Garcia River Forest

A project of The Conservation Fund in partnership with The Nature Conservancy, State Coastal Conservancy, Wildlife Conservation Board, and California Department of Fish and Game

Integrated Resource Management Plan

August 2006

Cover photograph: Garcia River, Mendocino County, California
Photo by Jenny Griffin

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LIST OF ACRONYMS AND ABBREVIATIONS

BF – board feet

BMP - best management practice

CALVEG - California Vegetation

CAP - Conservation Action Planning

CCF - Crown Competition Factor

CDFG - California Department of Fish and Game

CDF – California Department of Forestry and Fire Protection

CFL - Coastal Forestlands, Inc.

CNDDB - California Natural Diversity Data Base

CNPS - California Native Plant Society

CRYPTOS - Cooperative Redwood Yield Project Timber Output Simulator

CWHR - California Wildlife Habitat Relationships

DBH – diameter (of a tree) at breast height, measured 4.5 feet above the ground on the high side of the tree

ECP – Erosion Control Plan

EPA – Environmental Protection Agency

ERN - Ecological Reserve Network

ESU – Evolutionarily Significant Unit

FPS - Forest Projection & Planning System

FSC - Forest Stewardship Council

GIS - Geographic Information System

GRF - Garcia River Forest

GRWEP - Garcia River Watershed Enhancement Plan

IRMP - Integrated Resource Management Plan

JMWM - Jack Monschke Watershed Management

KRIS - Klamath Resource Information System

LTO – Licensed Timber Operator

LSS – late seral stage

LWD - large woody debris

Mbf – thousand board feet

MCRCD – Mendocino County Resource Conservation District

MWAT – mean weekly average temperature

MWMT – mean weekly maximum temperature

NCRM - North Coast Resource Management, Inc.

NCRWQCB - North Coast Regional Water Quality Control Board

NMFS - National Marine Fisheries Service

NOAA - National Oceanic and Atmospheric Association

NPS – Non-Point Source (Implemention Plan)

NSO - Northern Spotted Owl

PRBO – Point Reyes Bird Observatory

RPF - Registered Professional Forester

SCC – State Coastal Conservancy

SFI - Sustainable Forestry Initiative

SHALSTAB - shallow active landslide stablization (map product)

SOD - Sudden Oak Death

SSMP – Site Specific Management Plan

TCF – The Conservation Fund

THP - Timber Harvest Plan

TMDL – total maximum daily load

TNC - The Nature Conservancy

USGS - United States Geological Survey

WHR - Wildlife Habitat Relationship

WISP - Wildland Invasive Species Program

WLPZ – Watercourse and Lake Protection Zone

EXECUTIVE SUMMARY

INTRODUCTION AND OVERVIEW

The 23,780-acre Garcia River Forest (GRF) was acquired in February 2004 by The Conservation Fund (TCF) in partnership with The Nature Conservancy, the State Coastal Conservancy and the Wildlife Conservation Board. The project seeks to demonstrate that a large, under stocked tract of coastal forest can be returned to ecological and economic viability through patient, adaptive management by a non-profit organization in partnership with private and public entities and community stakeholders. The partners hope that a successful demonstration will stimulate similar projects in the redwood region and provide an example of how to balance the ecological needs of coastal forests with the economic imperatives of ownership, management and restoration. This Integrated Resource Management Plan presents our vision of what this balance looks like and how we will attain it over the coming decades.

The Plan identifies and describes in detail the following general management goals:

- Improve ecological conditions by increasing the viability of selected "conservation targets" identified during the planning process.
- Generate sufficient revenue to cover the costs of property taxes, on-site maintenance, management and restoration projects and, potentially, generate net revenues for other conservation initiatives.
- Practice continual improvement through adaptive management based on monitoring of ecological, financial and social values.
- Support the local business community by utilizing local contractors and suppliers.
- Engage the local community by providing compatible public access, educational and recreational opportunities.

This Plan describes integrated management activities that will efficiently achieve these goals and meet or exceed applicable local, state and federal regulatory and permitting requirements. Principal management activities that will be implemented to achieve these goals and improve the conservation targets are described in detail under the following headings: **Restoration and Enhancement** (including sections on the Ecological Reserve Network, Aquatic Restoration, and Invasive Species), **Watershed Management** (with sections on Water Quality and Roads), and **Silviculture**. Additional management activities include public use, monitoring, and research, education, and demonstration.

GENERAL PROPERTY DESCRIPTION

The 23,780-acre Garcia River Forest is located in the coastal mountain range of southwestern Mendocino County, California, and encompasses approximately one-third of the entire 72,000-acre Garcia River watershed. Large family and industrial timber interests (including the Garcia River Forest) own 75 percent of the watershed; 15 percent is under agricultural use, and ten percent is held in small private ownerships. A 150-year history of forest harvesting has resulted in the current forest conditions, which can be characterized as a young redwood/Douglas-fir forest with a high component of tanoak. Compared to pre-settlement conditions, the Forest is very young, relatively simplified and characterized by an unnaturally high density of hardwoods.

NATURAL RESOURCE VALUES OVERVIEW

GRF conservation values include habitats essential to maintaining various sensitive, rare, and/or endangered natural communities and plant and animal species such as coho salmon, steelhead trout and northern spotted owl. A total of 341 animal species and 35 special status plant species are predicted to occur on the Property. The highly diverse vascular flora of the GRF is represented by at least 504 species in 277 genera and 78 families. The Property is dominated by the redwood habitat type, which accounts for approximately 64 percent of the land-base. In most areas redwood would dominate if vegetation succession were allowed to proceed naturally.

CONSERVATION TARGETS

Conservation targets are species, natural communities, or ecological systems that have been carefully selected to represent the biodiversity of the Garcia River Forest. These targets will be a focus of our management activities, and periodic monitoring of the condition of the targets will provide a measure of the effectiveness of those activities at improving ecological conditions. The conservation targets for the Garcia River Forest are: redwood/Douglas-fir forest; anadromous fish bearing streams; oak woodlands/grasslands; non-riverine freshwater wetlands; and northern spotted owl. Protection and enhancement of these targets is expected to further provide for the conservation of 80 additional "nested" conservation targets that occur at the site but would not be practical to assess individually.

ECOLOGICAL RESERVE NETWORK

The Ecological Reserve Network (ERN) is a well-distributed and representative network of habitat types present on the Property including high-quality grassland, oak woodlands, anadromous fish-bearing streams, redwood/Douglas-fir forest, and eventually late-seral and old growth forest habitat. It totals approximately 35 percent of the Property (8,265 acres). The ERN was designed and will be managed in accordance with the latest understanding of conservation biology to protect and enhance the conservation targets and support large-scale ecological processes. Ecological purposes served by the ERN include:

- To establish ecological conditions over time that enhance the conservation targets;
- To maintain ecological functions and processes that might be absent or diminished in harvested areas—an example includes acting as a source network for slow-dispersing species such as lichens and fungi; and
- To serve an important research and monitoring function by providing for control (undisturbed) conditions.

Management guidelines for the ERN include the following:

- Ecological objectives will drive management of the ERN.
- Timber harvest and other intensive management activities (e.g. herbicide treatment, prescribed fire) will be applied within the ERN only to further ecological objectives, such as thinning to accelerate development of late-seral conditions. Activities including improving or relocating existing roads to serve the larger goal of an operating forest, and to reduce sediments and enhance water quality, will occur.
- Adaptive management of the ERN will be guided by long-term monitoring results.

AQUATIC RESTORATION

To achieve watershed restoration and address sediment delivery problems, sub-basin plans for comprehensive treatment of controllable sediment sources will be developed and implemented. Sub-basins will be prioritized as suggested by Bradbury et al. (1995), with those streams with high habitat quality for steelhead and coho salmon given highest priority for assessment and restoration activities. Detailed efforts currently scheduled and/or underway include: tributary and main stem habitat typing; property-wide road sediment source assessment; treatment of identified high priority sediment sites; assessment of instream structure sites and barriers; instream habitat enhancement; and implementation of monitoring plans.

TMDL

TCF has submitted a statement of intent to the North Coast Regional Water Quality Control Board (NCRWQCB) declaring the intention to submit an Erosion Control Plan (ECP) and Site Specific Management Plan (SSMP) per Option 2 of the TMDL Action Plan for the Garcia River Watershed. The ECP, currently under development, will identify areas of existing and potential sediment delivery and will describe how TCF will control sediment delivery due to past and ongoing management activities. The ECP will include: a baseline data inventory of sediment delivery sites; a sediment reduction schedule; an assessment of unstable areas; and a monitoring plan. The SSMP, approved by the North Coast Regional Water Quality Control Board on May 19, 2006 and as revised on July 21, 2006, identifies appropriate land management measures to control sediment suitable for the conditions and activities of the Property. The SSMP includes a description of land management measures to control sediment delivery from the following sources: roads; landings; skid trails; watercourse crossing construction, reconstruction, maintenance, use, and obliteration; operations on unstable slopes; use of skid trails and landings; and use of near stream facilities. It also includes a description of land management measures to improve the condition of the riparian management zone that addresses stream bank protection, the filtering of eroded material prior to its entering the watercourse channel, and the recruitment of large woody debris to the watercourse channel and flood plain. An associated long-term road system plan is currently under development and is included in draft form as Appendix J, "Draft Road Management Plan."

SILVICULTURE

Past management and site conditions have shaped timber stand components throughout the Property. The primary component is pole-sized and small second-growth sawtimber (30 to 50 or more years old) occasionally in pure conifer stands, but primarily mixed in with hardwoods. These stands developed from the heavy harvests of the 1950 and 1960s, and have been since re-entered after 1988. In addition there are numerous hardwood-dominated stands, predominately 30 to 50 year-old tanoak. In general, the commercial quality timber stand is young, healthy, and vigorously growing. The forest is almost equally populated by redwood and Douglas-fir, with a small amount of sugar pine. The timber stand is uniformly small, with an average merchantable tree size diameter of only 14 inches, and only 21 percent of the total sawtimber volume occurring in trees with diameters over 24 inches. Compared with historical composition and desired conditions, most stands are understocked with conifers and have a high degree of hardwood competition.

The overall goal of the forest management is to insure long-term and sustained-yield production of valuable forest products in a healthy, vigorous and diverse forest while protecting and

enhancing the associated values of watershed, wildlife, fish, soils, recreation and aesthetics. Key silvicultural strategy elements are described below.

- Our silviculture will be primarily uneven-aged, to develop and maintain a range of tree sizes and ages within a stand, with the goal of producing valuable sawtimber and utilizing natural regeneration.
- We have a responsibility to manage the Garcia River Forest to generate reasonable revenue for re-investment in the Property (e.g. restoration projects, road upgrades) and, potentially, for conservation projects elsewhere in the region.
- Our harvest levels will be significantly less than growth rates over the next few decades so as to increase the timber inventory (we expect that it will double in 25 years).
- We are providing for increased riparian buffers on our Class I streams so as to improve riparian habitat conditions and provide late-seral connectivity across the landscape.
- Special attention will be given to critical wildlife habitat features, such as snags, down wood, and trees of significant size.
- We recognize that because of past practices the Forest contains smaller trees and more hardwoods than would have occurred naturally and we will work to more closely approximate natural conditions.
- There are no old growth stands on the Property; there are a few individual trees that may be residual old growth—these and other very large trees and true oaks will be maintained.
- We anticipate no need to clearcut; we may use even-aged variable retention harvests (that retain large trees and habitat features) to rehabilitate conifer sites now dominated by hardwood or in future salvage situations; group selection will likely be used on Douglas-fir sites; and all regeneration harvests will encourage natural regeneration.
- We have committed to certification of our forest management under the Forest Stewardship Council and Sustainable Forestry Initiative standards and reporting our carbon sequestration through the California Climate Action Registry.

PUBLIC ACCESS

It is our goal to provide a variety of public access opportunities that can be reasonably managed and that are consistent with the protection of natural resources, long-term restoration and enhancement, and active forest management. These opportunities range from research, education, and demonstrations to citizen participation in restoration to unsupervised pedestrian trail access. Public access on the Garcia River Forest will be developed incrementally, beginning with supervised access and over time piloting an unsupervised public trail on an appropriate portion of the Property which may be expanded to other areas of the Property.

Phased development of public access will:

- Provide on-site demonstrations of sustainable forest management and other best management practices.

- Provide opportunities for public participation in research, education, and restoration projects.
- Provide a volunteer-based, guided public access program.
- Establish unsupervised trail access on an appropriate portion of the Property; evaluate the feasibility of expanding this access to other areas.
- Explore options to provide access for game hunting.

MONITORING METRICS AND APPROACH

To evaluate our success and improve our management we are developing a comprehensive monitoring program. Monitoring of conservation targets will include regular assessment and tracking of indicators of their long-term viability. A number of other Property attributes also will be monitored, including erosion and water quality, forest inventory and growth, carbon accumulation, rare plants and northern spotted owls.

While the Plan outlines our monitoring approach and priorities, it is not a comprehensive monitoring plan. TCF and The Nature Conservancy will prepare a detailed initial plan for an efficient and comprehensive monitoring program by the summer of 2007.

INTRODUCTION AND PURPOSE OF PLAN

BACKGROUND

The Redwood Region of California's North Coast is one of the richest, and rarest, ecosystems in the world. It is home to keystone species such as the northern spotted owl, marbled murrelet, mountain lion, coho salmon and steelhead trout. It is also home to some of the most productive forestlands in the world.

For decades, logging has been the predominant land use here, and has established a pattern of large landholdings that so far has prevented the fragmentation of the landscape into the patchwork of small parcels that typifies much of rural California. There is increasing awareness of the fact that maintaining large *sustainably managed* forestland tracts is essential to the protection and restoration of forest ecosystems.[1] Further, the timber industry is an important component of the regional economy. Even today, the counties of Mendocino and Humboldt account for fully half the value of the State's annual timber harvest.[2]

However, there is a growing consensus that the future viability of the North Coast timber industry has never been more uncertain. Investor expectations, inventory depletion, foreign competition and regulation are forcing timber industrial and non-industrial forestland owners to consider converting their properties to "higher and better uses" that may yield a greater financial return. As a result, rural residential subdivisions and vineyard conversions are increasingly common on the North Coast.[3]

The traditional land protection approach of public acquisition and preservation of forestlands cannot alone meet this challenge: there is not nearly enough public money to purchase or manage such large tracts of forestland. Further, local communities are increasingly resistant to the effects of such large purchases on the local economy and tax base. Accordingly, new forest conservation and financing strategies are needed to establish large, permanently protected

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[1] See, generally, "State Development Trends" - William Stewart, CA Dept. of Forestry, California Forest Futures 2005 conference (www.nature.berkeley.edu/forestry/forestfuture/ff_presentations/Stewart.pdf).

The California Department of Fish and Game's Recovery Strategy for coho salmon specifically recommends "Encourag[ing] continued economically sustainable management of forest and agricultural lands in the range of coho salmon to reduce the potential for conversion to residential or commercial development."

In addition, water quality goals have been established by the U.S. EPA and the North Coast Regional Water Quality Control Board for most of the coastal watersheds in the region. The Regional Board's Nonpoint Source Program Strategy and Implementation Plan, 1998 – 2013 identifies several management measures related to silvicultural activities that can enhance water quality.

[2] See, e.g., *Forestry, Forest Industry, and Forest Products Consumption in California*, Laaksonen-Craig and Goldman UC Davis Publication 8070.

[3] For a detailed discussion of the problem, see The Conservation Fund, 2005, *Conservation Prospects for the North Coast: A Review and Analysis of Existing Conservation Plans, Land Use Trends and Strategies for Conservation on the North Coast of California at pages 118 et seq.*

"working forests" that will prevent forest fragmentation and provide for the restoration and recovery of the wildlife, fisheries and local economies they support.

THE GARCIA RIVER FOREST PROJECT

The Garcia River Forest project was initiated in February 2004 by The Conservation Fund in partnership with The Nature Conservancy (TNC), the State Coastal Conservancy and the Wildlife Conservation Board. The overarching goals for this project are perhaps best stated in the conservation easement granted to TNC:

- Restore and protect a productive and relatively natural coastal California forest ecosystem.
- Protect fish and wildlife habitat associated with this ecosystem, in particular the oak woodlands, serpentine grasslands, and redwood/-Douglas-fir, forest, and spawning habitat for coho salmon and steelhead trout.
- Protect significant water resources, springs and the water quality thereof.
- Maintain the capacity of the Property for productive forest management, including the long-term sustainable harvest of high quality forest products, contributing to the economic vitality of the state and region in a manner that does not impair the Conservation Values or the other purposes of this Easement Purposes.
- Maintain the use of the Property for outdoor recreation.
- Maintain at least 35 percent of the Property as a permanent ecological reserve network (the "Ecological Reserve Network"), which shall include oak woodlands, grasslands, riparian areas and other areas with high value conservation features.
- Prohibit any use of the Property that will impair, degrade or damage the Conservation Values of the Property.

The project seeks to test the hypothesis that a large tract of coastal forest can be returned to sustainable timber production and ecological vitality through patient management by a non-profit organization in partnership with private and public agencies and community stakeholders. Whether this hypothesis can be proved on the Garcia River Forest (the Forest) is not a foregone conclusion – there are many challenges to be overcome, including low current timber volumes, a predominance of hardwoods in many stands, the burden of maintaining and improving an extensive road system, as well as the uncertain economic, regulatory and political environment affecting the timber industry as a whole.

Yet we have many reasons to believe we can be successful:

- The commercial quality timber on the Forest is young, healthy, and vigorously growing. Redwood quality is generally good since previous harvests removed most of the low quality trees and fire-damaged trees. The younger and smaller redwood that remains is clean and defect-free.

- Careful, selective harvests and pre-commercial thinning at levels significantly less than growth should generate modest income in the near-term.
- While there is much work to be done, the road system and other infrastructure is generally in good condition.
- As a non- profit, TCF's inherently low cost of management, together with the ability to raise private and public funds to implement management and restoration, will further reduce demands on the Forest to support its extensive infrastructure as it returns to a mature forest capable of maintaining itself economically with sustainable forest management practices.
- We will adaptively manage the Forest by continually monitoring the effects of our management actions and adapting them to best fulfill the stated conservation goals for the project.

Finally, and most importantly, the project continues to benefit enormously from the hard work and creativity of its partners, advisors, funders and community participants who are acknowledged at the beginning of this document. Their contributions to the project, and commitment to its success, reflect a shared sense that the North Coast forests are at an historic crossroad, with one road leading to fragmentation and loss of forest productivity, the other leading to intact watersheds, recovering fish and wildlife, and a sustainable timber economy for the region. This Integrated Resource Management Plan (IRMP) is our map for taking the latter, more hopeful road.

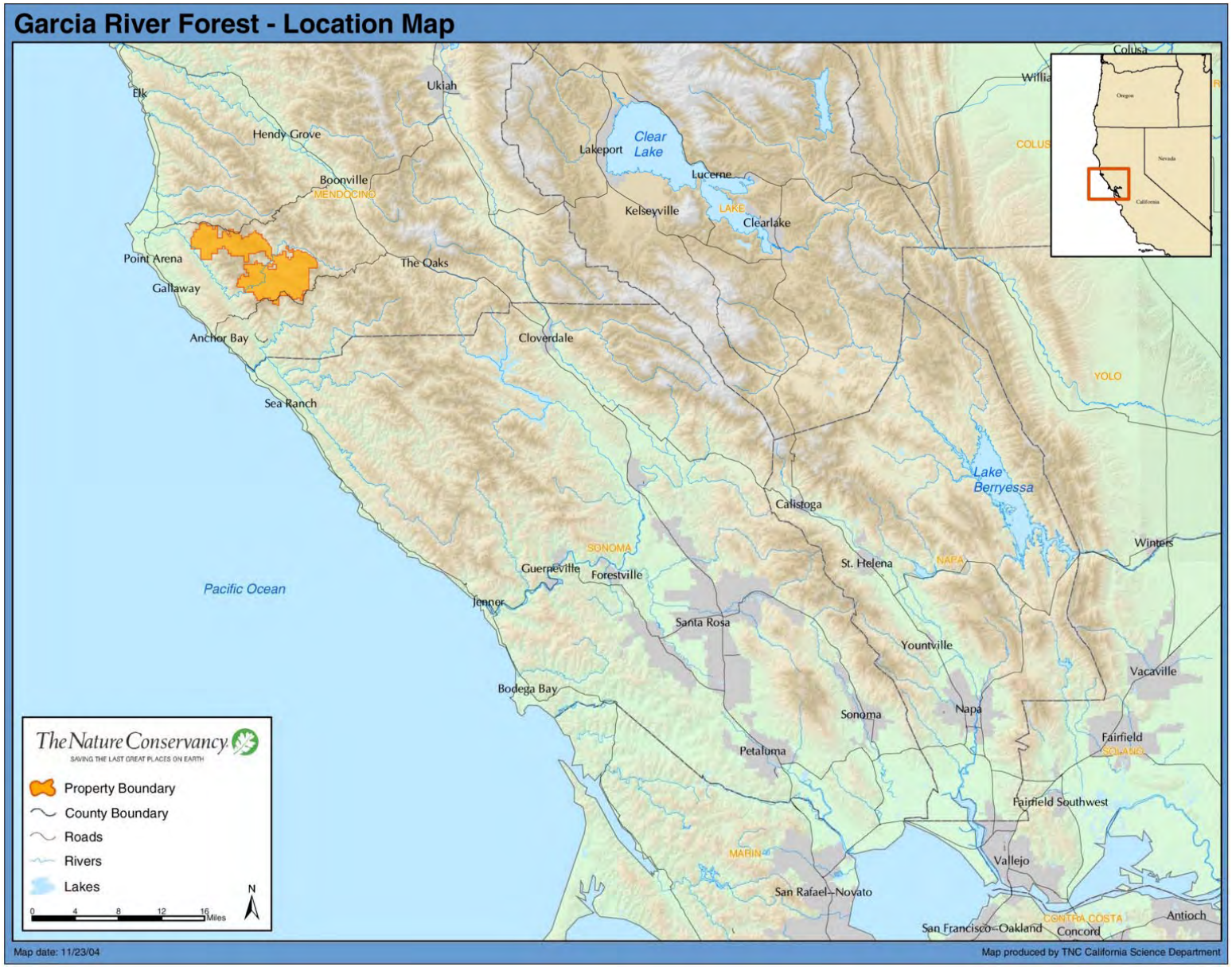
I. OVERVIEW OF GARCIA RIVER FOREST

A. GENERAL PROPERTY DESCRIPTION

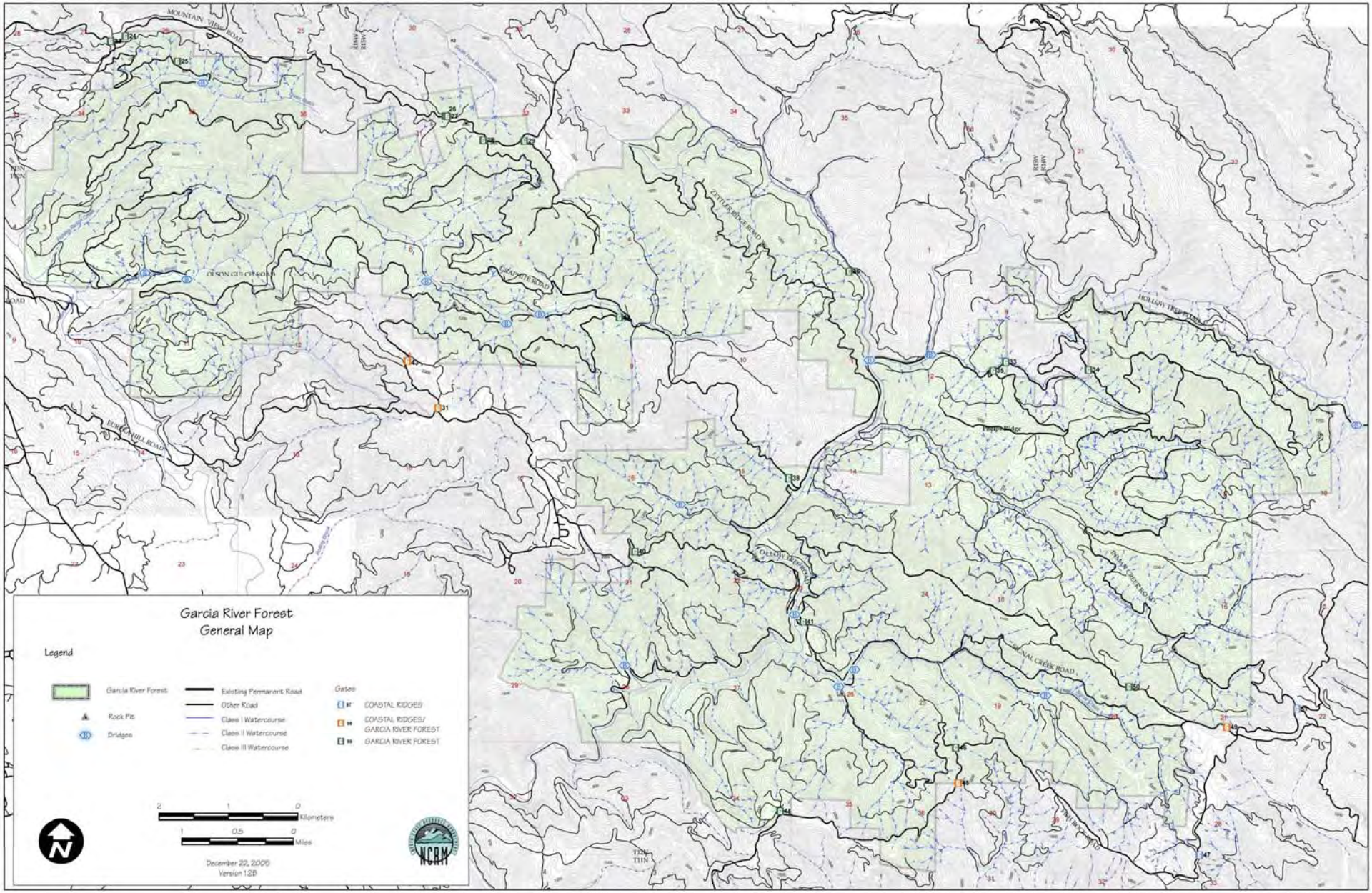
1. LOCATION OF THE PROPERTY

The Garcia River Forest (variously referred to as the "Forest," the "Property," or GRF) is located in the coastal mountain range of southwestern Mendocino County, California, closest to the towns of Boonville to the east and Point Arena and Manchester to the west. The general location is longitude 123 degrees 44' W and latitude 38 degrees 56' N, approximately 120 miles north of San Francisco and 40 miles south of Fort Bragg (see Map 1, Location Map). The Property is contained within three 7.5-minute USGS quad maps: Zeni Ridge, McGuire Ridge, and Eureka Hill. The Property is located within the central portion of the Garcia River watershed, encompassing approximately one-third of the entire 73,223-acre Garcia River watershed; it includes 70 percent of the North Fork Garcia River, over seven miles of Garcia River mainstem, 85 percent of the Signal Creek watershed, 82 percent of the Inman Creek watershed, and the majority of Blue Waterhole Creek West. Elevations range from 46 to 2,290 feet. Access is via adjoining county roads, Mountain View Road and Fish Rock Road, as well as an internal system of dirt and rocked roads. The Property encompasses approximately 23,780 acres and is made up of portions of 173 tax assessor parcels (see Appendix A for a list of assessor parcels and Maps 1 and 2, Location Map and General Map, which follow).

