learning objectives into project design. They also can be met through developing partnerships with county, state and federal agencies, Tribal governments, educational institutions, and interested publics. Opportunities are identified in Chapter 5.

CHAPTER 5

MANAGEMENT RECOMMENDATIONS

Introduction

The purpose of this final step is to present a set of management recommendations that respond to the issues and key questions identified in Chapter 2 and are based on the synthesis of data in Chapter 4. This watershed analysis focuses principally on the effects of the Megram Fire on the HLMTT watersheds in order to identify opportunities and possible management practices that could be implemented to meet the objectives of the Forest Supervisor:

6. Recovery of high intensity burned areas
7. Recovery of burned plantations
8. Watershed restoration in Tish Tang, Mill, Horse Linto and Red Cap drainages
9. Fuels management for community protection and protection of the LSR
10. Long term health and recovery of the LSR

The term “recovery” has several implications and meanings. For the watershed analysis team, “recovery” means moving from the existing post-fire conditions to the desired conditions identified in the Six Rivers LRMP and the Forest-wide LSRA. Therefore, the team relied heavily on both the LRMP and the Forest-wide LSRA for desired conditions and management direction during the analysis process. Although the above objectives are specific to the Megram Fire, they link closely with the management objectives identified in the Forest-wide LSRA:

1. Protect existing and potential late-successional habitat from catastrophic loss to maintain habitat for late-successional associated species
2. Accelerate the development of late-successional habitat to increase the amount and quality of habitat for late-successional associated species
3. Retain, restore and protect watershed functions that promote high quality habitat for native fish and other aquatic organisms
4. Manage access to reduce adverse effects to late-successional associated species and aquatic habitats

During the synthesis step of the watershed analysis, the watershed analysis team overlayed the maps and findings of individual team members and sub-groups to generate an interdisciplinary, landscape picture of watershed conditions and needs. Team members came to the conclusion that many of the opportunities discussed in Chapter 4 could meet multiple objectives if combined. Integration of these objectives from the various resource areas allows accomplishment of multiple goals by focusing efforts on the highest priority locations in these watersheds. Integration of objectives from the various resource areas would allow accomplishment of multiple goals focused on the highest priority locations in these watersheds. Because these opportunities and possible management practices are designed to meet multiple objectives, thereby linking many of the issues and key questions, this chapter is organized by opportunity to emphasize these links and avoid repetition.

Opportunities and Possible Management Practices

Almost all of the land outside wilderness in these three watersheds is within LSR 305. The overriding goal of management in LSRs is to maintain, protect, and restore conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth associated species. As discussed in the introduction, many of the opportunities in this chapter are designed to meet both the management objectives in the Forest-wide LSRA and those identified by the Forest Supervisor. In addition, the watershed analysis team identified opportunities that respond to the issues and key questions in Chapter 2. The opportunities are summarized below.

1. Reduce fuel levels in strategic locations to lower the potential for future catastrophic fire.
2. Protect remaining mature and old growth stands from catastrophic loss.
3. Accelerate the development of late-successional habitat.
4. Protect adjacent communities from future wildfires and extended exposure to smoke.
5. Restore watershed functions and manage access to protect high quality habitat for riparian and aquatic species as well as domestic water supplies.
6. Minimize impacts on Tribal trust resources on the Hoopa Reservation and mitigate adverse impacts on spiritual and traditional uses.
7. Provide safe roads for the public and forest employees.
8. Emphasize those activities that will benefit local and regional economies through fire recovery efforts
9. Minimize the introduction and spread of noxious weeds.
10. Monitor and further analyze habitat conditions and trends for threatened, endangered and sensitive species, survey and manage species and species of concern.
11. Protect heritage resource sites affected by the fire.
12. Minimize grazing impacts to meadow and riparian habitats.
13. Restore recreational facilities and opportunities affected by the fire.
14. Learn from the fire.

The following section discusses the possible management practices that could be implemented for each opportunity. Some management practices are listed under a number of the opportunities. Criteria for selecting treatment areas, considerations and criteria for treatment, and data gaps are also identified where relevant. The opportunities provide the purpose and need for action under NEPA, while the possible management practices provide a framework for future proposed actions under NEPA.

Opportunity 1 Reduce fuel levels in strategic locations to lower the potential for future catastrophic wildfire

Key Findings

The size and severity of the Megram Fire is unprecedented in the recent history of the Klamath Province. The resulting continuity and level of fuels poses an increased fire hazard across the landscape of the HLMTT area, with a high potential for high severity re-burn. Large areas of the moderate to high severity burned areas fell within the wilderness, where fuel treatments will not be undertaken. An extensive portion of the roadless area, which also suffered high to moderate severity burning, is located between the Hoopa Square and the wilderness. Breaking up the continuity of fuels and reducing fuel levels in strategic locations can reduce the potential severity and extent of future wildfires. Shaded fuelbreaks along major roads and ridges would form the "backbone" for fuel reductions (Figure 4-1). Large area burns are proposed in concert with these fuelbreaks. Specific fuelbreaks locations include:

- Happy Camp Mountain and vicinity
- Tish Tang Ridge, south of Hoopa Reservation Boundary
- Groves Prairie and vicinity
- Waterman Ridge
- Lone Pine Ridge
- Packsaddle Ridge

This combination of fuelbreaks and fuel reduction projects meets multiple objectives, including:

- Protect remaining mature and old-growth stands in order to achieve RMRs
- Protect remaining mature and old-growth habitat for plant, wildlife and riparian species of concern
- Mitigate impacts to Tribal trust resources
- Protect adjacent communities from future wildfires and extended exposure to smoke
- Protect soil and water resources from even greater impacts due t0 future wildfires

Figures 5-1 and 5-2 show the location of proposed shaded fuelbreaks, high severity burn areas and remaining mature and old-growth stands. Fuel reduction treatments should be strategically located to reduce hazards to remaining stands.

Possible Management Practices

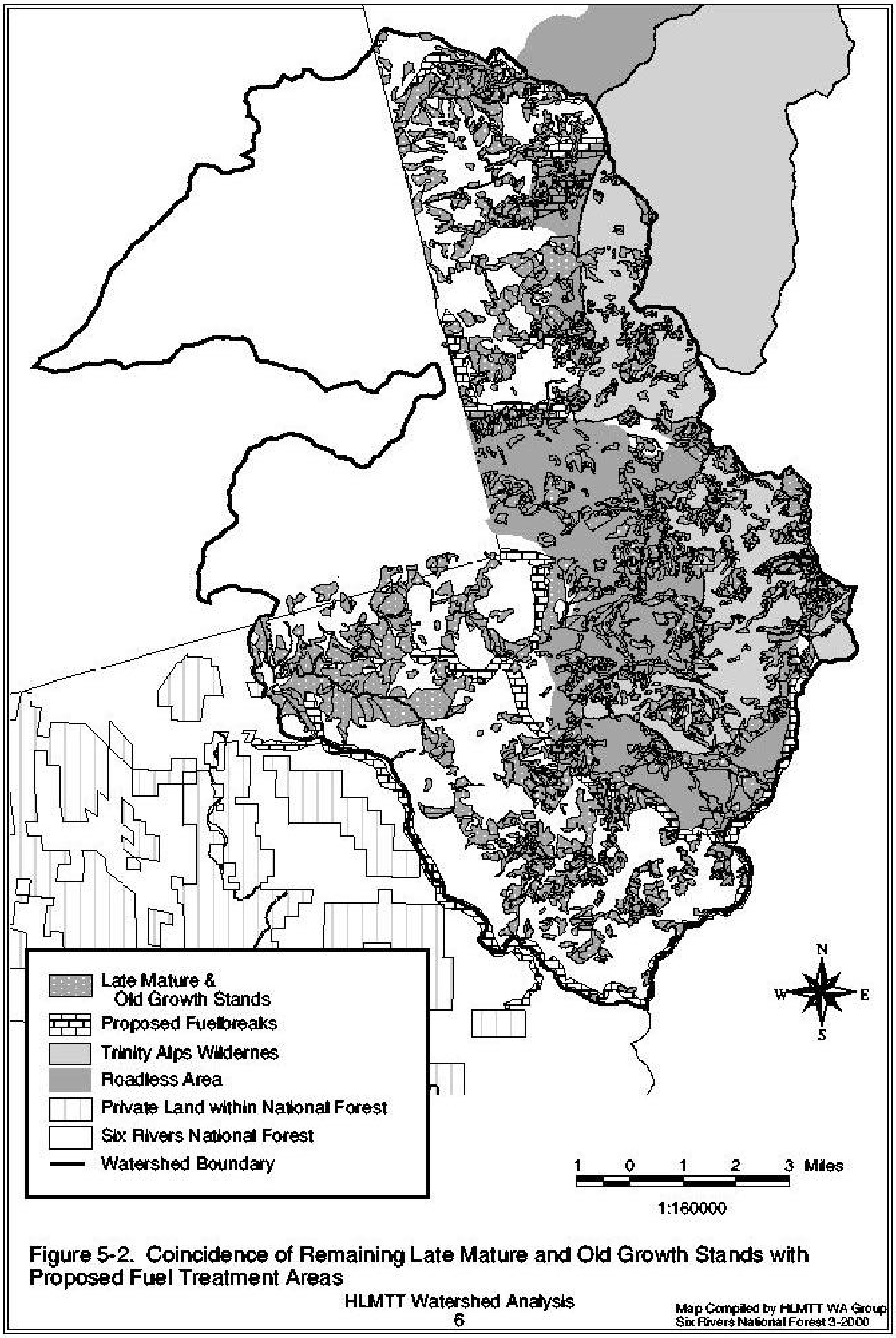
Table 5-1 lists the possible management practices that would be appropriate to meet Opportunity 1. Implementation of any of these practices would also meet Opportunity 2,3 and 4. They are provided below and are referenced under the discussion on Opportunities 2-4. Refer to Table 5-5 for a summary of possible management practice for Opportunity 1, 2, 3 and 4.The "Notes" column provides further explanation about the practices, where necessary.

Table 5-1. Possible Management Practices to Meet Opportunities 1, 2, 3 and 4

Possible Management Practice	Notes
Prescribed Fire	May require successive, large area treatments to adequately reduce hazard levels. Should be used in conjunction with fuelbreaks, thinnings and coarse woody debris removal to reduce fuel loading prior to burning.
Hand-Piling and Burning	Use in stands where fuel conditions or other resource conditions prevent a successful prescribed fire (e.g. disturbed sites in the Megram Fire that have excess fuel loading).
Mechanical Treatment	Use in stands where fuel conditions or other resource conditions prevent a successful prescribed fire (e.g. disturbed sites in the Megram Fire that have excess fuel loading).
Shaded Fuelbreak	Use in strategic areas to reduce the size and extent of future wildfires.
Wildland Fire Use	Wildland Fire Use is the management of naturally ignited wildfires to accomplish specific prestated resource management objectives. Apply where fuels and conditions are at levels conducive for use of wildland fire.
Remove merchantable trees killed by fire or insects in early and mid-mature stands within low and moderate burn severity burn through fuel treatment	Follow-up with treatments of slash and unmerchantable material using hazardous fuels and KV funds.
Reduce concentrations of large fuel in high intensity burn areas through salvage and fuel treatment	Follow-up with treatments of slash and unmerchantable material using hazardous fuels and KV funds. Reforest using similar practices used in plantation restoration.
Remove dead trees and trees of low vigor in early and mid-mature stands within low and moderate burn severity to reduce stand density	This will maintain growth and accelerate development of late seral stand structural attributes. This entails creation of gaps centering on groups of existing dead trees, removal of some individual dead trees and low vigor trees that will likely die within 10 years.

Figure 5-1. **Remaining Early and Mid-Mature Stands with Fuel Treatment Areas:**

Figure 5-2. **Remaining Late Mature and Old-Growth Stands with Fuel Treatment Areas:**



Criteria for Selecting Treatment Areas

Below is a list of the criteria, not in priority, to be used in determining which areas have the highest priority for treatment. In many cases, areas or stands may meet two or more of the criteria and the criteria may vary based on which opportunity is being met.

1. Areas that have a strategic location for fire suppression and resource protection
2. Areas with a high fire behavior potential
3. Low and moderate severity burn areas adjacent to strategic fuelbreaks and late seral stands
4. Areas in close proximity to late mature and old-growth stands (to increase patch size)
5. Along highly traveled roads
6. Naturally disturbed areas 10 acres or greater in size
7. Areas located in owl circles around activity centers that are deficient in nesting, roosting and foraging habitat
8. Areas where treatment could improve habitat for other late-successional associated species
9. Areas in the upper third of slopes
10. South and west-facing slopes
11. Early mature and mid-mature stands in low and moderate severity burn areas that would benefit from treatment to increase resilience to catastrophic loss
12. Remaining late mature and old-growth stands in low and moderate severity burn areas adjacent to strategic fuelbreaks
13. Areas in close proximity to private land and the Hoopa Reservation
14. Areas that are accessed by the existing transportation system
15. Areas where additional wildfire poses a significant threat to watershed values
16. Existing, planned fuel reduction units that were being implemented prior to the Megram Fire

In some cases, functional late-successional habitat may be treated if it is located in areas that meet the above criteria. For example, late-successional habitat may be treated when located in a strategic location for fire suppression or resource protection, such as a patch of habitat located between two anchor points in a fuel break. Only certain types of treatments are considered appropriate in late-successional stands, including low intensity understory burns, hand-piling and burning, and mechanical/manual treatment and burning (in areas with large continuous fuels, for example).

Considerations/Criteria for Treatment

- Minimize loud and continuous disturbances during critical nesting periods
- Field review all projects in diorite soils on slopes greater than 10 percent, and in other soil types on slopes greater than 35 percent. Design mitigations to minimize surface erosion.
- Design treatments to meet Aquatic Conservation Strategy objectives
- Leave sufficient organic material on sensitive hillslopes to anchor the site through recovery without leaving an undesirable fuel load that could re-burn at high severity
- Avoid building any new permanent roads. Temporary roads should be confined to ridge tops or other stable terrain (to be evaluated in the field) as much as possible.

- Design and layout projects within and adjacent to riparian areas to minimize negative, long-term effects to riparian-dependent species. All activities in and adjacent to riparian areas should be planned to minimize erosion.
- In some cases, riparian reserves may need to be considered for fuel treatments. Special conditions that would indicate a need to evaluate these riparian areas for fuel treatment include:
  a) high, continuous fuel loading both within and adjoining riparian area
  b) close proximity to high fire occurrence
  c) middle and upper slope position
  d) overlap of riparian area with strategically-placed shaded fuelbreaks
  e) absence of unstable terrain within riparian area
  f) outside the inner gorge but within the IRR
  g) substantial distance from fish-bearing stream
  h) IRRs that coincide with anadromous streams
  i) proximity to road-stream crossing
  j) presence of a water source where excessive fuel loading and high fire hazard could hinder its use during suppression.
  k) IRRs without a change in vegetation near the stream or swale
  l) IRRs where the high hazard would hinder the effective use of a water source for fire suppression

Data Gaps

Wildfires do not respect either watershed or administrative boundaries. Therefore, further analysis and discussion with the Hoopa tribe, adjacent landowners, and the Shasta-Trinity National Forest would be necessary to better determine fire hazard and associated effective fire suppression and fuel treatment strategies for the HLMTT watersheds.

Our data on fire regimes (distribution, intensity, and frequency) are somewhat limited for this area. Prior to our fire reporting period from the 1910's fire frequency data is lacking. Further data analysis would be of interest to determine the fire regime for this watershed. This could include fire frequency studies using fire slabs or the reconstruction of fire perimeters and severity based on fire scars and stand ages.

Fire effects data are also lacking, including effects on native and exotic plant and animal species. Localized data collection and analysis are critical to refining and improving prescriptions and assessments of fire effects. Models such as FOFEM (First Order Fire Effects Model), which was used to assess wildfire mortality based on species, trees/acre, dbh, tree height, and flamelengths, should be validated using Megram Fire and future prescribed fire mortality. Fire monitoring plots should be initiated in the watershed in selected vegetation types of interest (e.g. mature and old growth) to assess the short and long-term effects of fire on the ecosystem. The preferred protocol would be that developed by the Western Region of the National Park Service which collects data to document basic information, to detect identified trends, and to ensure that fire and resource management objectives are met (National Park Service 1992).

Opportunity 2 Protect remaining mature and old growth stands

Key Findings

The late mature and old growth seral stages were outside the HRV for the central zone even before the fire in the tanoak and Douglas-fir series due to past harvests. The fire exacerbated this in these series, and also reduced the late mature and old growth seral stages below the RMR in the white fir and red fir series.

Approximately 27 percent of the old growth seral stage habitat was affected by high severity wildfire. Mid mature and late mature seral stage habitats were also affected to a high degree by high severity wildfire. Due to the fire effects, which reduced and fragmented old growth and late mature habitats, it is doubtful that LSR 305 is functioning at the landscape level in providing late-successional habitat for the northern spotted owl. It is therefore essential to protect remaining mature and old growth habitat from future, catastrophic disturbance.

Possible Management Practices

Table 5-1 lists the possible management practices that would be appropriate to meet Opportunity 2, as well as Opportunity 1, 3, and 4. Refer to Table 5-5 for a summary of possible management practice for Opportunity 1, 2, 3 and 4. Table 5-2 lists the possible management practices that are designed specifically to meet Opportunity 2. The "Notes" column provides further explanation about the practices, where necessary.