MAP 1: LOCATION MAP



MAP 2: GENERAL MAP



2. OWNERSHIP AND LAND USE HISTORY

Before 1950 the only roads in the upper watershed were jeep trails into old homesteads and a few ranches. Logging in the Garcia area surged again in the 1950s in response to the post-World War II demand for new housing and the development of new logging machinery, which allowed for cheaper harvesting and transportation. The period of heaviest logging in the Garcia watershed was 1954-1961, during which time almost all of the forestland in the Garcia River watershed was roaded and logged. The GRF was extensively cutover during this period, during which most of the old growth timber was removed by Hollow Tree Lumber Company. Mill D, on the Garcia mainstem near Signal Creek, was built in the early 1960s and was operated until the early 1970s. Longview Fiber Company acquired the Property in 1965 and, although that acquisition allowed a ten-year timber reservation by Hollow Tree, relatively little harvesting took place from 1970 through 1988. R&J Lumber purchased the Property in 1988, at which time the timber stands consisted of very young second-growth and scattered residual timber left from previous harvests. Harvesting increased at this time, targeting slower-growing residual timber. In 1992, Coastal Forestlands (CFL) acquired the Property together with the remainder of the Longview tract in the Gualala watershed and a separate property in the Big River watershed known as Willits Woods. For most of the next decade CFL focused on thinning the smaller diameter classes throughout its ownership, while removing most of the remaining residual conifers. CFL sold the Property to Pioneer Resources in 1998, and subsequently repurchased it in 2004. TCF and partners acquired the Property from CFL in February 2004. There have been no timber harvest activities since the property was sold to Pioneer Resources in 1998.

The history of forest harvesting has resulted in the current forest conditions, which can be characterized as a young redwood/Douglas-fir forest with a high component of tanoak. Compared to pre-settlement conditions, the Forest is very young, relatively simplified and characterized by an unnaturally high density of hardwoods.

While timber harvesting continues to be the predominant land use for large forested properties in the vicinity of the Property, conversions of timberland to other uses, including rural residential development and vineyards, have become increasingly common. The pace of this conversion is aided by the existence of dozens of separate legal parcels that comprise the GRF and similar properties. TCF's acquisition of the Property was motivated by a desire to prevent fragmentation of the property and to protect and restore its ecological values in conjunction with sustainable timber management.

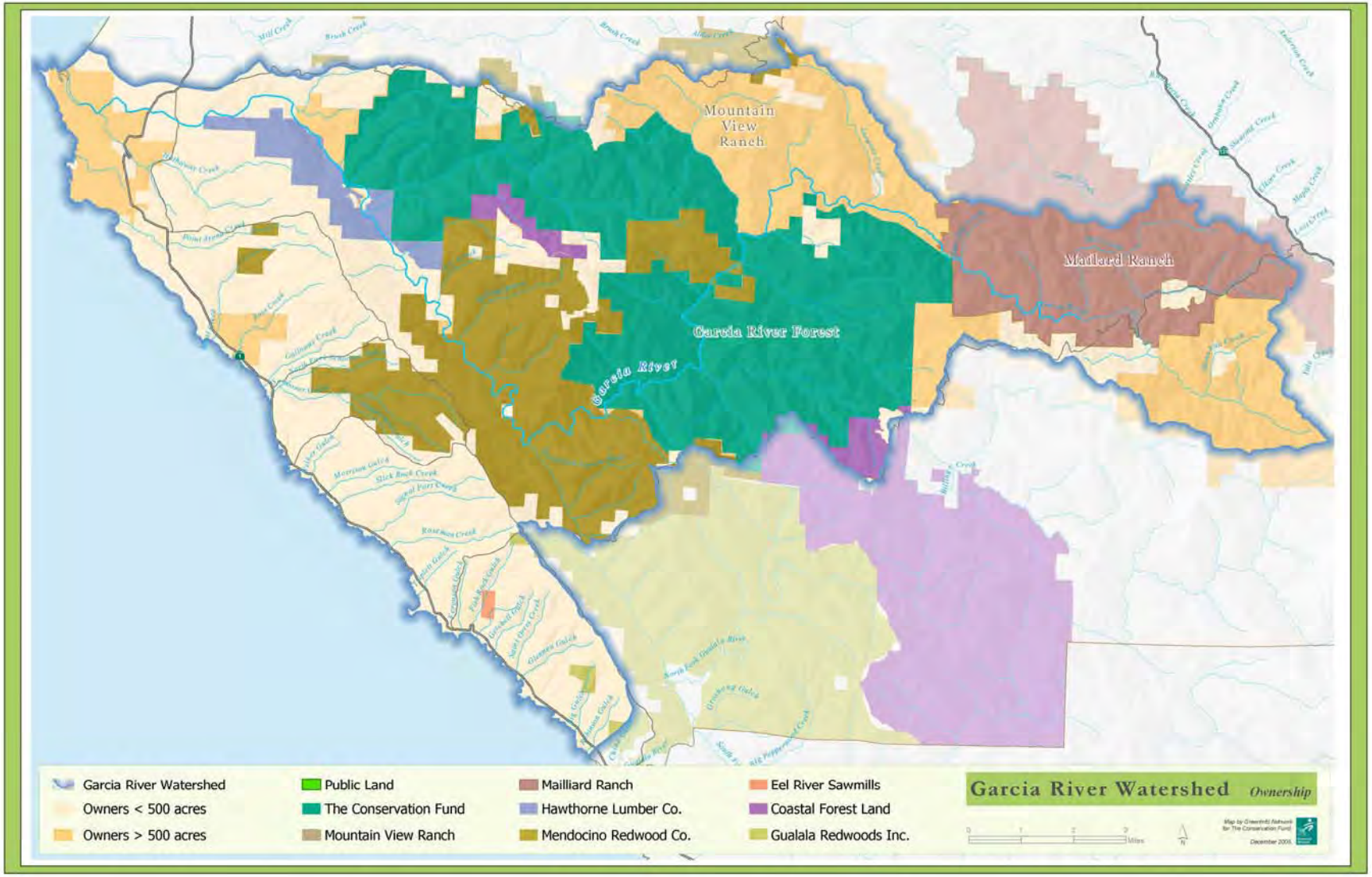
3. NEIGHBORS AND ADJACENT LANDS

Much of the land adjacent to the north, west, and south are large forestland holdings that are actively managed for timber production. Neighboring owners include Coastal Ridges LLC, Mendocino Redwood Company, Hawthorne Timber Company, and smaller interests. Another large timberland owner, Gualala Redwoods Inc., is nearby but not adjacent. Nearby sizable landowners include Mailliard Ranch, Mountain View Ranch, the United States Point Arena Air Force Station, United States Coast Guard Point Arena Lighthouse, and the Manchester Rancheria (Bureau of Indian Affairs). Nearby public lands include Bureau of Land Management lands (the recently conserved Stornetta Ranch property as well as several smaller inland tracts), Manchester Beach State Park and Marine Reserve (760 acres), Schooner Gulch State Beach, Mailliard Redwood State Reserve (seven miles to the east), and several additional state beaches (all California Department of Parks and Recreation). Properties to the east are generally drier and

are used for cattle pasture or vineyards. The Manchester and Point Arena Rancherias (tribal lands approximately 200 acres each) are located west of the GRF.

Including TCF, 75 percent of the Garcia watershed is owned by large family and timber interests. Fifteen percent is under agricultural use, and ten percent is held in small private ownerships.

MAP 3: WATERSHED OWNERSHIP MAP



B. GENERAL PHYSIOGRAPHIC FEATURES

1. WATERSHED OVERVIEW

The Garcia River watershed is a forested watershed with a coastally influenced climate in the lower half of the drainage and a Mediterranean-type climate in the upper half of the drainage. The watershed drains approximately 72,000 acres (114 square miles). The mainstem of the river is approximately 44 miles from the mouth to its headwaters at Pardaloe Peak, and the combined length of the mainstem and its perennial tributaries is approximately 105 miles. The River flows northwest along the San Andreas Fault Zone for nearly ten miles before bearing west to the Pacific Ocean. Elevations range from 2,470 feet at Pardaloe Peak to sea level.

The upper watershed is characterized by steep and rugged forestland, much of which has been harvested, and is scarred by erosion primarily from past logging practices and associated road construction predating the Z'Berg Negedly Forest Practice Act. The more gently sloping lower portion, with coastal terraces and alluvial bottomlands, is more commonly used for agricultural production, including potatoes, silage, forage, livestock grazing, and dairy. Residential development is modest. The relatively small estuary area (approximately 80 acres of open water and mud flats and 150 acres of more upland type vegetation) serves as an important habitat for anadromous and other fish, many species of shore birds and waterfowl, and numerous other forms of wildlife. Species of special interest in the Garcia watershed are the whistling swans, *Olor columbianus,* which winter in the area near the estuary, and the Point Arena Mountain Beaver, *Aplodontia rufa* (Hood, 1977) a federally listed endangered species. Other nearby stream systems to the south are the Gualala River and a number of smaller coastal drainages. To the north are Brush, Alder, Mallo Pass, Elk, and Greenwood Creeks.

2. CLIMATE

Located within the Oregonian Biotic Province, the watershed has a Mediterranean climate, characterized by a pattern of low-intensity rainfall in the winter and cool, dry summers with coastal fog. Temperatures in the Point Arena area, among the most constant in the state, reflect the strong maritime influence. The mean annual temperature is 54 degrees Fahrenheit, with a difference of less than ten degrees in mean temperatures of the coolest and warmest months. There is a substantial variation in temperatures and precipitation between upper and lower areas of the watershed, but continuous data is not available from the upper basins. Mean annual precipitation is 30 inches at the coast and up to 100 inches per year on the inland peaks. Ninety percent of this precipitation generally falls between October and April with the highest average precipitation in January. The USGS maintained a stream gauging station on the Garcia at river mile 8.2 from August 1, 1962 to September 30, 1983 (reflecting a drainage area of 98.5 square miles). Mean annual flows during the period of record varied from 712 cubic feet per second (cfs) in water year 1974 to 20 cfs in 1977. The lowest recorded flow was 2.3 cfs on September 16, 1977. The largest flood recorded on the Garcia River during the period of record was 30,300 cfs, recorded January 16, 1974 (Ott, 1979).[4]

[4] KRIS Garcia, 2003.

3. GEOLOGY

The North Coast of California is geologically young. The landscape has been shaped by the collision of the Gorda and North American tectonic plates, resulting in steep terrain and drainages and the San Andreas Fault. The lower river follows the San Andreas Fault for nearly ten miles before entering the ocean. The upper watershed areas are deeply incised by tributaries. High rainfall, legacy roads and the steep gradient of these streams give them a high capacity to transport sediment.

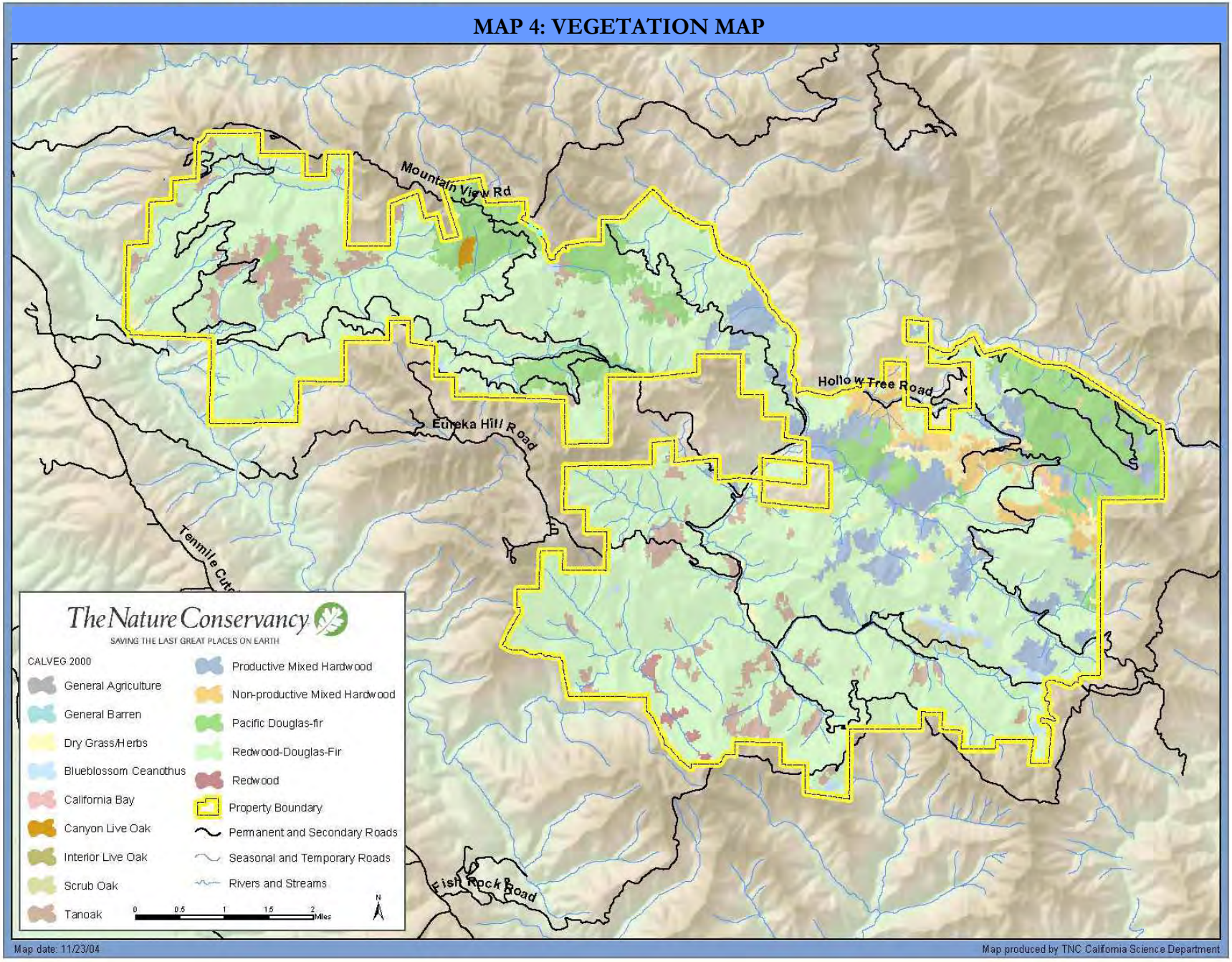
The watershed east of the San Andreas including all of the GRF is entirely composed of the Franciscan Complex. The parent rock in these formations is often weakly consolidated or sheared, leading to a high erosion risk. The exception on the Property is the Inman Creek sub watershed, which is comprised of a more erosive metamorphic geology with a higher clay component. Grasslands and oak woodlands are more concentrated in this area. This sub watershed is also characterized by a higher number of poorly constructed permanent roads; as a result, up to one-third of all mitigation sites property-wide are located in the Inman Creek sub watershed (see "Watershed Management and Water Quality " and Appendix B, "Jack Monschke Watershed Management Garcia River Forest Project Overview," for details).

4. SOILS

Soil types are identified and described in detail in Appendix C, "Soil Types and Descriptions." The Natural Resource Conservation Service soil survey depicts 13 soil complexes in the project area. Nine of these soils are capable of producing commercial-quality timber, although of varying potential. The other four non-timber soil types support grasslands, brush, and hardwoods.

Soils capable of growing commercial quality timber occupy 22,034 acres (92 percent of the total property acreage). The following four primary timber soil types comprise over nine-tenths of this timber-producing acreage: Yellowhound-Kibesillah, Woodin-Yellowhound, Ornbaun-Zeni, and DeHaven-Hotel complexes.

MAP 4: VEGETATION MAP



C. ECOLOGICAL CONDITIONS

NATURAL RESOURCES VALUES OVERVIEW

Conservation values of the Garcia watershed are widely known and generally well documented.[5] GRF conservation values include habitats essential to maintaining various sensitive, rare, and/or endangered natural communities and plant and animal species such as coho salmon, steelhead trout and northern spotted owl, as well as the significant public benefits of preserving open space from development and providing protection for scenic qualities unique to the area. These resources are summarized below and in several referenced appendices.

1. SPECIES OCCURRENCES AND HABITAT TYPES

A search of potential species present based on California Department of Fish and Game's (CDFG's) Wildlife Habitat Relationship (WHR) types predicts the occurrence of 341 animal species on the property (see Appendix D, "WHR Animal Species Predictions"). The California Native Plant Society's (CNPS) Inventory of Rare and Endangered Plants of California lists 35 special status plant species with the potential to occur on the Property (see Appendix E, "CNPS Search Results"). Four special status plant species were confirmed during rare plant surveys conducted in 2005, including two representing range extensions of 40-100 miles (see Appendix G, "Rare Plant Survey"). The highly diverse vascular flora of the Property is represented by at least 504 species in 277 genera and 78 families; approximately 20 percent of the flora is comprised of exotic species, primarily non-native annual grasses in the meadows and oak woodlands.[6]

The Property includes a significant representation of the vegetation types associated with the region. The Property is dominated by WHR category "RDW" (redwood habitat type), which accounts for approximately 64 percent of the land-base. Primary conifer species are coast redwood and Douglas-fir, with some sugar pine, western hemlock, and grand fir. The principal hardwood species is tanoak with a mixture of madrone, oak (*Quercus sp.*), California laurel, and other California hardwoods. In most areas redwood would dominate if vegetation succession

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[5] **a)** The Department of Fish and Game's "Recovery Strategy for Coho Salmon" (presented to the California Fish and Game Commission in February, 2004) identified the Garcia River watershed as a "refugia" for coho (refugia watersheds are defined as those that have "consistent presence of coho salmon" and are a top protection and restoration priority for CDFG).

b) The Upper Garcia River is identified as a "Tier 1 Portfolio Site," the highest statewide designation, by The Nature Conservancy of California ("California North Coast Ecoregional Plan," June 2001).

c) Northern California Coastal Forests are designated as having "globally outstanding biodiversity" by the World Wildlife Fund (WWF) in "Terrestrial Ecoregions of North America," and are identified as a Class 1 ecoregion, or "Globally outstanding ecoregion requiring immediate protection of remaining habitat and extensive restoration." Urgent action priorities developed by the WWF include greatly increasing "…the number of certified forests where timber is being harvested sustainably," which is "…essential for maintaining the integrity of ecosystems outside protected areas."

d) The Garcia River watershed is identified as a "high priority" conservation area in the "Mendocino County Coastal Conservation Plan" (Mendocino Land Trust, April 2003).

e) The Garcia watershed is identified as a conservation focal area in "A GIS-Based Model for Assessing Conservation Focal Areas for the Redwood Ecosystem" prepared for Save-the-Redwoods League (1999).

6) The Coastal Element of Mendocino County's General Plan lists the Garcia River as "one of the most important anadromous fish streams in the County" relative to miles of use.

[6] Hulse-Stephens, 2005.

were allowed to proceed naturally. The redwood habitat type has been shown to provide food, cover, or special habitat elements for 193 wildlife species including a variety of sensitive species.

In addition to the redwood habitat type, Oak Woodlands (i.e. *Quercus* forests), Riparian Habitat, Meadow/Prairie, Chaparral, and Coastal Scrub occur on the Property to varying degrees, each providing unique elements beneficial to many wildlife species. Oak Woodlands have been reported to provide food or cover to at least 60 wildlife species, and are important food sources for resident populations of quail, squirrels and deer. Riparian habitats have an exceptionally high value for many wildlife species, providing water, thermal cover, migration corridors, and diverse nesting and feeding opportunities.

TABLE 1
WILDLIFE HABITAT RELATIONSHIP (WHR) TYPES ON GARCIA RIVER FOREST

Habitat Patch Type	Representative Acreage on Property
Annual Grassland (AGS)	357
Coastal Scrub (CSC)	121
Coastal Oak Woodland (COW)	9
Douglas-Fir (DFR)	2,234
Mixed Chaparral (MCH)	103
Montane Hardwood-conifer (MHC)	1,417
Montane Hardwood (MHW)	4,054
Redwood Forest (RDW)	15,131
Non-forest	10
Sub-Totals:	23,435
Fee Portion in Point Arena Watershed:	344
Total Acreage:	**23,780**

Descriptions of these vegetation habitat types are included as Appendix F, "Vegetation Types."

RIPARIAN COMMUNITIES

The smaller tributary streams are intermittent and do not show much distinctive riparian tree development. However, there is a dense riparian corridor along the North Fork Garcia River, Garcia River mainstem, Signal, Inman and Blue Waterhole Creeks. This is where neotropical migratory birds are expected to be most abundant.

Table 2, below, is a summary of the total miles of stream in each Planning Watershed from CDFG's GIS for the Garcia River watershed based on ten years of THPs from 1987 to 1997 and USGS data. Shaded boxes represent greater than average values (Best et al. 1997). Note: figures represent watershed-wide information, and are not specific to the Property.

TABLE 2
SUMMARY OF TOTAL STREAM MILES IN GARCIA RIVER PLANNING WATERSHEDS

Planning Watershed	Predominant Stream	Square miles	Class I (mi/mi^2)	Class II (mi/mi^2)	Class III (mi/mi^2)	Unclass. Perennial (mi/mi^2)	Unclass. Intermittent (mi/mi^2)
113.70010	Pardaloe	16.36	0.47	0.33	2.29	0.19	1.83
113.70011	Larmour	10.23	0.50	0.80	1.71	0.48	0.99
113.70012	Stansbury	6.21	1.03	1.23	4.22	0.00	0.00
113.70013	Blue Waterhole	7.70	0.67	0.96	2.47	0.58	0.14
113.70014	Inman	8.56	0.88	1.86	6.56	0.00	0.00
113.70020	Signal	6.18	0.84	1.48	4.35	0.00	0.12
113.70021	Graphite	5.35	1.01	1.65	4.45	0.00	0.00
113.70022	Beebe	4.10	0.74	2.42	3.13	0.00	0.00
113.70023	South Fork	8.74	0.35	0.26	0.51	0.85	0.63
113.70024	Rolling Brook	12.50	0.53	0.71	1.23	0.32	0.33
113.70025	North Fork	16.21	0.76	1.82	3.94	0.03	0.00
113.70026	Hathaway	12.26	0.28	0.86	1.00	0.45	0.19
113.700	Garcia basin	114.40	0.67	1.20	2.99	0.24	0.35

NORTH COAST RIVER

North Fork Garcia River, Garcia River mainstem

The Property encompasses approximately 70 percent of the North Fork Garcia River and over seven miles of the Garcia River mainstem. Stream habitat surveys by CDFG in 2004 reveal that while in the North Fork canopy cover was generally good, pool frequency and pool shelter (particularly woody cover) both need improvement (CDFG 2005). Shade canopy is not at acceptable levels in the Garcia mainstem and needs restoration (CDFG 2005).

Large numbers of juvenile anadromous salmonids (predominantly steelhead) have been observed in the North Fork Garcia below a 20-foot-high bedrock falls, which precludes migration to the uppermost two miles of the Class I system (Mendocino County Resource Conservation District 1992, North Coast Resource Management [NCRM] 2002b). Both the North Fork and the mainstem of the Garcia contain steelhead, coho, and Chinook habitat (NCRM 2002a).

NORTH COAST PERENNIAL STREAM

Signal, Inman, Graphite, and Blue Waterhole Creeks

The Property encompasses approximately 85 percent of Signal Creek, 82 percent of Inman Creek, 65 percent of Graphite Creek, and much of Blue Waterhole Creek West. Potential steelhead, coho and Chinook habitat has been identified in all four creeks (NCRM 2002a), however temperature data indicates that temperatures in these Class I streams are often above temperatures suitable for anadromous fish (Maahs and Barber 2001, IFR 2003, CDFG 2005).

Signal Creek represents 3.47 miles of Class I stream habitat (NCRM 2002b). In 2002, NCRM updated 1997 stream habitat quality assessment work done by Best et al. Evaluations were for Class I streams only and were based on canopy closure percentage, percent of sand on riffles, and quantity and volume of large woody debris. (For more information on habitat quality assessment protocols see Best et al. 1997.) Overall, channel conditions in Signal Creek were rated relatively good and fair numbers of juvenile steelhead and very small numbers of coho have been observed here in recent years (Bell 2003, NCRM 2002b, CDFG 2005). However, CDFG survey work in 2004 indicates that Signal Creek has streambank erosion problems in places, and needs improved pool frequency and shelter (particularly woody cover) (CDFG 2005).

Inman Creek includes 7.08 miles of Class I stream and channel conditions are moderate (NCRM 2002b). CDFG survey work in 2004 indicates that Inman has streambank erosion problems in places, that shade canopy is not at acceptable levels and that Inman needs improved pool frequency and shelter (particularly woody cover) (CDFG 2005). Few juvenile salmonids were seen in 1995, but small numbers were observed during channel assessment fieldwork done in 1996 and 2004 (NCRM 2002b, CDFG 2004).

Graphite Creek needs improvements in pool frequency and shelter (particularly woody cover), as well as supplementation of spawning gravels (CDFG 2005).

Blue Waterhole West includes 5.33 miles of Class I stream (NCRM 2002b). Blue Waterhole has consistent temperatures above those acceptable for anadromous fish (Maahs and Barber 2001, IFR 2003, CDFG 2005), and needs significant riparian forest planting to improve riparian canopy cover and shading, as well as restoration to improve pool frequency and shelter (particularly woody cover) (CDFG 2005).

NORTH COAST HEADWATER STREAM AND NORTH COAST INTERMITTENT STREAM

The streams on the Property retain a natural hydrological regime, feed lower anadromous fish habitat, and are important habitat for native species of amphibians. This is true even for streams that dry up completely. They are important breeding sites for amphibians, which can utilize other sites for refuge during the dry season. They also provide habitat for a large number of invertebrate species (e.g. mayflies, stoneflies, caddis flies) that only require the presence of water for part of the year. Protection of these headwater streams is important for improving water quality, and reducing erosion and sedimentation in the watershed.

INTERIOR WETLANDS, SPRING, AND SEEPS

Interior wetlands on the Property include springs, seeps and at least two marshes. One hot spring and 11 other small springs have been documented on the Property (we expect the number of documented springs to increase significantly as they are routinely surveyed for during timber harvest plan preparation). The major wetlands occurring on the Garcia River Forest are the riparian areas draining the upper Garcia River watershed. Other wetland types include seeps or wet meadows characterized by low but prolonged water discharge rates. Seeps and springs share the characteristic high diversity of traditional stream and wetland habitats and provide important habitat and resources for invertebrates, amphibians, reptiles, birds and mammals. In

addition, there are many plant species that are unique to such habitats. Eleven of the special status plant species and plant species of special concern listed in Appendix E, "CNPS Search Results," occur in seep habitats.

2. OTHER SIGNIFICANT HABITATS

RIPARIAN

The main branch of the Garcia River near the western end of the Property is quite wide (10-15m) supporting dense Red Alder (*Alnus rubra*) and Sitka Willow (*Salix sitchensis*) with mature Redwood (*Sequoia sempervirens*) along the banks. The Torrent Sedge (*Carex nudata*) grows in large, conspicuous tussocks next to boulders in the mainstream channel. In flatter areas along silty terraces and gravel bars several native and exotic species occur such as *Scirpus microcarpus, Cyperus eragrostis*, Mugwort (*Artemsia douglasiana),* Durango Root (*Datisca glomerata*), *Equisetum* spp., Velvet Grass (*Holcus lanatus)*, Rabbit's Foot Grass *(Polypogon monspeliensis*), Cocklebur (*Xanthium strumarium*), and *Setaria viridis*. In shady recesses and alcoves along the rivers edge the vegetation is very lush and Streamside Orchid (*Epipactis gigantea*), Leopard Lily (*Lilium pardalinum*), Lady Fern (*Athyrium filix-femina*), and Five Finger Fern (*Adiantum aleuticum*) are common.

Further east and higher into the upper reaches of the main forks and tributaries of the watershed, stream channels narrow and become more rocky, gradients increase, and the character of the vegetation changes. White Alder (*Alnus rhombifolia*) along with Large-leaf Maple (*Acer macrophyllum*) dominate the riparian zone replacing Red Alder. Elk Clover (*Aralia californica*), Giant Chain Fern (*Woodwardia fimbriata*), and Western Azalea (*Rhododendron occidentalis*) are common species filling in the voids among mossy covered rocks.