Table 5-2. Possible Management Practices to Meet Opportunity 2

Possible Management Practice	Notes per Criteria
Seasonal Road Closures	Use in areas with high road density and high potential for human-caused fires. Seasonal closure would occur during periods of high fire danger.
Firewood Gathering	Use to reduce fuel loadings in directed areas. Can be used as a treatment prior to implementing shaded fuel break.
Fire Prevention	Focus educational and awareness programs on local residents and forest visitors. Involve local communities and tribal members as much as possible.
Fire Preparedness	Increase initial attack and detection resources along with preattack planning.

Considerations/Criteria for Treatment

- None

Data Gaps

- None

Opportunity 3 Accelerate the development of late-successional habitat

Key Findings

The late mature and old growth seral stages are below the RMRs for the central zone, and below the desired conditions outlined in the Forest-wide LSRA. There are opportunities to accelerate the development of early and mid-mature habitats toward the desired condition of functional mature and late successional stands. Reforesting burned plantations and other severely burned stands will also accelerate their development towards late-successional characteristics.

Many of the possible management practices identified to meet Opportunity 1 can also be used to accelerate the development of late-successional habitat.

Use hazard reduction techniques and apply silvicultural prescriptions to low and moderate severity burn stands to reduce stand density. This will maintain growth and accelerate development of late seral stand structural attributes. This entails creation of gaps centering on existing dead trees, removal of some individual dead and low vigor trees that will likely die within 10 years.

Possible Management Practices

Table 5-1 lists the possible management practices that would be appropriate to meet Opportunity 3, as well as Opportunity 1, 2, and 4. Refer to Table 5-5 for a summary of possible management practice for Opportunity 1, 2, 3 and 4. Table 5-2 lists the possible management practices that are designed to specifically meet Opportunity 3. The "Notes" column provides further explanation about the practices, where necessary.

Table 5-3. Possible Management Practices to Meet Opportunity 3

Possible Management Practice	Notes per Criteria
Reforest plantations lost to the fire.	Include release treatments at age 3 to 6 to ensure survival and rapid early growth.
Young Stand Thinning	Applicable to plantations that are in the shrub/forb or pole-seral stages. Includes appropriate fuel treatment.

Criteria for Selecting Treatment Areas

- High severity burned plantation should be reforested first
- Plantations needing site prep are second priority for reforestation
- Moderate severity burn plantations would be reforested based on extent of loss

Data Gaps

Field evaluate all plantations for burn severity and rehabilitation needs.

Opportunity 4 Protect adjacent communities from future wildfires and extended exposure to smoke

Key Findings

Hazardous fuels conditions existed before the Megram Fire. This fire, which was the largest in Six Rivers recorded history, has contributed to this situation, resulting in extensive, continuous areas of high to extreme hazard throughout the HLMTT landscape. Lightning has been the predominant cause of wildfires within these watersheds, with this area having the highest lightning occurrence on the Forest. Human-caused fires are also frequent and widespread in the vicinity of these watersheds. The extent and distribution of this fire hazard and risk presents a substantial threat to local communities, both from wildfires and high levels of smoke, for many years into the future.

Fears and concerns of long-term public health issues are significant to the local communities, as is preventing a future similar episode from occurring. Community and property safety is a driving issue.
The possible management practices in opportunities 1, 2, 3 and 4 will also meet this opportunity. Additional possible management practices are identified below.

Possible Management Practices

Table 5-1 lists the possible management practices that would be appropriate to meet Opportunity 4, as well as Opportunity 1, 2, and 3. Table 5-4 lists the possible management practices that are designed to specifically meet Opportunity 4. Refer to Table 5-5 for a summary of possible management practice for Opportunity 1, 2, 3 and 4. The "Notes" column provides further explanation about the practices, where necessary.

Table 5-4. Possible Management Practices to Meet Opportunity 4

Possible Management Practice	Notes
Seasonal Closure	Use in areas with high road density and high potential for human-caused fires. Seasonal closure would occur during periods of high fire danger.
Firewood Gathering	Use to reduce fuel loadings in directed areas. Can be used as a treatment prior to implementing shaded fuel break.
Fire Prevention	Focus educational and awareness programs on local residents and forest visitors. Involve local communities and tribal members as much as possible.
Fire Preparedness	Increase initial attack and detection resources along with preattack planning. Preposition forces and equipment during periods of high fire danger or multiple fire starts occurring elsewhere.
Develop a Community Safety Plan	Develop in partnership with the Forest Service, CDF, Hoopa Tribe, Humboldt County Office of Emergency Services, local volunteer fire departments, homeowners' associations, and other organizations to assist communities in reducing private property risks from wildfires.
Develop a Firewise Community Plan	"Firewise", which is managed by the National Wildland/Urban Interface Fire Protection Program, should also be investigated. The concept provides workshops to communities using GIS mapping, role playing, and simulated exercises to develop a Firewise Community Plan that would enable people to survive wildfires without using agencies.

Considerations/Criteria for Treatment

None

Data Gap

Air quality impacts from the Megram Fire were severe due to the high amounts and duration of the smoke. Since the majority of residents did not evacuate during the fire, it is important to follow the health of the residents to see, what, if any impacts can be attributed to the smoke levels experienced during this fire. The Center for Disease Control has initiated a smoke-related study to follow the health of residents in Hoopa over time.

Table 5-5. Possible Management Practice Summary for Opportunities 1, 2, 3 and 4

Possible Management Practice	Opportunity 1 Fuels Reduction	Opportunity 2 Protect mature and old growth	Opportunity 3 Develop late-successional habitat	Opportunity 4 Protect Communities
Prescribed Fire	X	X	X	X
Hand-Piling and Burning	X	X	X	X
Mechanical Treatment	X	X	X	X
Shaded Fuelbreak	X	X	X	X
Wildland Fire Use	X	X	X	X
Remove merchantable trees killed by fire or insects in early and mid-mature stands within low and moderate burn severity burn through fuel treatment	X	X	X	X
Reduce concentrations of large fuel in high intensity burn areas through salvage and fuel treatment	X	X	X	X
Apply silvicultural prescriptions in early and mid-mature stands within low and moderate burn severity to reduce stand density	X	X	X	X
Reduce concentrations of large fuel in high intensity burn areas through salvage and fuel treatment	X	X	X	X
Reforest plantations lost to the fire.			X	
Seasonal Road Closures		X		X
Fire Prevention		X		X
Fire Preparedness		X		X
Firewood Gathering	X	X		X
Young Stand Thinning			X	
Develop a Community Safety Plan				X

Develop a Firewise Community Plan	X

Opportunity 5 Restore watershed functions to provide high quality habitat for riparian and aquatic species and protect domestic water supplies

Key Findings

Historic sediment delivery to fish-bearing streams has resulted mostly from flood-induced mass wasting in the lower parts of these watersheds. Resource management appears to have played a much larger role in sediment production in Tish Tang and Mill Creeks than in Horse Linto Creek, and roads have clearly been associated with higher levels of sediment production and delivery than timber harvest. As a result of the Megram Fire, extensive parts of all three watersheds are now vulnerable to accelerated surface erosion on steep slopes and increased mass wasting on sensitive terrain. The greatest threat is in Horse Linto Creek because more acres of high and moderate burn severity are located on steep, erodible slopes in that watershed. Short-term increases in large woody debris recruitment will be considerable, while long-term recruitment may be limited for many decades. Riparian and aquatic species and their habitat are faced with years of effects from this fire and the additional risk of similar problems if another large high severity fire occurs.

The following general response to the fire would help meet ACS objectives and the specific needs of anadromous and resident fish.

<u>Horse Linto Creek</u>: Maintain good habitat conditions in areas that did not burn and rehabilitate stream corridors and riparian areas damaged by the fire through watershed restoration, flood proofing and road decommissioning. Maintain or enhance coarse woody debris loading and large roughness within channels as deemed appropriate by field review to provide suitable habitat conditions for anadromous and resident fish. Monitor range allotment use and utilize livestock exclosures as needed to meet ACS objectives for stream and riparian habitat.

<u>Mill and Tish Tang Creeks</u>: Reduce fine sediment input to channels through watershed restoration, flood proofing and road decommissioning. Rehabilitate stream corridors and riparian areas damaged by the fire as deemed appropriate by field review to provide suitable habitat conditions for anadromous and resident fish. Monitor range allotment use and utilize livestock exclosures as needed to meet ACS objectives for stream and riparian habitat.

The considerations and criteria for treatments to reduce fuel levels in all watersheds (as discussed under Opportunity 1 will reduce future risk to riparian and aquatic species and habitats by lowering the long-term potential for surface erosion. BAER treatments and fire suppression rehabilitation will also reduce these risks.

Potential slope failure and erosion are generally related to the design, location, and maintenance of a road and its structures. Off-site influences of the Megram Fire could have substantial adverse effects on road-related erosion, even with adequate routine on-site road maintenance. Road-stream crossings on steep channels with heavy organic debris loading that lie below areas susceptible to debris flows or greatly elevated surface erosion are especially at risk of plugging and failure.

One objective of the Forest-wide LSRA is to “manage access to reduce adverse effects to late-successional associated species and aquatic habitats”. The ATM for this analysis area recommended about 25 miles of road for restoration (including decommissioning). About 20 miles had been treated prior to the fire (either decommissioned or made hydrologically maintenance free), but two miles were re-opened for suppression efforts during the Megram Fire. After the fire, the ATM was revisited to re-evaluate the other five miles of untreated roads and determine how much the decommissioned roads had hampered fire suppression effectiveness. It was concluded that there was no significant impact.

Possible Management Practices

Table 5-6 lists management practices that could be appropriate to meet Opportunity 5. The "Notes" column provides further explanation about the practices where necessary.

Table 5-6. Possible Management Practices Used to Meet Opportunity 5

Possible Management Practice	Notes
Erosion Control Treatments	Use in areas where it appears likely that sediment would be delivered to streams. Kinds of treatments include contour falling, strip mulching, installing energy dissipaters at culvert outlets, aerial seeding, installing waterbars on roads and skid trails.
Stream Channel Stabilization	Add large woody debris to stream channels where it is lacking and expected to be lacking in the short or long term; focus on perennial streams affected by the fire, especially in areas where future LWD recruitment may be deficient.
Revegetation of Riparian Areas	Plant native riparian shrubs in moderate to high severity burn riparian corridors.
Reforestation of burned plantations	Emphasize restoring the conifer component along riparian zones that were included within the former harvest unit.
Road upgrades and decommissioning	Implement remaining decommissioning projects associated with the ATM. Focus on upgrading stream crossings to handle anticipated increases in sediment, woody debris and runoff. Install rocked rolling dips to reduce diversion potential, especially in moderate and high severity burn areas.
Maintain Level 2,3 and 4 roads	Roads within and adjacent to burned areas should be maintained as necessary to minimize erosion and failure potential. Clean ditches and culverts to minimize chances of plugging. All identified road damage caused by the fire or suppression activities, as well as maintenance needs, should be implemented as soon as ground conditions permit.
Control road use in areas of concern	Close roads or restrict use to prevent surface erosion and damage to roads during wet weather and lower the risk of fire ignitions in very dry weather.

Criteria for Selecting Treatment Areas

Criteria to be used in determining the highest priority treatment areas to meet Opportunity 5 are listed below. In many cases, areas may meet two or more of the criteria.

- Areas that experienced high or moderate severity burning
- Areas where future wildfire poses a significant threat to watershed values
- Areas located in middle or lower slope positions that are more likely to deliver sediment to streams
- Hillslopes susceptible to mass wasting
- Areas containing stream crossings at risk of failure
- Native surface and other roads that are prone to rutting. Inventoried native surface roads include 6N50, 7N02A, 7N04S, 7N06, 7N06A, 7N09, 7N30, 7N53, 8N03, 8N03J, 8N03T, 8N03U, 8N15, 8N33C, 8N33D, 8N41, and 10N02B. In addition, surfacing along a 3.5-mile segment of 7N04 has broken down to the extent that it now acts as a native surface road.

Considerations/Criteria for Treatment

- Exercise caution during the layout and design of projects, particularly in riparian areas. All activities in and adjacent to riparian areas should be designed and executed to avoid the risk of measurably increasing erosion.
  - Design treatments to meet Aquatic Conservation Strategy objectives
  - Field review all projects on slopes greater than 10 percent in diorite soils, and on slopes greater than 35 percent in other soil types; design mitigation measures to minimize surface erosion and sediment delivery to streams.
  - Leave sufficient organic material on sensitive hillslopes to anchor the site through recovery without leaving an undesirable fuel load that could re-burn at high severity
  - Provide for adequate retention of downed woody debris and future recruitment, especially along perennial streams.
  - Avoid building any new permanent roads, and confine temporary roads to ridge tops or other stable terrain (to be evaluated in the field) as much as possible.

Data Gaps

Review the condition of lower standard roads in the area, especially maintenance level 2 roads with native surface. Confirm the location and condition of gates and other closure devices.

Monitoring

Continue the existing monitoring in Horse Linto Creek to meet our tribal trust responsibilities regarding fish and water quality. This includes annual juvenile and adult fish monitoring, turbidity and stream temperature monitoring. Additional water temperature monitoring sites should be set up in more of the headwaters such as East Fork Horse Linto, Cedar, Groves Prairie, Mill, and Tish Tang Creeks to better understand post-fire conditions.

A systematic field examination of surface erosion evidence (soil pedestals, rilling, accumulations of soil wash) should be conducted for several years to validate the predicted levels of elevated erosion in this analysis. Monitored areas should include both treated and untreated areas to gauge the effectiveness of erosion prevention practices on different slopes and soil types. Sediment levels in nearby headwater channels should also be documented (photographic record) to verify the extent of sediment delivery from eroding hillslopes. The disposition and movement (or lack of movement) of large woody debris within riparian areas should be monitored through photographic records or tagging of individual pieces of debris.

Opportunity 6 Mitigate impacts on Tribal trust resources on Hoopa Reservation and spiritual and traditional uses

Key Findings

Insect infestation is expected to affect individual trees and small groups of trees, but should not reach epidemic levels. Insects will attack individual trees under stress from fire damage, causing additional mortality. It is not expected that insects will leave the fire area in large numbers and impact unburned stands. Therefore, there is little risk of insect infestation spreading onto the Hoopa Reservation. The affect from insect activity lies in increased mortality contributing to fuel build-up and helping to set the stage for future fires.

The known anadromous habitat in the Mill and Tish Tang watersheds are all within the Hoopa Valley Indian Reservation. It is likely that the Megram Fire's effects on anadromous fish and their habitat will last at least a decade. The stream habitat quality for both Mill and Tish Tang creeks were judged to not be properly functioning refugia prior to the fire, while Horse Linto was properly functioning refugia. The fire effects in the headwaters riparian reserves are expected to trickle down to the anadromous habitat. Sedimentation of stream channels within and downstream of the burned areas on all three watersheds is expected to occur.

The Yurok Tribe's reservation is on the Klamath River, with the Trinity River as a tributary. Effects to the Yurok Tribal fisheries are distant to non-existent based on current information.

The Hoopa Tribe depends on Mill Creek for domestic water supply for the eastern portions of the Reservation. Due to high turbidity levels during high flows, the water supply is periodically shut down for water quality purposes. Tish Tang Creek is under an engineering feasibility and design study for use as domestic water supply.

The De-No-To Cultural District is eligible for the National Register of Historic Places, which makes it an important cultural resource from the National Forest and Hoopa Tribe perspective. Fire suppression activities and the fire itself damaged aspects of the National Register property.

A significant use of the analysis area is gathering of native plants to sustain cultural life ways of the Hupa. Subsistence gathering and hunting are major human uses of the analysis area and the most consistent use over the years. The Hupa traditional species of concern would be directly impacted by the removal of substantial canopy cover. Some species appear to respond favorably to disturbance. The fire has directly affected culturally significant vegetation. The degree of effect, and whether some plants were enhanced in the low severity burned area, is not known at this time.

Possible Management Practices

Table 5-7 lists management practices that could be appropriate to meet Opportunity 6. The "Notes" column provides further explanation about the practices where necessary. All treatments will meet Aquatic Conservation Strategy objectives to protect watershed values.

Table 5-7. Possible Management Practices Used to Meet Opportunity 6

Possible Management Practice	Notes
Identify areas of high potential for future fires spreading on to the Hoopa Reservation and reduce this potential risk	Cooperatively identify these areas and conduct appropriate management activities to reduce this potential risk.
Hoopa - Ensure protection of fishing related rights.	Tribal scientific staffs are requesting that off-reservation jurisdictional agencies coordinate and consult with the Council on rehabilitation and monitoring efforts associated with the Big Bar Complex fires (USDI – memo November 1, 1999)
Yurok - ensure protection of fishing related rights	Tribal scientific staffs are requesting that off-reservation jurisdictional agencies coordinate and consult with the Council on rehabilitation and monitoring efforts associated with the Big Bar Complex fires (USDI – memo November 1, 1999)
Develop partnerships to monitor water quality in Tish Tang, Mill, and Horse Linto watersheds	Cooperative partnership with BIA, Hoopa Tribe and Forest Service to conduct long-term water quality for T&E habitat and domestic water sources monitoring and treatment of watershed emergencies in these watersheds by increasing the number of sampling and monitoring sites. Jointly monitor water quality for a period of no less than three years to assess impacts on fisheries and domestic water quality (USDI-BAER). Monitoring to occur at various control points (off reservation) for monitoring the affected watershed areas and any fire-affected drainages flowing into reservation lands jointly selected these locations. Provide result of water quality and fisheries monitoring information from Tish Tang, Horse Linto, and Mill Creeks to the Yurok Tribe.
Assess fire impacts to the De-No-To District	Conduct an assessment of the nature and extent of the damage to the integrity of the on the De-No-To Cultural District working with individual practitioners, seeking the perspectives and data from the Hoopa Tribe.
Assess impacts of fire on spiritual and traditional properties	Inventory, including consultation with traditional practitioners to identify if any values are at risk from the deteriorated watersheds and identify what measures if any need to be implemented to protect those values.
Conduct spawning surveys	Cooperatively conduct spawning surveys within the analysis

Data Gaps

- Work with Individual traditional practitioner of the De-No-To cultural district to determine how suppression efforts and fire-related landscape changes affect their uses, the qualities needed in the landscape and the resources utilized in their activities.
- Need to assess the degree the fire affected culturally significant vegetation

Opportunity 7 Provide safe access for the public and forest employees

Key Findings

There is a potential hazard to the public and Forest employees from fire-damaged trees falling on Forest development roads. The highest potential hazard to road users is generally in areas where roads cross through moderate to high burn severities. However, there is some degree of hazard anywhere in the burned area where there are dead and dying trees within close proximity to the road. Use of the roads during hazard tree felling and removal could also present a safety risk. Impacts to other resources from hazard tree removal can be minimized with restrictions on heavy equipment use and protection of roadways and drainage structures.

Possible Management Practices

Table 5-8 lists the possible management practices that would be appropriate to meet Opportunity 7. The "Notes" column provides further explanation about the practices, where necessary.

Table 5-8. Possible Management Practices Used to Meet Opportunity 7

Possible Management Practice	Notes
Road closures or road use restrictions	Issue road closure orders or road use restrictions to prohibit or restrict public access if hazard tree conditions make a road inherently unsafe for travel. Such closures or restrictions should remain in place until hazard tree reduction activities have been completed or the hazardous condition is otherwise remedied. Publicize any such orders to minimize inconvenience to the public.
Hazard tree removal along Level 2, 3, and 4 roads	Reduce the safety threat along area roadways by felling designated hazard trees. Remove and utilize those trees in locations compatible with other resource management goals and restrictions
Road maintenance	Repair, replace, or maintain all damage or wear that hazard tree operations cause to road surfaces, cutslopes, fillslopes, culverts, ditches, or other road structures.

Considerations/Criteria for Treatment

- Close or restrict road use only when such measures are necessary to insure public safety. If available, provide alternative routes to the closed roads.
- Hazard trees should be designated as defined in the "Megram Roadside Hazard Tree Project Scoping Document" (February 2000). The Environmental Assessment for this project will reference other project design features, management requirements, and mitigation measures.
- The primary areas designated for hazard tree reduction are shown in Figure 4-2. Actual treatment areas may vary as ground conditions are verified in the upcoming field season.
- During hazard tree felling and removal, close or restrict use on the affected roads, or require warning signs and flag persons if road closure is not necessary to insure public safety.
- Restrict heavy equipment use to roads, landings, and other previously-disturbed areas.
- Prohibit the use of tracked vehicles on paved surfaces; require rubber-tired equipment on these roads.
- Require all activity generated slash and debris be removed from stream channels, ditches, and culvert inlets.
- Manage felling, endlining, and skidding operations in order to minimize the physical impacts of these activities on roadbeds, cutslopes, fillslopes, stream channels, and adjacent lands.

Opportunity 8 Contribute to local economies through fire recovery efforts

Key Findings

Although the management objectives for LSR and wilderness do not include economic benefits, many of the opportunities and possible management practices proposed would contribute to local economies through fire recovery efforts.

Possible Management Practices

Refer to Opportunity 1, 2, 3, 4, 5, 6, 7, 12 and 13

Considerations/Criteria for Treatment

- Hire local people
- Partnerships
- Stewardship contracts
- Package projects so that local small businesses can compete

Opportunity 9 Minimize the introduction and spread of noxious weeds

Key Findings

Noxious weeds have been documented in the analysis area and include scotch broom and yellow starthistle. Noxious weeds readily spread into disturbed area with minimal canopy cover. The fire and activities related to wildfire suppression could have favored noxious weed introduction and establishment. Subsequent recovery efforts could also bring about the introduction and spread of these weeds.

Possible Management Practices

Table 5-9 lists the possible management practices that would be appropriate to meet Opportunity 9. The "Notes" column provides further explanation about the practices, where necessary.

Table 5-9. Possible Management Practices Used to Meet Opportunity 9

Possible Management Practice	Notes
Survey to locate noxious weed sites	Survey before and after project implementation
Roadside reconnaissance	Conduct a reconnaissance of roadsides to locate noxious weed site
Reduce introduction and spread of noxious weeds	Depending on risk, recommendations could include: immediate removal of satellite populations (relatively small and local occurrences), removal of more extensive populations along a stretch of the roadway to provide a “weed break” between occupied and unoccupied settings, and equipment cleaning.

Data Gaps

Undertake a roadside reconnaissance of the area within the first year after the fire to monitor for noxious weeds. At this time, populations would be mapped. Once more detail is generated, the management recommendations can include a risk assessment based upon mapped findings.

Opportunity 10 Monitor and further analyze habitat conditions and trends for threatened, endangered and species, survey and mange species and species of concern.

The Megram Fire altered habitat conditions for many of the TES species dependent on late-successional habitat. The Megram Fire reduced the amount of late mature and old growth habitat by 21 percent and increased the amount of shrub/forb habitat by 400 percent.

Prior to the fire, 29 of the 37 NSO activity centers in LSR 305 were above the “take” threshold for nesting and roosting habitat at the 1.3-mile radius. Additionally, the baseline analysis for the northern province determined that LSR 305 was functioning at a high level for providing habitat for northern spotted owls. Based on the mapping of burn severity, only 21 of the 37 activity centers are currently above the “take” threshold at the 1.3-mile radius.

Additionally, many other species dependent on late-successional habitat may have been significantly impacted. Specific effects to riparian dependent species are currently unknown; however, given the levels of high severity wildfire within riparian reserves, it is probable that impacts to habitat may be significant to these species. The majority of S&M species predicted to occur within the analysis area are vulnerable to fire even at low burn intensities. The effect of the Megram Fire on these species has yet to be determined in the absence of limited monitoring data after the fire. It is expected that in the areas of high burn severity, species were consumed and the area is no longer considered habitat, however, species may have survived in adjacent areas of unburned habitat or areas of low to moderate burn severities.

Outside of the intensely burned areas, sites of plant species of concern are for the most part dated, having not been visited since the 1980s. Suitable habitat exists within the analysis area in the low to moderately burned areas.

Possible Management Practices

Table 5-10 lists the possible management practices that would be appropriate to meet Opportunity 10. The "Notes" column provides further explanation about the practices.

Data Gaps

- Re-analyze the baseline assessment for LSR 305 utilizing vegetation data that has been field verified during the spring and early summer of 2000.
- Identify special habitats including caves, mines, old buildings, wooden bridges, ponds, seeps, talus deposits. Survey and inventory special status species associated with these special habitats.
- Current surveys are needed to determine presence and extent of plant species of concern.

Table 5-10. Possible Management Practices to Meet Opportunity 10

Possible Management Practice	Notes
NSO Activity Center surveys and monitoring	Conduct surveys and monitor spotted owl activity centers that were impacted by the fire, specifically activity centers that are below the "take" threshold.
Review "take" assessment	Review preliminary "take" assessments after field verification of stand conditions
Monitor know survey and manage species sites	Monitor known sites for survey and manage species. Emphasize monitoring efforts on sites with moderate and high burn severities.
Monitor sensitive species dens and/or sites	Monitor known nest and/or den sites for Forest sensitive species
Survey for plant species	Survey for the presence and extent of plant species of concern.
Monitor and survey for riparian dependent species	Monitor and survey for riparian dependent species, specifically within riparian habitats affected by moderate and high burn severities.

Opportunity 11 Protect heritage resource sites affected by the fire

Key Findings

The analysis area is within the aboriginal territory of the Hupa people. It has had consistent historic and contemporary use of hunting, gathering, and cultural-spiritual activities.
The analysis area has not been subject to systematic research but rather several dozen reports prepared in support of agency efforts to comply with the National Historic Preservation Act.
There is documented presence of cultural resource localities, including artifact scatters, possible camp areas, prayer sites, trails, as well as historic period sites.
Heritage resources were a priority throughout the Big Bar Complex fire, and the Hoopa Valley Tribe, as well as other tribes, and their representatives and resource managers were involved throughout the fire. Despite this some sites were impacted from fire suppression activities and the fire itself.

Possible Management Practices

- Conduct a field inventory, in consultation with traditional practitioners and the Hoopa Tribe, to identify any values or cultural resources at risk from the deteriorated watersheds and what measures, if any, need to be implemented to protect those values.

Data Gaps

- The lack of definitive data related to the age and function of archaeological sites within the analysis area makes the evaluation of significance of prehistoric sites problematic.
- The thermal effects of the Big Bar complex fire on cultural resources are unknown at present.

Opportunity 12 Cattle grazing and meadows/riparian areas

Key Findings and Considerations/Criteria for Treatment

Based on an initial assessment of the meadows and associated riparian areas, it appears as if they experienced a low to moderate burn severity. Additional field review needs to be conducted before a determination is made on whether or not cattle can be turned out on the allotments affected by the Megram Fire. The Cattle Turn Out Key following will be utilized to make this determination.

CATTLE TURN OUT KEY

The following key will be used to determine when cattle may be turned out on allotments affected by the Megram Fire.

7) Forest land adjacent to areas grazed by cattle not damaged to extent where cattle wandering onto it will cause adverse effects: soil erosion, impede revegetation (natural or artificial), etc.

    Yes – Go to 2
    No – Consider keeping cattle in another portion of the unit or off the allotment until healing has occurred. If not possible, go to 6

8) Stream channels leading into and out of areas grazed by cattle still vegetated.

    Yes – Go to 3
    No – Consider fencing to restrict cattle access to stream channel. If not possible, go to 6

9) Meadows not affected by fire or have recovered from effects of fire.

    Yes – Go to 4
    No – Consider keeping cattle in unaffected meadows. If not possible, go to 6

10) Range readiness inspection shows meadows are ready for cattle.

    Yes – Go to 5
    No – Consider offering alternative allotment area to permittee, if available. If not possible, go to 6

11) Cattle can be turned out.

12) Keep cattle off allotment unit.

Data Gaps

Need to assess meadow and riparian conditions this spring.

Opportunity 13 Restore recreational facilities and opportunities affected by the fire

Key Findings

Some trails were extensively used during fire-suppression efforts and need maintenance and some rehabilitation. Trails located in high severity burn areas have risks from hazard trees and pose risk from surface erosion. Currently, the highest priority for facilities is to implement short-term actions to restore or maintain the roads, trails and other facilities that were affected by the Megram Fire.

Some of the roads identified for decommissioning in the ATM have been used historically to access dispersed recreation sites in Groves Prairie (7N04G, 7N04M, 7N04N, and 7N04P). These roads should stay open to provide continued access to these sites.

Possible Management Practices

Table 5-11 lists the possible management practices that would be appropriate to meet Opportunity 13. The "Notes" column provides further explanation about the practices, where necessary.

Table 5-11. Possible Management Practices to Meet Opportunity 13

Possible Management Practice	Notes
Maintain 7N04G, 7N04M, 7N04N, and 7N04P as ML2 roads	Keep these roads open (status quo) due to historic use of the roads to access existing dispersed recreation sites
Complete trail surveys	Complete trail surveys on unsurveyed trails to assess damage from the fire and rehabilitation needs.
Trail maintenance/ reconstruction	Perform trail maintenance and/or reconstruction on trails that were impacted/damaged by the fire or fire suppression efforts. Request a chainsaw exemption for wilderness to remove hazard and downed trees along trails due to season limitations and employee and visitor safety. Apply hazard tree guidelines (see Transportation and Access section of Chapter 3) when identifying trees to remove.
Sign trailheads	Post signs at trailheads regarding safety hazards, or close and sign severely impacted trails to the public until repair work is completed. Install new or replace signs damaged by the fire. In the wilderness, keep signing to a minimum and as unobtrusive as possible. Follow national sign standards for both wilderness and non-wilderness trails.

Table 5-11. Possible Management Practices to Meet Opportunity 13 (continued)

Possible Management Practice	Notes
Complete fire suppression rehab activities	Restore wilderness attributes altered by fire suppression activities such as fire crew campsites and fire rings, and fire lines that may be mistaken for trails.
Conduct trails analysis	Evaluate trails in the analysis area to determine if all are needed. Identify high priority trails and secondary use trails. Especially consider previously existing and little used trails that were affected by the fire.
Reroute trails causing resource impacts	Reroute any sections of trail where there are resource impacts due to original poor location (i.e. through meadows) to eliminate further damage by hikers and stock.
Repair damaged recreation structures	Repair any recreation structures such as SSTs that may have been damaged by the fire.
Educate public on fire rehabilitation efforts, closures, projects, etc.	Develop information on fire rehabilitation efforts for posting at trailhead bulletin boards, around town, and at forest offices. Establish web pages about the fire rehabilitation efforts, projects, recovery status, closures, etc. on the Forest's web site for public access and information.

The following possible management practices would benefit the recreation and tourism opportunities in the area. They are lower priority actions than those dealing with the immediate effects of the fire and its impacts, and would be considered as opportunity and resources allow.

Table 5-12. Additional Possible Management Practices to Meet Opportunity 13

Possible Management Practice	Notes
Improve trailhead facilities	• Improve trailhead facilities including signing, bulletin boards, and parking. Consider if visitor use and impacts to resources warrant an SST (toilet). Consider opportunity for turnaround loop for parking for easier access/staging for stock use.
Install facility signs	• Install facility signs at all facilities such as Grove's Prairie.
Assess Horse Linto camping facility	• Include Horse Linto camping facility in the forest-wide recreation facility analysis to determine its future status and maintenance needs to achieve Meaningful Measures standards.
Improve directional signing	• Improve directional signing along highways and forest roads to trailheads and other recreational facilities.
Develop interpretive information	• Develop interpretive information about the historical significance of Grove's Prairie, Trinity Summit area, the historical trails, etc.
Inform public about recreational opportunities	• Highlight through a variety of means the recreation opportunities and facilities within the analysis area that can be accessed via the proposed Bigfoot Scenic Byway (State Highway 96) after it is designated and the Trinity Scenic Byway (State Highway 299).

Criteria for Selecting Treatment Areas

- Priorities for trail rehabilitation are National Recreation Trails and high use trails in high severity burn areas.

Considerations/Criteria for Treatment

- Coordinate trail work and other rehabilitation mitigations in the wilderness with the Shasta-Trinity National Forest to more effectively and efficiently use resources and perform needed trail rehab work.
- Install trail features such as waterbars, etc. to reduce impacts to soil and water resources.

Opportunity 14 Learn from the Fire

Key Findings

There are numerous opportunities to learn from the Megram Fire. These opportunities can be built as learning objectives into project design. They also can be met through developing partnerships with County, State and Federal Agencies, Tribal Governments and Educational Institutions.

Possible Management Practices

- Seek research opportunities with educational institutions, graduate students, PSW, PNW, the Joint Fire Science Program, local communities, the Trinity County Fire Safe Council, Hoopa Tribe, grants, etc.
- Design learning objectives into fire rehabilitation projects and other project proposals.
- Use untreated burned areas as a control and for monitoring and research projects to compare with treatment areas.
- Pursue research opportunities within riparian areas impacted by the fire for neo-tropical birds, amphibians, and survey and manage species.
- Pursue research opportunities on northern spotted owl utilization of habits burned by varying degrees of fire severity.

Due to the extent and variability within the Megram Fire, the list of research or further analysis opportunities is vast and varied, touching virtually every resource discussed in this document. This list includes the following:

1. How effective were the fuel treatments that coincided with the Megram Fire? How was the survival of these fuel treatment areas affected by their design and the environmental conditions that were burning around them?
2. How well will this LSR survive into the future? Has its functionality been compromised and, if so, for how long will this status exist?
3. How will affected activity centers and NSOs function in the future?
4. What will be the recovery rate and pattern for displaced wildlife species?

5. What will be the recovery rate for survey and manage species within the high and moderate severity burn areas? Were survey and manage species affected in the low and moderate severity burn areas? And if so, to what extent? Are there refugia in the high severity burn areas?
6. What will be the vegetational and fuel succession patterns throughout the Megram landscape? How can vegetation management affect these patterns?
7. What were the smoke impacts from the Big Bar Complex? Besides evacuation what measures can be taken to lessen smoke impacts for local residents?
8. How was the fire progression affected by environmental variables (e.g., topography, fuel loading and distribution, weather patterns)?
9. What impact did fire suppression have on the fire progression?
10. How can fire severity be more accurately mapped in a short time frame?
11. How will unburned blowdown areas recover over time compared to areas with similar blowdown levels that were consumed in the fire?
12. Were the weather patterns experienced in this fire unusual for this area?
13. How can management lessen further degradation of resources or future wildfire impacts? At what scale can active management "make a difference"?
14. How can fire and air quality information be better distributed to our publics real-time?
15. How does this fire compare with the Hog Fire of 1977 or the Dillon Complex of 1987? What can be learned from how these fires look after 20 or 10 years?
16. What affect did the fire have on riparian areas, and how will this impact change over time?
17. What information can be gleaned from monitoring the approximately 20 Continuous Forest Inventory plots that are within the Megram Fire boundary?
18. What impact will "no management" in the wilderness have on adjacent areas, both in terms of wildfire damage and smoke?
19. How can vegetation management affect the invasion of noxious plants?
20. How can the community benefit from the Megram Fire – economically, educationally, etc.?
21. How would the fire progression compare with results from fire progression models (e.g., FARSITE) and what is the reason for differences?
22. How will Native American spiritual areas be affected by this fire? Is the effect a beneficial or a detrimental one?
23. How does sediment delivery to streams (ephemeral, intermittent) differ by burn severity and by treatment or no treatment?
24. How do areas left to "natural succession" compare with treated areas (e.g., thinning, density management in mature stands)?
25. How valid are the fuel model assignments made by subseries and seral stage?
26. What is the pattern and extent of reburning in larger stand-replacing wildfires in the Klamath Mountains?