WET SEEPS

Depressions or channels cut along the inboard side of roads intercept and hold water moving down slope creating wetland habitat. Roadside seeps are generally linear features common throughout the Property and support largely common wetland taxa such as *Carex* spp., *Juncus* spp., *Typha* spp., *Equisetum* spp., and *Salix* spp. Common species include *Carex bolanderi, C. deweyana var. leptopoda, Cyperus eragrostis, Juncus bolanderi, J. effuses var. pacificus, J. balticus*, Hedge Nettle (*Stachys ajugioides var. rigida*), Bolander's Water Starwort (*Callitriche heterophylla var. bolanderi*), and Loosestrife (*Lythrum hyssopifolium*).

SERPENTINE HABITAT

The only substantial area of serpentine is located in the Inman Creek watershed and consists of a reddish ultramafic outcrop approximately two hectares in size composed largely of serpentinite, derived from Franciscan Formation ophiolites of Mesozoic age. The outcrop itself is very sparse in plant cover but supports a rich suite of species found nowhere else on the Property. A band of serpentine influenced grassland lies adjacent to the outcrop which in turn is surrounded by a mixed coniferous forest of Douglas-fir, Redwood, and Pacific Madrone.

Species restricted to the outcrop include *Minuartia douglasii, Claytonia exigua ssp. exigua, Eriogonum luteolum*, Turpentine Weed (*Trichostema laxum), Microseris douglasii, Vulpia microstachys var. ciliata,* Indian's Dream (*Aspidotis densa*), and Blue-eyed Mary (*Collinsia parviflora*). Additional species are

restricted to the adjacent serpentine grassland and include *Hordeum brachyantherum ssp. californicum* and *Trifolium albopurpureum var. dichotomum*.

In addition to these the site is rich in other native bunch grasses including California Fescue (*Festuca California*), Western Fescue (F. occidentalis), and California Oat Grass (*Danthonia californica*). Many serpentine indicator taxa such as Cream Cups (*Platystemon californicum*), *Sidalcea diploscypha*, Gold Fields (*Lasthenia californica*), *Lotus wrangelianus*, and *Lomatium utriculatum* are also present.

Some roadcuts in the central portion of the Property have serpentine rocks and support the CNPS List 3 plant, *Erigeron biolettii*.

3. SPECIAL STATUS ANIMAL SPECIES

NORTHERN SPOTTED OWL

The northern spotted owl (*Strix occidentalis caurina*) is federally threatened and a CDFG species of special concern. Northern spotted owl (NSO) has been confirmed on the Property, and has been surveyed every year since 2000. PRBO Conservation Science successfully completed the first year of the two-year NSO survey requirements for the north-eastern portion of the Garcia River Forest and documented two nesting pairs which each successfully fledged one young (PRBO, 2006). Two additional pairs were located with unknown nesting status as well as one resident single male. Two other single males were heard but efforts to pinpoint their locations were not successful. Remaining call points along Hollow Tree, Inman and Graphite roads were surveyed with no response after three night visits; two sites were determined unoccupied.

According to CDFG, spotted owls prefer dense, old growth, multi-layered mixed conifer, redwood, and Douglas-fir forests, and prime habitat includes moderate-to-dense stands of medium-to-large trees and multi-layered stands of redwood and Douglas-fir, with mature, multi-layered stands required for breeding; however, recent investigation in northwestern California indicates that the greatest habitat fitness for northern spotted owls is found in landscapes that are a mix of mature and old growth forest, and of open vegetation types like brush land and young forest (Franklin et al. 2000). A primary prey for the owl in this area includes an early successional species, the dusky-footed woodrat, which may explain the owl's preference for such a mixed landscape. Other prey includes flying squirrels, mice and voles, including the red tree vole. They also prey on small rabbits, small birds, bats and large arthropods. They use dense, multi-layered canopy for roost seclusion and appear to prefer north-facing slopes in the summer, due to intolerance for high temperatures. Individuals require permanent water and suitable nesting trees and snags with broken tops or cavities.

RED TREE VOLE

The red tree vole (*Arborimus pomo*) is both a federal and CDFG species of special concern. Red tree voles occur along the North Coast and are more or less restricted to the fog belt and old growth and other forests, mainly Douglas-fir, redwood and montane hardwood-conifer habitats. There have been four sightings on the Property and five sightings immediately adjacent to the Property by G. Gould of CDFG in 1998, Galea Wildlife Consulting in 2000 and S. McKinstry of PVT-Pioneer Timber Company in 2002 (CDFG 2004a). Prime habitat includes open-to-dense stands of medium-to-large Douglas-fir trees, as well as multilayered stands of Douglas-fir.

Primary food sources are the needles of Douglas-fir and grand fir. Nests are also made of Douglas-fir needles and are constructed either on a whorl of limbs near the trunk or at the outer limits of branches, preferably in tall trees. Red tree voles are mainly nocturnal outside the nest, although they feed throughout the day on needles stored in the nest. The home range probably encompasses one to several fir trees, with males visiting several trees and females often living in one tree. A major predator is the northern spotted owl.

COHO SALMON

Coho have been definitively observed in Signal Creek in 1998 (Bell 2003) and in North Fork Garcia River in 2002 (CDFG 2003). The coho salmon (*Oncorhynchus kisutch*) was listed as federally threatened on December 2, 1996 within the Central California Coast Evolutionary Significant Unit (ESU) and was listed as state and federal endangered status in 2005. This ESU includes all naturally spawned populations of coho salmon in coastal streams south of the Mattole River to the San Lorenzo River in Santa Cruz County. Coho salmon are anadromous salmonids that require migration access to streams, cold, clean, well oxygenated water and prefer the cover of overhanging vegetation, undercut banks, submerged vegetation, rocks, and logs and deep, slow-moving water. Coho typically initiate upstream migration between late October and mid-February. Preferred mean weekly average temperatures (MWATs) found in the literature for coho range from 14.8 to 18.3° C (60-67° F), while mean weekly maximum temperatures (MWMTs) range from 16 to 18° C (62-66° F). Redds are laid in gravel that range in size from 1.3 to 10.2 cm. in diameter and intergravel mortality occurs when fine sediments exceed 13 percent of the substrate composition. After emergence from gravels, juvenile coho spend the rest of the year in the freshwater environment. This makes coho reliant on over-summer and over-wintering habitat needs within rivers and streams, engendering susceptibility to impacts from degraded freshwater habitat. Favored summer habitat is deep coldwater pools often formed by the presence of large woody debris and sufficient cover. Winter habitat includes low velocity stream habitats (alcoves, backwaters, side channels and floodplains) where juveniles can weather high winter flows. Coho migrate to the ocean at age one and return to fresh water to spawn after two to three years.

CHINOOK SALMON

Chinook salmon (*Oncorhynchus tshawytscha)* within the California Coastal ESU was listed as federally threatened November 15, 1999. This ESU includes only naturally spawned coastal spring and fall Chinook salmon between Redwood Creek in Humboldt County and the Russian River in Sonoma County. Chinook are believed to be extinct in the Garcia River basin; however, potential habitat has been identified on the Property (NCRM 2002b). Environmental requirements for successful spawning include: substrate size 1.3 to 10.2 cm., with few fine sediments; preferred depths 0.24 to 3.0 m.; water velocity 0.3 to 0.91 m/sec.; temperature 5.6 to 13.9° C; and dissolved oxygen at saturation. The incubation period for eggs is usually 60 days, and fry emerge from gravel in about 30 days. Juveniles begin their dispersing downstream migration towards the estuary within a few weeks of emergence. Juveniles may spend from ten days to four months in the estuary before entering the ocean. Adult Chinook migrate to freshwater and spawn at ages one to five with the majority of their life having been spent in the marine environment.

STEELHEAD TROUT

Steelhead has been observed on the property (Mendocino County Resource Conservation District [MCRCD] 1992, Maahs and Barber 2001). The steelhead (*Oncorhynchus mykiss*) was listed as federally threatened on June 7, 2000 within the Northern California ESU which includes steelhead in California coastal river basins from Redwood Creek in Humboldt County south to the Gualala River. The vast majority of steelhead stocks present in the North Coast are winter-run whose adult upstream spawning migrations occur from December through March, with spawning taking place shortly after the arrival to the spawning grounds. Unlike Chinook and coho, most steelhead do not die after spawning, but migrate back to the marine environment and return to spawn in following years. Steelhead have flexible life histories with most spending between one and three years in freshwater before migrating to the ocean as smolts. They also spend a variable amount of time (one to four years) in the marine environment before returning to spawn. While this provides flexibility to adapt to variable stream conditions, it makes juvenile steelhead susceptible to adverse over-summer and over-winter stream conditions. Adverse conditions concerning this species are elevated water temperatures and sedimentation of spawning gravels. Steelhead mortality at the different life stages is closely affiliated with water temperatures. Preferred MWATs found in the literature for steelhead range from 15 to 17° C (60-64°F), while MWMTs range from 16 to 22° C (62-74° F). Steelhead prefer to spawn in gravels 0.6-10.2 cm. in diameter, with eggs developing in approximately 31 days. When fine sediments exceed 13 percent of the substrate composition, intergravel mortality can occur.

PINK SALMON

Pink salmon (*Oncorhynchus gorbuscha*) are a CDFG species of special concern. Once believed to be extinct in California, they were identified in 2003 and 2004 by Craig Bell in the lower reaches of the Garcia River. Pink salmon live for two years, although occasionally three-year-old fish are reported. Adults move into fresh water between June and September and spawn from mid-July to late-October. As most pink salmon spawn in the intertidal or lower reaches of streams and rivers, it is unlikely that pink salmon would be found on this Property. It is possible, however, as they have been found to spawn 100-700 km. upstream in some rivers. Spawning occurs in gravelly riffles with water depths between 20-60 cm. and temperatures of 4.4 -13° C. Embryos hatch after four to six months and fry emerge in April or May and immediately begin migrating downstream. Embryos require fast-flowing (21-101 cm/sec.) and well-oxygenated water (>6 mg/l.) for normal development. Once in an estuary, they school and remain in inshore areas for several months before moving out to sea.

FOOTHILL YELLOW-LEGGED FROG

The foothill yellow-legged frog (*Rana boylii*) is a federal and CDFG species of special concern. The foothill yellow-legged frog is diurnal and found on or near rocky streams in a variety of habitats, including annual grasslands, coastal oak woodlands, Douglas-fir, mixed chaparral, montane hardwood and redwood habitats which are found on the Property. Main food sources include: aquatic and terrestrial invertebrates, as well as algae and diatoms. The foothill yellow-legged frog is common in the redwood region and can likely be found in all of the Property's streams. Prime habitat includes river and stream areas with submerged gravel, cobbles and boulders, as well as areas with seasonal flooding. Intermittent streams are a preferred habitat, although individuals are rarely found far from permanent water.

CALIFORNIA RED-LEGGED FROG

The California red-legged frog (*Rana aurora draytonii*) is a federally threatened species (except in Humboldt, Trinity & Mendocino Counties; Glenn, Lake & Sonoma Counties west of the Central Valley Hydrologic Basin; Sonoma & Marin Counties north & west of the Napa River, Sonoma Creek & Petaluma River drainages which flow into San Francisco Bay, & north of the Walker Creek drainage which flows to the Pacific Ocean) and a CDFG species of special concern. It has not been observed on the Property, however, the Point Arena area represents the northern end of the range for this species, so it is possible it could be present (Brad Shaffer, personal communication). The red-legged frog is found in humid forests, woodlands and grasslands and inhabits quiet pools of streams, marshes and ponds, and prefers shorelines with extensive vegetation. They require permanent water for larval development, but can survive in intermittent streams if water remains in pools year-round. Adults prey on terrestrial and aquatic insects, worms, and fish, as well as tadpoles and smaller frogs. Prime habitat on the Property includes submerged areas along slow, permanent watercourses.

4. SPECIAL STATUS PLANT SPECIES

Special status plant species identified to date (Sept. 2005) are:

List 1B: Santa Cruz Clover (*Trifolium buckwestiorum*), 3 locations.
List 2: Marsh Pea (*Lathyrus palustris*), 1 location.
List 3: Streamside Daisy (*Erigeron biolettii*), 2 locations.
List 4: Bristly Linanthus (*Leptosiphon acicularis*), 1 location.
White-Flowered Rein Orchid (*Piperia candida*), 1 location.
Cal. Code of Reg. 15380: Long-beard Lichen (*Usnea longissima*), 1 location.

Two of these listed species, Santa Cruz Clover and Marsh Pea, are recent discoveries, represent range extensions, and were not included in the pre-survey data base search for potential special status plants. The Santa Cruz Clover population is a range extension of approximately 40 miles north of the most northerly reported population. The Marsh Pea occurrence represents a range extension of approximately 100 miles south of the most southerly reported population (CNPS 2001). See Appendix G, "Rare Plant Survey," for details.

D. FOREST MANAGEMENT CONDITIONS

The following is a general description of forest management conditions, including general characteristics (primary species, timber quality, essential stand components, overall volume breakdown), management history, roads and infrastructure. See "Silviculture and Harvesting Planning and Operations," Section II, for detailed forest assessments and plans.

1. GENERAL FOREST CHARACTERISTICS

The Property's timber stand is a typical south Mendocino coast young-growth redwood/Douglas-fir forest. Primary conifer species are redwood and Douglas-fir, although there is a significant volume of sugar pine, and traces of western hemlock and grand fir. The principle hardwood is tanoak. Understory species include blue blossom (*Ceanothus sp.)*, greenleaf manzanita (*Arctostaphylus sp.*), and evergreen huckleberry (*Vaccinium ovatum*).

In general, the commercial quality timber stands are young, healthy, and vigorously growing. Redwood quality is generally good since previous harvests removed most of the low quality trees and fire-damaged residuals (i.e. generally over 28 inches dbh). The younger and smaller redwood, which now remains, is clean and defect-free. General form of both redwood and Douglas-fir varies from very good on north-facing slopes and in canyon bottoms to fair on upper south and west aspects near ridge tops.

Past management and site conditions have shaped the timber stand components throughout the Property. These general components include:

- Poles and small second-growth saw timber (30 to 50+ years old), often mixed with hardwoods.
- Larger second-growth timber, often located within Class I and Class II WLPZ areas.
- Young (less than 20 year-old) redwood sprouts and Douglas-fir seedlings/saplings.
- Tanoak-dominated stands.

Overall forest volume breakdown is:

- Redwood 30%
- Douglas-fir 30%
- Other conifer 10%
- Hardwood 30%

2. HISTORY OF FOREST MANAGEMENT

The Property was extensively cutover in the 1950's and 1960's, at which time most of the old growth and larger second growth timber was removed by Hollow Tree Lumber Company, which operated a sawmill on the Property. Longview Fiber Company acquired the Property in 1965 and, although the acquisition allowed a ten-year timber reservation by Hollow Tree, relatively little harvesting took place from 1970 through 1988. Longview treated tanoak with herbicides in many locations within the Garcia during this period.

R&J Lumber purchased the Property in 1988, at which time the timber stands consisted of very young second-growth and scattered residual timber left from previous harvests. Harvesting increased at this time, targeting slower-growing residual timber. In 1992, Coastal Forestlands (CFL) acquired the Property. For most of the next decade CFL focused on thinning the smaller diameter classes and removing most of the remaining residuals. CFL sold the Property to Pioneer Resources in 1998. From that time to the present, no harvest activity has occurred although Pioneer did treat tanoaks in some stands.

3. ROADS

The following is a general description of the Forest's roads and related infrastructure. Detailed descriptions and plans are included under "Watershed Management," Section II, Part B.

Map 2 shows the Property's primary roads. In addition to frontage on county-maintained roads (Mountain View and Fish Rock), there is an extensive system of gravel and dirt roads on the Property that have been used for timber harvesting and all-season access. The road system on the Property was developed over time to facilitate timber harvesting activities, including servicing the old Hollow Tree Mill (aka "Mill D") near the confluence of Signal Creek and the Garcia River. Due to accepted construction practices of the day, the presence of the mill, and increased traffic associated with the mill, many of the roads are wider than one would normally expect in a present-day forest setting. More recently progress has been made to improve the forest roads. Many bridges have been installed on the larger watercourses, road surfaces have been rocked, rolling dips installed and in some cases road widths have been reduced. The roads on the Property at the time of TCF's purchase could generally be characterized as average forest roads. The rock surface applied by previous owners protected the permanent roads and prevented major failures from occurring due to gullying and culvert diversions. However, the road system is in need of maintenance and upgrading to conform to modern design criteria including the installation of rolling dips, critical dips and outsloping the running surface. Common problems noted include: perched or raveling fills on the outside edge; gullying of fills at watercourse crossings; shot-gunned culverts or short culverts; inadequate or missing downspouts; and plugged inside ditches. Some secondary roads are impassable due to brush encroachment. Due to the past harvesting history there is an extensive, and mostly unmapped, network of skidtrails (used for tractor logging). Many of these roads are on steep slopes where new construction would not be appropriate. A major challenge for the future will be identifying and remediating these sites, including continuing to use some of them, where practical and non-deleterious. A summary of GRF roads by class and mileage follows in Table 3.

TABLE 3
MILES OF ROAD PER GARCIA RIVER FOREST PLANNING WATERSHED

Road Class	Item Description	Total
EP	Existing Permanent	60.64
ES	Existing Seasonal	163.9
ET	Existing Temporary & 4WD	13.1
PS	Proposed Seasonal	2.16
RE	Reconstructed	1.54
SR	Secondary Road	5.36
Total		**246.7**

Notes: Item Descriptions from CDF Forest Practice Database Dictionary; mileage calculations from NCRM.

Roads are currently being maintained and upgraded by TCF to meet current standards in a phased approach. Some mainline roads have been identified for permanent maintenance and other roads will be assessed on a variety of factors including future timber harvests and potential for adverse environmental effects. The seven mainline roads include: Hollow Tree Road, Graphite Road, Inman Creek Road, Signal Creek Road from the Zeni Ranch to Graphite Road, The Big Cheese Road from Fish Rock Road to Signal Creek Road, the Olson Creek Road from Mountain View Road back to Graphite Road, the old bus route from Hollow Tree road to Point

Arena Air Force Base and the midslope road on Zettler Ridge traveling northwest from Hollow Tree Road (refer to Map 2, General Map).

4. BRIDGES

The majority of the bridges on the Property were originally constructed with redwood log stringers and decked with soil. Over time the soil surface was replaced with pressure-treated cross members and a wooden running surface. Bridge conditions vary greatly on the Property and repair and replacement are needed in some cases. See Appendix H, "Bridge Conditions," for details on bridge status, repair and estimated replacement costs. Over time some bridges may be removed as roads are abandoned and some bridges may be installed in place of culverts.

5. ROCK PITS

Numerous rock pits are known to occur on the Property and have been used as a source of rock for road surfacing and bridge construction (see descriptions in Appendix I, "Rock Pits," and locations on Map 2). Many other pits exist but have not been identified or mapped. Hundreds of small road cutbanks have also served (and will continue to serve) as minor sources of rock and have not been mapped. The use and development of new rock pits will be necessary for the future road construction and maintenance needs of the Property and as a source of rip-rap for erosion control. These needs cannot be accurately forecast but will be described in the future in annual road maintenance plans and in updates to the IRMP.

E. CULTURAL RESOURCES

1. ARCHAEOLOGICAL AND HISTORICAL SITES

The Garcia watershed lies within the Pomo ethnographic province and was inhabited by a native people known as Bokeya, or Central Pomo. The ancestral lands of this tribe extended along the coast from just north of the Navarro River southward about 35 miles to near the mouth of the Gualala River. A permanent village was located on the Garcia River not far from the present Rancheria; known as "pdahaw" (translated as "at the stream mouth"), the population was estimated at around 200.[7] These factors and the various previously recorded sites indicate that the prehistoric resources most likely to be encountered on the Property are lithic scatters with groundstone present, reflecting generalized use of the area. Native American sites are commonly situated along trending ridgelines or spurs, broad mid-slope terraces, and areas adjacent to season and perennial watercourses, including springs.

Archaeological and cultural resource surveys have been conducted by previous landowners during the preparation of timber harvest plans; over 30 cultural sites have been located on the Property. Existing cultural resources are protected from management activities through exclusion of heavy equipment operation in the immediate vicinity. Specific areas proposed for timber harvest are surveyed during the timber harvest planning process in order to detect and protect any previously unknown sites or artifacts. In accordance with the American Indian Religious Freedom Act and the Antiquities Act, the State of California cultural records data base (maintained at Sonoma State University) will be consulted prior to any land disturbing activities.

[7] KRIS Garcia, 2003.

Continued assessments will be made to locate cultural resources before any significant activity in the forest, and personnel trained in archaeological inventory methods will inventory all sites before timber harvest activity. These Acts require that site locations and descriptions are kept confidential to protect the resources; therefore, no listing is included in this Plan.

The most likely types of historic sites to be encountered within the Property are those related to timber harvest. These types of site range from simple logging camps and historic trails to mill sites and infrastructure related to timber transport. Most of the substantial historic sites in the region are associated with watercourses and historic era dams and camps and are relatively common throughout the Garcia watershed.

2. AESTHETICS

Good stewardship of the Property will lead not only to a productive and healthy forest, but also to a visually pleasing forest as well. By its very nature, logging causes disturbance. However, it is not so much the selective removal of trees that impairs forest aesthetics, as it is the seemingly chaotic aftermath, especially unsightly piles of slash combined with disturbed bare earth. While it is not possible to eliminate disturbance, there are methods to reduce the visual impact. At the same time, openings may be among the most visually appealing parts of the forest. In a forest clearing, one can stand back and actually "see" the forest in a way that cannot be done from beneath the canopy.

Since almost all forest visitors are confined to main roads, and because landings are the principal forest openings, these areas deserve special attention; therefore the following measures will be considered, subject to budget constraints, when harvesting adjacent to forest roads:

- **Clean landings**---blade landings clean of debris, crush/spread debris on nearby skid trails, remove all human litter, skid cull logs back into the woods.

- **Lop slas**h---to within 30" of the ground within view from landings and truck roads, including upper portion of cable corridors.

- **Seed bare ground**---such as roadsides, landings, and visible skid trail approaches with native grasses, erosion control mixes or plant with conifer.

- **Promote view corridors**----by selective hardwood/brush/conifer removal and/or pruning to create open vistas from roads.

- **When constructing new roads**---avoid vertical bank cuts, taper where feasible; minimize soil movement; remove or hide unsightly stumps and logs.

- **Maintain open grasslands** free of slash and debris.

II. MANAGEMENT GOALS

The Garcia River Forest was acquired to protect, enhance and restore the Property's significant natural, ecological, and aesthetic values and to develop and implement sustainable forestry practices – ultimately creating a successful example of landscape-level forest conservation. To achieve these outcomes, specific management goals have been identified, including:

- Improving the status of conservation "targets" identified during the planning process, described below.
- Restoring diversity, complexity and late-seral characteristics to early-successional forests.
- Maintaining and enhancing high quality spawning and rearing habitat for anadromous salmonids.
- Reducing the possible impacts of existing roads and other transportation infrastructure on aquatic ecosystems and water quality.
- Establishing a forest management program that increases forest health and productivity.
- Establishing a monitoring framework for restoration activities within an adaptive management context.
- Generating reasonable revenue by responsible forest management for re-investment in the Property (e.g. restoration projects, road upgrades) and, potentially, for conservation projects elsewhere in the region.

Our intent is to implement an integrated program of management activities that efficiently achieves these goals and meets or exceeds applicable local, state and federal regulatory and permitting requirements. The principal management activities that will be carried out to achieve these goals are **Restoration and Enhancement**, **Watershed Management**, and **Silviculture and Harvest Planning and Operations**. Each of these management activities is discussed in detail in this section.

A. RESTORATION AND ENHANCEMENT

The Property provides significant opportunities for restoring and enhancing aquatic and terrestrial habitats due to its size, location, and existing habitat diversity. To select priorities for management activities to restore and enhance habitat conditions, the planning team first established the Ecological Reserve Network required by the conservation easement and the Coastal Conservancy Grant Agreement. Once the Reserve was established, priorities for restoration and enhancement in the Reserve and the working forest were identified and described. Management of the Property both in and out of the Reserve will seek to enhance and maintain ecological processes critical to the conservation targets. Indicators of the status of the targets will be monitored to evaluate the effects of management actions on the Property.

This process, and the conclusions reached, are discussed in the following pages under the subtitles: "**Ecological Reserve System and Conservation Targets**," "**Aquatic Restoration**,"

and "**Invasive Species Management**." Related subjects are also addressed under "Watershed Management and Water Quality" and "Silviculture and Harvest Planning Operations."

1. ECOLOGICAL RESERVE NETWORK AND CONSERVATION TARGETS

The over-riding goal of the project is to protect significant natural, ecological, and aesthetic values in the context of developing and implementing a commercially viable working forest with sustainable forestry practices. Key to this goal is to establish an "Ecological Reserve Network (ERN, or "Reserve") within the Property which protects features of high ecological value and supports large-scale ecological processes. The conservation easement and the State Coastal Conservancy grant agreement require that at least 35 percent of the land base should be included in the ERN.

PLANNING PRINCIPLES

Large ecological reserves are fundamental to any comprehensive conservation plan. The goals, selection, design, and management of reserve areas are often an involved and iterative process. Typical goals and objectives for establishing forest reserves include capturing and maintaining a representative sample of ecological processes, all biota or a subset of biota, including selected threatened and endangered species, or other species of concern (Lindenmayer and Franklin 2002). While recognizing the challenges inherent in meeting the ecological needs of the Property as well as the economic imperatives of long-term forest management, TCF and TNC endeavored to let classic reserve design principles derived from the theory of island biogeography (MacArthur and Wilson 1963, 1967) guide the reserve design process at the Forest. These principles postulate that:

1. Large reserves are better than small reserves.
2. A single large reserve is better than a group of small ones of equivalent area.
3. Reserves close together are better than reserves far apart.
4. A compact cluster of reserves is better than a line of reserves.
5. Circular reserves are better than long, thin ones.
6. Reserves connected by corridors are better than reserves not connected (Lindenmayer and Franklin 2002).

Reserve design principles developed by the Scientific Review Panel for the Mendocino Redwoods Company's Natural Community Conservation Plan program (Noss et al. 2003) were also considered and include:

1. Conserve target species throughout the planning area.
2. Large reserves are better.
3. Keep reserve areas close to one another.
4. Keep habitat contiguous.
5. Link reserves via corridors.
6. Reserves should be diverse.

7. Protect reserves from encroachment.
8. Maintain natural processes.

The Property presents several challenges to classic reserve planning. While the Garcia watershed is recognized as a landscape level conservation priority (TNC 2001), there are currently very few signature elements to drive the reserve planning process. Due to the young age of the second-growth redwood and Douglas-fir forest, the Property's forest conditions are relatively homogeneous, and at this point there are few areas that stand out for large tree size, legacy elements, or other outstanding existing habitat values. In addition, the geology is relatively homogenous and principally composed of Coastal Belt Franciscan Complex and Franciscan Melange (TNC 2005) with many areas of high erosion potential spread throughout the Property (Monschke 2005).

It is also important to consider that classic reserve design principles operate with the "worst-case" assumption that land between reserve areas or habitat islands will be of marginal habitat value. Given that "working," non-reserve portions of the Property will be sustainably managed for timber production while giving high priority to maintaining and enhancing wildlife habitat and their populations, habitat contiguity, and late-seral characteristics, the ERN may play a less important role at the GRF because the surrounding matrix forest will be of high quality habitat value (Noss et al. 2003). However, reserves at the Forest are important as future old growth areas, and as refugia for species that are very sensitive to human activities. Furthermore, the ERN is intended to maintain ecological functions and processes that might be absent or diminished in harvested areas—an example includes acting as a source network for slow-dispersing species such as lichens and fungi. In addition the Reserve will serve an important research and monitoring function by providing for control conditions.