APPENDIX A

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APPENDIX B

LIST OF ACRONYMS

AQMD	North Coast Air Quality Management District
AUM	Animal Unit Month
BAER	Burned Area Emergency Rehabilitation
BIA	Bureau of Indian Affairs
B.P.	Before Present
BMP	Best Management Practices
CCC	Civilian Conservation Corps
CDF	California Department of Forestry
cfs	Cubic Feet per Second
CHU	Critical Habitat Unit
CNPS	California Native Plant Society
DBH	Diameter at Breast Height
DOI	Department of Interior
EA	Environmental Assessment
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionary Significant Unit
FEIS	Final Environmental Impact Statement
FL	Flame Length
FOFEM	First Order Fire Effects Model
FSEIS	Final Supplemental Environmental Impact Statement
FY	Fiscal Year
GIS	Geographic Information System
HLMTT	Horse Linto, Mill, and Tish Tang Creek Watersheds
HRV	Historic Range of Variability
HVIR	Hoopa Valley Indian Reservation
HVT	Hoopa Valley Tribe
IRR	Interim Riparian Reserve
KSDB	Known Sites Database
LRMP	Land and Resource Management Plan
LSR	Late-Successional Reserve
LSRA	Late-Successional Reserve Assessment
LWD	Large Woody Debris
ML1	Maintenance Level 1
ML2	Maintenance Level 2
NEPA	National Environmental Policy Act
NF	National Forest
NR	Nesting and Roosting Habitat
NRF	Nesting, Roosting, and Foraging Habitat

NRT	National Recreation Trail
NSO	northern spotted owl
NTU	Turbidity Units
NWFP	Northwest Forest Plan
PM10	Particulate Matter Smaller than 10 Microns
RARE	Roadless Area Review and Evaluation
RMR	Recommended Management Range
ROD	Record of Decision
ROS	Rate of Spread
ROS	Recreation Opportunity Spectrum
RNA	Research Natural Area
S&M	Survey and Manage
SIS	Special Interest Species
SLID	Specimen Label Information Database
SRNF	Six Rivers National Forest
SST	Sweet-Smelling Toilet
TCP	Traditional Cultural Property
TES	Threatened, Endangered, and Sensitive
TMDL	Total Maximum Daily Load
TRpz	Triassic-Paleozoic Belt
USDI	United States Department of the Interior
USFWS	U.S. Fish and Wildlife Service
USLE	Universal Soil Loss Equation
VQO	Visual Quality Objective
WA	Watershed Analysis

APPENDIX C

ROADLESS CHARACERISTICS

This appendix provides a detailed description of the current conditions and the roadless characteristics of each of the three portions of the Orleans Mountain “C” Roadless Area.

North Portion

The northern parcel incorporates 1,840 acres, all of which are located within the Mill Creek watershed. All lands within this parcel are National Forest System lands. This parcel encompasses the headwaters and mid-slope portions of South Fork Mill Creek and Domingo Creek. The east side of this parcel is adjacent to the Trinity Alps Wilderness. Forest road 10N02 (maintenance level 3) generally parallels the north and west sides of this parcel and the south side is bordered by Forest Road 8N10 (maintenance level 2). Elevations within this parcel range from approximately 4,560 feet at the bottom of South Fork Mill Creek to 5,800 feet at the top of Horse Trail Ridge.

White fir is the dominant (71 percent) vegetation series within this parcel and typically occupies high elevation areas associated with upper and mid-slope areas. Red fir is the second most common (16 percent) vegetation series and is located in the higher elevation areas found in the northeast portion of this parcel. Small scattered stands of alder, typically associated with moist areas, are scattered amongst the white and red fir stands.

Approximately 128 acres of vegetation within the northern parcel of the roadless area show indications of harvest and logging activities (skid roads, skid trails and landings) that occurred in the late 1960s and early 1970s. Twenty-four of these acres are currently within the pole seral stage, and 104 acres are represented by mid-mature seral stage stands. The locations of previously harvested areas, skid roads and landings are shown in Figure 3-3.

Seventy-two percent (1,327 acres) of the area in the northern parcel was burned during the 1999 Megram fire. Extreme fire intensities, where almost all of the vegetation cover was killed, occurred on 279 acres. High intensity fire, where greater than 70 percent of the vegetation cover was killed, occurred on 379 acres. Moderate intensity fire, where 25 to 70 percent of the vegetation cover was killed, occurred on 669 acres. Ninety-eight percent of the extreme and high fire intensity acres are concentrated in the northern one-third of this parcel (Figure 3-4).

Approximately 1.7 miles of fireline (0.8 mile dozer line, 0.9 mile hand line) is located within the northern portion of the roadless area (Figure 3-4). This fireline was constructed in 1999, in an effort to suppress the Megram fire.

There are approximately 3 miles of trail within this area, including 2.2 miles of the Horse Ridge National Recreation Trail. There are several undeveloped campsites along the trail in the vicinity of Red Cap tree.

The Horse Trail, Red Cap Prairie, and Mill Creek Lake units of the Mill Creek grazing allotment overlap the northern parcel of the roadless area. Cattle represent the primary type of livestock grazed on these units. There are two corrals located on the perimeter of the roadless area near trailheads. Both corrals are utilized in conjunction with this grazing allotment.

Roadless Characteristics

Natural Integrity

The long-term ecological processes within the northern portion of the roadless area appear to be intact and functioning on 93 percent (1,703 acres) of this area. Firelines, skid roads/trails and landing construction have affected long-term ecological process on seven percent (138 acres) of this area (Figure 3-5). All of the trees, shrubs, and ground cover have been removed from these areas. Compaction and topsoil loss associated with these areas decreases the rates of vegetation reestablishment and water infiltration. It is expected that the hand lines will recover in the next year or two, while the dozer line will take longer to recover.

Multiple decades of cattle grazing have affected the plant species composition in the mountain meadows. It appears that the balance of annual to perennial grasses has been altered, as well as the ratio of native to non-native species.

Apparent Naturalness

Ninety-six percent (1,768 acres) of the landscape within the northern parcel appears mostly to have been affected by the forces of nature. Although human activities associated with timber harvest are located within this parcel, they tend to be disappearing due to natural process and are not obvious to the casual observer. It is evident that firelines constructed in association with the recent Megram fire are not a natural occurrence. Human activities associated with fireline construction have affected the apparent naturalness on approximately four percent (73 acres) of the landscape (Figure 3-5). The hand lines will recover and are expected to appear natural in a year or two, but the dozer line will take longer to return to a natural appearance.

Human activities are also evident in small isolated areas associated with undeveloped campsites, and along trails. The presence of, and indicators left by cattle, detracts from the apparent naturalness of this area and are most evident in areas of concentrated use.

Remoteness

The northern parcel is perceived to be quite remote, as this area is buffered from the main road (10N02) on the west by a substantial distance, and is bordered to the east by the Trinity Alps Wilderness. Large expanses of land exist where there are no trails or evidence of humans. Benchy topography and dense stands of large conifers dominate the landscape and screen much of the area from human impacts. Any loss of perceived remoteness would be limited to the south and north perimeter areas where roads, trailheads, and corrals may be apparent.

Solitude/Primitive Recreation Opportunities

The opportunity to experience solitude ranges from moderate in small isolated areas along the north and south perimeter of this parcel to high in the remainder of the area. The proximity of roads, trailheads, corrals and firelines to the north and south borders of this parcel increases the chances of seeing or hearing other visitors or of being exposed to the developments of humans.

The physical setting (including alterations to vegetation, trails, firelines, and dispersed campsites) does not meet the recreation opportunity spectrum criteria associated with a primitive recreation experience. The northern parcel currently meets criteria consistent with a semi-primitive non-motorized recreation experience.

Unique Features

There are no unique features associated with this area, however the western portion of Red Cap Prairie is a popular destination point and Redcap Tree is a locally known landmark.

Special Places or Values

The northern portion of the roadless area is valued by Hupa for culturally important plants and ceremonial activities.

Manageability/Boundaries

The northern parcel encompasses less than the 5,000 acres typically required for an area to be a candidate for future wilderness designation. However, since this parcel is contiguous with the Trinity Alps Wilderness it could still be a candidate for wilderness designation.

The boundaries of the northern portion of the roadless area are currently difficult to identify on the ground, as they frequently do not correspond to topographic features such as streams, ridgelines, or specific elevations. In areas where roads dictated the extent of the roadless area, the distance between the roads and roadless area boundary tends to change frequently and significantly.

Central Portion

The central parcel is a 9,720-acre tract of which 5,820 acres are in Tish Tang watershed and 3,900 acres are in Horse Linto watershed. Eleven of the acres within the Tish Tang watershed are located in the Hoopa Valley Indian Reservation, the remaining acres are comprised of National Forest System lands. The south and east sides of this parcel are adjacent to the Trinity Alps Wilderness. The north side of this parcel is bounded by a combination of features including, from east to west, the Trinity Alps Wilderness, Forest Roads 8N10, 10N02, 8N15 and an unnamed ridge. The Hoopa Valley Indian Reservation, South Fork Tish Tang Creek and Horse Linto Creek border the western side of this parcel. Elevations within this parcel range from approximately 1,360 feet along Horse Linto Creek to 6,200 feet in the Trinity Summit area.

This parcel includes the headwaters and mid-slope portions of Tish Tang a Tang, Bret, South Fork Tish Tang a Tang, and Horse Linto Creeks. Horse Linto Creek provides some of the highest value habitat for anadromous fish in Northern California and is a major contributor to fish populations in the Klamath and Trinity Rivers.

White fir is the dominant (50 percent) vegetation series within this parcel; it typically occupies the upper and mid-slope areas. Tanoak is the second most common (19 percent) series followed by red fir (12 percent). Small scattered stands of alder and several meadow areas are scattered amongst the white and red fir stands. Red fir stands are concentrated in the higher elevation areas found in the northeast portion of this parcel. The mid to lower slope areas are comprised of Douglas-fir stands. The lower slope or elevation areas are typified by tanoak stands with a scattering of canyon live oak and white oak.

Approximately 84 acres of vegetation within the central parcel of the roadless area show indications of harvest and logging activities (skid roads, skid trails and landings) that occurred in the late 1960s and early 1970s. Twenty-six of these acres are currently in the shrub/forb seral stage, 21 acres are classified as pole, 14 acres are mid-mature, and 23 acres are within late mature stands. The locations of previously harvested areas, skid roads and landings are shown in Figure 3-3.

Ninety-six percent (9,371 acres) of the acres in the central parcel were burned during the 1999 Megram fire. Extreme fire intensities, where almost all of the vegetation cover was killed, occurred on 781 acres. High intensity fire, where greater than 70 percent of the vegetation cover was killed, occurred on 1,475 acres. Moderate intensity fire, where 25 to 70 percent of the vegetation cover was killed, occurred on 7,005 acres. The remaining 110 acres incurred low intensity fire, where less than 25 percent of the vegetative cover was killed. Sixty-six percent of the extreme and high fire intensity acres are concentrated in the central portion of this parcel (Figure 3-4).

Approximately 5.5 miles of hand-constructed firelines are located within the central portion of the roadless area (Figure 3-4). These firelines were constructed in 1999, in an effort to suppress the Megram fire.

There are approximately 14 miles of trail within the central parcel of the roadless area, and numerous undeveloped campsites. There is a short (about 100 feet) section of fence separating McKay Meadows from a nearby campsite.

The Water Dog Lake, Ferguson, and Haypress units of the Trinity Summit grazing allotment overlap the central parcel of the roadless area. Cattle represent the primary type of livestock grazed on these units. There is one corral located on the western perimeter of the roadless area near Tish Tang trailhead.

Two cabins are associated with the central parcel of the roadless area; one was located at Patterson Meadows and the other is at Trinity Summit. The Patterson Meadows Cabin, which was primarily used by grazing permittees, burned during the Megram fire. The Trinity Summit Cabin (guard station) is located on Horse Trail Ridge between the roadless area and the Trinity Alps Wilderness. Fire and wilderness patrol personnel have used the Trinity Summit Cabin.

Roadless Characteristics

Natural Integrity

The long-term ecological processes within the central portion of the roadless area appear to be in tact and functioning on 95 percent (9,270 acres) of this area. Firelines, skid roads/trails and landing construction have affected long-term ecological process on five percent (445 acres) of this area (Figure 3-5). All of the trees, shrubs, and ground cover have been removed from these areas. Compaction and topsoil loss associated with these areas decreases the rate of vegetation reestablishment and water infiltration. It is expected that the hand lines will recover in the next year or two.

Multiple decades of cattle grazing have affected the plant species composition in the mountain meadows. It appears that the balance of annual to perennial grasses has been altered, as well as the ratio of native to non-native species. A small area associated with the Trinity Summit Cabin has been affected by the building site itself, and the trampling and compaction resulting from concentrated human activity.

Apparent Naturalness

Ninety-five percent (9,260 acres) of the landscape within the central parcel appears mostly to have been affected by the forces of nature. Some human activities associated with timber harvest tend to be disappearing due to natural process and are not obvious to the casual observer, while other harvest areas remain apparent. It is evident that firelines constructed in association with the recent Megram fire are not a natural occurrence. Human activities associated with timber harvest and fireline construction have affected the apparent naturalness on approximately five percent (455 acres) of the landscape (Figure 3-5). The hand lines will recover and are expected to appear natural in a year or two.

Human activities are also evident in small scattered isolated areas. These areas are associated with undeveloped campsites, short segments of fence, the Trinity Summit Cabin, and along trails. The presence of, and indicators left by cattle, detracts from the apparent naturalness of this area and are most evident in areas of concentrated use.

Remoteness

The central parcel is perceived to be quite remote. The size, shape, topography and vegetation associated with this area contribute to the perceived feeling of being remote. Large expanses of land exist where there are no trails or evidence of humans. Benchy ridgelines, steep side slopes, and dense stands of large conifers dominate the landscape and screen much of the area from human impacts. Any loss of perceived remoteness would be limited to the western perimeter where roads, trailheads, and corrals may be apparent.

Solitude/Primitive Recreation Opportunities

The opportunity to experience solitude ranges from moderate in small isolated areas along the west perimeter of this parcel to high in the remainder of the area. The proximity of roads, trailheads, corrals and firelines to the western portion of this parcel increases the chances of seeing or hearing other visitors or of being exposed to the developments of humans.

The physical setting (including alterations to vegetation, trails, firelines, fence line, cabin and dispersed campsites) does not meet the recreation opportunity spectrum criteria associated with a primitive recreation experience. The central parcel currently meets criteria consistent with a semi-primitive non-motorized recreation experience.

Unique Features

Trinity Summit Cabin, located within the central portion (on the boundary with Trinity Alps Wilderness) is potentially eligible for listing in the National Register of Historic Places. Although not considered unique, many prominent land marks, topographic features and popular destination points including McKay Meadows, Patterson Meadows, Trinity Summit Cabin, Bret Hole, Tish Tang Point, Graveyard Prairie, Ladder Rock and Bell Swamps are located in this area.

Special Places or Values

The central area is valued by Hupa for culturally important plants and ceremonial activities. Corral Creek in the vicinity of McKay Meadows is valued for hunting and brook trout fishing. The rocky area associated with Bret Hole is valued as a good hunting area.

Manageability/Boundaries

The central parcel encompasses more than the 5,000 acres typically required for an area to be a candidates for future wilderness designation and is located adjacent to the Trinity Alps Wilderness.

Portions of the north and west boundaries of the central portion of the roadless area are currently difficult to identify on the ground as they do not correspond to topographic features such as streams, ridge-lines, or specific elevations. In areas where roads dictated the extent of the roadless area, the distance between the roads and roadless area boundary tends to change frequently and significantly.

Southern Portion

The southern parcel includes 940 acres, all of which are located within the Horse Linto watershed. All lands within this parcel are National Forest System lands. This parcel encompasses the area between the Trinity Alps Wilderness and the East Fork of Horse Linto Creek. This parcel is bordered to the north by the Trinity Alps Wilderness, to the south and west by East Fork Horse Linto Creek, and to the east by Forest Road 7N53 (maintenance level 2). Elevations within this parcel range from approximately 2,100 feet at the bottom of East Fork Horse Linto Creek to 5,100 feet along the ridgeline bordering the Trinity Alps Wilderness.

White fir is the dominant (62 percent) vegetation series within this parcel, and occupies the higher elevation area in the eastern half of this parcel. Tanoak is second most common (24 percent) vegetation series followed closely by Douglas-fir (13 percent).

All of the acres in the south parcel were burned during the 1999 Megram fire. Extreme fire intensities, where almost all of the vegetation cover was killed, occurred on 187 acres. High intensity fire, where greater than 70 percent of the vegetation cover was killed, occurred on 300 acres. Moderate intensity fire, where 25 to 70 percent of the vegetation cover was killed, occurred on 455 acres. There are two separate areas in this parcel where extreme and high intensity fire areas are concentrated; one is in the northeast portion of this parcel between Forest Road 7N53 and the Trinity Alps Wilderness, and the other is in the western side of this parcel between the East Fork Horse Linto Creek and the Trinity Alps Wilderness (Figure 3-4).

The Grizzly Camp trailhead is within the southern parcel of the roadless area. Facilities associated with this trailhead include a concrete restroom building, trail informational signs and three fire pits.

Roadless Characteristics

Natural Integrity

The long-term ecological processes within the southern portion of the roadless area appear to be in tact and functioning throughout this area. A minor (less than one acre) amount of human induced change is evident in the Grizzly Camp area where compaction and trampling have resulted from the development and use of trailhead facilities (restroom, parking, fire pits).

Apparent Naturalness

The landscape within the southern parcel appears primarily to have been affected by the forces of nature. Evidence of human activity is only apparent in the Grizzly Camp trailhead area where it is obvious that existing facilities were constructed and placed by humans.

Remoteness

The central and western portion of the southern parcel is considered remote. Perceived remoteness is impacted on approximately 210 acres in the northeast portion of this parcel (Figure 3-5), which is closely bordered by road 7N53. Grizzly Camp (which includes a trailhead, restroom, fire pits and parking areas) is located on road 7N53 and is also adjacent to the roadless area. Extreme and high intensity fires burned throughout the northeast corner of this parcel killing most of the vegetation that previously screened out some of the sights and sounds associated with road and trailhead use.

Solitude/Primitive Recreation Opportunities

The opportunity to experience solitude ranges from low in the northeast corner of this parcel to high in the remainder of the area. The northeast corner of this area is immediately adjacent to a road (7N53), a popular trailhead (Grizzly Camp), and a developed campsite, all of which increase the potential of seeing or hearing other visitors or of being exposed to the developments of humans. In addition extreme and high intensity fire burned throughout the northeast area and killed most of the vegetation that previously screened out some of the sites and sounds associated with human use. This area, with low opportunity for solitude, corresponds with the 210-acre area described in the previous section, where remoteness is impacted.

The social setting (associated with remoteness and solitude) does not meet the recreation opportunity spectrum criteria associated with a primitive recreation experience. The southern parcel currently meets criteria consistent with a semi-primitive non-motorized recreation experience.

Unique Features

There are no unique features associated with the southern portion of the roadless area.

Special Places or Values

No specific special places or values were identified as a result of public involvement associated with this analysis.

Manageability/Boundaries

The southern parcel encompasses less than the 5,000 acres typically required for an area to be a candidate for future wilderness designation. However, since this parcel is contiguous with the Trinity Alps Wilderness, it could still be a candidate for wilderness designation.

The boundary of this parcel is, for the most part, readily locatable on the ground, as it tends to follow creeks and ridgelines that are readily locatable. The exception is in the area where road 7N53 dictates the extent of the boundary. The distance between the road and the roadless area boundary fluctuates frequently.

APPENDIX D

PLANT SPECIES OF CONCERN

Table D-1. Known and Potential Vascular Plant Species of Concern in HLMTT Area

Species	Status[1]	Known or Potential	General Habitat
Allotropa virgata sugarstick	S&M-1,2	Known	Forest
Bensoniella oregana bensoniella	FS, S&M-1,2	Known	Meadows, riparian
Collomia tracyi Serpentine collomia	CNPS	Known	Rocky, gravelly serpentine
Cypripedium fasciculatum fascicled lady's slipper	FS, S&M-1,2	Potential	Forest
Cypripedium montanum mountain lady's slipper	FS, S&M-1,2	Potential	Forest
Draba howellii Howell's draba	CNPS	Known	Outcrops
Gentiana plurisetosa Klamath gentian	CNPS	Known	Meadows
Iliamna latibracteata California globe mallow	CNPS	Known	Meadows
Lewisia cotyledon var. *heckneri* Heckner's lewisia	SIS	Known	Outcrops, cliffs
Lewisia cotyledon var. *howellii* Howell's lewisa	CNPS	Known	Outcrops, cliffs
Lilium washingtonianum ssp. *purpurascens* purple-flowered Washington lily	CNPS	Known	Forest, chaparral, rocky sites
Lilium rubescens redwood lily	CNPS	Known	Forest, chaparral
Listera cordata heart-leafed twayblade	CNPS	Known	Forest
Lupinus tracyi Tracy's lupine	CNPS	Known	Gravelly barrens, exposed ridges
Piperia candida white-flowered rein orchid	CNPS	Known	Forest
Pityopus californicus California pinefoot	CNPS	Known	Forest
Pleuropogon refractus nodding semaphore grass	CNPS	Known	Meadows
Sedum divergens Cascade stonecrop	CNPS	Known	Gravelly barrens
Sedum laxum ssp. *flavidum* pale yellow stonecrop	SIS	Known	Outcrops

Table D-1. Known and Potential Vascular Plant Species of Concern in HLMTT Area (continued)

Species	Status[1]	Known or Potential	General Habitat
Sedum laxum ssp. *heckneri* Heckner's stonecrop	CNPS	Known	Outcrops
Sedum paradisum Canyon Creek stonecrop	FS	Potential	Outcrops, gravelly barrens
Sidalcea oregana ssp. *eximia* coast checkerbloom	SIS	Known	Meadows
Stellaria obtusa obtuse starwort	CNPS	Known	Moist forest sites, riparian
Tauschia glauca glaucous tauschia	CNPS	Potential	Gravelly barrens, serpentine
Tauschia howellii Howell's tauschia	FS	Potential	Gravelly barrens, granitics
Thermopsis robusta robust false lupine	FS	Potential	Early successional habitats in forest
Trientalis arctica Arctic starflower	CNPS	Known	Meadows
Veratrum insolitum Siskiyou false hellebore	CNPS	Known	Forest openings, grasslands

[1]Status refers to the category of rarity assigned to the species below being either Forest Sensitive (FS), Special Interest Species on the Forest (SIS), California Native Plant Society rare (CNPS) or Survey and Manage (S&M, the numbers following refer to the categories in the Record of Decision, 1=manage known sites, 2=surveys are required prior to ground disturbance.

Table D-2. S&M Plant Species Requiring Management and Surveys in the HLMTT Area

Species	Survey Strategy	Habitat	Range	Management Recommendation	Survey Protocol
Bryophytes					
Buxbaumia viridis	Protection Buffer	Well rotted logs (decay class 4 and 5) and peaty soil and humus, in moist coniferous forests.[1]	From low to middle elevations from Northern CA into WA.[2]	Yes-Maintain decay class 3, 4, and 5 logs, leaving windfalls in place to provide structurally diverse habitat and maintain a dense overstory to maintain humidity, with greater than 70% canopy closure.[1]	Yes-Surveys must be conducted when mature sporophytes are visible.[2]
Ptilidium californicum	Strategy 1, 2, 3	In N. CA attached to base of white fir or Doug-fir old growth forests under 5000 ft. elevation.[2]	Known through out the Pacific Northwest including 3 sites on federal land in CA.[3]	Yes-Retain occupied substrate, associated stand and microclimatic conditions near populations. Restrict activities that alter stand and microsite conditions or affect occupied substrate.[3]	Yes – Survey anytime area is accessible.

Table D-2. S&M Plant Species Requiring Management and Surveys in the HLMTT Area (continued)

Species	Survey Strategy	Habitat	Range	Management Recommendation	Survey Protocol
Bryophytes (continued)					
Ulota megalospora	Protection Buffer	On twigs and branches of conifers, hardwoods and shrubs. Substrates on Forest have included Douglas-fir and tanoak. Shrubs are also potential substrates. Moist to mesic micro-climate.	Endemic to Pacific Northwest. In Humboldt and Del Norte Counties, inclusive of the Outer North Coast Range and lower elevation Klamath River.[2]	Yes-Retain occupied substrate. If locally widespread, manage a sample as known sites.	Yes-Conduct any time of year when bryophytes are visible.[2]
Fungi					
Bondarzewia Polypore					
Bondarzewia mesenterica *= (B. montana)*	Strat. 1, 2, 3	Often associated with stumps or snags in late successional conifer forests.[4]	Known from Northern CA to Washington. Known sites in Del Norte and Humboldt Cos.[4]	Yes – Maintain current habitat conditions and micro-climatic conditions.	Yes-Survey when fruits mature; Aug. - Dec.
Noble Polypore					
Bridgeoporus nobilissimus *= (Oxyporus nobilissimus)*	Strat. 1, 2, 3	On live trees, standing dead trees, snags, stumps and on the ground on collars and root crowns in mesic to wet microsites in forests of all seral stages in the range of Pacific Silver Fir and Noble Fir.[6]	Known from Oregon to Washington. Suspected range includes Northern CA.[6]	Yes - Maintain current habitat conditions and micro-climatic conditions. Establish a 600 acre Temporary reserve around known site until all potential habitat is inventoried within that reserve area.	Yes – Survey anytime of year when area is accessible.[8]
Resupinates and Polypores					
Otidea leporina	Protection Buffer	Associated with *Picea* spp., *Pseudotsuga menziesii*, and *Tsuga heterophylla*.[4]	Known from Northern CA and Oregon. Known sites in Del Norte and Humboldt Co.[4]	Yes – Maintain current habitat conditions and micro-climatic conditions.	Yes– Survey when fruits mature; Oct. - Dec.[11]
O. onotica	Protection Buffer	Associated with *Pseudotsuga menziesii* dominated forests.[4]	Known from Northern CA to Washington. Known sites in Del Norte Co.[4]	Yes – Maintain current habitat conditions and micro-climatic conditions.	Yes-Survey when fruits mature; Aug. - Dec.[11]
O. smithii	Protection Buffer	Solitary to gregarious on exposed soil, duff or moss under *Populus trichocarpa*, *Pseudotsuga menziesii*, and *Tsuga heterophylla*.[4]	Known from Northern CA to Washington. Known sites in Del Norte Co.[4]	Yes – Maintain current habitat conditions and micro-climatic conditions.	Yes – Survey when fruits mature; Aug. - Dec.[11]

Table D-2. S&M Plant Species Requiring Management and Surveys in the HLMTT Area (continued)

Species	Survey Strategy	Habitat	Range	Management Recommendation	Survey Protocol
Resupinates and Polypores					
Sowerbyella rhenana	Protection Buffer	Associated with accumulated duff and humus in low to mid-elevation mixed conifer or conifer-hardwood forests.	Known from Northern CA to Washington. Known sites in Humboldt Co. [4]	Yes- Maintain current habitat conditions and micro-climatic conditions.	Yes- Survey when fruits mature; Oct.-Dec. [11]
Black Chantarelle					
Polyzellus multiplex	Protection Buffer	Associated with the roots of Abies sp. In late-successional, mid-elevation, montane, coniferous forests.	Known from the coast and Cascade Ranges of WA, OR, and CA.	Yes—Maintain current habitat conditions and micro-climatic conditions.	Yes- Survey when fruits are mature; Oct.- Dec. [11]
Cup Fungi					
Sarcosoma mexicana	Protection Buffer	Solitary to gregarious on or near decaying wood, or on litter and soil. Fruiting in conifer forests from low to high elevation.[4]	Known from Northern CA to Washington. Known sites in Del Norte, Siskiyou, and Mendocino Cos.[4]	Yes – Maintain current habitat conditions and micro-climatic conditions.	Yes – Survey when fruits mature; Nov. –May.[10]
Vascular Plants					
Allotropa virgata sugarstick	Strat. 1, 2	Occurs under partial or full shade, on dry, well drained, acidic soils; canopy cover is high, low shrub and herb cover; leaf litter is high, associated with decaying wood. Occurs in young stands but with older predoms.[8]	Known from CA to British Columbia.	None necessary on the Forest.[10]	Yes-Conduct during flowering or fruiting periods (May through September) when plants are most easily seen and identifiable.[8]
Bensoniella oregana Bensoniella	Strat. 1, 2	Associated with wet sites including meadows, seeps, and riparian areas. Structural diversity such that understory canopies filter light, overstory canopies provide peripheral shade, and down logs provide shade and act as reservoirs for moisture.[8]	Known from the Klamath Mountain Province and Coast Range of southwest Oregon and northwest California.[8]	Yes- See management recommendations for survey and manage for vascular plants in appendix.[10]	Yes-Conduct during flowering or fruiting periods (mid June through mid August) when plants are most easily seen and identifiable.[8]

Table D-2. S&M Plant Species Requiring Management and Surveys in the HLMTT Area (continued)

Species	Survey Strategy	Habitat	Range	Management Recommendation	Survey Protocol
Vascular Plants					
Cypripedium fasciculatum fascicled lady's slipper	Strat. 1, 2	Variety of habitats from, partial shade, generally >60% cover, in drier areas appears to be associated with riparian areas.[8]	Known from within a broad distribution in the western U.S.[8]	Yes- See management recommendations for survey and manage for vascular plants in appendix. [10]	Yes-Conduct during flowering or fruiting periods (mid April through August) when plants are most easily seen and identifiable.[8]
Cypripedium montanum mountain lady's slipper	Strat. 1, 2	Variety of habitats; partial shade; generally 60%-80% cover; acidic, sandy, dry soils; generally northerly aspect.[8]	Known from within a broad distribution in the western U.S and Canada.[8]	Yes- See management recommendations for survey and manage for vascular plants in appendix. [10]	Yes-Conduct during flowering or fruiting periods (May through August) when plants are most easily seen and identifiable.[8]

[1]1996. Harpel, J. Draft Management Recommendations Bryophytes, Installment 1, Version 1.1.
[2]1997. Harpel, J. Survey Proptocols for Survey and Manage Component 2 Bryophytes, Version 2.0.
[3]1999. Harpel, J. Survey Protocols for Protection Buffer Bryophytes. Version 2.0.
[4]1998. Harpel, J. Management Recommendations for Bryophytes. Version 2.0
[5]1999. USDA. Handbook to Strategy 1 Fungal Species in the Northwest Forest Plan. USDA Forest Service General Technical Report PNW-GTR-476.
[6]1994. Appendix J2 of the Supplemental Environmental Impact Statement for Management of Habitat for Late-Successional and Old-Growth Related Species Within the Range of the Northern Spotted Owl.
[7]1998. Hibler, C., T.E. O'Dell. Survey Protocols for *Bridgeoporus* (=*Oxyporus*) *nobilissimus*. Version 2.0.
[8]1997. Castellano, M.A., T.E. O'Dell. Management Recommendations for Survey and Manage Fungi. Version 2.0.
[9]1998. Whiteaker, L., et. al. Survey Protocols for Survey & Manage Strategy 2 Vascular Plants. Version 2.0.
[10]1998. Wogen N. and L. Hoover and R. Holmes, J.Seevers and F. Lang. Management Recommendations for Vascular Plants.
[11]1999. O'Dell, T.E. Survey Protocols for *Bondarzewia mesenterica, Otidea leporina, O. onotica, O. smithii, Polyzellus multiplex, Sarcosoma mexicana, Sowerbyella rhenana*. Version 1.3.

Management Recommendations for Survey and Manage Plant Species

The following management recommendations are for: *Bridgeoporus* (=*Oxyporus*) *nobilissimus*, *Otidea leporina* var. *leporina*, *Otidea onotica, Otidea smithii, Polyzellus multiplex, Sarcosoma mexicana, and Sowerbyella rhenana*[1]

For sites within land allocations that protect populations from timber management maintain current habitat conditions and micro-climatic conditions.

1. Maintain dominance of specific overstory tree associates.

2. Minimize loss or disruption of host tree snags and stumps, particularly from management, road, trail and campground construction or recreational activities.

3. Manage tree diseases in the area to minimize loss of overstory trees.

4. Relative to *Bridgeoporus nobilissimus* for sites not in land allocations that protect populations from timber management create 600 acre temporary reserve around them until: (1) all of the potential habitat within the reserve is inventoried for additional *Bridgeoporus nobilissimus* conks and potential hosts and (2) a site specific *Bridgeoporus nobilissimus* management plan is prepared.

Management Recommendations for Vascular Plants[2]

Allotropa virgata

Populations in the California Coast Range (Six Rivers NF) will not receive any special management.

Bensoniella oregana

1. Manage timber adjacent to known sites and selected experimental populations in a manner that will minimize blowdown potential.

2. Design, construct, and maintain roads to avoid hydrologic impacts at known sites. Redesign or decommission existing roads when it is necessary to restore hydrologic processes.

3. Maintain partial shade and edge habitat. Avoid logging prescriptions, firewood cutting or other management activities that would result in direct sunlight to occupied habitat for extended periods.

4. Maintain coarse woody debris to provide micro-site shading and to retain soil moisture.

5. Manage livestock to avoid consumption of plants, trampling of plants, soil compaction, increased soil erosion, and the introduction of nonnative vegetation.

6. Manage recreation to avoid trampling of plants, removal of coarse woody debris, soil compaction, and increased soil erosion.

7. Control exotic vegetation, noxious weeds, and encroaching native vegetation competitive with *Bensoniella.*

Cypripedium fasciculatum

1. Maintain or restore habitat conditions in areas with populations of *C. fasciculatum*.

2. Maintain canopy closure at 60 percent or greater.

3. Maintain down logs, snags, and duff layer within the habitat area for soil moisture and mycorrhizal associates. Provide for future recruitment of coarse woody debris.