PLANNING GOALS

TCF and TNC endeavored to design and manage the ERN in accordance with the latest understanding of conservation biology. In addition, where feasible TCF and TNC designed and will manage the Reserve to address the following:

- Aim for a connected network of large areas totaling at least 35 percent of the Property area.
- Represent all major cover types.
- Assure distribution across the major planning watersheds.
- Protect, restore, and enhance key ecological attributes (e.g. habitat elements, ecological processes) of identified conservation targets.
- Maintain and enhance large-scale ecological processes.
- Maintain and enhance ecological legacies.
- Focus on stand-level resources (isolated site-specific conservation features will be addressed in individual THPs).
- Include those sites that have high biodiversity conservation value and would not be managed for timber production—such as grasslands, oak woodlands, and riparian areas.

- Include those sites that may have only average conservation value but are difficult to manage for timber production—such as unstable slopes near watercourses and less-accessible areas.
- Include those sites that have timber production value but also provide for important connectivity and representation.
- Give preference to those areas that are in high priority watersheds for coho salmon recovery.
- Try to include the entire catchments basin for several headwater streams.
- Give preference to those areas that have been prioritized for road removal.
- Attempt, where possible, to create reserves at the watershed scale.

IDENTIFICATION OF CONSERVATION TARGETS AND ASSOCIATED INDICATORS

The planning team used a conservation planning approach to identify key objectives and metrics for management of the Property. TNC's *Conservation Action Planning* (CAP) process (also known as the "5-S" planning process) (TNC 2000, Low 2003) is designed to help identify conservation targets, develop strategies to protect those targets, take action, measure success, and adapt. The CAP process for the Forest began with the selection of initial "conservation targets," and forms a central underpinning to our management objectives. In accordance with adaptive management, our selection of targets will re-assessed and updated periodically.

Primary conservation targets selected for the GRF are:

- Anadromous fish bearing stream;
- Redwood/Douglas-fir forest;
- Oak woodland/grassland;
- Non-riverine wetlands; and
- Northern spotted owl.

All of the selected targets are presumed to represent and capture other "nested" targets at the Property as well as other relevant levels of biodiversity organization (nested targets are identified in Appendix K, "Conservation Targets"). Key ecological attributes (components that most clearly define or characterize a conservation target, limit its distribution or determine its variation over space or time) were identified for each target. Because key ecological attributes are often difficult to measure directly, indicators that can be reasonably and efficiently measured were also identified. Indicator status ratings, where possible, are based on the scientific literature and/or expert opinion. For indicators where expert opinion has not yet been solicited and literature citations were not available or discovered, indicator ratings were based on best estimates by TNC science staff. These ratings were reviewed with expert input and revised. Current indicator statuses for various targets were based on the various data sources available for the Garcia River basin (see References and Bibliography). A draft analysis was reviewed by local experts to verify the appropriateness, efficacy, accuracy and strength of current targets, key ecological attributes, indicators and indicator thresholds.

Once the conservation targets were determined, TNC's CAP tool was used to identify the factors that must be maintained to ensure the long-term viability of the targets, including structure, composition, interactions, and abiotic and biotic processes. Management of the Property both in and out of the ERN will seek to enhance and maintain ecological processes critical to the conservation targets and will monitor indicators of these targets to evaluate the effects of management actions on the Property. Section V, Part C, "Monitoring Metrics and Approach," details indicators and associated monitoring plans.

DATA SOURCES

Data sources reviewed and utilized to assess conservation value and reserve design priorities include:

- Forest stand data delineated by NCRM using aerial photos (NCRM 2005).
- CALVEG maps.
- California Natural Diversity Database (CNDDB) maps.
- Mapped northern spotted owl activity centers.
- SHALSTAB maps of areas of high erosive potential.
- Coho priority streams (Doug Albin and Craig Bell, personal communication).
- Roads prioritized for removal (Jack Monschke and Scott Kelly, personal communication).

THE PLANNING PROCESS

TCF and TNC undertook reserve planning with the understanding that the ERN would need to be carefully planned to maximize its long-term conservation benefits as well as the economic efficiency of the working-forest portion of the Property. The steps of the planning process included:

1. Review the proposed process.
2. Agree on goals and constraints.
3. Identify data sources to be used.
4. Develop first iteration maps.
5. Develop first iteration policies.
6. Review by larger forest management planning team.
7. Develop second iteration maps and policies.

It is recognized that the ERN was created using a limited data set, consisting of the best available data at the time, and it should be reviewed at five to ten year intervals and possibly adjusted as new data become available. Permanent forest inventory plots and long-term monitoring will provide some information on the development through time of these stands, but additional monitoring will be necessary to determine if the needs of conservation targets are being met.

RESERVE COMPONENTS

Data layers were assembled by planners for TCF and TNC, and features prioritized by conservation and timber value. Where conservation value is high and timber value is either low or neutral for a feature, the feature is included in the Reserve. Where conservation value is neutral and timber value is low, the feature may be included in the Reserve. Where conservation value is low and timber value is high, the feature is excluded from the Reserve. It is important to note that the ERN includes more than just riparian buffers and other areas undesirable for harvesting—in order to meet the goal of being representative of the landscape as a whole, it also includes productive forestland.

TABLE 4
RESERVE DESIGN FEATURES RATED BY CONSERVATION AND TIMBER VALUE

Feature	Conservation Value*	Timber Value	Status	Notes
Grasslands and oak woodlands (CalVeg)	+	-	Include	
Riparian buffers (300' on Garcia mainstem and 200' on other Class I streams)	+	=	Include	
Large conifer type	+	+	N/A	Stand data indicates few large conifers yet present.
Mass-wasting sensitivity zones	=	-	Include	Ensures large wood delivered if slope fails.
High erosion potential zone	=	-	Include	
Historic landslides	=	-	Include	
Signal Ridge fire	+	-	Include	Natural catastrophic disturbance site
Owl activity centers	+	-	Partial	See footnote below[8]
Removable roads	+	=	Where possible	

**: "+" indicates positive contribution; "=" indicates neutral; "-" indicates negative value*

[8] Owl centers will move around as the habitat develops. Existing regulations and monitoring requirements provide for appropriate protective measures within the working forest.

DEVELOPMENT AND DESCRIPTION OF THE ECOLOGICAL RESERVE NETWORK

The process to develop the ERN was iterative, involving a series of GIS analyses, draft mapping exercises, meetings, and conference calls among TNC and TCF staff and the GRF planning team. Nine draft reserve design maps were created that varied in amount of reserve area primarily in the western part of the Property near Olson Gulch and the southern part near the Garcia River mainstem below the confluence with Signal Creek; the drafts consistently included a large portion of the Inman Creek watershed. One initial reserve design focused solely on small-scale features in an effort to capture all potential reserve sites (because of the lack of connectivity and interior habitat this did not meet or exceed the basic reserve design goals). Each design was then reviewed and in cases where reserve design goals conflicted with the operational or economic feasibility goals of the working forest, compromises were identified and designs were revised. While some adjustments were made as a consequence of this review, TNC and TCF concluded that the selected reserve design reflects a principled accommodation of the need to address the stated ecological needs and the economic requirements of the project.

The ERN is comprised of two large reserve areas connected by extensive riparian corridors and high-habitat value working-forest matrix (see Map 5, "Ecological Reserve Network", below). The Reserve meets the design goal of representing diverse parts of the Property, including both the drier, eastern portion of the Property and the wetter, more coastally influenced west-side forest. An extension of the riparian buffer (beyond 300 feet) serves as a third small reserve area on the southern bank of the Garcia mainstem. The ERN comprises 8,265 acres or 34.8 percent of the total Property area, essentially equivalent to the 35 percent goal stated in the conservation easement. The ERN is designated for old growth development and riparian enhancement, while the surrounding working-forest matrix will be managed for late-successional characteristics, riparian protection, and sustainable commercial timber harvest.

The three reserve areas of the ERN include the 4,646.37-acre Inman Creek/Signal Burn Reserve, the 1,652.07-acre Olson Gulch Reserve, and the 124.67-acre Garcia River extended buffer. The riparian buffer reserve areas are composed of 502.17 acres of Garcia mainstem buffer (300 feet) and 1,316.42 acres of other Class I stream buffer (200 feet).

The Inman Creek/Signal Burn area was the easiest area to design and agree upon. Putting the whole Inman watershed in reserve met almost all of the reserve design goals. The Inman reserve area is large, created on a watershed scale that includes both redwood/Douglas-fir forest suitable for timber production and some sites that have high biodiversity conservation value that would not be managed for timber production. It goes a long way toward representing major cover types, as the vast majority of the oak woodland and grassland on the Property lies in the Inman drainage. With the addition of the Signal Ridge burn area, the Inman Creek/Signal Burn area also connects to another potential coho watershed and captures chaparral and scrub types on the Property as well as legacy elements present as a result of the burn.

Additional biodiversity components captured in the ERN include ten known springs on the Property, both known wet meadows, three northern spotted owl activity centers, and one recorded red tree vole occurrence. Additionally, the Inman watershed has many roads prioritized for removal, and is representative of the drier, eastern portion of the Property. Further, the Inman Creek drainage has the second highest density of Class I and Class II streams (providing aquatic habitat) and unclassified perennial streams in the whole Garcia basin (NCRWQCB

2000), and has the highest potential for coho on the Property (Doug Albin and Craig Bell, personal communication) due to its channel characteristics (meandering, riffle/pool channels on low gradients gravel dominant substrates) and relatively cool summer water temperatures.

The west side, Olson Gulch reserve area was more difficult to design. Initial iterations adhered well to reserve design goals of large, well-connected reserves, however these designs potentially compromised the economic viability of the project. One of the few areas amenable to tractor logging on the Property lies north of the mouth of the North Fork, and this area was originally included in the Olson Gulch Reserve to increase connectivity between the Olson Gulch and North Fork watersheds, and to provide more reserve in the heart of the Property rather than along the Property edge. Tractor logging makes high-retention, large diameter, single-tree selection silviculture more operationally feasible and is considerably less expensive to perform than cable yarding. With such little tractor logging ground available on the Property due to topography, and much of it in the Inman Reserve, it was decided that this area should be removed from the ERN to help meet economic feasibility goals of the project.

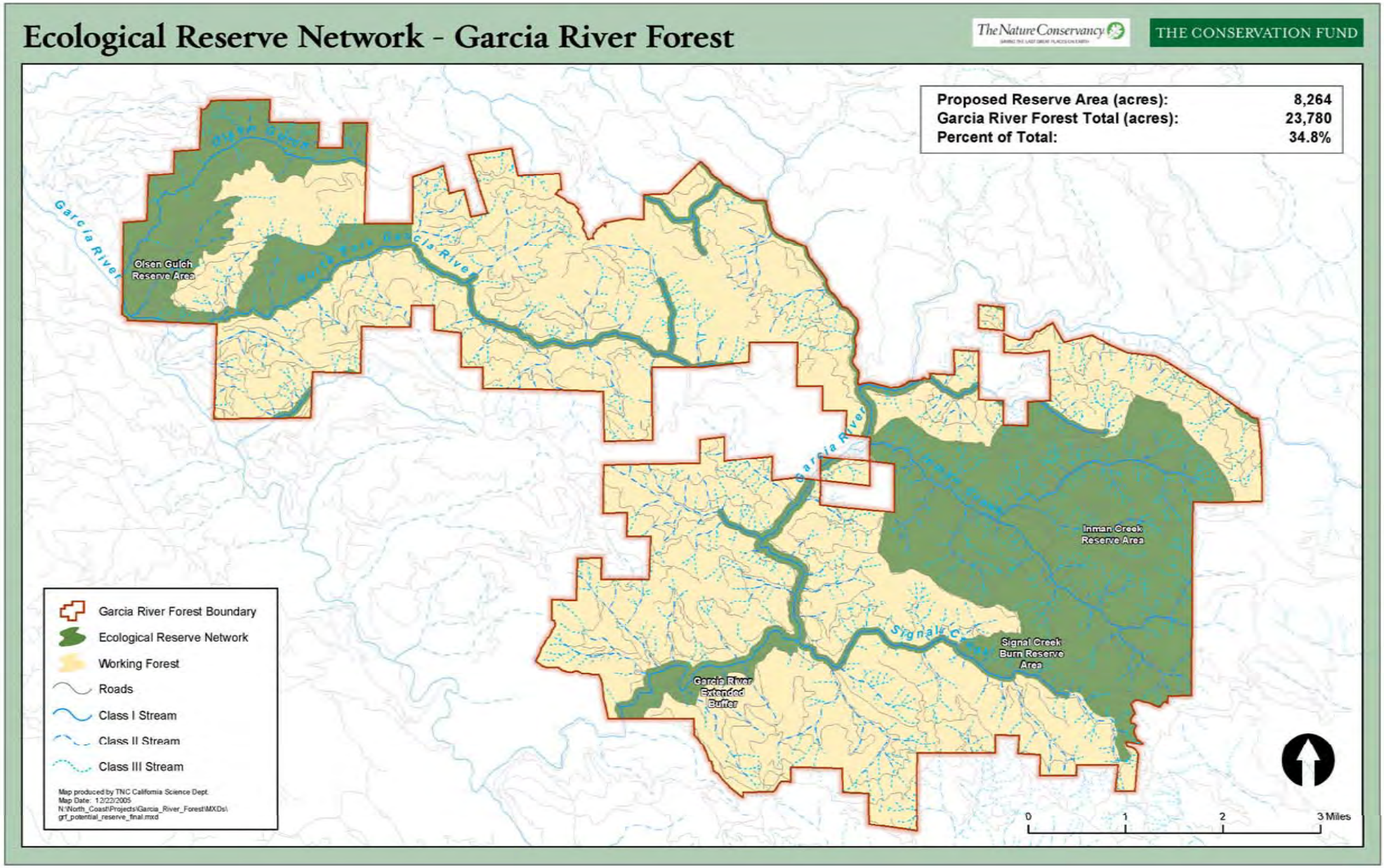
The Olson Gulch reserve area meets most of our initial reserve design goals. It is a large area that represents the wetter, more coastally influenced west-side forest present on the Property, and in concert with the Inman Creek/Signal Burn area assures distribution of reserve land across the major planning watersheds. It includes the stand with the largest diameter conifers on the Property, and the only alluvial redwood flats on the Property. It also includes areas of high erosion potential where timber production would likely be inappropriate or more expensive. Additionally, the Olson Gulch area contains most of the Olson Gulch watershed, and harbors four northern spotted owl activity centers.

The Garcia River extended buffer was added to provide additional potential for shading, as well as large woody debris recruitment into the mainstem in the event of a large natural landslide. The added buffer extends beyond the 300 foot riparian buffer on the southern bank of the Garcia mainstem, and has potential to provide additional shading of the river by increasing canopy cover on the southern bank where it has the most potential to interfere with the angle of the sun. This 2.8-mile reach of the Garcia mainstem is believed to provide the best existing anadromous fish spawning and rearing habitat on the Property (Doug Albin, Craig Bell personal communication).

In total, the ERN contains the following elements:

- NSO Activity Centers: 7.
- Class I 200 foot Buffer: 1,316.42 acres (29.1 miles).
- Class I 300 foot Buffer: 502.17 acres (7.2 miles of Garcia mainstem).
- Oak Woodland: 248.38 acres.
- Grassland: 287.88 acres.
- Timber Vegetation Types: 7,376.8 acres (both conifer and hardwood dominated) (NCRM, 2005).

MAP 5: ECOLOGICAL RESERVE NETWORK



ECOLOGICAL RESERVE NETWORK MANAGEMENT GOALS

ERN management goals for the GRF include the following:

- The ERN will serve ecological purposes:
    - The Reserve will be a well-distributed and representative network of habitat types present on the Forest, including late-seral and (eventually) old growth forest habitats, high-quality grassland, aquatic, anadromous fish, and other habitats totaling at least 35 percent of Property area;
    - The purpose of the ERN is to establish ecological conditions over time that enhance the conservation targets;
    - The Reserve is intended to maintain ecological functions and processes that might be absent or diminished in harvested areas—an example includes acting as a source network for slow-dispersing species such as lichens and fungi; and
    - The Reserve will serve an important research and monitoring function by providing for control conditions.
- Ecological objectives will drive management of the ERN.
- Timber harvest and other intensive management activities (e.g. herbicide treatment, prescribed fire) will be applied within the Reserve only to further ecological objectives, such as thinning to accelerate development of late-seral conditions (e.g. large trees, canopy closure, structural diversity, snag and down woody debris recruitment, in-stream woody debris). Activities including improving or relocating existing roads to serve the larger goal of an operating forest, and to reduce sediments and enhance water quality, will occur.
- Monitoring will guide adaptive management of ERN:
    - Establish monitoring program of viability indicators for conservation targets;
    - Establish applied research projects to guide adaptive management.

ECOLOGICAL RESERVE NETWORK MANAGEMENT OBJECTIVES

Specific ERN management objectives include the following:

- Maintain and enhance viability of conservation targets within the ERN.
- Identify and prioritize stands where silvicultural prescriptions could accelerate the development of complexity, diversity, and ecological values associated with late-successional forests.
- Identify and prioritize the removal or decommissioning of unnecessary roads that have high potential to deliver sediment.
- Improve existing road condition and reduce incidence of road-related sediment delivery to aquatic ecosystems.
- Identify areas most suitable for habitat restoration.

- Identify and prioritize areas where silvicultural prescriptions could reduce the risk of catastrophic wildfire.
- Identify and treat areas affected by plant pathogens, such as Sudden Oak Death (currently, no known occurrence).
- Maintain and enhance high-quality spawning and rearing habitat for anadromous salmonids.

ECOLOGICAL RESERVE NETWORK MANAGEMENT POLICIES

- Timber harvest and other intensive management activities (e.g. herbicide treatment, prescribed fire) will be applied within the Reserve only to further ecological objectives (e.g. accelerating development of late-seral conditions, management of invasive species, reducing stream sedimentation).
- Coordinated management actions, including timber harvests, will be planned that simultaneously address management objectives within the Reserve and the working forest. For example, a single timber harvest plan (THP) may call for timber harvesting within the Reserve and working forest in a single operation. However, the sole reason for incorporating the Reserve within a given THP or other management action will be to establish the desired ecological conditions within the Reserve.
- Road maintenance projects on roads that cross the Reserve will support the overall goal of creating an operating forest with reserves.
- Ecological enhancement and restoration opportunities throughout the Forest shall be prioritized based on a number of criteria including severity or threat, with some restoration activities centered in the Reserve and others spread over the Property. For example, proactive habitat enhancement for the northern spotted owl (e.g. cavities, tree-topping, etc.) will likely only happen in the Reserve. Instream habitat restoration projects will occur across the Class I streams, wherever they are prioritized by fish benefits. Road improvement projects will occur both in and out of the Reserve and will be driven by THP and TMDL requirements. Grassland burning and oak woodland health projects will preferentially occur in the Reserve because that's where most, but not all, of this habitat occurs.
- Silvicultural activities, such as thinning, will be conducted in accordance with applicable state and federal regulations concerning northern spotted owls.
- Disturbance from skidding and mechanical site preparation during forest restoration, road reconstruction, and road upgrading should be avoided to the extent feasible during the winter period (November 15 through April 1) and during wet weather conditions outside of the winter period, where activities will result in soil compaction and increased potential for sediment delivery to stream channels.
- Structures permitted by the conservation easement including one home and an educational facility will not be constructed within the Reserve, unless otherwise agreed to by the easement holder.

2. AQUATIC RESTORATION

> "There is little question that we are not going to be able to do everything we want to do for salmon immediately. So how do we decide what we should do first? There are millions of federal and state dollars being spent on salmon restoration right now. That expenditure presents both a significant challenge and opportunity. The challenge is to target all these expenditures to the most important efforts first. The opportunity is to actually make a difference for salmon. We can only do that if we pay attention to the biology -- not the politics, not the agency turf, not "the money's got to be spread over the landscape" -- but rather prioritizing our efforts based on the biology of salmon, which very quickly leads us to the biology of healthy watersheds."
>
> Oregon State Senator Bill Bradbury
> (Bradbury et al., 1995)

The Property offers a unique opportunity to carry out comprehensive restoration of a large forested landscape, while sustainably harvesting timber. Conservation measures on key pieces of Property in combination with active restoration of uplands and riparian zones can help the Garcia River advance in recovery.

The intent of this aquatic restoration planning element is to: 1) synthesize existing reports and recommendations pertaining to aquatic restoration in the Garcia River basin; and 2) identify and prioritize aquatic restoration and management actions. This planning process involved collating pertinent regional planning documents with field surveys and other literature, and extracting restoration objectives and recommendations germane to the Forest. The suggested approach gives a rationale for a restoration strategy and then defines steps to attainment. The approach prioritizes key sub-basin and main stem Garcia River reaches for treatment. Techniques range from upslope erosion control, to riparian planting, placement of large wood in stream channels, and fish migration barrier modification. This approach will be further reviewed and refined by the planning team and a range of experts prior to adoption in 2006.

BACKGROUND

Steelhead trout and coho salmon stocks of the Garcia River basin are listed as threatened or endangered species under the California and federal Endangered Species Acts. In addition, the Garcia River was listed in 1993 under the Clean Water Act section 303(d) List of Impaired Water bodies for excessive sedimentation and subsequent anadromous salmonid habitat loss. Portions of the Garcia River are listed for excessive water temperatures. The Total Maximum Daily Load (TMDL) and implementation plan was adopted by the State Water Resources Control Board in 2000, was approved by the Office of Administrative Law in 2002, and is now in effect.

The restoration strategy described here, in combination with implementation of the silvicultural measures described earlier in this Section, will maintain, restore and expand habitats for endangered and threatened fish and promote significant reduction of sediment.

The goals of the project are to foster conditions that not only meet the requirements of law, but also facilitate restoration of Garcia River aquatic and terrestrial biodiversity. An opportunity may exist to restore historic spawning populations of coho salmon, which are now found only in low numbers and not each year. An opportunity may exist to restore historic populations of Chinook and pink salmon which now occur in low numbers and not in all years. While historic populations of pink salmon did not likely spawn or rear on the GRF, sediment reduction efforts are likely to improve downstream Garcia River reaches.

The long and fruitful history of Garcia River aquatic and riparian habitat restoration activity includes dozens of agencies, organizations, and individuals collaborating over a 30-year period, with accomplishments ranging from formation of effective stakeholder groups to fisheries enhancement work to the creation and implementation of TMDL strategies, monitoring plans, and erosion control plans. This planning document draws upon this wealth of information, including the following specific documents:

- *Action Plan for the Garcia River Watershed Sediment TMDL* (NCRWQCB 2001)
- *California Salmonid Stream Habitat Restoration Manual* (Flosi et al. 1998)
- *Evaluation of Garcia River Restoration with Recommendations for Future Projects*, (Bell, 2003)
- *Garcia River Forest Project Overview and Preliminary Action Plan* (Monschke 2005)
- *Garcia River Instream Monitoring Project* (Maahs and Barber, 2001)
- *Garcia River Sediment Total Maximum Daily Load* (EPA 1998)
- *Garcia River Forest 2004 Stream Inventory Reports* (California Department of Fish and Game 2005)
- *Garcia River Watershed Enhancement Plan* (GRWEP) (Monschke and Caldon for the MCRCD, 1992)
- *KRIS Garcia Project* (IFR, 2003)
- *Limiting Factors Assessment for the Garcia River* (Manglesdorf, 1997)
- *Recovery Strategy for California Coho Salmon* (CDFG 2004)
- *Reference Document for the Garcia River Watershed Water Quality Attainment Action Plan for Sediment* (NCRWQCB 2000)
- *Watershed Assessment and Cooperative Instream Monitoring Plan for the Garcia River, Mendocino County, California* (Euphrat 1998).

GARCIA RIVER IMPAIRMENT AND FOUNDATION FOR APPROACH

CDFG (Fisk et al., 1966) found that 85 percent of the 104 miles of Garcia River tributaries surveyed after the 1964 flood had sustained damage from logging and sediment (Figure 1) and 50 percent of reaches had moderate to severe damage. Severely damaged streams sometimes had complete loss of riparian zones due to heavy equipment operation in streambeds. While operation of equipment in stream channels ceased with the passage of the California Forest Practice Rules in 1974, another major wave of logging took place in the 1980's and early 1990's,

which caused an additional pulse of sediment (U.S. EPA, 1998). The Garcia River Watershed Enhancement Plan (Monschke and Caldon, 1992) recognized that if erosion risks are not reduced, manipulation of stream channels might be a futile exercise. Many instream structures installed to improve fish habitat diversity throughout the Pacific Northwest have been buried in sediment or scoured from stream channels because watershed conditions had not recovered sufficiently (Frissel and Nawa, 1992).

Figure 1. *This 1955 photo of Signal Creek tributary where heavy equipment operation has obliterated the riparian zone and stream channel and where a legacy of high erosion risk is in evidence (CDFG, 1955).*

The Garcia River watershed appears to be in recovery from intensive logging and road building in the 1950's and 1960's (Monschke, 2005; Bell, 2003; IFR, 2003). Recent geomorphic studies in the estuary (Leopold and McBain, 1995) and gravel recruitment studies (Swanson and Associates, 1993) suggest that sediment supply has decreased. As a result of increased awareness and the Clean Water Act and subsequent TMDL listing, the main thrust of restoration effort in the Garcia watershed is appropriately focused on stabilizing upslope areas to help reduce management related sediment.

Healthy riparian zones buffer help keep water temperatures cool and also supply large wood to streams, which is essential for the diverse aquatic habitat conditions to which salmonids have adapted (FEMAT, 1993). "Organic debris in streams increases aquatic habitat diversity by forming pools and protected backwater, provide nutrients and substrate for biological activity, dissipate energy of flowing water and traps sediment" (Siddell et al., 1988). Downed logs form stair steps in streams providing a favorable mix of pool riffle pool sequences. Large wood also

helps sort gravel into sizes favorable for salmonid spawning. Reeves et al. (1988) found that coho salmon prefer deeper pools formed by large wood or with large woody cover. Cedarholm et al. (1998) found that conifers may last decades to hundreds of years when recruited to streams whereas hardwoods decay within a decade.

Natural recovery of streamside willow and alders is advancing in most tributaries and the main stem on the Property, but riparian communities tend to be dominated by "pioneer species" like willow and alders. These early successional colonizers help moderate stream temperatures and provide nutrients from leaf fall, but long-term recovery of conifers is imperative and may take decades or centuries (McHenry et al., 1998). Consequently, the recovery strategy will have to include artificially recruiting large wood to streams as well as managing to speed riparian succession and primary shade canopy for streams, helping to decrease stream temperatures. Sustainable timber harvest practices, conifer planting, and the Ecological Reserve Network will accomplish those goals over time.

Consistent with these findings, specific aquatic restoration **objectives** for the Property drawn from the primary reference documents listed above, include:

- Reduce water temperatures in Class I watercourses believed to have supported coho (Inman Creek, Signal Creek, North Fork Garcia, and Garcia mainstem) to 62.1° F or lower during critical summer months (see CDFG 2004 and Welsh et al. 2001).

- Meet numeric targets set by the Action Plan Garcia River Watershed Sediment TMDL (NCRWQCB 2001) including:
    - Reduce percent fines smaller than 0.85 mm to less than 14 percent of fines found in spawning habitats in Class I watercourses.
    - Reduce percent fines smaller than 6.5 mm to less than 30 percent of fines found in spawning habitats in Class I watercourses.
    - Increase primary pool frequency to at least 40 percent of total habitat length in Class I watercourses.
    - Remove all human caused migration barriers on Class I watercourses.
    - Create an improving trend in large woody debris instream.
    - Improve riparian canopy cover to meet TMDL specific sub-watershed numeric targets (see section 2.3).

- Increase pool shelter complexity, and meet the CDFG recommended mean pool shelter rating of 100 (Flosi et al. 1998).

A summary[9] of specific aquatic restoration **recommendations** for the Property, below, is also drawn from existing regional planning documents, and is the basis for a suggested approach that follows. This summary will aid in prioritizing future restoration action in concert with coho recovery, TMDL and other requirements. Restoration priorities will be sequenced from this comprehensive list by evaluating the magnitude of conservation target threat abatement achieved

[9] The summary includes CDFG's 2005 *Garcia River Forest 2004 Stream Inventory Reports*, which features a detailed list of GRF-specific recommendations that is available on request.

by each restoration activity, feasibility, probability of success, funding opportunities and stakeholder interest. An implementation schedule will be developed incorporating both required and optional activities, and reflecting project priorities and available funding among other criteria.

Aquatic restoration recommendations specific to the Property drawn from existing regional planning documents:

- Increase pool shelter complexity in streams or stream reaches where the mean pool shelter ratings are calculated to be less than 80 by installing new LWD, boulders, and other features, and restore native riparian vegetation to provide for future recruitment of LWD. Coordinate placement of LWD in streams as part of logging operations and road upgrades to maximize size, quality, and efficiency of effort. Specific watercourses in need of LWD placement include: Blue Waterhole, North Fork, Inman Creek, Signal Creek, and Graphite Creek.
- Increase canopy by conducting native riparian planting of willow, alder, conifers, and other native species representative of the site to increase shade to reduce high ambient temperature and raise humidity along streams. Specific watercourses in need of planting include: Blue Waterhole, Inman Creek and Garcia mainstem.
- Monitor functional connectivity of North Fork Garcia River to the mainstem. Past planning documents have recommended restoring connectivity and surface flows of the lower North Fork Garcia River, which for many years has gone subsurface in the summer months, stranding thousands of salmonids. Recent surveys (Bell 2005, 2006) indicate that the reduction of upslope sediment inputs combined with significant storm-related flows are contributing to a natural correction of the condition. In late summer 2005 surface flows and main stem connectivity were observed for the first time in many years. These observations make treatment a lower priority.
- Design and engineer pool enhancement structures to increase the number of pools or deepen existing pools, where the banks are stable or in conjunction with stream bank armor to prevent erosion. Specific watercourses in need of pool enhancement include Blue Waterhole Creek, North Fork Garcia River, Inman Creek, Signal Creek, and Graphite Creek.
- Inventory fish population status on priority streams and sub watersheds.
- Conduct continuous temperature monitoring between June and October.
- Inventory and map sources of stream bank erosion and prioritize them according to present and potential sediment yield. Identified sites should then be treated to reduce the amount of fine sediments entering the stream. Remove landings and unstable fill near streams.
- Active and potential sediment sources related to the road system should be identified, mapped, and treated according to their potential for sediment yield to the stream and its tributaries. A draft Road Management Plan which prioritizes criteria for replacement, decommissioning and maintenance is attached as Appendix J.
- Implement restoration activities on road segments identified to have high potential for failure during a major storm event, including outsloping, rocking, berm removal, and

creating dipped crossings. Seasonal and temporary roads should be storm-proofed so that they only need maintenance when reopened for forestry or other management objectives.

- Where culverts pose migration barriers, modify or remove culverts to improve passage. Size culverts to withstand 100-year storms, and set culverts to actual stream grade. Install bridges instead of culverts in locations of high flows and where fish passage could be compromised.
- Properly pull stream crossings by removing fill in such a way as to provide for adequate channel width capacity down to the natural stream gradient, and at a slope that will not slough material into the stream.
- Consider projects to open logjam migration barriers while maintaining LWD in the North Fork.
- There are several log debris accumulations present on Unnamed Left Bank Tributary to Inman Creek that are retaining large quantities of fine sediment. The modification of these debris accumulations is desirable, but must be done carefully, over time, to avoid excessive sediment loading in downstream reaches.
- There are several log debris accumulations present on Signal Creek that are retaining large quantities of fine sediment. The modification of these debris accumulations may be desirable, but must be done carefully, over time, to avoid excessive sediment loading in downstream reaches; this would only be undertaken in consultation with DFG, Water Quality, NOAA fisheries staff, and others with considerable instream restoration experience. Well thought out barrier modification is within the scope of recommended restoration practices and would not be carried out as a widespread practice.
- Suitable size spawning substrate on Graphite Creek is limited to relatively few reaches. Projects should be designed at suitable sites to trap and sort spawning gravel.
- Determine the fish barrier status of the culvert in Unit 12 on Graphite Creek and remediate if appropriate.

WATERSHED APPROACH TO GARCIA RIVER FOREST RESTORATION

Considerable understanding of the "watershed approach" in addressing ridgetop to stream problems grew out experiences in Redwood Creek National Park, where studies found catastrophic erosion and stream damage from old logging roads (Hagans et al., 1984) and prompted a move away from the single focus on in-stream conditions. This awareness has promoted widespread watershed and road-related erosion control throughout northwestern California as a means of promoting stream health and allowing salmonid recovery. The restoration elements described below pertain to erosion control, riparian recovery, large wood recruitment to stream channels, increasing channel complexity, and fish passage improvements in key reaches.

To achieve watershed restoration and address sediment issues, we will develop and implement sub-basin plans for comprehensive treatment of controllable sediment sources. Sub-basins will be prioritized as suggested by Bradbury et al. (1995), with those streams with high habitat quality for steelhead and coho salmon given highest priority. Criteria are: riparian condition, cool water

temperatures, spawning gravel quality, pool frequency, depth, and complexity. Where possible, multiple objectives will be met when equipment is in the field to increase cost-efficiency. These coordinated restoration efforts may occur in discrete phases described below.

UPSLOPE EROSION CONTROL

Strategic erosion control measures across the Property will help resolve problems that currently limit salmonid carrying capacity such as improving the depth and complexity of pool habitat, aiding both juvenile and adult salmonids. Decreasing fine sediment inputs will improve spawning gravels to increase egg and alevin survival, and decrease turbidity to allow active winter feeding of juvenile salmonids. As the width to depth ratio improves from sediment reduction, stream temperatures should improve (Poole and Berman, 2000) and ultimately approach optimal for salmonid rearing throughout summer.

The development of sub-basin plans currently underway by Pacific Watershed Associates (PWA) involves the careful review of: aerial photo history, geologic, road, and landslide feature maps, drainage flow calculations (Level 1), coupled with on the ground inventories (Levels 2 and 3). Using this information PWA staff can rate the relative risk of various sites of contributing deleterious sediments to watercourses. Sites are numbered, mapped and given a low, medium, or high priority. Prescriptions will include a cost benefit ratio for sediment savings. Hagans et al., 1986 estimate that 70 percent of the controllable sediment entering North Coast rivers comes from roads and stream crossings, therefore remediating road related problems is a logical first step.

Specific treatable problems include**:**

- Side cast road construction with perched and sloughing fill.
- Roads with inboard ditches and/or insufficient cross drains.
- Unstable road surfaces or erodable road surface such as clay or sand.
- Lack of winter maintenance.
- High road densities (six to ten miles of road per sq. mile). Densities of 2.5 miles per square mile (or less) better reflect greatly reduced erosion risk (NMFS, 1996).
- Near stream roads, and roads in unstable or wetland areas (to be evaluated in consultation with foresters and other planners to determine future access needs for timber harvests, research, restoration, fire access, maintenance, and other potential activities).
- Improperly sized or placed culverts and lack of culvert maintenance.
- Near stream landings and unstable fill.
- Barrier to fish passage caused by culverts or other anthropogenic barriers.
- Legacy roads and crossings which have not been brought up to current design standards.
- Disturbed soils that would benefit from vegetation cover such as mulching and/or conifer planting.

Much has been accomplished in terms of restoring stream channels and decommissioning or storm proofing of roads in the Garcia River basin (Monschke and Caldon, 1992; Bell, 2003) and early signs of improvement are encouraging. Figures 2 and 3, below, illustrate a bridge/creek restoration project installed by Jack Monschke Watershed Management (JMWM) in 1996.

Figure 2. *"This photo shows a flatcar bridge spanning the channel of Olsen Gulch in the middle of a stream channel restoration project. The stream here was formerly disrupted by fill from a landing likely placed shortly after World War II. Jack Monschke directed excavation of 50,000 cubic yards of material and re-contoured the stream channel under contract to Coastal Forest Lands, Inc." (KRIS Garcia, 2003.)*

Figure 3. *The same Olsen Gulch location in 2004. Note flatcar bridge spanning the channel, LWD and resulting pools, and willow now over 20 feet high (photo by Jenny Griffin, June 2005).*

As part of the assessment and implementation, PWA staff can field train road crews, equipment operators and contract loggers. The experience gained during road decommissioning will be shared with TCF staff and contractors so that future road design and timber harvest activities will help to prevent soil loss and sediment deposition. By comprehensively carrying out road improvement prescriptions, sub-basins can be restored to close to background level sediment contributions.

Finally, as described in more detail in the next section on water quality, TCF has prepared a draft Road Management Plan to guide road improvements, decommissioning, and other activities. The draft Plan is included as Appendix J.

GARCIA RIVER FOREST SEDIMENT REDUCTION UNDERWAY

In addition to the restoration work described in Monschke and Caldon (1992) and Bell (2003), there has already been notable progress on erosion control planning at the Forest. Upon completion of the purchase of the Property, TCF initiated recovery efforts while developing the IRMP by compiling baseline information and contracting with Jack Monschke Watershed Management[10] to summarize current conditions and potential sediment delivery risks of the Forest and to make recommendations for specific road maintenance, upgrades, and potential road closures and/or decommissioning (see Appendix B, *Garcia River Forest Project Overview and Preliminary Action Plan,* Monschke 2005). After reviewing existing planning documents and in consultation with the local watershed coordinator, TCF also worked cooperatively with PWA to secure a CDFG Fisheries Restoration Grant to fund a comprehensive road assessment of Inman and Signal Creek watersheds. PWA field crews began conducting sediment surveys in 2005 that will continue through mid-2006. This timely action allowed work to begin in previously identified, high priority sub-basins without missing a yearly CDFG grant cycle. TCF and PWA have also applied (2005 application) for CDFG Fisheries Restoration Grant funding to assess roads on the remainder of the Property. Additionally, TCF collaborated with JMWM to seek grant funding to correct several high priority sediment sources identified in the course of preparing the Overview report.

RIPARIAN RESTORATION AND LARGE WOODY DEBRIS PLACEMENTS

A long term goal of forestry practices and riparian planting on the Property will be to create healthy riparian zones well stocked with late seral conifers, where they were historically present. This will be achieved in part thorough the creation of reserve areas in riparian areas and inner gorges, thinning from below to allow conifer release, and the planting of conifers and other native species. In highly disturbed areas willow and alder will be planted to stabilize banks and capture sediment from the river's bed load. While alder and willow may dominate the early successional riparian community, the Property will ultimately be managed for the re-establishment of conifers. Accelerating riparian succession will take place through thinning of hardwoods to let in sunlight, allowing existing and planted conifers to release. In areas that were historically oak woodland, native oak species will be planted. Additional native tree species to be used may include California bay and big leaf maple.

[10] Jack Monschke worked as a consultant to the former property owner and co-authored the Garcia River Watershed Enhancement Plan (Monschke and Caldon, 1992).

The California Conservation Corps has expressed an interest in carrying out planting projects. Additionally there has been a long and successful riparian planting history by AmeriCorps Watershed Stewards, Trout Unlimited, local schools, and citizen volunteer groups such as Friends of the Garcia River (Bell, 2003).

Based on the documented lack of large wood in stream channels (CDFG, 2005), the recognized relationship of LWD to salmonid carrying capacity, and the deficit of large wood available in riparian zones because of past logging, large wood instream structures will be placed in salmonid spawning and rearing tributaries on the Property. Instream structure types will be guided by CDFG habitat typing and placement locations by TCF consultants and restoration contractors. A mix of techniques will include anchored and unanchored LWD. There are numerous examples of anchored LWD performing well in Garcia River tributaries, and it should be noted that available LWD is scarce in tributaries on the GRF. Unanchored LWD would likely be employed in the form of whole, dedicated trees or long log (with root wad) sections. Protocols established in the California Stream Habitat Restoration Manual (CDFG, 1998) will be followed.

In-stream structures will be in reaches with appropriate gradient and confinement, with emphasis placed on pool forming structures. There has been a mixture of successes and failures with previous in-stream structure placement (Bell, 2003). A large wood structure on the North Fork is shown in Figure 4, below. Best results for salmonid habitat improvement will likely be achieved through the use of upstream V log and boulder weirs, boulder clusters and cross channel plunge pool logs. Structures can have greatest benefit in transforming monotypic riffle reaches into more diverse reaches with substantially increased carrying capacity. Pools with poor cover and depth can sometimes be improved by placement of complex large structures, known as "spider logs."

Figure 4. *Craig Bell with large wood structure on the North Fork Garcia River placed in 1996, creating scour and providing cover for juvenile and adult salmonids. (Photo by Pat Higgins, Winter 2003.)*

Temporary and affordable pool structures can be constructed by fastening appropriately pruned willows and alders with bailing-type twine; these structures can be placed in the spring and will function until high flows in the winter. Care will be taken not to place these in large numbers

above known partial barriers to prevent accumulation that might impede fish passage, as instructed by John Schwabe of CDFG, who taught construction and biologic/cost benefits of these temporary structures at a summer 2005 Salmonid Restoration Field School on the Garcia River.

Costs for placing instream structures can be roughly calculated for the purposes of fundraising and long term budgeting. For best results it is preferable to construct complex structures. A complex log structure (the most typically suited for Garcia River tributaries) is defined as one that has three or more logs. The figure of $1,000 per placed log can be used as a cost guideline (California Conservation Corps, personal communication). Therefore an average cost $3,500 to $4,000 per structure can be expected. Based on Garcia River field surveys and typical North Coast stream rates, up to ten to fifteen structures per mile may be necessary. These figures yield a range of costs from $35,000 to $60,000 dollars per stream mile to be enhanced. High priority tributaries for initial, instream structure placement are: Inman Creek (five miles), Signal Creek (four miles), Olsen Gulch (two miles), North Fork Garcia (three miles) for a total of 14 miles. For the purposes of budgeting and funding for instream habitat enhancement costs a minimum, base figure of $500,000 dollars can be anticipated.

California Conservation Corps staff has toured the Property and expressed interest in implementing instream habitat projects. This program's excellent track record and work experience opportunity for young people makes them well suited for partnering in restoration efforts.

FISH PASSAGE BARRIERS AND POTENTIAL MODIFICATION

A number of partial and complete natural and man-made barriers to salmonid migration have been identified on tributaries located in the Forest. These have been surveyed and mapped as part of past and ongoing monitoring efforts. A comprehensive survey is currently in progress. As part of instream restoration each of these will be evaluated for modification. Several of these are debris jams that might serve as a source of large woody debris as part of modification for passage or as a source without modifying for passage. Careful consideration will be given to the potential benefits to fish passage and risks of release of harmful fine sediments and effects on gradient control. Barriers with large amounts of stored fine sediments should be considered for excavation to prevent release. Barrier modification will only occur after consultation with CDFG, Regional Water Quality Control Staff, NOAA Fisheries, Army Corps of Engineers, and experienced restoration contractors.

COORDINATION KEY TO GARCIA RIVER FOREST AQUATIC RECOVERY STRATEGY

To best apply limited restoration funding and maximize on the ground results there will be an emphasis on cooperation and coordination between contractors carrying out road and sediment reduction work, timber harvesting, and instream habitat projects. This coordination will enable instream crews to utilize more durable and effective large logs and boulders by taking advantage of available, heavy equipment such as cable yarding systems, excavators, bulldozers, and dump trucks.

The restoration activities described above are proposed in the following phases:

Phase One (2004-2006)

- Habitat typing of tributaries and main stem Garcia River by CDFG (nearly complete with only Olsen Gulch to be surveyed, spring 2006).
- Comprehensive road sediment source assessment of key tributaries Inman Creek and Signal Creek (funded and currently underway by PWA).
- Grant funding applied for treatment of identified sediment sites with high potential for failure on Inman Creek (Jack Monschke Watershed Management).
- Grant funding applied for road sediment source assessment and control plan for remaining sub basins and road network (PWA).
- Assessment of instream structure sites and barriers (funded and currently underway, PWA and C. Bell).
- Develop a water quality and habitat condition monitoring plan for the Property (initial draft presented in the monitoring section of this IRMP).
- Riparian tree planting of Inman Creek and lower North Fork Garcia River (funded, with work underway 2005-2006, C. Bell).

Phase Two (2006-2008)

- Secure funding to implement sediment control measures on high and medium priority sites as identified in the PWA survey of Inman and Signal Creek sub basins currently underway.
- Implement monitoring plan.
- Secure funding for instream habitat enhancement work by contractor, California Conservation Corps, on Inman and Signal Creeks.
- Secure funding to implement monitoring plan with assistance from the State and Regional Water Quality Control Boards staff.
- Ongoing riparian tree planting.

Phase Three (2008-2010)

- Implement sediment control measures on medium and high priority sites identified in current PWA survey in Inman and Signal Creeks.
- Implement instream habitat enhancement work in Inman and Signal Creeks.
- Ongoing monitoring.
- Secure funding to address high and medium priority sediment sites identified in remainder assessment (areas other than Inman and Signal Creek).
- Secure funding to implement identified instream enhancement projects on Olsen Gulch and North Fork Garcia.

- Ongoing riparian tree planting (including Blue Waterhole Creek).

Phase Four (2010-future)

- Ongoing monitoring.
- Implement sediment control measures on high and medium priority sediment sites identified by PWA in remainder assessment.
- Assess additional secondary tributaries for instream habitat enhancement.
- Ongoing riparian planting.

MONITORING RECOVERY TO DEMONSTRATE EFFECTIVENESS

Monitoring is an integral part of a restoration plan, and the monitoring of aquatic conservation targets on the Property provides an opportunity to measure the success of management in the working forest context, as well as inform future management strategy. Monitoring of restoration activities closes the loop in an adaptive management cycle, by assessing the impacts of management actions, and providing the opportunity to evaluate the effectiveness of methods (measured against restoration objectives) and use this information to refine restoration priorities, methods, and objectives. The Garcia River has already had the benefit of a number of monitoring projects that provide baseline and trend data for aquatic habitat (Maahs and Barber, 2001): see Appendix L, "Aquatic Restoration Baseline Data," for a detailed summary of existing data. As detailed in this appendix, CDFG survey crews carried out extensive habitat typing of the Garcia River main stem and most tributaries on the Property in 2004, and automated turbidity monitoring was carried out on Inman Creek (MCRCD/Barber, winter 2004-2005). The strategic choice of standard and cost-effective monitoring tools will allow for trend monitoring.

"Monitoring Metrics and Approach" (Section IV, Part C) provides an overview of GRF monitoring plans. Included in that overview are descriptions of the aquatic targets, indicators of which will be monitored at least every five years (see tables 5 and 6).

TABLE 5
AQUATIC TARGETS OF THE GARCIA RIVER FOREST

Target	Factor	Indicator
Anadromous Fish Bearing Streams	Water quality	% fines less than 0.85mm in size in potential spawning sites on Class I watercourses
Anadromous Fish Bearing Streams	Water quality	% fines less than 6.5mm in size in potential spawning sites on Class I watercourses
Anadromous Fish Bearing Streams	Water quality	Mean weekly average water temperature in Class I watercourses
Anadromous Fish Bearing Streams	Habitat features	Mean pool shelter rating in Class I watercourses
Anadromous Fish Bearing Streams	Habitat features	Primary pool frequency on Class I watercourses
Anadromous Fish Bearing Streams	Habitat features	Riparian canopy cover in Class I watercourses

Specific monitoring protocols and data standards for these indicators are being developed. Where possible, we hope to leverage existing data collection efforts and existing long-term data sets to implement indicator monitoring. In addition to the six 'no regrets' indicators, we identified several additional indicators for which we lack a local baseline or lack standard protocols (Table 6, below). These indicators, which include life history and population parameters of anadromous fish species, will be the focus of future research, data collection and information gathering to calibrate, refine, and eventually include in the monitoring program.

TABLE 6
POTENTIAL FUTURE INDICATORS FOR THE
ANADROMOUS FISH BEARING STREAM TARGET

Target	Factor	Indicator
Anadromous Fish Bearing Streams	Migration passage	# of anthropogenic migration barriers on Class I watercourses
Anadromous Fish Bearing Streams	Water quality	Mean V* (pool sediment volume) in 3rd order streams with gradients between 1-4%
Anadromous Fish Bearing Streams	Water quality	Estimated annual deliverable sediment rate
Anadromous Fish Bearing Streams	Habitat features	LWD (instream) in Class I watercourses
Anadromous Fish Bearing Streams	Habitat features	LWD (potential) on Class I watercourses;
Anadromous Fish Bearing Streams	Presence/abundance of characteristic species	Abundance of steelhead juveniles Inman, Signal, North Fork, Garcia mainstem
Anadromous Fish Bearing Streams	Presence/abundance of characteristic species	Abundance of coho juveniles Inman, Signal, North Fork, Garcia mainstem
Anadromous Fish Bearing Streams	Presence/abundance of characteristic species	Redd counts (adult spawner survey)

The effectiveness of specific restoration activities will be monitored at least qualitatively pre- and post-restoration, and quantitatively pre- and post-restoration where possible. Qualitative protocols from CDFG's *California Coastal Salmonid Restoration Monitoring and Evaluation Program Interim Restoration Effectiveness and Validation Monitoring Protocols* (Collins 2003) will be followed to monitor restoration activities. Additionally, permanent photo plots will be established to monitor aquatic restoration activities following CDFG's protocols (Collins 2003). Ideally, baseline data will be collected at least one season before restoration activities commence.

Where warranted and feasible, quantitative monitoring will be implemented to assess the impact of restoration activities. Quantitative protocols are also outlined in CDFG's *California Coastal Salmonid Restoration Monitoring and Evaluation Program Interim Restoration Effectiveness and Validation Monitoring Protocols* (Collins 2003).

PARTNERSHIPS ESSENTIAL TO GARCIA RIVER WATERSHED RECOVERY

To succeed, TCF will continue its partnership with a wide range of public and private partners. In the face of reduced state and federal restoration dollars, partnering with private, state and federal organizations will help all parties achieve their respective goals.

3. INVASIVE SPECIES MANAGEMENT (PLANT AND ANIMAL)

THE THREAT OF INVASIVES

The introduction of a foreign species to a new landscape that is not adapted to its presence can cause ecological chaos by altering natural processes and reducing biodiversity. In their home environment, plant and animal populations are regulated by slowly-evolved natural controls, like predators and food supply. When introduced to a novel environment without these controls, however, some exotic species become invasive. Invasive species spread rapidly, disrupt natural cycles and crowd out native species and cost billions nationwide in economic productivity and property damage. Invasive species are the second greatest threat to endangered and threatened species in the United States, and contribute directly to the decline of 52 percent of such listed species (Wilcove et al. 1998).

IDENTIFIED INVASIVE SPECIES AND LOCATIONS

Exotic flora of the Property were noted peripherally in the context of a 2005 rare plant survey which identified 110 species represented largely by the Poaceae, Asteraceae, and Fabaceae families. The total number of these exotic taxa is shown below by vegetation type.

TABLE 7
NUMBER OF TAXA ASSOCIATED WITH VEGETATION TYPES

	Total	Exotics	Rare Species
Mixed Hardwood	232	58	0
Redwood/Douglas-fir	184	28	2
Grassland (mesic & xeric)	163	55	2
Riparian	121	25	0
Roadcuts, Cliffs, Outcrops	115	21	1
Wet Seep	93	23	1
Serpentine Habitat	65	12	0
Ceanothus Shrubland	49	11	0

Many of the more conspicuous exotics are associated with the roads that traverse the Property and represent disturbed habitat. Two species, pampas grass (*Cortaderia jubata*) and French Broom (*Genista monspessulana*) are on the California Invasive Plant Council (Cal-IPC) List A-1 (Most Invasive Wildland Pest Plants: Widespread) and have been observed along the roadways. These species, once established, have the potential to displace native species.

Pampas grass occurs in dense patches along the upper portion of the Olson Gulch Road near Gate 23 where it is associated with disturbed areas such as landings and clearings along the road. Other occurrences have been observed along Signal Creek Road. A large patch of French Broom occurs along the Hollow Tree road between the intersections of Graphite Road and the Eureka Hill Road; this population is also associated with a portion of road that has been widened. Because of their invasive potential and close proximity to the road efforts should be made to control the spread of these plants

In addition to the two invasive species mentioned above, other conspicuous exotic plants include a suite of annual grasses which have become naturalized and are stable components of grassland communities.

The western portion of the Property has sizable infestations of Forget-me-Not (*Myosotis latifolia*) along the Olson Gulch road where it crosses the North Fork of the Garcia River. This species and foxglove (*Digitalis purpurea*) are the most conspicuous exotics species associated with redwood forest.

A complete inventory of invasive species has not yet been undertaken. As such, impacts to conservation targets have not been determined. Following an expert inventory and analysis of weeds and pests, this report will be revised to more accurately reflect the number, nature, and treatment options of exotics.

The following is a list of invasive species identified to date.

INVASIVE PLANT SPECIES

Annual and sweet vernal grasses (*Anthoxanthum arisatum, A. ordoratum*)

Bull thistle (*Cirsium vulgare*)

Bur-clover (*Medicago polymorpha*)

Cheat grass (*Bromus tectorum*)

Edible fig (*Ficus carica*)

English Ivy (*Hedera helix)*

Filarees (*Erodium* spp.)

French broom (*Genista monspessulana*)

Himalayan blackberry (*Rubus discolor*)

Italian ryegrass (*Lolium multiflorum*)

Italian thistle (*Carduus pycnocephalus*)

Mediterranean barleys (*Hordeum* spp.)

Napa thistle (*Centaurea melitensis*)

Pampas Grass (*Cortaderia jubata*)

Penny royal (*Mentha pulegium*)

Ripgut brome (*Bromus diandrus*)

Soft chess brome (*Bromus hordeaceus*)

Wild oat (*Avena barabata*)

Yellow star thistle (*Centaurea solstitialis*)

INVASIVE ANIMAL SPECIES

Wild Turkey

INVASIVE PATHOGENS

Outbreaks of Sudden Oak Death caused by the pathogen *Phytophthora ramorum* have killed tens of thousands of native oak and tanoak trees in 14 coastal counties in California.[11] Intensive efforts to monitor the extent, pathology and control are underway by the California Oak Mortality Task Force and other research institutions, however, there is as yet no cure for *P. ramorum* and its associated diseases. Current best management practices focus on monitoring its extent and attempting to prevent further spread. Surveys and samples for sudden oak death on the Property have not detected sudden oak death. It has, however, been detected on an adjacent property, and could pose a significant threat to the Forest. See "Pests and Diseases," under "Silviculture and Harvesting Strategy" for recommendations to prevent its spread.

INVASIVE SPECIES MANAGEMENT APPROACH

Consistent with the guiding principal of our management, invasive species management will be adaptive in nature, using lessons learned from previous work to shape future efforts.

Primary management goals include: protecting target species and communities; containing the spread of existing invasive species; and preventing new infestations.

Initial management actions will include an expert inventory and analysis of weeds and pests, including the number, nature, and location of species as well as treatment options (including projected effectiveness and estimated costs). The selection of targets and treatments will be determined by a variety of criteria, including threat to target species and communities, cost, and effectiveness. Control methods will be evaluated in consultation with TNC's Wildland Invasive Species Program (WISP), preserve stewards, weed extension agents, and other experts. Regular monitoring of the spread of existing species as well as the potential introduction of new species will occur to maximize efficiency via early detections and treatments. Monitoring will also enable an assessment of the effectiveness of employed methods (i.e., adaptive management). A GRF policy on hardwood control and herbicide use is under development and will be included in updates of this Plan. It is anticipated that application of chemical herbicides will be necessary to cost-effectively control some invasive plants. (Note: hardwood treatment is also discussed under "Silviculture and Harvesting Planning and Operations" in Section II.)