4. Avoid activities that alter soil, duff, down wood, and the mycorrhizal community in the habitat area.

5. Maintain/secure known sites from prescribed burns except in Adaptive Management Areas where research should be conducted to determine the role of fire in *C. fasciculatum* habitat.

6. Manage population sites to include an area large enough to maintain current habitat and associated microclimate, primarily temperature and moisture. The size should be determined by a field visit and should consider factors such as canopy cover, slope, aspect, topographic position, vegetations structure (growth form, stratification, and coverage), and species composition.

7. Manage for biological (mycorrhizae and pollinators) and ecological (soil temperature, moisture, and organic matter) requirements at each life stage. Each life stage may require specific mitigation. Ensure that indiscribminate insecticide spray does not affect the populations of bees or other insects this species depends on for pollination.

Cypripedium montanum

1. Maintain or restore habitat conditions in areas with populations of *..montanum*.

2. Maintain canopy closure at 60 percent or greater.

3. Maintain down logs, snags, and duff layer within the habitat area for soil moisture and mycorrhizal associates. Provide for future recruitment of coarse woody debris.

4. Avoid activities that alter soil, duff, down wood, and the mycorrhizal community in the habitat area.

5. Maintain/secure known sites from prescribed burns.

6. Manage population sites to include an area large enough to maintain current habitat and associated microclimate, primarily temperature and moisture. The size should be determined by a field visit and should consider factors such as canopy cover, slope, aspect, topographic position, vegetations structure (growth form, stratification, and coverage), and species composition.

7. Given the long life-span of individuals, manage *C. montanum* and associated communiteis to be responsive to short-term (wildfire, soil disturbance) and long-term (ecological succession) environmental changes and maintain the species evolutionary potential.

8. Manage for biological (mycorrhizae and pollinators) and ecological (soil temperature, moisture, and organic matter) requirements at each life stage. Each life stage may require specific mitigation. Ensure that indiscriminate insecticide spray does not affect the populations of bees or other insects this species depends on for pollination.

End Notes

[1]1997. Castellano, M.A., T.E. O'Dell. Management Recommendations for Survey and mange Fungi. Version 2.0
[2]1998. Wogen, N. and L. Hoover and R. Holmes, J.Seevers and F. Lang. Management Recommendations for Vascular Plants.

APPENDIX E
WILDLIFE SPECIES OF CONCERN

Forest Service Sensitive Species

Northern Goshawk

Goshawks in northern California use older pole-sized, mature, and old-growth conifer forests with relatively dense canopy closures, usually little understory vegetation, close proximity to riparian corrodors, and flat or moderately sloped terrain. Moderate and high quality habitats contain abundant large snags and large logs for prey habitat and plucking perches (Hall 1984). The general habitat in this area consists of Douglas-fir and white fir in the mid-mature, late mature, and old-growth seral stages. Prior to the Megram Fire, approximately 43,850 acres of suitable habitat for the northern goshawk existed within the watershed analysis area. After the fire, there are presently 33,930 acres of suitable habitat within the analysis (represents a loss of 23 percent due to the Megram Fire).

There are four known and two suspected goshawk territories in the watershed analysis area. South Fork Mill Creek, Ladder Rock, Tish Tang East, and Tish Tang West are known territories. Grove's Prairie and Horse Trail are suspected territories. The Ladder Rock and the Horse Trail territories were extensively impacted by loss of habitat by high intensity wildfire. The South Fork Mill Creek, Tish Tang East, Tish Tang West and Groves Prairie territories were affected by a combination of low and moderate wildfire intensity levels. Future impacts to habitat may be expected in the future due to additional conifer mortality from insects and fire related stress.

This species is considered to be declining in numbers and distribution over the past several decades. Factors cited as contributing to this decline include alterations in habitat distribution patterns and the availability of suitable habitat.

Marten

Marten prefer multi-storied mature and old-growth true fir and mixed conifer forests with moderate to dense canopy closure. The species is most abundant within forested areas adjacent to meadows and/or riparian corridors. Marten utilize travelways comprised of closed canopy forests to move between foraging areas (Freel 1991). Marten are generally limited to habitats greater than 4,000 feet in elevation. Moderate and high quality habitat contains 2 to 3 large snags and 10 to 20 large logs per acre; these habitat elements are important for foraging, denning, and resting. Habitat for this species is considered to be provided for within Late-Successional Reserves.

In 1995 through 1997, Bill Zielinski of Redwood Sciences Laboratory and Carlos Caroll of Oregon State University completed extensive surveys for forest carnivores within and adjacent to the analyis area. No detections of marten occured during the surveys within the analysis area.

However, there are records of marten within the analysis area. The majority of these sighting records have been associated within the true fir habitats within the analysis area. Post-fire effects to marten habitat at this time are largely unknown, but given the extent of true fir communities affected by high wildfire intensities, it is likely that this species habitat was altered to a significant degree.

Fisher

The fisher occupies habitat similar to that used by the marten and northern spotted owl. Their habitat consists of multi-storied mature and overmature conifer forests with moderate to dense canopy closure and scattered patches, with six to eight large snags per acre and abundant down logs (Buck et al., 1983). This carnivore forages primarily in dead wood; therefore, both standing and snag and downed log densities are important indicators of habitat quality. Fisher utlize travelways along ridges and streams comprised of closed canopy forests. Habitat for the fisher is considered to be provided for within Late-Successional Reserves. Numerous or heavily traveled roads can disrupt movement of this species.

There are records of the Pacific fisher within the analysis area. Within and adjacent to the analysis area, Bill Zielinski of the Redwood Sciences Laboratory and Carlos Carroll of Oregon State University have completed extensive surveys for forest carnivores (fisher and marten) using trach plates and cameras in 1995-1997. These surveys yielded detections of fisher at four of four stations within the analysis area. Prior to the Megram Fire, there were approximately 43,850 acres of habitat for the fisher within the watershed analysis area. As a result of the Megram Fire, the current level of suitable habitat has been reduced to 33,930 acres.

Willow Flycatcher

Willow flycatchers' breeding habitat is typically moist meadows with perennial streams, lowland riparian woodlands dominated by willows, cottonwoods, or smaller spring fed boggy areas with willows or alders (Serena 1982 and Harris et al. 1987). Willow flycatchers prefer wet meadows or riparian zones dominated by willow with open areas for foraging.

The willow flycatcher has been extirpated as a breeding bird from most of its California range. This decline has been attributed to habitat loss, cowbird parasitism, livestock grazing, loss of meadow habitat due to hydroelectric power development, and conifer encroachment in meadows (Harris etal. 1987, Serena 1982).

Although willow flycatchers have been found during the fall season along several northern California rivers and within the analysis area adjacent to Groves Prairie, they are not known to nest on the Forest. Potentially suitable habitat is limited on the Forest, and the species could occur in willow stands within several high elevation meadow systems near the Trinity Summit area and the adjacent meadow systems found within the Trinity Alps Wilderness. The amount of habitat degradation that occurred from the Megram Fire for this species is currently unknown.

Wolverine

Wolverines utilize a variety of habitats in large undisturbed areas, most often at higher elevations. The species tends to use talus slopes and large downed woody debris for denning (White and Barret 1979). The wolverine may be dependent on access to mature conifer forest habitat, especially in winter. During the winter, wolverines may follow herd animals (deer) down to lower elevations, where they may feed on salmonid carcasses. Home range size varies between 62 and 550 square miles (USDA 1994). The Forest has over 60 reported sightings of the California wolverine; however, only 11 records have occurred since 1980 and there have been no reported sightings in the 1990s. There are are 11 sighting records within the analysis area and several more within the Trinity Alps Wilderness Area, the Hoopa Valley Indian Reservation and along the Trinity River. Potential habitat for this species exists within the Trinity Alps Wilderness Area. Habitat for this species is considered to be provided for within Late-Successional Reserves. Numerous or heaviliy traveled roads can disrupt movements of this species.

Great Gray Owl

The great gray owl is not known to occur in the watershed analysis area. Suitable habitat consists of mature and old-growth red fir, mixed conifer, or lodgepole pine forest adjacent to large meadows at 4,500 to 7,500 feet in elevation. This species has been found to winter along the northern California coast; however, they are not known to nest on the SRNF. Potential suitable habitat is limited on the Forest. An expert panel on the great gray owl met in May of 1996 to reassess the status of the species within the area of the Northwest Forest Plan. This conference and status report (Huff et al. 1996) determined that none of the habitats on the SRNF were likely to be used by this species.

Peregrine Falcon

There are two historic peregrine falcon territories within the analysis area, which include the Mill Creek and Horse Linto territories. Both territories are entirely located within the watershed analysis area. The Horse Linto Territory, specifically the foraging habitat, was extensively impacted by a combination of high and moderate intensity wildfire. The foraging habitat within the Mill Creek Territory was affected to lower degree given the lower wildfire intensities that occurred within this territory. Presently, the specific amount of habitat degradation is unknown. However, peregrine falcons are known to forage within a wide variety of habitats of which are specific to containing high populations of avian prey. The areas within and adjacent to the existing territories may offer a unique guild of prey items in the near future for the species.

Special Status Species

The following species list includes species that are either USFWS species of concern, survey and manage species, or protection buffer species listed within the SRNF LRMP.

White-Headed Woodpecker, Flammulated Owl, and Pygmy Nuthatch

Flammulated owls are secondary cavity-nesters that use cavities in snags and live trees. Territories occur in loose loose colonies in mixed woodland habitats containing either ponderosa or Jeffery pine, or California black oak (Marcot and Hill 1980). There are reported detections of the flammulated owl within the analysis area.

The white-headed woodpecker is thinly distributed throughout higher inland montane pine and fir forests with large trees and snags. There are reported sightings of the white-headed woodpecker within the analysis area.

The pygmy nuthatch utilizes mature ponderosa and Jeffery pine habitat and requires cavities in trees and snags for roosting and nesting. There are no known sightings in the watershed and the species is not likely to occur within the watershed analysis area.

Bats

Eight species of special status bats are suspected to occur in the watershed analysis area. These species are listed within Appendix J2 of the FSEIS ROD and/or are USFWS Species of Concern. They fall into four groups:

1. Small, nonmigratory, crevice-roosting bats with widespread distributions. These bats use snags, decadent trees, buildings, bridges, and caves for roosting and hbenating (includes long-eared myotis, fringed myotis, long-legged myotis, and the pallid bat).
2. Large, solitary, migratory, obligatory foliage-roosting bats with widespread distribution (hoary bat)
3. Large, migratory, widely distributed, snag and decadent tree-roosting bat. This bat may occasionally use buildings and caves for roosting (silver-haired bat).
4. Coastal species. These nonmigratory, uncommon species are extremely sensitive to disturbance of roosting sites. They require caves, mines, tunnels, buildings, or other human-made structures for roosting (Pacific western big-eared bat and Pale Townsend's big-eared bat).

No specific surveys for bats or their habitats have been conducted on federal lands within the watershed analysis area. There are no known caves in the analysis area. However, suitable habitat is present in the form of rock outcrops, cliff crevasses, snags, and within the undersides of several bridges. Although, no specific surveys for bats or their habitats have been completed in the watershed analysis area, there have been demonstrated and hypothesized decreases in bat populations throughout the region (Pierson 1988, Gellman and Zielinski in press). Decreases in bat populations are thought to be due largely to loss of roosting habitat and disturbance. There is a strong concern that loss of snags and and decadent trees from widespread cutting of old-growth forests, destruction of caves and mines, demolition of old bridges and buildings, and human disturbance have significantly reduced the availability of potential roost sites for all these species. Since these species also forage over riparian zones, there is concern that previous timber harvest practices and over grazing may have significant impacts on bats, as riparian vegetation is a critical component in the life cycle of the bat's preferred prey species (Idaho State Conservation Effort 1995).

Herpetofauna

Numerous reptiles and amphibians are dependent on riparian habitat. The northwestern pond turtle, red-legged frog, foothill yellow-legged frog, and southern torrent salamander are sensitive riparian-dependent species that are suspected in the watershed analysis area.

Northwestern Pond Turtle

Northwestern pond turtles are often concentrated in low velocity and low gradient sections of creeks and rivers, especially in sloughs, side channels, and backwater areas. They prefer creeks that have deep, still water and sunny banks. Hatchlings are small and cryptic, and require shallow edgewater areas with minimal currents. Adults concentrate in deep-water pools with lots of underwater debris. For nesting and overwintering, turtles require an adjacent terrestrial area (within 500 meters of the watercourse) with uncompacted soil and a duff layer (Jennings et al. 1993).

Although pond turtles have been eliminated from an estimated 30 to 40 percent of their historic range, habitat conditions and population trends are largely unknown in the HLMTT watershed analysis area. Major threats to this species are loss or alteration of habitat (including wetland reclamation, water diversions, dams, and grazing), fragmentation of habitat, over-exploitation, and spread of exotic species (especially bullfrogs and bass) (Jennings et al. 1993).

There are no known records of western pond turtles within the analysis area. Surveys for this species have occurred within the several of the streams and lakes within the analysis area and have not yielded any detections. However, this species is a habitat generalist and inhabits a wide variety of habitats and is very likely to occur in some of the pools associated with low gradient streams within the analysis area.

Red-Legged Frog

Northern red-legged frogs require ponds, pools in slow streams, marshes, or reservoirs with submerged vegetation for egg attachment, a depth greater than one meter to accommodate singing males, and a maximum stream width greater than two meters. This frog is found in coniferous/mixed hardwood forests with greater than 50 percent canopy closure, and with downed logs in and out of water. It requires cool water, having the lowest upper (21 degrees Celsius) and lower (4 degrees Celsius) lethal embryonic temperature of any North American ranid frog (Licht 1971).

Threats to this species are similar to those discussed under the northwestern pond turtle (e.g. loss, fragmentation, or alteration, of habitat resulting in increased water temperatures, decreased pool depths, or decreased riparian vegetation, and introduction of exotic fishes or bullfrogs). Riparian reserves are expected to provide adequate protection for these species. There are no known records for red-legged frogs within the watershed analysis area.

Foothill Yellow-Legged Frog

Foothill yellow-legged frogs inhabitat rocky, higher gradient, shallower streams with less vegetative streamside cover than red-legged frogs. Both species require partially submerged rocks and logs for basking and cover. The yellow-legged frog population is considered stable in the north coast area. Surveys for this species have been accomplished in many of the streams associated with anadramous fish surveys. Yellow-legged frogs have been recorded in the watershed analysis area, specifically within Horse Linto Creek and its drainages.

Southern Torrent Salamader

Southern torrent salamaders reside in headwaters, springs, seeps, and first to third order streams with high canopy closure. This species is an aquatic obligate, sensitive to dessication, increased sedimentation, and habitat alteration. Torrent salmanaders require cold water temperatures that consistently range from 8 to 12 degrees Celsius in summer. Their headwater stream habitat has declined substantially due to extensive logging. There are three records of the the southern torrent salamander within the analysis area, all of which are located within the Horse Linto drainage.

Management Indicator Species

The Six Rivers National Forest selected 41 species as management indicator species (MIS) or species assemblages (groups of species with similar habitat requirements); these species utilize a wide variety of habitats affected by resource management activities on the Forest. Indicator species were selected based on their roles in their respective biotic assemblages or community. Many MIS occupy a niche in their particular assemblage that may be extremely sensitive to management related activities. Other MIS were selected based on concern for their current population status. MIS are indicative of the integrity of communities as a whole, and provide an assessment of the overall health of the represented habitats or ecosystems. Table E-1 lists the MIS species and species assemblages for the Forest.

Species Assemblages

Many special habitats occur within the HLMTT area. These include wetlands, springs, ponds, meadows, cliffs, talus slopes, and hardwood stands. These habitats may support endemic or rare wildlife species in the watershed. However, little has been done to adequately survey these areas, and so the status of these sites and potentailly associated species is unknown.

In 1991, the Six Rivers National Forest wildlife department mapped the location of many special habitat areas across the Forest from aerial photographs. Many small areas, such as bogs and springs, may not have been visible and are most likely under-represented.

Table E-1. Management Indicator Species

Individual Species	**River/Stream/Creek Assemblage**
Northern Spotted Owl	Tailed frog
Pileated Woodpecker	Common merganser
Black Bear	Winter wren
American Marten	Winter Wren
Fisher	American dipper
Black-tailed deer	Yellow-breasted chat
	Cutthroat trout
Bog/Seep/Wet Meadow Assemblage	Steelhead/rainbow trout
Olympic salamander	Summer Steelhead
Down Woody Material Assemblage	**Marsh/Lake/Pond Assemblage**
Arboreal salamander	California red-legged frog
Clouded salamander	Wood duck
Blue grouse	Western pond turtle
Dusky-footed woodrat	
Western fence lizard	**Black Oak/White Oak Assemblage**
	Acorn woodpecker
Snag Assemblage	Scrub jay
Flammulated owl	Lazuli bunting
White-headed wodpecker	Western gray squirrel
Western screech owl	
Vaux's Swift	**Tanoak/Madrone Assemblage**
Red-breasted sapsucker	Hammond's flycatcher
Western bluebird	Western tanager
Downy woodpecker	
Brown creeper	
Hairy woodpecker	
Douglas squirrel	

Bog/Seep/Spring/Wet Meadow/Talus Assemblage

There are 550 acres of wet meadow habitats, 3 bog/seep areas, and 3 springs known in the watershed analysis area. It is likely that other suitable habitat for the species in this assemblage exists within the watershed. Special microhabitat characteristics are required by the species in this assemblage. Most are especially sensitive to variations in water temperature, chemistry, siltation levels, adjacent forested habitats, downed woody debris, and disturbance.

Marsh/Lake/Pond Assemblage

There are 3 lakes and approximately 80 acres of wetlands located throughout the analysis area. The wood duck occurs within the watershed. Documented presence of the California red-legged frog and western pond turtle have not been reported for the analysis area. Special microhabitat characteristics are required by the species dependent on these habitat types. As with other aquatic species, all are extremely sensitive to any change in microhabitat, temperature, chemistry or siltation levels. The level of impacts from the Megram Fire is currently unknown for these specific habitats.

River/Stream/Creek Assemblage

The full effects of the recent Megram Fire on riparian vegetation associated with this assemblage is yet to be verified; however, some information can be extrapolated from aerial photographs and preliminary field visits. The fire covered extensive headwater areas within the analysis area. Burn severity within perennial, intermittent and ephemeral streams is discussed within Chapter 3 under the heading ‘Megram Fire and Interim Riparian Reserves’. All of the species in the assemblage are or suspected to occur in the analysis area with the exception of summer steelhead. Resident populations of trout are found in several of the upper stream reaches within the watershed analysis area.

Black Oak/White Oak Assemblage

Prior to the Megram Fire there were aproximately 480 acres in the white oak series, which comprise one percent of all series within the watershed. These series are primarily associated with the white fir, Douglas-fir and canyon live oak series. The amount of black oak in the analysis area is negligible and is reflective of less than half of one percent. The specific impact of the fire on this assemblage is unknown. However, it is expected that many of these oaks are now snags, which will become an important component for species that depend on this assemblage.

Tanoak/Madrone Assemblage

Tanoak and Pacific madrone are common components for the Douglas-fir/mixed evergreen type. Tanoak produces acorns and possesses more natural cavities than conifers and therefore is very valuable for wildlife. Madrone produces berries which provides an important food source for wildlife, particularly in the fall, and madrone is also used as a nest tree by cavity excavators (USDA, Forest Service 1995). Prior to the Megram Fire there were approximately 12,070 acres of tanoak habitat in the early mature, mid mature, late mature, and old growth seral stages. The effects of the Megram Fire resulted in a loss of approximately 2,000 acres of tanoak habitat due to high intensity wildfire. All of the species associated with this assemblage are present in the watershed analysis area; Hammond’s flycatcher, western tanager, and the black-headed grosbeak.

Down Woody Material Assemblage

All of the species in this assemblage are known to occur in the watershed analysis area, except the clouded and arboreal salamanders. These two species have not been recorded in the analysis area, but their range includes the HLMTT watershed analysis area.

Snag Assemblage

All of the species in the snag assemblage are known to occur in the watershed. Snag density estimates for the Forest are based on ecology plot and ecological unit inventory information for the vegetation series and seral stages across the Forest. The Forest-wide LSRA identified desired ranges of snags and downed logs, which are shown in Table E-2. These levels are a refinement of the desired snag and log levels specified in the SRNF LRMP, and reflect the desired to maintain higher levels of snags and logs in LSRs than in other land allocations. Snag and downed log levels are currently much higher than levels due to the Megram Fire.

Table E-2. Snag and Downed Log Densities by Series and Seral Stage

Series/Seral Stage	Snags/Acre[1]	Downed Logs/Acre[2]
Tanoak/Douglas-fir		
Early Mature	2-5	8-12
Mid-Mature	3-6	4-8
Late Mature	1-3	1-3
Old-Growth	3-8	8-12
White-fir		
Early Mature	1-4	3-7
Mid-Mature	4-8	3-7
Late Mature	4-8	7-11
Old-Growth	4-10	10-16

[1]Snags greater than 20-inches dbh and 20 feet tall
[2]Downed logs greater than 20-inches dbh and 20 feet long

APPENDIX F

LSR 305 NSO HABITAT ASSESSMENT

In 1994, the Northwest Forest Plan (NWFP) established a network of Late Successional Reserves (LSRs) and accompanying management direction. The network of reserves is intended to provide late-successional forest habitat, provide for populations of species that are associated with late-successional habitat, and to help maintain the viability and diversity of late-successional species. This direction was incorporated into the Six Rivers National Forest's Land and Resource Management Plan (LRMP) in 1995.

Management objectives within LSRs are designated to protect and enhance conditions of late-successional forest ecosystems, which serve as habitat for late-successional dependent species such as the NSO (northern spotted owl) (USDA, USDI, 1994). Protection includes reducing the likelihood of large-scale disturbance, including stand-replacing fire, insect and disease epidemics, and major human-caused activities. Enhancement includes silvicultural treatments designed to accelerate the development of late-successional stand characteristics.

LSR 305 is contiguous with the Trinity Alps Wilderness to the east. Several other LSRs ring the Trinity Alps Wilderness, making this the largest reserve complex in the Klamath Province. The USFWS and the U.S. Forest Service have, over the last four years, been involved in a landscape level evaluation of LSRs relative to their ability to provide habitat for the northern spotted owl. As a result of this analysis, LSR 305 was determined to be functioning at a high level in regard to providing a high level of habitat for spotted owls. The analysis also determined that all of the LSRs on the Six Rivers National Forest were functioning at this level as well.

Habitat Conditions before the Megram Fire

Before the Megram Fire, there were approximately 47,000 acres of nesting/roosting habitat and 22,410 acres of foraging habitat for the NSO within LSR 305. Capable (e.g. foraging and dispersal) habitat is defined as stands with the capability of becoming suitable habitat. Specific to LSR 305, there are 86,390 acres that are capable of providing suitable NSO habitat. The acreage identified as capable reflects that approximately 91 percent of LSR 305 is capable of providing habitat for the northern spotted owl. Table F-1 displays a summary of suitable NSO habitat in LSR 305 by ownership prior to the Megram Fire. Figure 3-18 displays suitable northern spotted owl habitat prior to the Megram Fire within LSR 305.

Table F-1. Northern Spotted Owl Habitat Prior to Megram Fire within LSR 305

Habitat Type	SRNF Acres	STNF Acres	Private Acres	Total Acres
Foraging	10,710	11,390	300	22,410
Nesting/Roosting	29,100	17,800	100	47,000
Unsuitable	17,420	7,590	280	25,280
Total Habitat	39,810	29,200	680	69,130

Before the Megram Fire, LSR 305 supported 37 activity centers for the northern spotted owl. It provided a total of 69,130 acres of suitable NSO habitat. An additional 17,260 acres are capable or have the potential to mature into suitable NRF (nesting/roosting/foraging) habitat. While 91 percent of LSR 305 is capable of providing suitable habitat, before the Megram Fire approximately 80 percent of the capable acres were providing suitable habitat. Within LSR 305, approximately 50,830 acres are designated as critical habitat for the northern spotted owl (CHU CA-30).

The USFWS considers an owl territory to be taken when the amount of NR habitat drops below 500 acres within 0.7-mile radius around the activity center and 1,340 acres within a 1.3-mile radius circle. Preliminary take assessments have been conducted on the 37 activity centers located within LSR 305 before the Megram Fire (see Table F-3).

Before the Megram Fire, the preliminary take assessments for the activity centers located within LSR 305 determined that 20 activity centers were below the “take” threshold within the 0.7-mile radius, with 8 of these also below the “take” threshold within the 1.3-mile radius. Seventeen activity centers are above the “take” threshold completely. Table F-3 summarizes the NSO assessment of suitable habitat within activity centers.

Table F-2. NSO Activity Centers (AC) within LSR 305; Assessment of Nesting, Roosting (NR), and Foraging (NRF) Habitat within 0.7 and 1.3 mile Radius

Total Activity Centers within LSR 305	# AC > 500 acres NR within 0.7 Miles	# AC > 500 acres NRF within 0.7 Miles	# AC > 1,340 acres NR within 1.3 Miles	# AC >1,340 acres NRF within 1.3 Miles
37	17	32	29	35

The draft recovery plan for the northern spotted owl predicted this LSR (as DCA CD-45 and at 95,900 acres) would support 20 current Projected Federal owl pairs and 25 Future Projected owl pairs (Table 3.23 in Recovery Plan). The Hoopa Valley Indian Reservation boundary adjustment affected two of the owl activity centers. The habitat conditions prior to the Megram Fire did provide suitable habitat for 17 activity centers above the “take” threshold; however, the analysis displayed that the amount of suitable habitat did not meet the habitat requirements for 20 current Projected Federal owl pairs and 25 Future Projected Federal owl pairs as projected in the draft recovery plan.

Habitat Conditions after the Megram Fire

Habitat conditions have been greatly altered greatly by the recent Megram Fire; and this section focuses on the current conditions. Current habitat conditions have been derived from aerial photograph interpretation and a limited amount of field verification. The acreage of habitat degraded or removed by the Megram Fire is expected to change as future mortality occurs and conditions are verified on the ground. This analysis is intended to be utilized as a tool to display the conditions based on preliminary post-fire findings.

Table F-3. Acres of Suitable NSO Habitat within 0.7 and 1.3 Miles of Known Activity Centers in LSR 305 Prior to the Megram Fire.

Owl Number	Territory Name	NR Acres 0.7 Mile	F Acres 0.7 Mile	Total NRF Acres 0.7 Mile	NR Acres 1.3 Mile	F Acres 1.3 Mile	Total NRF Acres 1.3 Mile	Status[1]
98	Whitey's	451	22	473	1,159	393	1,552	P
99	Lockhart	395	229	624	1,038	469	1,507	P
106	NF Mill Creek	545	303	848	1,428	1009	2,437	P
108	Middle Fork	214	68	282	1,356	168	1,524	P
113	Mill Creek	445	70	515	1,030	374	1,404	P
114	Tish Tang Pt	200	132	332	800	348	1,148	P
115	SF Tish Tang	662	68	730	2,281	418	2,699	T
116	Tish Tang East	807	50	857	2,242	545	2,787	P
117	Tish Tang Creek	473	219	692	1,418	521	1,939	P
118	C Lone Pine	641	243	884	1,719	1042	2,761	T
119	W Lone Pine	521	283	804	1,613	903	2,516	P
120	McKay Meadows	347	14	361	1,149	195	1,344	T
121	Ladder Rock	622	178	800	1,828	540	2,368	T
123	EF Horse Linto	483	208	691	1,547	682	2,229	P
124	E Lone Pine	419	371	790	1,982	718	2,700	T
125	Cedar Creek	541	200	741	1,882	574	2,456	P
126	Groves Prairie	439	287	726	1,530	832	2,362	P
127	E Cedar Creek	624	196	820	1,977	737	2,714	P
128	S Cedar Creek	386	352	738	1,342	705	2,047	P
130	N Waterman	393	306	699	1,336	1149	2,485	P
131	Horse Range C	711	166	877	2,240	428	2,668	P
132	Horse Creek	561	88	649	2,250	321	2,571	P
133	W Maple Spring	328	296	624	1,222	1367	2,589	T
134	E Waterman	460	237	697	1,644	543	2,187	P
135	Horse Range	478	309	787	1,712	987	2,699	P
136	C Waterman	438	78	516	1,403	514	1,917	P
137	S Waterman	665	71	736	1,655	593	2,248	P
273	Corral South	590	174	764	2,345	451	2,796	T
274	Corral North	639	168	807	1,914	472	2,386	T
319	Groves Prairie C	406	288	694	1,477	805	2,282	T
335	Horse Linto	721	160	881	2,289	560	2,849	T
358	W Horse Ridge	652	59	711	2,123	466	2,589	T
ST 403	STNF	578	255	833	1,780	1123	2,903	P
ST 404	STNF	436	400	836	1,566	1027	2,593	P
ST 502	STNF	124	275	399	449	341	790	T
ST 503	STNF	493	91	584	1,501	486	1,987	P
ST 504	STNF	634	238	872	2,096	880	2,976	P

[1]P=Pair; T=Territorial Single

After the Megram Fire, there are now approximately 37,620 acres of NR habitat and 24,910 acres of foraging habitat within LSR 305 for the northern spotted owl. The total acreage of suitable spotted owl habitat after the fire represents a loss of approximately 10 percent of suitable habitat for the northern spotted owl. Presently within LSR 305, approximately 72 percent of the capable acres are currently providing suitable habitat, as compared to 80 percent prior to the Megram Fire. Table F-4 displays a summary of suitable spotted owl habitat by ownership post Megram Fire, and Table F-6 displays the preliminary take assessments for the 37 activity centers within LSR 305 post Megram Fire. Figure 3-19 displays suitable habitat for the northern spotted owl post Megram Fire within LSR 305.

Table F-4. Northern Spotted Owl Habitat Post Megram Fire within LSR 305.

Habitat Type	SRNF Acres	STNF Acres	Private Acres	Total Acres
Foraging	13,271	11,342	300	24,913
Nesting/Roosting	20,453	17,072	94	37,619
Unsuitable	23,499	8,371	282	32,152
Total Habitat	33,724	28,414	394	62,532

Post Megram Fire, the preliminary take assessments for the activity centers located within LSR 305 determined that 27 activity centers are below the “take” threshold within the 0.7 mile radius, with 21 of these also below the “take” threshold within the 1.3 mile radius. Eleven activity centers are above the “take” threshold completely. Table F-5 summarizes the NSO assessment of suitable habitat within activity centers for both pre and post habitat conditions of the Megram Fire.

Table F-5 NSO Activity Centers (AC) within LSR 305; Assessment of Nesting, Roosting (NR), and Foraging within 0.7 and 1.3 mile Radius and Comparison of Pre and Post Megram Fire Habitat Conditions.

Time Period	Total Activity Centers within HTMTT Watersheds	# AC > 500 acres NR within 0.7 Miles	# AC > 500 acres NRF within 0.7 Miles	# AC > 1,340 acres NR within 1.3 Miles	# AC > 1,340 acres NRF within 1.3 Miles
Pre-Megram	37	17	32	29	35
Post Megram	37	11	29	16	32

Table F-6. Acres of Suitable NSO Habitat within 0.7 and 1.3 Miles of Known Activity Centers in LSR 305 Post Megram Fire.

Owl Number	Territory Name	NR Acres 0.7 Mile	F Acres 0.7 Mile	Total NRF Acres	NR Acres 1.3 Mile	F Acres 1.3 Mile	Total NRF Acres	Status
98	Whitey’s	451	22	473	1159	393	1,552	P
99	Lockhart	395	229	624	1038	469	1,507	P
106	NF Mill Creek	360	349	709	895	943	1,838	P
108	Middle Fork	214	68	282	957	441	1,398	P
113	Mill Creek	445	70	515	1030	374	1,404	P
114	Tish Tang Pt	160	145	305	714	333	1,047	P
115	SF Tish Tang	509	126	635	1,600	560	2,160	T
116	Tish Tang East	807	50	857	2,180	596	2,776	P
117	Tish Tang Ck	472	219	691	1,412	520	1,932	P
118	C Lone Pine	641	243	884	1,714	1,042	2,756	T
119	W Lone Pine	521	282	803	1610	902	2,512	P
120	McKay Meadows	32	253	285	163	740	903	T
121	Ladder Rock	97	239	336	362	795	1,157	T
123	EF Horse Linto	4	323	327	166	851	1,017	P
124	E Lone Pine	177	583	760	751	1,263	2,014	T
125	Cedar Creek	222	390	612	822	991	1,813	P
126	Groves Prairie	260	395	655	783	1283	2,066	P
127	E Cedar Creek	404	269	673	978	968	1,946	P
128	S Cedar Creek	337	353	690	995	841	1,836	P
130	N Waterman	386	306	692	1,324	1,151	2,475	P
131	Horse Range Ck	711	166	877	2,209	443	2,652	P
132	Horse Creek	514	118	632	2,004	305	2,309	P
133	W Maple Spring	327	297	624	1,216	1,371	2,587	T
134	E Waterman	458	237	695	1,603	520	2,123	P
135	Horse Range	434	306	740	1,217	1,073	2,290	P
136	C Waterman	428	80	508	1,375	472	1,847	P
137	S Waterman	640	69	709	1,576	556	2,132	P
273	Corral South	572	186	758	1,890	546	2,436	T
274	Corral North	348	152	500	1,133	528	1,661	T
319	Grove Prairie Ck	392	279	671	1,333	843	2,176	T
335	Horse Linto	175	183	358	641	920	1,561	T
358	W Horse Ridge	619	84	703	1,997	468	2,465	T
ST 403	STNF	578	255	833	1,780	1,123	2,903	P
ST 404	STNF	436	400	836	1,566	1027	2,593	P
ST 502	STNF	124	275	399	449	341	790	T
ST 503	STNF	493	91	584	1,501	486	1,987	P
ST 504	STNF	634	238	872	2,096	880	2,976	P

Summary of Findings

The draft recovery plan for the northern spotted owl predicted this LSR would support 20 Current Projected Federal owl pairs and 25 Future Projected Owl pairs. Given the habitat conditions after the Megram Fire, LSR 305 does not meet the level of suitable habitat necessary to provide for 20 Current Projected Federal owl pairs nor the 25 Future Projected Federal owl pairs as per the Recovery Plan. The Megram Fire reduced the amount of NR habitat by approximately 20 percent and the amount of foraging habitat by 10 percent. Currently only 72 percent of the capable spotted owl habitat within LSR 305 is classified as suitable. The preliminary assessment exhibits that LSR 305 is only providing for suitable habitat that is above the “take” threshold for 11 of the 37 activity centers. In light of the above data regarding the effects of the Megram Fire on NSO habitat, it is doubtful that LSR 305 is adequately functioning at the landscape level in providing late-succesional habitat for the northern spotted owl. Given the loss of approximately 20 percent of the total nesting/roosting habitat, it is critical that nesting and roosting habitat be maintained and management activities focus on the maintenance and acceleration of early-mature and mid-mature seral stages within activity centers below the “take” threshold for development into nesting and roosting habitat for spotted owls. Additional management direction should also focus on reducing the future wildfire risk associated with areas that burned with moderate and high severities during the Megram Fire. By reducing the high accumulations of fuels that resulted from the Megram Fire, this additional protection would reduce the hazard and would therefore increase the probabilities needed to allow the early mature and mid-mature stands to reach late-seral habitat conditions. The long-term beneficiaries would ultimately be the northern spotted owl and late-seral dependent species.