[11] For more information see California Oak Mortality Task Force (COMTF) at http://nature.berkeley.edu/comtf/.

B. WATERSHED MANAGEMENT

1. WATER QUALITY

The following sections present a general description of the water quality management issues found on the Forest, the regulatory framework addressing water quality and the remediation measures to be implemented. Chief among these will be road management measures which will be essential to achieving a variety of water quality protection and enhancement goals identified for the Property, particularly with regard to sediments. These road management measures are described in detail in Appendix J, "Draft Road Management Plan."

POLLUTION PROBLEM

The Water Quality Control Plan for the North Coast Region ("Basin Plan") designates the beneficial uses of water bodies within the North Coast Region (North Coast Regional Water Quality Control Board, 2000). The uses include municipal drinking water use, cold freshwater habitat, estuarine habitat, spawning, reproduction, migration and early development of cold water fish. (*Resolution No. R1-2004-0087; Total Maximum Daily Load Implementation Policy Statement for Sediment-Impaired Receiving Waters in the North Coast Region* ("TMDL Implementation Policy")).

The GRF has been managed for industrial timber production for many decades. The *Recovery Strategy for California Coho Salmon* prepared by the Department of Fish and Game ("Coho Strategy") states that "[h]istorical forestry practices and some current forestry practices have been shown to impact several freshwater habitat components important to anadromous salmonids in general, and coho salmon specifically. These impacts include increased maximum and average summer water temperatures, decreased winter water temperature, and increased daily temperature fluctuations; increased sedimentation; loss of large woody debris; decreased dissolved oxygen concentrations; increased instream organic matter; and decreased stream-bank stability…" (Id at 3.8).

The Garcia River watershed has been listed as impaired due to excessive sediment and temperature on the 303(d) list of impaired water bodies and a Total Maximum Daily Load (TMDL) for sediment has been established for the Garcia River watershed by the North Coast Regional Water Quality Control Board (NCRWQCB).

IMPACTS

Past and current forest management practices have been identified as a principal source of sediments. According to the Non-Point Source Implementation Plan, "[s]ilviculture contributes pollution to 17 percent of the polluted rivers… in California (SWRCB). Without adequate controls, forestry operations may degrade the characteristics of waters that receive drainage from forest lands. For example, (1) sediment concentrations can increase due to accelerated erosion, (2) water temperatures can increase due to removal of over-story riparian shade, (3) dissolved oxygen can be depleted due to accumulation of slash and other organic debris, and (4) concentrations of organic and inorganic chemicals can increase due to harvesting and fertilizers and pesticides."

REMEDIATION STEPS

A variety of policy and planning documents have been developed that identify remediation and restoration measures to address these pollution problems and associated impacts. Chief among those are the Recovery Strategy for California Coho Salmon (CDFG 2004), the TMDL Implementation Policy and associated TMDLs established by the U.S. EPA (EPA 1998, NCWQCB 2001) and the NPS Implementation Plan.

These remediation steps may include the following:

THE COHO STRATEGY

The Coho Strategy includes both range-wide and watershed specific restoration recommendations, including the following:

> "Identify and prioritize specific sediment source locations for treatment that may deliver sediment to coho salmon streams." (Id at 7.4).
>
> "Identify and implement actions to maintain and restore water temperatures to maintain habitat requirements for coho salmon in specific streams." (Id at 7.4).
>
> "Encourage economically sustainable management of forest and agricultural lands in the range of coho salmon to reduce the potential for conversion to residential or commercial development." (Id at 7.7).

THE NON-POINT SOURCE IMPLEMENTATION PLAN

The NPS Implementation Plan identifies 61 management measures to address non-point source pollution in California during the Five-Year Implementation Plan. Of those, 12 relate to forestry and include such measures as pre-harvest planning, streamside management areas, road construction/reconstruction, road management and timber harvesting.

TOTAL MAXIMUM DAILY LOADS

TMDLs developed by the U.S. EPA have identified implementation measures that seek to address non-point source pollution problems (TMDL Implementation Policy at page 5). A TMDL for the Garcia River was established in 1998 (EPA 1998) and an Action Plan was created in 2001 (NCRWQCB 2001). The main objective of the TMDL and Action Plan is a 60 percent reduction of the average annual sediment load to the Garcia River watershed through the reduction of anthropogenic sources of sediment and an increase in the channel structure necessary to flush existing sediment and provide sufficient salmonid habitat. Existing data in the watershed do not allow specific elements of the TMDL to be partitioned to individual landowners or sub-watersheds. General load requirements have been developed, however, and landowners are required to document sediment delivery sites on their property and reduce the controllable volume of sediment.

IMPLEMENTATION OF RECOMMENDED MANAGEMENT MEASURES

The TMDL and Action Plan for the Garcia will provide the basis for our management plans regarding water quality and watershed management. TCF is currently developing its program for

compliance with the Garcia TMDL, which will include development of baseline data, an Erosion Control Plan, and a Site Specific Management Plan, proposed monitoring activities and aquatic restoration plans.

While the TMDL plans will likely not be ready for submittal to the NCRWQCB until June of 2007, TCF has pursued an active program to assess current watershed conditions and begin implementation of high priority management measures. This program has included:

- Retaining Jack Monshcke Watershed Management (JMWM)[12] to summarize current conditions and potential sediment delivery risks of the Property and to make recommendations for specific road maintenance, upgrades, and potential road closures and/or decommissioning (described in detail below under "JMWM Assessment").
- Working cooperatively with Pacific Watershed Associates (PWA) to acquire a CDFG Fisheries Restoration Grant to fund a comprehensive road assessment of Inman and Signal Creeks. PWA field crews began conducting sediment surveys in 2005 that will continue through mid-2006. This timely action allowed work to begin in previously identified, high priority sub-basins without missing a yearly CDFG grant cycle.
- Collaborating with JMWM to seek grant funding to correct several high priority sediment sources identified in the course of preparing the Assessment.
- Finally, an interim road maintenance plan for the Property was developed in collaboration with the NCRWQCB and implemented for the 2004 operating season, resulting in significant sediment savings and advancements toward self-maintaining road systems (see Appendix M, "2004 Road Maintenance Plan and Implementation Summary").

JACK MONSCHKE WATERSHED ASSESSMENT

In 2004, TCF retained JMWM to prepare a preliminary, property-wide assessment of watershed conditions. (See Appendix B, *Garcia River Forest Project Overview and Preliminary Action Plan,* Monschke 2005). The purpose of the Assessment was to provide current information at a scale suitable for developing the IRMP and to identify priorities for immediate action to enhance water quality. The Assessment presented a broad summary of current conditions on the Property, with special emphasis on potential sediment delivery risks. The Assessment was developed using aerial photography, an office-based review of geologic and sensitivity zone maps and other data gleaned from existing documentation of conditions in the watershed. This review resulted in the identification of approximately 320 sediment delivery sites throughout the Property. During subsequent field reviews, approximately 130 of these delivery sites were visited and 22 new sites were discovered. In addition, more detailed assessments planned for late 2005 and 2006 will likely identify additional sites needing treatment.

The following table summarizes the preliminary data gathered in the seven watershed areas comprising the Property. The first column represents the number of sites that are a high priority to assess and treat. The second and third columns represent the number of medium and low priority sites. The fourth column lists the number of sites that were functioning in accordance

[12] Jack Monschke worked as a consultant to the former property owner and co-authored the Garcia River Watershed Enhancement Plan (Monschke and Caldon, 1992).

with best management practices (BMP). The fifth column is the estimated potential sediment delivery of all the high, medium, and low priority sites that were assessed within each reach.

TABLE 8
SEDIMENT PRIORITIES BY PLANNING SUBWATERSHED

Watershed Area Inventoried	*Number of High Priority Sites*	*Number of Moderate Priority Sites*	*Number of Low Priority Sites*	*# of Sites Considered to be BMP*	*Inventoried Delivery Potential (yds^3)*
Inman Creek	15	3	4	8	28,080
Signal Creek	2	7	8	11	10,100
Hot Springs	2	10	7	7	5,500
Graphite Creek	1	1	1	8	2,200
Blue Water Hole	3	3	2	2	3,350
North Fork	2	2	12	10	2,800
Whitlow and Lamour Creek	4	12	3	2	6,550
TOTALS	**29**	**38**	**37**	**48**	**58,580**

A table within the JMWM Assessment (Appendix B), "Estimated Sediment Delivery and Cost of Implementation for Different Road Types," itemizes the cost of mitigating both projected (i.e., those additional sites likely to be found upon completion of the more detailed assessments) and identified high priority sediment delivery sites associated with roads. The estimated cost for mitigating all of the identified high priority sites on permanent, seasonal and temporary roads is $158,000.

The excerpt below from the JMWM Assessment describes the recommended prescriptions for sediment delivery mitigation for each of the three road types:

> **GENERAL COMMENTS** - The general philosophy for road upgrades should stress reshaping the road to reduce the amount of fill. This includes berm removal and out-sloping to reduce the size of the road prism. To eliminate fill and potential sediment delivery, crossings should be dipped and follow the contour whenever possible. It is also recommended that crossing upgrades should emphasize rock armored critical dips rather than replacing culverts to 100 year storm standards.
>
> **PERMANENT ROADS** - Most of the crossings on the permanent roads function well during large events. Thus, instead of replacing a few of these crossings, a broader approach should be taken to improve road drainage and reduce diversion potential on a large scale across the Property. A good example of this is the rolling dips installed on Graphite Road in 2004. Similar projects

should take place on all permanent roads when funding is available. Rolling dips are a relatively new development in road drainage and they require a skilled operator to construct a dip with the proper shape. Traffic on the road and sediment buildup often reduces the effective drainage of rolling dips. Thus, it is important to construct dips with a steep out-slope to maintain proper drainage over time.

SEASONAL AND TEMPORARY ROADS - Most of the crossings on seasonal and temporary roads are functioning well at this time. However, due to lack of winter maintenance these sites pose a greater risk for future sediment delivery. Crossings on these roads should be diversion-proofed and armored with rock. Where feasible, culverts should be removed and replaced with armored fords.

TMDL STATUS

TCF submitted a Statement of Intent to the NCRWQCB regarding the Property in June 2004, declaring the intention to submit an Erosion Control Plan (ECP) and Site Specific Management Plan (SSMP) per Option 2 of the TMDL Action Plan for the Garcia River watershed (NCRWQCB 2001). The ECP will outline how TCF will identify areas of existing sediment delivery and potential sediment delivery, as well as control sediment delivery due to past and present management activities. The ECP must include: a baseline data inventory of sediment delivery sites, a sediment reduction schedule, an assessment of unstable areas, and a monitoring plan. The SSMP will determine the appropriate land management measures to control sediment suitable for the conditions and activities of the Property. The SSMP must include a description of land management measures to control sediment delivery from the following sources: roads, landings, skid trails, watercourse crossing construction, reconstruction, maintenance, use, and obliteration; operations on unstable slopes; use of skid trails and landings; use of near stream facilities, including agricultural activities; and gravel mining. It must also include: a long-term road system plan, and a description of land management measures to improve the condition of the riparian management zone that addresses stream bank protection, the filtering of eroded material prior to its entering the watercourse channel, and the recruitment of large woody debris to the watercourse channel and flood plain.

Elements of the ECP critical to the development of the SSMP shall be developed in stages eventually covering the entire ownership. The ECP and SSMP will focus on silvicultural practices, timber harvesting methods, road construction, road reconstruction and road decommissioning; no commercial gravel mining, ranching or other industrial operations are expected to occur. The ECP is currently under development. The SSMP was submitted and first approved by the NCRWQCB on May 8, 2006; it has subsequently been revised and was approved July 21, 2006.

2. ROADS

BASELINE ROAD DATA

An initial road inventory, including skid trails, was developed by TCF during the first year of ownership based on data from the previous landowner, CDF, aerial photos, and fieldwork.

Expanding on this baseline of information, a detailed road inventory is currently underway by PWA (fall 2005 through spring 2006) on the Inman and Signal Creek watersheds, as previously described. Data by road classification and associated priority ratings of Low, Moderate or High will be provided for each road segment along with the year the work is expected to be performed. A complete description of each site and yards to be saved per site will be attached with the road inventory data.

Prescriptions to be used on sites noted in the base line road data will be developed by PWA during the road assessment.

As noted, an overview and general analysis of sediment sources across the Property (JMWM Assessment) was completed by JMWM in February 2005, one year after purchase of the Property in 2003. The specific baseline data inventory required in the ECP for roads and watercourse crossings is expected to require two to three years to complete from commencement in fall 2005. Baseline inventories of the Inman and Signal Creek planning watersheds, currently underway by Pacific Watershed Associates (PWA) through grant funding by CDFG are expected to be completed in 2006. The remainder of the Property including the North Fork Garcia, Middle Fork Garcia, Blue Waterhole Creek and Upper Garcia watersheds are expected to be completed in 2007. Site-specific remediation measures for each site identified during the road inventory will be recorded and prioritized following completion of the road inventory.

An assessment of geologically unstable areas was completed by Monschke and Best (1997) for the previous landowner in connection with a Watershed and Aquatic Habitat Assessment. The data and maps applicable to the Garcia River Forest are being utilized and adapted as the Assessment of Unstable Areas within the ECP. The Overview prepared by Jack Monschke is also being incorporated into the Assessment of Unstable Areas. Other sources such as KRIS Garcia may be used to develop and refine the mass wasting component of the ECP. Guidelines for operations on and near unstable areas are described in the SSMP and include provisions for silvicultural prescriptions, logging methods and road construction or reconstruction.

See Appendix J for the Draft Road Management Plan.

C. FOREST MANAGEMENT, SILVICULTURE AND HARVESTING OPERATIONS

This section describes the starting characteristics, objectives, policies, and expected outcomes for our forest management. We plan to practice what we consider to be the best forestry for our environmental, financial, and community goals given our specific forest and market conditions. The conservation targets and restoration goals for the whole Property described earlier in this Section informed the goals for the working forest (non-reserve) portion of the Property.

The overall goal of the forest management is to insure long-term and sustained-yield production of valuable forest products in a healthy, vigorous and diverse forest while protecting and enhancing the associated values of watershed, wildlife, fish, soils, recreation and aesthetics. The history of the GRF has created an overstocked, young second-growth forest with a disproportionate amount of tanoak. The overall restoration goal is to create, through forest management, a diversity of conditions including: fewer, older, larger trees that are more widely spaced; a higher proportion of conifers, especially redwood and Douglas-fir; a higher diversity of forested wildlife habitats; as well as riparian canopy closure and stream shading. Sustainable forestry provides an opportunity to treat the current condition of the forest to eventually meet

the conservation goals of the project to provide high habitat values as well as a sustainable supply of valuable forest products.

Sustainability can be defined as "development or resource use that meets the needs of the present without compromising the ability of future generations to meet their own needs" (e.g. Brundtland 1987). Strong economies are dependent on healthy ecosystems to provide the basic services and functions upon which societies ultimately depend (Lubchenco et al. 1991, Perring 1995, Costanza et al. 1997). The GRF project will develop management which ensures the biological integrity and ecological sustainability of multiple ecosystems, while also meeting economic goals of the project. An important component of this is certification, by a third party, of GRF's forest management program within five years. The conservation easement specifies certification by both of the nationally recognized sustainable forestry certification programs – the Forest Stewardship Council (FSC) and the Sustainable Forestry Initiative (SFI).

Specific detailed objectives and policies are described in the following sections. Some of the key elements are described below:

- Our silviculture will be primarily uneven-aged, to develop and maintain a range of tree sizes and ages within a stand, with the goal of producing valuable sawtimber and utilizing natural regeneration.
- We have a responsibility to manage the GRF to generate reasonable revenue for re-investment in the Property (e.g. restoration projects, road upgrades) and for conservation projects elsewhere in the region.
- Our harvest levels will be significantly less than growth rates over the next few decades so as to increase the timber inventory (we expect that it will double in 25 years).
- We are providing for increased riparian buffers on our Class I streams so as to improve riparian habitat conditions and provide connectivity across the landscape.
- Special attention will be given to critical wildlife habitat features, such as snags, down wood, and trees of significant size.
- We recognize that because of past practices our forest contains smaller trees and more hardwoods than would have occurred naturally and we will work to more closely approximate natural conditions.
- There are no old growth stands on the Property; there are a few individual trees that may be residual old growth—these and other very large trees and true oaks will be maintained.
- We anticipate no need to clearcut; we may use even-aged variable retention harvests (that retain large trees and habitat features) to rehabilitate conifer sites now dominated by hardwood or in future salvage situations; group selection will likely be used on Douglas-fir sites; all regeneration harvests will encourage natural regeneration.
- We have committed to certification of our forest management under the Forest Stewardship Council and Sustainable Forestry Initiative standards and reporting our carbon sequestration through the California Climate Action Registry.

1. PLANNING PROCESS

Detailed assessment of the forest conditions and specific management prescriptions for silvicultural treatments are central to this IRMP. The planning team has been working on this aspect of plan development for over 12 months, led principally by Craig Blencowe, an experienced local consulting forester (Blencowe & Associates), and Evan Smith, The Conservation Fund's Director of Forestry Projects. Because we were starting with limited data and no ongoing operations, we have spent considerable time and money defining our goals, conducting assessments of current conditions and developing the set of prescriptions to help us achieve our goals. This is the process that all landowners face as they begin to implement forestry, and our challenges are not unique.

Figure 5: Marc Jameson and Bill Stewart of CDF viewing permanent plot in Jack's Opening THP area (photo by Jenny Griffin, May 2005).

We have made significant investments in new information—new aerial photographs, new photo delineation and standtyping, new inventory plots on over 5000 acres, and a new stand-based inventory database. Thanks to the involvement of TNC, we used conservation planning tools and extensive analysis to define ecological restoration targets. We also re-measured 43 permanent plots that were established in 1994 by Coastal Forestlands, Ltd. (CFL); their commitment to research and foresight to establish these permanent plots has benefited us tremendously.

Despite all the new information, the nature of forestry requires decision-making in the context of unknown future conditions with limited information on current conditions. In many cases we made significant assumptions, such as the appropriate stocking level and current growth rates. We have used our best analysis of silvicultural techniques and estimates of future timber growth, but we must also emphasize the core philosophy of adaptive management. We will closely monitor our activities and forest conditions and will need to adjust our activities to reflect changes to such diverse factors as log markets, available logging equipment technology, habitat requirements, and observed growth rates. As those areas change we will likely need to redefine how we are going to best meet our management goal and objectives. It is important to note that this document is not intended to satisfy any forest practice rule requirement and that we have different abilities and requirements to update this plan than an Option A or Sustained Yield Plan. In addition we do not contemplate developing an Option A, Sustained Yield Plan, or Program Timberland Environmental Impact Report (PTEIR).

2. MANAGEMENT GOALS AND OBJECTIVES

The overall goal of forest management at the GRF is to insure long-term and sustained-yield production of valuable forest products in a healthy, vigorous and diverse forest while protecting and enhancing the associated values of watershed, wildlife, fish, soils, recreation and aesthetics.

The forest management objectives to attain this overall goal are:

a) Use each harvest as an opportunity to adjust the spacing, size, and quality of the timber stand to improve growth, value, health and habitat characteristics.

b) Increase inventory by harvesting less than periodic growth until the desired inventory level and sustained yield is achieved.

c) Employ commercial thinning and selection prescriptions and individual tree marking to remove low quality trees and retain high-quality vigorous trees.

d) Maintain trees in all sizes and age classes, from seedlings to 80+ year-old trees (allowing for older wildlife trees), which attain "target" sizes of 24+" diameter at breast height (dbh) for Douglas-fir and 30"+ dbh for redwood.

e) Favor redwood, but not to exclusion of other species; maintain natural ecological balance.

f) Improve conifer growth by controlling hardwoods, pre-commercial thinning, and replanting, where appropriate.

g) Achieve and maintain an overall annual growth rate of three percent on a standing inventory of 17,500 board feet per acre.

h) Maintain and enhance key wildlife components such as grassland, true oaks, snags, legacy trees, and large woody debris.

i) Maintain and enhance riparian areas.

j) Selectively harvest within the Reserve only to promote late seral stand development or to meet other specific Reserve objectives.

These objectives are designed to meet the ecological restoration targets established for the Redwood Douglas-fir forest and to help meet the goals for the other conservation targets (see "Ecological Reserve Network and Conservation Targets," Section II). As part of our planning, we have explicitly accepted less than maximum timber production so as to meet our other objectives for the forest. This is apparent through the designation of an Ecological Reserve Network, focus on uneven-aged selection, wider riparian buffers, and many other commitments. Despite these policies, it is still very much the core focus of the forest management to sell timber and generate cash returns, albeit in a reasonable and sustainable manner and dedicated to support further investments in watershed improvement, habitat enhancements, and other conservation projects. Many of the specifics of these objectives, such as desired standing inventory level and growth rate, are based on professional judgment and have been criticized by some for being too conservative and by others for being too aggressive. We will continue to use these figures until time and further analysis gives us reason to change.

3. FOREST SOILS

As detailed in Appendix C, "Soil Types and Descriptions," the Natural Resource Conservation Service Soil Survey (Rittiman, C, and T. Thorson, 2002) depicts 13 soil complexes in the project area. Nine of these soils are capable of producing commercial-quality timber, although of varying potential. The other four non-timber soil types support grass, brush, and hardwoods.

Soils capable of growing commercial quality timber occupy 22,034 acres (92 percent of the total Property acreage). Four primary timber soil types comprise over nine-tenths of this timber-producing acreage: Yellowhound-Kibesillah, Woodin-Yellowhound, Ornbaun-Zeni, and DeHaven-Hotel complexes.

The remaining eight percent of the timberland is comprised of Irmulco, VanDamme, Big River, Casabonne, and Pardaloe soils. Except for the Pardaloe soil, these soils have generally higher productive capacity than the four primary soils. However, since these secondary soils are of such limited occurrence, their effect on overall forest productivity is minimal.

TABLE 9
SOIL COMPLEXES, ACREAGE, AND CHARACTERISTICS

Primary Timber Soil Complexes	Acres	Percent of Timber-Producing Area	Site Class	Growth Potential (bf/acre/yr)
Yellowhound-Kibesillah	9,982	45	III, IV	335-630
Woodin-Yellowhound	4,872	22	III, IV	245-660
Ornbaum-Zeni	3,716	17	III, IV	525-770
DeHaven-Hotel	1,780	8	II, III, IV	880-1,325
Total	**20,350**	**92**		**515**
Secondary Timber Soil Complexes				
VanDamme-Irmulco-Tramway	725	3	II	1,500
Pardaloe-Woodin	356	1.5	IV	245-455
Irmulco-Tramway	329	1.5	II, III	1,130-1,545
Casabonne-Wohly	237	1	III, IV	420-665
Big River Loamy Sand	37	<1	I	2,050
Total	**1,684**	**8**		

Non-Timber Soil Complexes				
Garcia	140			
Gube	317			
Squawrock	857			
Yorkville	432			
Total	**1,746**			

4. MANAGEMENT COMPARTMENTS

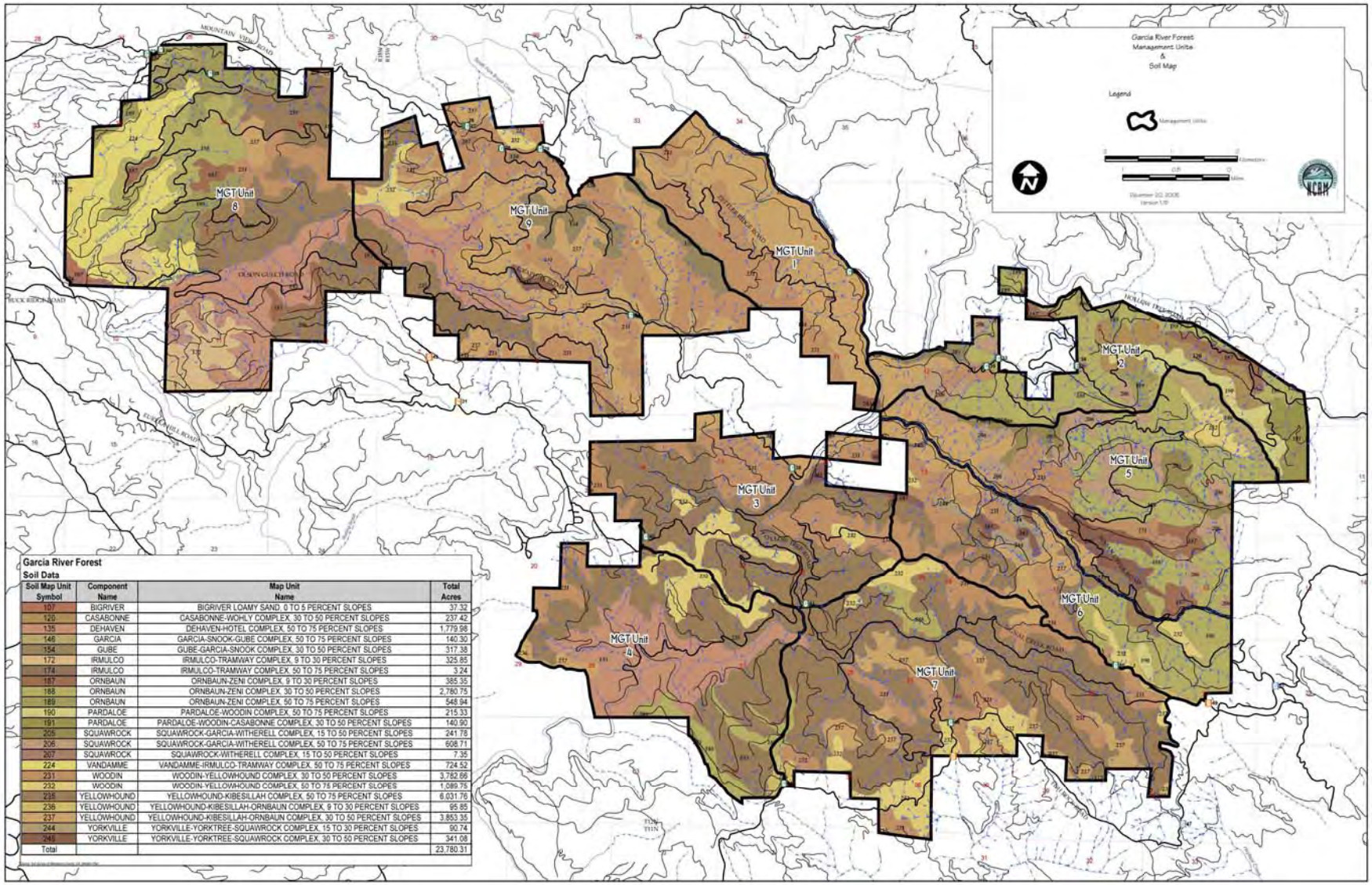
Based primarily upon operability, logistics, and transportation systems, eight management compartments have been defined (see Map 7, Management Compartments, below). Seven of these compartments, or portions thereof, are included in the GRF working forest. Compartment No. 5 (Inman) is entirely within the Reserve. The following table summarizes the compartments by location and acreage.

TABLE 10
SUMMARY OF ACRES BY MANAGEMENT COMPARTMENT

Compart-ment #	Compartment Name	Forested Acres in Working Forest	Acres in Reserve
1	Lower North Fork	2,037	2,036
2	Upper North Fork	3,337	234
3	Blue Waterhole	1,441	166
4	Whitlow	1,469	287
5	Inman	0	4,426
6	Signal	3,010	568
7	Mainstem	2,045	199
8	Hot Springs	1,981	328
	Total	**15,320**	**8,244**

Important note: all volume data, growth and yield calculations, and harvest scheduling apply only to the working forest and do not include Reserve acreage.

MAP 6: MANAGEMENT COMPARTMENTS



Garcia River Forest
Soil Data

Soil Map Unit Symbol	Component Name	Map Unit Name	Total Acres
107	BIGRIVER	BIGRIVER LOAMY SAND, 0 TO 5 PERCENT SLOPES	37.32
120	CASABONNE	CASABONNE-WOHLY COMPLEX, 30 TO 50 PERCENT SLOPES	237.42
135	DEHAVEN	DEHAVEN-HOTEL COMPLEX, 50 TO 75 PERCENT SLOPES	1,779.98
146	GARCIA	GARCIA-SNOOK-GUBE COMPLEX, 50 TO 75 PERCENT SLOPES	140.30
154	GUBE	GUBE-GARCIA-SNOOK COMPLEX, 30 TO 50 PERCENT SLOPES	317.38
172	IRMULCO	IRMULCO-TRAMWAY COMPLEX, 9 TO 30 PERCENT SLOPES	325.85
174	IRMULCO	IRMULCO-TRAMWAY COMPLEX, 50 TO 75 PERCENT SLOPES	3.24
187	ORNBAUN	ORNBAUN-ZENI COMPLEX, 9 TO 30 PERCENT SLOPES	385.35
188	ORNBAUN	ORNBAUN-ZENI COMPLEX, 30 TO 50 PERCENT SLOPES	2,760.75
189	ORNBAUN	ORNBAUN-ZENI COMPLEX, 50 TO 75 PERCENT SLOPES	548.94
190	PARDALOE	PARDALOE-WOODIN COMPLEX, 50 TO 75 PERCENT SLOPES	215.33
191	PARDALOE	PARDALOE-WOODIN-CASABONNE COMPLEX, 30 TO 50 PERCENT SLOPES	140.90
205	SQUAWROCK	SQUAWROCK-GARCIA-WITHERELL COMPLEX, 15 TO 50 PERCENT SLOPES	241.78
206	SQUAWROCK	SQUAWROCK-GARCIA-WITHERELL COMPLEX, 50 TO 75 PERCENT SLOPES	608.71
207	SQUAWROCK	SQUAWROCK-WITHERELL COMPLEX, 15 TO 50 PERCENT SLOPES	7.35
224	VANDAMME	VANDAMME-IRMULCO-TRAMWAY COMPLEX, 50 TO 75 PERCENT SLOPES	724.52
231	WOODIN	WOODIN-YELLOWHOUND COMPLEX, 30 TO 50 PERCENT SLOPES	3,782.66
232	WOODIN	WOODIN-YELLOWHOUND COMPLEX, 50 TO 75 PERCENT SLOPES	1,089.75
235	YELLOWHOUND	YELLOWHOUND-KIBESILLAH COMPLEX, 50 TO 75 PERCENT SLOPES	6,031.76
236	YELLOWHOUND	YELLOWHOUND-KIBESILLAH-ORNBAUN COMPLEX, 9 TO 30 PERCENT SLOPES	95.85
237	YELLOWHOUND	YELLOWHOUND-KIBESILLAH-ORNBAUN COMPLEX, 30 TO 50 PERCENT SLOPES	3,853.35
244	YORKVILLE	YORKVILLE-YORKTREE-SQUAWROCK COMPLEX, 15 TO 30 PERCENT SLOPES	90.74
245	YORKVILLE	YORKVILLE-YORKTREE-SQUAWROCK COMPLEX, 30 TO 50 PERCENT SLOPES	341.08
Total			23,780.31

5. FOREST INVENTORY PROCESS

A major effort was expended in 2005 to increase the information available to make forest planning decisions. A new stand delineation was created based on aerial phototyping by Scott Kelly, North Coast Resource Management (NCRM). This served as the basis of a new field inventory to develop stand-based estimates of forest inventories. The 2005 inventory was conducted by TerraVerde, Inc., and sampled over 5,000 acres, measuring 849 variable radius plots using a 20 basal area factor prism. No plots were installed within 200 feet of Class I streams (anticipating riparian reserve areas), so volume summaries do not include the higher volume riparian areas (which might raise the average volume per acre by one thousand board feet (Mbf) or more). The plot measurements and stand GIS information were entered into the Forest Projection & Planning System (FPS) computer model which creates a spatially-explicit Microsoft Access database for all stands (Arney, J.D., K.S. Milner, M.A. Jafvert, and C.E. Vopicka, 2004). A fundamental component of the FPS model is that it allows sampling design and inventory summaries to be constructed based on representative sampling of stand types. This stratified approach means that the inventory record for a cruised stand will contain the direct measurement from its cruise but that the inventory records for uncruised stands will include the average information for all cruised stands of the same type. On the Property all major forest types were cruised-- one or more of the largest stands of each type was randomly selected for sampling. Several minor stand types were not cruised and inventory information from the 1999 and 2000 cruise for CFL was entered into FPS.

The inventory information contained below is a product of the FPS database. FPS may also be used for growth projections and harvest scheduling. All volume information is reported in Scribner rule, with minimum merchantable diameter breast height of 8", minimum log diameter of 6", and a standard 5% defect deduction. No hardwood species are considered merchantable. Important note: all volume data, growth and yield calculations, and harvest scheduling apply only to the working forest and do not include Reserve acreage. Volumes for the large reserve areas can be calculated with the exception of certain riparian areas. Also, volume information does not include the 2005 and 2006 growing seasons.

In the next few years we will be updating our inventory by fully integrating it with computer growth and yield models and utilizing new data sources such as the high resolution imagery acquired by TNC to develop more detailed vegetation and habitat typing.

6. TIMBERLAND CHARACTERISTICS

SPECIES MIX

The working forest's conifer species are principally redwood and Douglas-fir, with a minor amount of sugar pine, and incidental volumes of western hemlock and grand fir. These conifer species intermix with hardwood (mainly tanoak) to varying degrees throughout the Property. The board foot volume is approximately 45 percent Douglas-fir, 40 percent redwood, and 15 percent other conifers. The conifer basal area follows a similar distribution by species, and hardwoods comprise 25-70 percent of the total basal area, depending on the stand type. Across the Property and all the management compartments, hardwoods comprise 45-55 percent of the basal area (and 75 percent of that is tanoak). As described above, these ratios are a significant deviation from the historic conifer dominance for much (but not all) of the Property.

AGE CLASSES

Due to the stand management history, there presently exist several age classes of timber, but in the majority of the stands the average overstory trees are 45-55 years old. The historic harvest patterns have resulted in scattered overstory trees intermixed with young trees in some stands (hence the "10 year-old" stands below still have 5 Mbf/acre).

TABLE 11
SUMMARY OF STANDS BY AGE CLASS

Age Class	Acres	Conifer Basal Area	Mbf/acre	Total Mbf
10	194	162	5.0	962
30	2,765	95	2.5	6,901
40	72	93	6.0	431
50	11,122	156	6.3	70,110
60	916	159	5.9	5,422
80	21	149	9.5	200
100	231	112	8.8	2,026
Total	**15,320**			**86,051**

STAND TYPES

The standtyping is the best way of understanding the inventory variations within the Property. The Property has been called "heterogeneously homogenous," meaning it contains a lot of different conditions that are all kind of the same—numerous variations on the same theme. In our case, lots of slightly different types of small sawtimber stands with a high component of hardwood. The classification methodology is described below—it was designed to provide a useful differentiation between stands with some similar features but different management needs. It will be possible to create cross-references to other popular stand-typing classifications, such as the Wildlife Habitat Relationships.

TABLE 12
SUMMARY OF STAND TYPES

VegType*	Acres	Conifer Basal Area	Mbf/acre	Net Mbf
CH21	14	104	6.3	87
CH22	225	161	6.8	1,539
CH31	222	94	4.6	1,021
DR22	67	153	7.9	524
DR31	453	95	5.9	2,679

DR32	927	203	12.1	11,259
DS21	102	74	5.0	514
DS32	12	109	8.6	101
HDR1	774	139	5.7	4,384
HDR2	2,711	168	6.0	16,197
MH21	30	128	3.5	103
MH22	1,958	171	5.9	11,632
MH32	4,973	145	5.6	28,021
MH42	76	174	13.1	992
QQ31	4	89	0.0	0
RD32	2,755	95	2.5	6,901
RD33	9	200	10.6	99
Total	**15,320**			**86,051**

*** VEGETATION TYPE KEY**

First two letters relate to dominant species:

CH = no dominant species, conifer more prevalent

DR = Douglas-fir most prevalent; DF + RW > 60% of basal area

DS = Douglas-fir most prevalent; DF + SP > 60% of basal area

HDR = hardwoods are dominant but also Douglas-fir and redwood

MH = mixed hardwoods > 60% of basal area

QQ = true oak > 60% of basal area

RD = redwood is most prevalent; redwood + Douglas-fir > 60% of basal area

First digit relates to DBH; specifically the diameter which at least 50% of the basal area is greater than

1 = 0 - 7.9"

2 = 8 - 11.9"

3 = 12 - 15.9"

4 = 16 - 19.9"

5 = 20 +

Second digit relates to stand density, ranked by Crown Competition Factor (CCF)

0 = poorly stocked (CCF<50)

1 = low density (50<CCF<200)

2 = medium density (200<CCF<350)

3 = high density (CCF>350)

As you can see, about two-thirds of the acreage (and the volume) is in stands where hardwoods are the majority of the basal area. There is very little acreage in large sawtimber size class or the high-density class.

BY MANAGEMENT COMPARTMENT

The seven management compartments show a slight variation in species composition and size proportion, as well as overall volume levels. Remember, only a small portion of the stands in any compartment have been cruised, so while these figures are accurate for the whole Property they will not be as accurate at a compartment level until more stands are cruised.

TABLE 13
BOARD FOOT PER ACRE VOLUMES BY MANAGEMENT COMPARTMENT, SPECIES, AND DIAMETER

	Compartment Name:	Lower North Fork	Upper North Fork	Blue Waterhole	Whitlow	Signal	Main Stem	Hot Springs		
	Compartment Number:	1	2	3	4	6	7	8	Average (Acres)	Average (%)
Species *	Acres	2,037	3,337	1,441	1,469	3,010	2045	1,981	15,320	
RW	8-12	204	195	258	178	285	167	168	208	3.7%
	12-16	521	437	485	453	490	331	405	446	7.9%
	16-20	696	567	634	543	714	519	553	604	10.7%
	20-24	437	284	329	317	319	271	375	333	5.9%
	24+	618	361	416	380	572	429	474	464	8.3%
	RW subtotal	2,476	1,845	2,122	1,872	2,381	1,716	1,975	2,055	36.6%
DF	8-12	624	612	541	368	718	589	413	552	9.8%
	12-16	978	1,106	1,088	732	1268	1290	917	1054	18.8%
	16-20	425	377	365	263	444	357	319	364	6.5%
	20-24	272	203	250	195	342	291	205	251	4.5%
	24+	490	695	588	633	605	555	836	629	11.2%
	DF subtotal	2,790	2,994	2,832	2,191	3,377	3,081	2,690	2,851	50.8%
OC	8-12	85	88	71	93	77	44	52	73	1.3%
	12-16	154	164	170	139	175	127	124	150	2.7%
	16-20	229	299	293	169	334	311	215	264	4.7%
	20-24	123	119	134	93	139	106	113	118	2.1%
	24+	94	90	125	106	132	84	99	104	1.9%
	OC subtotal	686	760	793	599	858	671	603	710	12.6%
ALL	**Total**	**5,951**	**5,599**	**5,747**	**4,662**	**6,616**	**5,468**	**5,268**	**5,616**	**100.0%**
	8-12	913	896	870	639	1080	799	634	833	14.8%
	12-16	1,653	1,707	1,743	1,324	1,934	1,747	1,446	1,650	29.4%
	16-20	1,350	1,243	1,292	975	1,493	1,186	1,086	1,232	21.9%
	20-24	832	606	714	605	800	668	693	703	12.5%
	24+	1,203	1,147	1,128	1,118	1,309	1,067	1,408	1,197	21.3%

**: RW = redwood; DF = Douglas-fir; OC = other conifer.*

GENERAL CONCLUSIONS

As briefly noted under "General Forest Management Conditions," past management and site conditions have shaped the timber stand components throughout the Property. These components include:

- Pole-sized and small second-growth sawtimber (30-50+ years old) occasionally in pure conifer stands, but primarily in a matrix of hardwoods. These stands developed from the harvest of the 1950-1960's, and have been since re-entered after 1988. This is the most common forest component.
- Larger second-growth timber which also regenerated from the 1950-1960's logging, but has not been re-entered. Most of this timber is located within the WLPZ of Class I and Class II watercourses.
- Young (<20 year-old) redwood sprouts and Douglas-fir seedlings and saplings mostly naturally regenerated following harvests since 1988.
- Hardwood-dominated stands, mostly with tanoak ranging in average diameter from 3" to 20" dbh. The hardwoods occur either in pure stands, over a conifer understory, or share canopy dominance with under-stocked conifers.

DISCUSSION

In general, the commercial quality timber stand is young, healthy, and vigorously growing. Redwood quality is generally good since previous harvests removed most of the low quality trees and fire-damaged residuals (i.e. generally 28"+ dbh). The younger and smaller redwood that now remains is clean and defect-free. General form of both redwood and Douglas-fir varies from very good on north-facing slopes and in canyon bottoms to only fair on upper south and west aspects near ridgetops.

Because most of the older trees have been removed, Conk fungus (*Phellinus pini*) is seldom observed in the Douglas-fir. Where larger fir may remain, (>30" dbh), conk is likely present, rendering most of these trees as culls to be retained for wildlife. The younger fir (<20" dbh) is of good quality, showing virtually no defect and full crown ratios often in excess of 33 percent. Douglas-fir has aggressively regenerated in the wake of previous logging and this species will make a significant contribution to GRF volume over the next 20 years.

Sugar pine appears to not have been aggressively harvested since 1988, possibly because of high trucking costs to more distant markets and low value of small diameter logs. The pine also shows excellent growth and good form. It does well on harsh sites less suitable for redwood.

Redwood and Douglas-fir each comprise 40 and 43 percent of the merchantable timber volume; sugar pine comprises most of the remaining 15 percent. The timber stand is uniformly small, with an average merchantable tree size of only 14" dbh. As such, most of the volume occurs in trees 24" dbh and smaller, and 44 percent of this volume occurs in trees less than 16" dbh and smaller. Only 21 percent of the total volume occurs in trees over 24" dbh.

Merchantable (8"+) conifer basal area averages 55 square feet, but varies from 20 to 163 square feet, depending on the stand type. Stocking of pre-merchantable conifers (0-8" dbh) is good, on

average, although there is a high degree of competition from small hardwoods. Developing these small conifers into merchantable volume by protecting them during harvest operations and reducing the hardwood competition will be key to the future silvicultural success of the project.

Hardwood-dominated stands are a very significant forest component, covering 10,525 acres of the working forest (almost 70 percent). These stands have an average of 5.8 Mbf/acre, so they still include a significant component of conifer sawtimber. While pure stands exist, most intermix with conifers, often suppressing conifer growth to varying degrees. Tanoak comprises 75 percent of the hardwood component, with lesser volumes of madrone, California bay, and true oak. The average hardwood diameter is 4-5", and although there is a full range of diameter distributions (see "Trees Per Acre" charts in Appendix N), the majority of the stands contain a large portion of small brushy tanoak (average dbh <7"), which aggressively compete with young conifer poles and saplings. The larger-size tanoak component competes with pole-size and small sawlog-size conifers as well. This hardwood component is due to the open conditions and disturbances initiated by the 1950-1960's harvest.

7. SILVICULTURAL PRESCRIPTIONS

In the first harvest cycle, emphasis shall be upon commercial thinning from below, improvement of stand structure, hardwood reduction, and general sanitation. This will promote the objective of retaining high-quality redwood and Douglas-fir for future growth. The second cycle will utilize combinations of thinning from below and selection prescriptions. Numerous stand type strata have been recognized on the Property and we are not going to define a specific prescription for each strata. Project foresters will make silvicultural decisions in the field, based on the unique characteristics of the stand, and in consideration of our overall management objectives and the following general management strategies:

- Release the tremendous growth potential by commercially thinning young redwood clumps and overstocked pockets of Douglas-fir, currently 30-50 years old. As soon as these stands become merchantable, they should be thinned from below to promote spacing and light. The smaller, suppressed and intermediate trees should be removed. The initial harvest cycles will produce many stems and relatively little volume, but these improvement cuts are necessary to increase growth of vigorous dominant and codominant trees while selecting smaller stems for development.
- 16"-20" dbh trees are "crop" trees, which need to be carefully cultivated to ensure a future supply of 24"+ dbh trees to meet long-term "target size" goals.
- Favor retention of redwood where appropriate (not on the drier sites) by removing Douglas-fir which shade and crowd redwood clumps, but recognizing that many parts of the Property are best managed for Douglas-fir.
- Remove low-quality trees while cultivating and retaining important habitat features. Except for those specifically designated for wildlife purposes, remove trees which exhibit disease, poor form, slow growth, broken tops, etc. This promotes the retention of high quality trees for future growth.
- Reduce hardwood competition with conifers on sites that were historically conifer dominant. Both pre-commercial poles and saplings, as well as smaller sawtimber (8-16" dbh), should be released from tanoak competition as soon as possible. Herbicide

treatment, mechanical control and variable retention harvests (often called "fuzzy clear-cuts") could be judiciously used to remove hardwoods and re-convert areas back to conifer. Use of this prescription must consider aesthetic and ecological impacts.

- Secondarily, young redwood sprouts, saplings, and poles should be pre-commercially thinned (generally at a height of 10-15 feet), where necessary.
- Selectively remove crop trees and encourage natural regeneration. As target diameters are attained (20-30 years from now in most stands), trees may be removed singly or in small groups. Groups may be as small as 1/10 acre to as large as 2 1/2 acres. The closed-canopy forest can now be opened to increase light to the forest floor and promote regeneration. In particular, intolerant Douglas-fir will benefit since the closed canopy will have previously discouraged its regeneration.

A policy on harvest retention is under development and will be included in updates to this Plan.

8. SITE INDEX AND POTENTIAL PRODUCTIVITY

There are many measures and data sources to estimate the timber productivity of the forest. It is not practical to measure actual growth except at limited intervals (every ten years or at time of harvest) and at limited sampling locations. Thus, most approaches use an indirect estimate of likely growth. The most commonly used metric is site index, an estimate of a soil's productive potential for growing commercial quality timber. The index is based on two parameters, tree height and age, and is usually described as the expected tree height at a given age, e.g. 89 foot Douglas-fir at age 50. Site index classes are ranges of site index from Class I (excellent potential) to Class V (very poor potential). It should be noted that site index is not a function of management—but of the biological productivity of the soils and climate—and should represent the maximum growth potential that would occur under ideal conditions (proper tree spacing, no disease or defect) for a given area.

For the GRF we have three data sources from which we can draw conclusions regarding site productivity:

- Soil series information from the Natural Resource Conservation Service, as described above.
- Re-measurements of 43 permanent plots from 1994-2005.
- Site index information from CFL site index study from 1997, the TerraVerde inventory cruise in 2005, and Mendocino Redwood Company estimates.

As noted above, soil productivity on the Property varies from Site IV through Site III to low Site II. However, there exists more acreage on the Site IV end of the spectrum than on the Site II end. A weighted average of the annual growth potential is estimated, on the basis of the NRCS soil information, at 525 board feet per acre per year. This is roughly equivalent to a low-mid Site III, a fair-average productive potential for the redwood range.

The best indicators of future growth are derived from interpretation of precise measurements of historic growth. On the GRF we are very fortunate to have 43 permanent plots, originally installed in 1994, which were re-located and re-measured in 2005. These plots were laid out as

part of a larger randomized sample. They give a valuable indication of productivity and can be used as a cross-reference for growth-and-yield computer models. Detailed plot summaries are in Appendix N. Some observations from the re-measurements:

- The first volume measurement (1994) averaged 7,198 bf/acre, with a median of 4,089 bf/acre, and a range from 0 to 36,308 bf/acre.
- The second volume measurement (2005) averaged 13,571 bf/acre, with a median of 10,330 bf/acre, and a range of 0 to 52,189 bf/acre.
- The average and median interval between measurements was 10.6 years.
- The annual volume growth averaged 602 bf/acre/yr, with a median of 552 bf/acre/yr, and a range from 0 to 1,842 bf/acre/yr.
- The annualized percent rate of growth averages 6.9 percent, with a median of 6.1 percent, and a range of 0 to 22.8 percent.

The current conditions of the permanent plots (average 13.5 mbf/acre) do not correspond with our current average conditions (average 5.6 mbf/acre). However the starting conditions of the permanent plots (median 4.1 mbf/acre) are not so different from our current average condition, and thus the median volume growth observed on the permanent plots in the past ten years is probably fairly representative of the future growth for our average stand.

We also have three sources of information on site index. The first came from a large-scale site index study conducted in 1997 by CFL that covered the GRF and some adjoining property. This study was designed solely to assess site index at a high degree of detail and confidence. The second set of site index measurements were conducted as part of the 2005 forest inventory. In both instances site index information was collected at or near randomly located plots. In addition, we also have the estimates of site index used by our neighbor, Mendocino Redwood Company, for their forest planning and long-term growth-and-yield estimates. Not surprising, given the different study designs and objectives, these three site index estimates are different and each approach has some validity and relevance to our planning needs. We expect to study this topic further before coming to any conclusions about site index on the GRF.

9. GROWTH AND YIELD

The following describes the concept of timber growth:

a) Growth is actual physical size increase. As real volume growth, it is independent of inflation and economic discount factors.

b) Standing timber volume is best thought of as principal and the growth as interest earned upon that principal.

There is limited data upon which to base projections of future growth for this property under this proposed management. All calculations of this nature involve assumptions to some degree—either explicitly, such as in our calculations, or implicitly in the use of forest projection models (e.g. CRYPTOS, FPS). Also there is a relative crudeness involved with using growth rates as the primary calculation assumption, when many other relevant measures exist (e.g.

periodic annual increment) or sophisticated computer models could be used. Our style of management will not result in wide variations in stand condition and growth (such as the difference between recent clearcuts and forests approaching maturity), so it lends itself to a simpler growth and yield analysis. Nevertheless, we recognize our limited understanding in this area and have made it a top research and monitoring priority. Experienced foresters have provided a wide range of predicted growth rates. Through the course of our planning we have chosen to err on the side of being conservative, as that best suits the nature of this partnership project. It is possible that our long-term monitoring will indicate significantly higher rates of growth, which would justify an increase in allowable harvest volumes.

We are beginning with an assumed growth rate of 5.0 percent, which we feel is conservative based on the permanent plot data and FPS model projections. It is expected that this rate may gradually decrease as average volume and competition increases. Ultimately, the long-term growth goal is to attain an average growth rate of not less than three percent on an average inventory of 17-20 mbf/acre, comprised of trees of all sizes, up to 36" dbh. Additional volume contribution will come over the next 30 years as the current poles and saplings grow into merchantable size classes.

Based upon our initial growth assumption of 5.0 percent and an average per acre net volume of 5.6 mbf/acre, the average per acre current growth is 280 board feet per year. This growth goal is conservative, but realistic considering stocking levels and the percentage of hardwood naturally occurring on the Property. It is well below the growth rate observed on the permanent plots over the past decade. As described above, we have intentionally created low expectations, recognizing that future monitoring may indicate higher rates—at which point we would likely adjust our allowable harvest volumes.

Blencowe & Associates' experience on similar properties suggests that, under proper intensive management, the long-term growth rate of at least three percent is realistic and attainable when carrying the proposed inventories. We intend to closely monitor actual growth rates through the existing permanent plots and additional plots and use computer models to develop projected growth rates. We anticipate that the growth assumptions and harvest schedule will be revised every ten years until a high degree of predictability has been achieved.

The keys to reaching these growth goals are:

a) For the first eight decades, beginning in 2006, harvest less than the periodic growth increment, allowing surplus volume and ingrowth to accumulate and add to the growing stock (until the inventory goals are attained).

b) During initial entry, thin stand from below to adjust spacing, maximizing light and space to allow crop trees to attain "target" size.

c) At each entry, remove selected low quality and slower-grow trees, consistent with aesthetic and wildlife goals.

d) Reduce hardwood component on sites where conifer was historically dominant.

By the beginning of the fifth cycle, some 80 years hence, the total volume goal and long term growth rate goal should be met. This relatively gradual approach is necessary to preserve

aesthetics and avoid wind throw, which could result from removal of too much volume at any one entry.

TABLE 14: ALLOWABLE HARVEST SCHEDULE

Period	Volume Growth Rate	Harvest as % of Growth	Effective Harvest Rate as % of Inventory	Effective Harvest Rate (Whole Property)	Beginning Annual Growth bf/acre	Total Annual Allowable Cut (mbf)	Total Post-Harvest Inventory	Post-Harvest Inventory Per Acre
Current Year	5.00%	0.00%	0%	0%	280	0.00	85,917	5.60
2006-2015	5.00%	35.0%	1.75%	1.14%	280	1,504	118,298	7.72
2016-2025	4.67%	35.0%	1.63%	1.06%	361	1,934	159,532	10.41
2026-2035	4.33%	45.0%	1.95%	1.27%	451	3,108	201,866	13.18
2036-2045	4.00%	55.0%	2.20%	1.43%	527	4,441	241291	15.75
2046-2055	3.67%	65.0%	2.39%	1.55%	578	5,756	274,139	17.89
2056-2065	3.33%	75.0%	2.50%	1.62%	596	6,847	297,835	19.44
2066-2075	3.00%	85.0%	2.55%	1.66%	583	7,595	311,512	20.33
2076-2085	3.00%	95.0%	2.85%	1.85%	610	8,878	316,217	20.64
2086-2095	3.00%	100.0%	3.00%	1.95%	619	9,486	316,217	20.64
2096-2105	3.00%	100.0%	3.00%	1.95%	619	9,486	316,217	20.64

Notes: 1) Shaded cells are assumptions. 2) Growth is compounded annually. 3) Harvest is not compounded annually.

It is critical to realize that the allowable cut is the maximum sustained level of harvest. In reality, the actual annual harvest may be somewhat less or more, especially in the first two cycles. Logging logistics and stand structure are both influencing factors. For example, isolated patches of small trees may not be cost-effectively accessed until they are larger, or a group of well-spaced fast-growing trees may be temporarily left uncut to maximize their growth potential for the next cycle. Additionally, we anticipate updates to our harvest schedule in ten years after we have more data on actual growth and greater confidence in the productivity estimates. Again, this IRMP is not an Option A or Sustained Yield Plan and is not attempting to calculate Long-Term Sustained Yield.

10. HARVEST FREQUENCY

It is proposed that each harvest unit be entered no more often than once every 15 years. This cycle is sufficiently often to carry out remedial stand treatments, salvage mortality, and provide a relatively even income flow, but long enough to be practical, minimize aesthetic disturbance and allow release growth to accumulate.

It is imperative that compartment harvesting plans remain flexible to take advantage of good markets, and avoid poor ones. Depending upon silviculture needs, harvest logistics, and market conditions, it will likely be advisable to operate by sub-compartments, and harvest only a portion of the designated compartment volume in any single year. Thus, the compartment allowable harvest may be removed over several years, rather than in a single entry.

Regardless, the allowable cut for any one decade will not be exceeded over the Property. Because the silviculture will be focused on uneven-aged single-tree selection, there is no rotation age, per se. Should the conditions justify the use of group selection (for Douglas-fir stands) then we would anticipate managing by area regulation such as prescribed by the California Forest Practice rules. In some situations we make pursue stand rehabilitation with variable retention harvests; in those case we would be creating even-aged stands (although with enhanced structure) that would be transitioned to uneven-aged selection.