The baseline analysis for the northern spotted owl will be updated after field verification of stands affected by the Megram Fire within LSR 305. This analysis should be completed later this year and will yield a ground-verified evaluation of the LSR relative to its ability to provide habitat for northern spotted owls. The evaluation within this appendix is intended to display the habitat conditions both pre and post Megram Fire using the most current information from recent aerial photograph analysis with limited ground validation.

APPENDIX G
FIRE EFFECTS

General Fire Effects

The presettlement composition and structure of Pacific Northwest forests were greatly influenced by fire. Fire plays a direct role in processes associated with vegetation succession, nutrient cycling, and soil structure and stability. However, fire is a dynamic process. Ecosystem response to fire will vary depending on the amounts of organic matter consumed, season of burn, time since the last burn, and the many variables associated with biotic, physical, climatic, and anthropogenic features of an ecosystem (Kauffman 1990).

In addition to genetically adapted traits (e.g. serotinous cones, sprouting from below-ground plant organs), several other factors will influence plant response to fire. Characteristics of the individual plant include age and vigor. Specific adaptations and the capacity to survive a fire often will change with age. Environmental conditions which influence survival include type of fire (surface or crown fire), fire frequency or return interval, season of burn (during the active or the dormant growing season), fuel consumption, fire intensity, physical site characteristics (slope, aspect, soil type), and associated species. The high occurrence of younger seral stages indicates that mortality of these younger, less fire tolerant trees could be higher when wildfires do occur.

It is clear that large, stand-replacing wildfires with very high to extreme fire behavior could drastically affect wildlife habitat, soils, vegetation, water quality, and channel morphology. At the same time it is important for forest managers to understand the positive role of fire in forest systems, vegetation adaptations to survival in fire regimes, and the effects of altering fire regimes on vegetation composition. Alterations of fire regime have resulted from active fire suppression in these watersheds, which historically had a much more frequent fire return interval. Fire regimes have also been altered by management activities, which shortened fire return intervals (e.g. logging followed by slash burning) or lengthened fire return intervals (e.g. aggressive fire suppression). These potential fire effects need to be considered in terms of wildfires and prescribed burns. Considering the predominant tree species within the HLMTT watersheds, this appendix includes a brief, generalized discussion of potential fire effects.

Aggressive wildfire suppression actions, under a ground-based control strategy, could have detrimental effects, especially on unstable soils. Prescribed burning will result in some fire induced mortality, but this will mainly occur in the younger, less fire resistant seral stages or in the fire-intolerant vegetation types that would have been eliminated during more frequent fire return intervals. This substitute for the natural thinning process of light to moderate intensity wildfires would also remove some competition and could help accelerate the growth and vigor of the stronger, surviving trees. At the same time, mortality of any of the larger trees would contribute to the recruitment of snags and coarse woody debris.

Fire Effects by Species

The following is a brief, generalized discussion of potential fire effects for the predominant tree species listed for the HLMTT watersheds:

Canyon live oak: Above-ground foliage of canyon live oak is sensitive to fire, and this plant is generally top-killed by fires of even relatively low intensity (Green 1980). Light ground fires can seriously damage or girdle this oak or produce fatal cambium injuries to the crown and trunk (Minnich 1977). The dead flaky outer bark is extremely flammable and can carry fire several feet up the trunk (Plumb and McDonald 1981). The bark is relatively thin and offers little protection when compared with other species of oak (Minnich 1977). The trunk appears to be sensitive to heat damage (Plumb 1980), which often extends up the trunk, far above any obvious signs of charring (Plumb and Gomez 1983).

The total effect of fire on oaks varies according to fire intensity and severity, fire behavior, season of burn, and the size of the plants. Younger plants and those with smaller stems and lower crown heights tend to be most vulnerable (Plumb 1980). Trees with crown-to-ground distances of 15-30 feet or more tend to be most resistant to damage. Larger trees have relatively little dead fuel in the crown since leaf fall occurs in early summer prior to typical fire seasons. The thicker bark of larger oaks provides some additional protection as does the greater living biomass, which decreases overall flammability (Minnich 1980). Trunks of oaks are, in general, more seriously damaged by slower moving, lower intensity fires than those of higher intensity, but shorter duration (Plumb and Gomez 1983).

Crown damage is variable in oaks and the degree of damage can differ even within an individual crown. Damage may range from essentially none total removal of the foliage. Crown survival of larger trees is somewhat variable. Trees of 12 inches dbh have survived with wounds up to 20 feet in height (Plumb 1980).

The full effect of fire on oaks may not become obvious for some time. It may be necessary to wait for at least one growing season, and preferably three, before survival can be accurately determined. Undamaged leaf crowns of seemingly girdled canyon live oaks may appear alive for as long as eight years after a fire (Plumb and Gomez 1983).

Canyon live oak generally sprouts prolifically after fire (Minnich 1980). Even seedlings are often capable of sprouting after disturbance (Mallory 1980), and moderate to dense regrowth of sprouts is typical after fire (Plumb and Gomez 1983). Canyon live oak sprouts vigorously from the subsurface rootcrown even when the upper canopy is only partially defoliated by burning or scorching (Minnich 1980). The rootcrown itself has been described as a ``basal woody mass'' but does not appear to be lignotuberous (Keely 1981). Post fire stump-sprouting occurs where portions of the stump remains intact (Mallory 1980). Under certain circumstances, some larger trees crown sprout if only ``marginally singed'' (Minnich 1980). However, this appears to be somewhat unusual, with resprouting typically occurring from the base and not the crown (Minnich 1976).

Where sprouting occurs, recovery of canyon live oak is generally rapid. On many sites following lighter fires, canyon live oak frequently forms dense, virtually impenetrable stands 3 to 10 feet in height within 15 to 30 years after fire. After 30 years, canyon live oak generally grows in multistemmed clumps, which form a closed canopy 15 to 30 feet high (Minnich 1980). Frequent fires favor shrublike growth forms of canyon live oak, which often dominates other species following several fires at fairly close intervals (Burcham 1974). Open woodlands of canyon live oak are temporarily replaced by live oak chaparral after repeated burning. However, protection from fire favors the reestablishment of oak woodlands as oak sprouts ultimately grow tall enough to outcompete other associated plants (Mallory 1980).

A fuel management consideration is that, although the heat content of the outer bark of canyon live oak is relatively low when compared with other California oaks (Quercus spp.), its low density and flakiness contribute to heat buildup around the trunk (Plumb and Gomez 1983). In terms of prescribed burning, Plumb (1980) reports that ``the use of prescribed fire in the management of canyon live oak does not appear to be promising'' where primary goals include maintenance of oak woodlands. Trees are sufficiently sensitive to trunk girdling that even ground fires can kill the trunk surface. Prescribed fire can be used in stands of larger trees where fuel loading is low, or where trunks are protected from the direct effects of heat. Repeated fires at frequent intervals can maintain shrubby canyon live oak chaparral.

Fire in California oak woodlands can create favorable, although transitory, habitat for birds such as the flicker and hairy woodpecker, which feed on insects present in the branches of fire-killed trees (Clark 1935).

Douglas-fir: Low elevation Douglas-fir forests can be included with the Tanoak description below. But for higher elevation Douglas-fir the stands have a different composition and response to wildfires. In these forests, where summer moisture is quite limiting, adequate growing space for regeneration is often linked to forest disturbance, which creates sites for tree establishment as a result of overstory mortality. Historically, fire has been the most prominent disturbance in such stands. Multi-aged forests are a common result of moderate-severity fire regimes. Fire kills a portion of the canopy trees, and surviving trees often occur in patches. Many small trees are killed because of thin bark and low crowns. Some are killed immediately and others die slowly, weakened by decay that enters fire scars on stems and roots. Tree establishment occurs in the newly available growing space, and can continue for decades after fire. Such forests often have an “all-sized" diameter distribution but the age class initiation is not continuous but rather pulsed after fire disturbance (Agee 1993). The thicker bark of older Douglas-fir trees make them much more fire resistant.

Coastal Douglas-fir is more fire resistant than many of its associates and can survive moderately intense fires. Thick corky bark on the lower bole and roots protects the cambium from heat damage. In addition, the tall trees have their foliage concentrated on the upper bole, which makes it difficult for fire to reach the crown (Morrison and Swanson 1990). 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). Widely distributed as a canopy dominant in lower and middle elevation forests throughout the Pacific Northwest, Douglas-fir occupies forests with varied fire regimes. In general, the size and severity of natural fires tend to decrease, while fire frequency increases southward from western Washington to northern California (Morrison and Swanson 1990).

Crown fires commonly kill all trees over extensive areas. Hot ground fires that scorch tree crowns and char tree boles kill variable proportions of coast Douglas-fir (Agee and Huff 1980). Rapidly spreading ground fires tend to inflict more damage to Douglas-fir crowns, while slow spreading ground fires are damaging to the bole and can kill trees through cambial heating (Peterson and Arbaugh 1989). Crown scorching from summer fires is more damaging than late summer or fall fires because more buds are killed. During late summer, the buds are set and subsequent year needles are well protected (Wagener 1961). Seedlings and saplings are susceptible to and may be killed by even low-intensity ground fires (Volland and Dell 1981).

Tanoak: Tanoak is a fire-sensitive species. Aboveground portions are extremely susceptible to fire mortality. The thin bark provides little insulation from radiant heat, which usually kills the cambium around the base of the stem (McDonald and Tappeiner 1987). As a result, low-intensity ground fires readily top-kill tanoak seedlings and sapling-sized stems (Tappeiner and McDonald 1984), while larger, thicker barked trees occasionally survive light underburning. Bole injuries usually result following ground fires, however, and vertical wounds 4 to 10 feet long are common. Many older tanoak trees may initially survive light burns, but bole wounds facilitate the entry of insects, and disease and most injured trees eventually die (Roy 1974). In virgin redwood stands in Redwood National Park, Veirs (1982) found the oldest tanoak trees occupying sites where frequent underburning by indigenous peoples reduced fuel loadings to the point where only light-intensity ground fires occurred. Crown fires kill the aerial portions of all tanoak, regardless of age or size (Roy 1974).

Tanoak is more susceptible to fire mortality when it occurs beneath a mature conifer overstory. Plants under these conditions are subject to increased stress and are less able to survive fires than when growing in a more open environment (Kauffman and Martin 1985).

Tanoak resprouts following fire via dormant buds located on an underground regenerative organ (Plumb and McDonald 1981). Stored carbohydrates in the burl and an extensive taproot system aid in a rapid and aggressive portburn recovery. Unless fires are particularly severe, nearly all tanoak resprout to some extent during the first postburn growing season (McDonald and Tappeiner 1987).

Sites which are particularly prone to the rapid development of a dense tanoak understory are those where the preburn vegetation consists of low conifer stocking combined with high tanoak densities. Fires aimed at suppressing the tanoak understory can be expected to be most effective when conducted in 30 to 75 year old conifer stands (Tappeiner and McDonald 1984).

White fir: White fir's typically thin bark provides little insulation for the cambium during mild underburns until it reaches diameters greater than 8 inches. Smaller trees are either killed directly or weakened and later die from secondary infection of insects or disease (Atzet and Wheeler 1982). The bark of old white fir trees tends to be moderately thick. Their shallow roots show a tendency towards root char as a common way of killing. This may be the cause of the large amounts of white fir snags along the northeast corner of the watershed.

Sapling- and pole-sized white fir have thin bark that provides little insulation for the cambium, and shallow roots that are susceptible to soil heating. Because of its shade tolerance, white fir is slow to self-prune lower branches. These low-growing branches, which have slender twigs and finely divided foliage, easily ignite from burning undergrowth and provide a fuel ladder to the upper crown. Consequently, young white fir are often killed even by low intensity surface fires. Larger trees are more fire resistant. Mortality results from crown scorch, girdled stems from cambial heating, or root damage from soil heating. Trees damaged or weakened by fire are susceptible to attack by insects and disease. Fire wounds in contact with the ground provide an entry point for decay fungi. Fire-weakened trees that are attacked by insects can be killed within a few years.

Following stand-replacing fires, white fir reestablishes via wind-dispersed seed. Exposed mineral soil seedbeds created by fire favor seedling establishment. However, seedling establishment and survival in sunny locations is often poor. Seedlings establish quickly after fire if a canopy remains but may take several years to establish if the canopy has been removed.

Because sapling and pole-sized white fir are sensitive to even low-intensity fires, prescribed fire can be used as a thinning tool. In mixed conifer forests where white fir dominates the understory due to years of fire suppression, prescribed low-intensity surface fires will kill large numbers of white fir. This reduces the hazard of white fir providing a fuel ladder to ignite the crown of overstory trees and also restores tree species composition closer to that of pristine conditions. When fire prescriptions cannot ensure that young white fir will to ignite the crown of overstory trees, cutting all trees under a certain size before burning reduces this fire hazard.

Underburning before timber harvesting with the shelterwood method in mixed conifer forests can be used to aid natural regeneration. The combination of cutting and burning can remove all advanced regeneration, thus sanitizing the site of heart rot that is present in many 5- to 6-inch diameter white fir. Following harvest seedling establishment of all conifers was abundant (Mohr and Petersen 1984). In some locations preharvest underburning is not recommended because it stimulates dormant shrub seeds to germinate and thus promotes the growth of shrubby vegetation which restricts the establishment and growth of conifers (Weatherspoon 1985).

Exotics/rare plants: Exotic plants can displace native plants and alter or transform their habitat. Many aggressive exotic species are opportunistic invaders of openings, including those caused by fire or mechanical soil disturbance. When fires or machinery used in burning create openings they can provide opportunities for the spread of exotic plant species from external seed sources or from a latent on-site seed bank. Exotic grass species which are fire-conducting have been known to alter fire regimes by increasing fire frequency and, consequently, the composition of plant and animal communities adapted to less frequent fires. Also, rare plants or survey and manage species could benefit or be negatively impacted from burning.

APPENDIX H

MINIMUM SUPPRESSION TACTICS

Suppression

Hot-Line/Ground Fuels

- Allow fire to burn to natural barriers.
- Use cold-trail, wet line or combination when appropriate.
- If constructed fireline is necessary, use only width and depth to check fire spread.
- Consider use of fireline explosives for line construction.
- Use high-pressure type sprayers on equipment prior to assigning to incident to help prevent spread of pathogens.
- Constantly re-check cold trailed fireline.

Hot-Line/Aerial Fuels

- Minimize felling of trees and snags unless they threaten the fireline or seriously endanger workers. In lieu of felling, identify hazard trees with a lookout or flagging.
- Scrape around tree bases near fireline if it is likely they will ignite.

Mopup/Ground Fuels

- Minimize bucking of logs to extinguish fire or to check for hotspots; roll the logs instead if possible.
- Use gravity socks in stream sources and/or a combination of water blivits and fold-a-tanks to minimize impacts to streams.
- Personnel should avoid using rehabilitated firelines as travel corridors whenever possible because of potential soil compaction and possible detrimental impacts to rehab work, i.e. water bars.

Mopup/Aerial Fuels

- 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.

Logistics

Campsite Considerations

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

- 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. Locate at least 200 feet from lakes, streams, trails, or other sensitive areas.

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

- 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 utilized.

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

- Constantly evaluate the impacts that 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 bears. 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

Aviation Use Guidelines

- Maximize back haul flights as much as possible.
- Use long line remote hook instead 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.

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.

Hazardous Materials

Fire Retardant/Foaming Agents

- Do not drop retardant or other suppressants near surface waters.

- Use caution when operating pumps or engines with foaming agents to avoid contamination of water sources.

Fire Rehabilitation

Rehabilitation is a critical need, which 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 rehabilitation personnel as well as quality control.

Rehabilitation Guidelines

If impacted trails have developed on slopes greater than six percent, construct waterbars according to the following waterbar spacing guide:

Trail Grade (%)	Maximum Spacing (ft)
6-9	400
10-15	200
15-25	100
25+	50

- Where soil has been exposed and compacted (e.g., 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. It is unlikely that seed and fertilizer for barren areas will be appropriate, in order to maintain the genetic integrity of the area. It may be possible, depending on the time of year and/or possibility of a rainy period, to harvest and scatter nearby seed, or to transplant certain native vegetation.

- Tear out sumps or dams, where they have been used, and return site to natural condition. Replace any displaced rocks or streambed material that has been moved. Reclaim streambed to its predisturbed state, when appropriate.

Demobilization

Because demobilization 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.