11. HARVEST IN ECOLOGICAL RESERVE NETWORK

Timber harvest shall only occur within the Reserve to attain specific Reserve management goals in these areas (i.e. hasten creation of late seral stand conditions, increase woody debris, provide material for salmonid improvement projects, etc.). (Note: see "Ecological Reserve Network" under Section II, "Management Goals," for Reserve management details such as principals, goals, objectives, and operating policies.)

Where harvest is used to promote late seral conditions by increasing average tree size and differentiated structure, it is anticipated that no more than two commercial thinning entries will occur in any Reserve area. These entries will not only thin from below and for spacing to increase growth on the dominant trees, but would also leave "low-quality trees" with specific wildlife advantage. For example, large, very full-crowned, fast-growing Douglas-fir "wolf" trees, showing excessive limbiness and occupying disproportionate growing area, would still be retained in the Reserve. The goal is to create multi-storied stands with the full range of late-seral characteristics—large and decadent trees, site-appropriate species, snags and downed wood.

Over the next 20-30 years, it is unlikely that there will be any perceptible difference between the appearance of the working forest and the Reserve. Thereafter, target-diameter trees will be harvested in the working forest, while the same diameter trees in the Reserve will be permitted to grow. But the preceding thinnings will have allowed the large trees in the reserve areas to develop faster than they would have with no management.

Harvest in the Reserve will be planned in conjunction with harvests in the working forest to increase efficiency and limit frequency of entries in any given portion of the Property. Because operations will be decided on a site- and time-specific basis, the extent of volume and value contributions from the Reserve cannot be predicted at this time. As such, these volume and value figures are ***not*** included in the management data.

12. RIPARIAN BUFFERS

Protection and improvement of water quality and watershed health is a critical goal for the GRF project. Expanded riparian buffers on Class I streams are included in the Reserve Network. This includes a 200 or 300-foot buffer on both sides of the stream that will be managed solely for late-successional forest conditions. Buffers on Class II and III streams will meet or exceed the

Forest Practice Rules and TMDL requirements for Watercourse and Lake Protection Zones (WLPZs). The other major benefits to water quality will come from improving road conditions and maintaining a healthy forest throughout the watershed—e.g., no development or large even-aged harvest openings.

13. SIGNIFICANT MANAGEMENT CONSIDERATIONS

- Establishing true non-declining, even-flow, economically viable sustained yield of high quality forest products involves three essential elements: Harvesting less than growth until the desired sustainable inventory level is attained. This addresses the concept of over-cutting; it is a harvest quantity issue.
- Retaining vigorous, high-quality trees in the post-harvest forest. This addresses the concept of volume high-grading; it is a harvest quality issue.
- Retaining the more valuable species in the post-harvest forest. This addresses the concept of value high-grading; it is a harvest economics issue.

Simply put, you cannot have economically-viable sustained-yield if you: a) cut more than you grow; b) leave poor quality trees with little growth potential; or c) cut too many high-value trees. These are basic, but essential, concepts built into our management.

14. MANAGEMENT PRIORITIES

Generally, the most cost-effective forest management focuses initially on the more valuable species growing on better sites. This approach provides the greatest economic return in relation to costs of management. Management priorities for the first decade are:

1. Selective harvest of larger young-growth redwood in well-stocked stands that can be maintained.
2. Thinning 30-50 year-old small sawtimber where redwood is the dominant component.
3. Thinning 30-50 year-old small sawtimber where fir is the dominant component.
4. Selectively harvesting (to the extent feasible) conifer stands where they intermix with hardwoods, while reducing the hardwood component.
5. Releasing young conifers from hardwood suppression where adequate conifer regeneration is present.
6. Converting hardwood stands back to conifer on timber-producing soils.

The first two strategies will produce immediate income. The third strategy will produce more modest immediate income. The fourth may likely be a break-even operation. The last two strategies will be a net expense.

15. HARVEST LOGISTICS

For the next 20-25 years, the success of our management depends upon adequately responding to the Property's biggest challenge:

"*How can we generate meaningful income by cutting small low-value trees on steep ground, and then trucking them to distantly-located sawmills?"*

California's timber industry has traditionally responded to this situation by either avoiding it (waiting until the trees are larger), or taking everything (clear-cutting). Neither of these options meets our management goals. Thus, to realize the goals, we may need to pioneer harvest techniques that have little precedent in the redwood region.

The first harvest cycle will generate many small stems (10-14"dbh trees) and many low value trees (Douglas-fir). Furthermore, to minimize erosion potential, steeper slopes will mandate cable logging (except where existing skid trails can facilitate selection harvest with minimized environmental impact). Small fir logs are not very valuable at the sawmill; cable-logging small trees is expensive. Thus, two main variables affect financial return:

- delivered log value at the sawmill; and
- cost to harvest the timber.

Return is enhanced if you can increase the former, and decrease the latter.

DELIVERED LOG VALUE

Primarily market-driven, it is difficult to influence log value. It is possible, albeit unlikely, that sawmills will pay more for FSC-certified wood, especially if some agreed-upon volume is guaranteed over a multi-year period.

HARVEST COSTS

There is little indication that present methodology will permit cost-effective cable logging of the Forest. To do so will require thinking "outside the box." Accordingly, we will consider a range of factors and options to make harvesting financially viable, including:

- Logging prices decrease in the winter---consider cable-logging logs during winter and cold-deck logs in yarder chute. Truck logs during dry periods or during summer.
- Loggers value security---logging rates could drop with a multi-year work guarantee and/or when road work, re-habilitation, etc. is part of guarantee.
- Timber marking by RPFs is expensive---in steep, less accessible areas, consider having timber fallers or technicians select trees to be cut. Train fallers accordingly and check their work.
- Speed is important---scattered low volume removal requires a cable machine that moves quickly from corridor to corridor with minimal set-up time. Though not common in California, the technology does exist and should be investigated.
- Tractor logging is cheaper than cable logging---for at least the first cycle, minimize operations requiring cable-logging; focus on gentle slopes.

16. DESIRED STAND STRUCTURE

The key to our timber management over the next two decades lies with the rapidly developing 30-50 year-old stands. This age class will provide the first crop of sawlogs that attain target diameters. Since there are presently very few trees of target diameter size, there will be a 15-20 year "large sawtimber gap" until the first crop tree harvest. While this waiting period will be busy with improvement cuttings, volume and income will be modest.

The current youngest age class (10-20 years) will be a vital recruitment source to replace those crop trees to be harvested two decades hence. This young age cohort is vital to successfully transition from an even-aged to an uneven-aged management strategy. As the young trees "fill in" behind harvested trees, future timber gaps will be avoided. Continuity of timber supply is assured because the 10-20 year-old timber will be attaining target diameters at a time when the last of the older 30-50 year-old trees are being harvested.

Over the next 20-25 years, the single most critical aspect of stand management is to avoid cutting too many high quality trees in the 18-24" dbh class. In general, when properly spaced, these trees should be allowed to grow. Under this regime, no "timber gap" is anticipated in the overall uneven-aged prescription.

Proposed management should "flatten" the typical inverse J-shaped curve normally associated with uneven aged management. The stand table curve (i.e., number of trees per acre vs. diameter) should become less steep-sided as more large trees (e.g. 20"+) are retained relative to smaller trees. This is due to two factors:

- Selective harvests, which reduces the overall number of smaller trees by removing suppressed fir and redwood; and
- Retention of larger trees to develop high-quality sawlog redwood and fir.

Selective harvests will remove trees in all size classes, including thinning smaller suppressed trees from "below," and retention of larger trees to develop "target-size" high-quality sawlog redwood and fir. Target-size diameter goals are:

- Redwood 30-36" dbh
- Douglas-fir 24-28" dbh

17. HARDWOOD MANAGEMENT

While true oak species and oak woodlands are an identified conservation target and primarily protected in the Reserve Network, there is a significant tanoak presence in the working forest. At present, lack of viable commercial markets prohibits bona-fide hardwood management. For this reason, specific long-term management strategies for tanoak and madrone are limited to reducing the hardwood component to more closely approximate its historic abundance (10-30 percent on most sites, although we recognize that pure tanoak stands were historically present on some sites and that it may be appropriate to leave them as such). With a viable sawlog market, hardwood management could include production of high-quality sawlogs through thinning and crop tree management. However, given the present market conditions, hardwood management will encompass:

- Production of fuelwood.
- Physical removal, girdling, or herbicide treatment to release and improve conifer growth, where cost-effective.
- Specific retention for wildlife values.

In each management compartment, there are areas where hardwoods suppress conifer growth and/or inhibit conifer regeneration. This is especially true where the 1950-60's logging was most intense. In many cases, these hardwoods are either too dense or too inaccessible to cost-effectively remove for site preparation or to release understory conifers.

With the inception of viable hardwood markets, detailed management strategy will be developed and added to this management plan. Until that time, the following guidelines shall be implemented:

a) Give removal preference to hardwoods competing with conifers when selecting firewood. Avoid damaging conifers when hardwoods are cut and skidded.

b) Retain large hardwoods (>18") for wildlife. Two to four large hardwoods are adequate per acre. Retain hardwood snags, where feasible. Retain all true oaks where feasible. *(Note: a policy on harvest retention is under development and will be included in updates to this Plan.)*

c) Retain straight, thrifty hardwoods and remove defective, low-quality trees.

18. FOREST IMPROVEMENT ACTIVITIES

PRE-COMMERCIAL THINNING

Pre-commercial thinning reduces the number of conifer stems per acre. This permits more recoverable growth to occur on fewer, but higher quality, stems. "Crop" trees should have at least 1/3 their height in vigorous crown. Poor quality trees should be weeded out and well-formed dominant trees retained. Spacing should vary from six to 14 feet. Basal area levels will be based, in part, on existing stocking conditions.

Because the selective prescription makes only limited light available to young regeneration, thinning cost-effectiveness will vary within the project area, and will be dependent upon tree species and size.

Optimum economic return results when thinning redwood 3-6" dbh, or 15-20' in height. Trees larger than this are more expensive to thin, and trees smaller than this have usually not yet fully expressed dominance.

Pre-commercial thinning Douglas-fir in the Ten Mile River area, Mendocino County, has been followed by blackstain root disease attacking the "crop" trees. Thus, the decision to thin fir should be made on a site-specific basis. The highest priority is to thin redwood on better growing sites.

Young conifers should be released from overtopping hardwoods by careful falling practices. If the hardwoods are to be skidded, added care should be used so conifers are not damaged in the process.

CONIFER PLANTING

Though the preference is for natural regeneration and all post-harvest stands will meet Forest Practice stocking standards, harvest areas may need to be inter-planted in the first winter after logging. Ground disturbance during operations will adequately prepare the site for interplanting in most cases. Redwood and Douglas-fir will be planted in various ratios depending upon local site conditions. The purpose of inter-planting is to maximize conifer stocking.

Either bare root or plug stock may be used. Bare root should be two-year old stock. Spacing will likely be ten feet by ten feet; however, it is much more important to plant in the best micro-site than it is to adhere to strict spacing criteria.

On harsh south aspects, partial shade will protect seedlings. The north side of stumps, logs, and rocks provide "dead" shade. Avoid planting in grass sod or beneath hardwood canopies. Favorable survival occurs when seedlings are planted in bracken fern areas.

If deer browsing becomes a problem on saplings, vexar mesh can be applied to the apical leader until the sapling grows beyond the reach of the deer. Trees to be vexared can be selected on a ten by ten foot grid.

HARDWOOD COMPETITION CONTROL

Large portions of the Property are overstocked with hardwoods, meaning that the hardwood component is greater than desired (and than was historically present) and is reducing the present and future growth of conifers. Based on old growth stands in the area, we believe that the historic range of hardwood abundance was probably 10-20 percent of the basal area on the wetter sites and 20-50 percent on the drier sites. Currently hardwoods account for around 50 percent of the basal area in an average stand. The dominant hardwood species is tanoak, with a smaller component of madrone and, in the riparian areas, alder. These are, for the most part, early successional species that became established following the aggressive harvests in the 1950s. On sites that were likely to have been historically dominated by conifers we will seek to reduce the hardwood component through several means. On sites where the conifers are well established in the overstory, an efficient means of reducing the hardwood component is simply to wait 10-20 years until the conifers achieve full dominance and shade out the hardwoods. Unfortunately, in many areas hardwoods have become established in the canopy and waiting for conifers to re-establish themselves could take several decades to a hundred years. Where it makes financial and ecological sense we will seek to accelerate the re-establishment of conifer by mechanical girdling of hardwoods, stem application of herbicides, and/or planting of conifers. In no case will we try to eliminate hardwoods—they are an important part of a natural stand. Particular attention will be paid to retaining high wildlife value hardwoods, such as den trees. Our neighbors at the Mendocino Redwood Company have experimented with the most effective and environmentally responsible approaches to hardwood competition control and we hope to learn from their experience. It is important to note that the Property contains a great deal of true oak species, usually on south facing ridges and interspersed with grasslands. These oak woodlands would never support significant conifers and are a very important habitat type.

For the most part they are protected as part of the Reserve Network. Where they occur in the working forest and it is operationally feasible, true oaks of all sizes will be maintained and protected.

A GRF policy on hardwood control and herbicide use is under development and will be included in updates to this Plan.

PESTS AND DISEASES

(Note: see also "Invasive Species Management" in Section II). Insects and disease often become initially established in damaged, weakened, or over-crowded trees. The best prevention is to maintain a healthy vigorous stand. Several pest problems either presently occur on the Property or have the potential to occur.

The Douglas squirrel causes some top mortality in redwood. While not uncommon, this is probably not an overly significant problem. Significant damage from black bear activity has not been observed.

Red ring conk rot (*Phellinus pini*) has been observed in Douglas-fir, but it is not a significant problem. Conk rot, which is always present, tends to infect suppressed and over-mature Douglas-fir, with most damage occurring in trees older than 80 years. Because the present stands are so young, conk is uncommon. By growing Douglas-fir to less than 80 years, and by removing the suppressed and over-mature trees, the fungus can be kept to a minimum. Where conk has rendered fir trees less than 50 percent merchantable, they will be retained as wildlife habitat.

Leptographium wageneri v. pseudotsugae, or black stain root disease of Douglas-fir, is also an endemic fungus in the Western United States. This fungus does not cause rotting of wood, but attacks the roots and spreads to the lower tree bole. The disease causes a decline in tree crown (from bottom to top), needle size reduction, and eventual death. Black stain attacks trees of all ages, often causing small pockets of mortality, since the disease can be spread through root grafts.

There is some evidence that black stain is aggravated by disturbance such as pre-commercial thinning or logging. Thus, future timber marking and interplanting decisions may depend, in part, on the potential effects of this disease. In addition, blackstain is capable of living in soils for decades. Hence, if black stain pockets develop, they should be regenerated with another species that is not susceptible to blackstain (such as redwood or sugar pine) in order to minimize the effects of this disease.

Coastal sugar pine seems less affected by the white pine blister rust than the Sierra sugar pine, probably due to the absence of the alternate blister rust host *Ribes* sp. However, the coast variety is susceptible to bark beetles (e.g. *Dendroctonus* sp., *Ips* sp.) which girdle trees by gallery construction beneath the bark. These borers breed in green pine slash. To discourage them, all pine slash should be lopped and scattered, thus hastening the drying process.

Of concern with tanoak in particular is "Sudden Oak Death" (SOD), caused by a strain of *Phytophthora* fungus. Leaves of infected trees can quickly all turn brown prior to death. The greatest threat for disease spread is movement of infected foliage and small diameter (<4") woody material. There is also potential for fungal spread via wet soil encrusted onto mobile

equipment. Recent samples (2005) obtained from suspect tanoak and bay trees by CDF proved negative for the presence of SOD.

Figure 6: Jack Marshall, CDF Forest Pathologist, collecting samples that tested negative for SOD (photo by Jenny Griffin, October 2005).

Department of Forestry recommendations to minimize risk of SOD:

- Conduct a visual survey of the property and notify CDF of any symptoms.
- If an infection is known on the property, all equipment and vehicles associated with the operation shall be cleaned of all foliage and small diameter woody debris and soil prior to leaving the site.
- Small diameter material (including chips) shall be left on site. Following chipping, non-host material should be run through the chipper to clean out host material.
- Conduct timber operations during the dry season.
- Locate landings, log decks, roads and other equipment sites away from host plants.
- No host firewood shall be removed from the property if within 1/4 mile of a known infected site.

If unprocessed wood is to be transported to an unregulated county (outside of the Zone of Infestation), the receiving county's Agricultural Commissioner shall be contacted to approve of the shipment or method of shipment/transportation.

FIRE MANAGEMENT

As a natural disturbance component, fire will be evaluated as a potential future management tool in both the working forest and/or in the Reserve.

Fire danger reaches extreme during the summer months. Long, dry summers, high winds and large concentrations of logging slash can contribute to this problem. The Property is currently closed to public vehicles, thus greatly reducing the danger of human-caused fires. Roads along ridgetops serve as potential firebreaks.

Fire hazard increases with stand age, as fuels in the form of dead organic material build up on the forest floor. Logging or pre-commercial activities generate slash, which can also increase the fuel load; however, the fuel load is generally distributed low on the ground to minimize potential of fire spread into tree crowns.

Forest management operations which can minimize unnatural fire hazard include:

- Disposing or lopping of slash along roadways
- Keeping roads and fire trails clear of debris
- Constructing shaded fuel breaks along roadways on major ridges
- Lopping slash within 100 feet of any public road (per Forest Practice Rules); it is additionally advisable to remove all slash within 25 feet of any public road
- Piling and burning should be discouraged; slash should be crushed/spread along skid trails where feasible.

HABITAT IMPROVEMENTS

Seeding

During erosion control and following logging operations, roadsides, portions of WLPZ, and all landings shall either be seeded (with non-persistent cereal grains or regionally appropriate natives if feasible), or treated with non-vegetative methods for temporary erosion control until native vegetation is established. Non-vegetative methods include jute mat, wood chip mat, straw mat, straw mulch (clean or weed free), or tractor compacted and/or lopped native slash. Native species are preferred where practical (natives often require more time for establishment, which limits their use for erosion control).

Snags

Snags are a critical component of optimum wildlife forest habitat. For example, many mammals den in them, raptors perch on them, and woodpeckers feed in them. Except for safety purposes, all snags should be retained. Inventory data indicates a current average of one snag per acre in stands not treated with herbicide (stands that were treated with herbicide by the previous owner have considerably higher number of snags).

TABLE 15: SNAG DISTRIBUTION BY SPECIES AND SIZE

	Total Snags/Acre	Hardwood <18"	Hardwood >18"	Conifer <18"	Conifer >18"
Stands Not Treated w/Herbicide	1.03	0.37	0.04	0.53	0.09
Stands Treated w/Herbicide	169.94	165.20	1.51	2.80	0.32

Until snags reach a density of one per acre greater than 16", and one per five acres greater than 24", timber marking will protect snags, as identified in conservation target planning. Snags and decadent trees will be recruited through wind damage (on the ridges), lightening, and *Phellinus pini* in the stand. Snags may also be artificially created. These natural disturbances, combined with timber marking discretion, will ensure a future source of snags and large woody debris (LWD).

Although management will remove defective, diseased, suppressed, and low quality trees, it is recognized that a portion of this component must be retained. To this end, conky Douglas-fir and partially rotten redwood have the highest priority for recruitment as snags. Additionally, wind buffers along ridgetop margins will be retained to protect the interior stand and selected large trees will be allowed to become deformed by age and wind.

The CDFG's "Snag Resource Evaluation" (Administrative Report #93-1) states:

> *"In selection cuts, the snag recruitment may be accomplished by maintaining adequate numbers of green trees in size classes necessary to replace retained hard snags as they fall."*

Therefore, retention of adequate numbers of green trees in all size classes will ensure that snags will always be present within the future stand.

Rare Plants

A survey of vascular plants with special emphasis on the rare and endangered species was conducted on the Property in 2005. See "Ecological Conditions," Section 1, and Appendix G, "Rare Plant Survey," for details. The findings and recommendations of that survey in addition to future surveys prepared in connection with timber harvest activities will guide forest management relative to the protection and enhancement of rare species and communities. See also general guidelines described under "Water Quality" and "Roads," Section II, Part B.

Downed Logs

Reptiles, amphibians, and small wildlife live within and around old down logs. Wildlife value is proportional to log diameter and length, with logs on the contour being better utilized than those lying perpendicular to the slope. Merchantable redwood logs are sometimes salvaged, but others are left undisturbed. Unmerchantable logs skidded to the landings are hauled back into the forest and cull logs produced during timber operations are left in the woods, insuring ample future supply of coarse woody debris. By providing habitat for many small species, down logs serve as focal points which attract larger wildlife to feed upon the smaller log dwellers.

Hardwood Retention

Although hardwoods may be removed to improve conifer growth, selected larger hardwoods (>18" dbh) should be retained. These trees, especially those with rotten cavities, are favored by wildlife. Cavities are excavated by woodpeckers into denning sites for mice, owls, and squirrels.

Late Seral Stage Forest (LSS)

Wildlife late seral stage requirements will be met as a by-product of the proposed management program in the following ways:

1. Special late seral wildlife habitat features include snags, live cull trees, down non-merchantable and logs. Special attempts will be made to retain the four components of old growth ecosystems:

a. Large standing trees
b. Large standing snags
c. Large down logs
d. Large woody debris in watercourses.

2. A multi-layered canopy will be maintained and enhanced by employing uneven-aged management where the goal is to provide trees in all ages and size classes, and by retention of selected hardwoods, sometimes even at the expense of conifer growth.

3. Connectivity is provided by continuous stand cover resulting from uneven-aged management.

4. Large average tree diameters are provided by the management goal of growing quality trees. It is proposed that the average diameter of dominant trees in managed 70-80 year-old stands will exceed the average diameter of unmanaged stands at 100 years. There is much more to late-seral forest than large trees, but accelerating the development of individual stems can assist in the several-century process of restoring old growth characteristics.

19. FUTURE INITIATIVES

CERTIFICATION

We have committed to seeking third-party certification of our forest management under both the Forest Stewardship Council and Sustainable Forestry Initiative standards. Sustainable forestry certification programs generally evaluate three components of forest management: environmental, social, and economic factors. For example, FSC certifies whether the management of a particular forest meets the following criteria (from www.fsc.org):

1) **Environmentally appropriate** forest management ensures that the harvest of timber and non-timber products maintains the forest's biodiversity, productivity and ecological processes.

2) **Socially beneficial** forest management helps both local people and society at large to enjoy long term benefits and also provides strong incentives to local people to sustain the forest resources and adhere to long-term management plans.

3) **Economically viable** forest management means that forest operations are structured and managed so as to be sufficiently profitable, without generating financial profit at the expense of the forest resources, the ecosystem or affected communities. The tension between the need to generate adequate financial returns and the principles of responsible

forest operations can be reduced through efforts to market forest products for their best value.

Certification by SFI must meet SFI's principles (from www.aboutsfi.org): "These principles call upon SFI program participants to meet market demands while using environmentally responsible practices that promote the protection of wildlife, plants, soil, air and water quality to ensure the future of our nation's forests."

These standards were designed to provide independent verification of the quality of forest management practices and systems for a given property. We have designed this IRMP to position the Property to be well-qualified for approval but there is no guarantee of success until we have passed our audit, as certification is not just about how good your plan might be, but also how well you are able to implement it.

While it is the hope of everyone involved in forest certification that good land managers will be rewarded with higher prices or better market access for their timber, we do not anticipate that forest certification will provide a premium. Instead we expect to achieve value through improvement of our management practices because of the audit process and through increased public recognition and support of our activities.

Several of the partners involved in this project have extensive experience with forest certification. Craig Blencowe and his consulting firm were one of the first Forest Stewardship Council (FSC) Certified Resource Managers, meaning their management practices and system has passed an audit and all of their designated client properties are certified. TNC is also a recent FSC Certified Resource Manager for its large forest management projects in other parts of the country. Because of the involvement of both of these parties we could seek to be included in either Blencowe or TNC's pool of certified properties. Additionally, TCF has achieved dual forest certification on one of its large forestry projects on the east coast.

We have several options for how and when we seek certification and at this point we have not made any specific plans. The conservation easement requires that we receive dual FSC-SFI certification within five years (or we need to fully demonstrate compliance with the forest management requirements to the easement holder). There is an incentive to wait a few seasons as, logically, audits of operations that have been functioning for several years are more meaningful and helpful than audits of start-up operations. Additionally, these audits are a not insignificant expense, in both staff time and consultant fees, and we need to balance our significant management expenses (road improvement, watershed assessments, hardwood competition control) with our modest potential revenue from timber sales in the short term. At the same time we recognize the need to demonstrate to our partners and stakeholders our commitment and (hopeful) success with certification. We are committed to seeking dual FSC and SFI certification and expect to begin that process within one to two years.

CARBON SEQUESTRATION

Global climate change is the result of the significant anthropomorphic release of "greenhouse gases," particularly carbon dioxide. Forests consume carbon dioxide during photosynthesis, effectively removing a greenhouse gas from the atmosphere and storing it in woody biomass. Approximately 45-60 percent of the terrestrial carbon on earth is stored in forests. Since the redwood and Douglas-fir forests found at GRF grow relatively rapidly, they are expected to

accumulate carbon at a similarly rapid rate. Thus, the restoration and sustainable management of the Property creates a great opportunity to store carbon and help to counteract the causes of global warming.

Recognizing the opportunity and responsibility associated with managing the GRF in the context of climate change, we have identified two carbon-related goals:

1. Counteract negative impacts of global climate change and contribute to climate stabilization via increased long-term sequestration of carbon at the GRF.
2. Aid and abet the development of a market for forest carbon that will provide financial rewards for exemplary forest stewardship.

Figure 7: Carbon sequestration fieldwork at GRF by UC Berkeley, fall 2005 (photo by John Birchard).

Creating financial value for forest carbon can help provide economic incentives for landowners to keep their land as forests. California has the institutional infrastructure in place through the California Climate Action Registry and its forest protocols to certify forest projects that benefit the global climate, thus the GRF is well positioned to play a founding role in establishing a global market for forest carbon and creating such incentives.

As part of this planning process, TCF has announced its intent to participate in the California Climate Action Registry and certify our increasing carbon stocks under their forest entity protocols (see www.climateregistry.org). This comes with a responsibility to exceed forest practice regulations, prevent forest conversion, and monitor and report on forest growth. To insure compliance with the California Climate Action Registry Forest Protocols, the intent of this Plan is to provide management of the GRF in conformance with Section 42823 (d) (1)-(5) of the California Public Health and Safety Code.

Currently, TNC, under a grant from the Department of Energy and in partnership with the University of California and others, is conducting research at the Property on techniques to estimate forest carbon. This information will be useful to TCF in registering the Forest and to forest landowners and scientists throughout the world in efforts to quantify carbon levels stored in forests of all types.

BIOMASS

In releasing conifers from competition and/or restoring hardwood-dominated areas back to conifer, a tremendous volume of tanoak will be eliminated. Cost-effective harvest and utilization of this tanoak is preferable to expensive chemical treatment. The presence of a nearby co-generating facility could provide a market that might actually make tanoak harvest profitable, or at least reduce the cost of tanoak elimination. TCF welcomes any opportunity to work with the local community and Mendocino Resource Conservation District to explore the possibility of locating such a small energy-producing facility in the nearby coastal area.

Such a facility would provide many benefits:

- Allow local communities to become energy self-sufficient
- Reduce the cost of conifer release and re-conversion
- Reduce need for chemical tanoak treatment
- Reduce fire potential on the Property
- Increase local jobs in the woods and at the facility
- In conjunction with conifer harvest, tanoak harvest could reduce overall logging cost

Planning, developing, and operating such a facility would be a complex and lengthy process involving the support of a wide range of agencies, landowners, and stakeholders.

III. PUBLIC ACCESS

INTRODUCTION AND BACKGROUND

Establishing public access is a goal of TCF and of GRF project partners including the State Coastal Conservancy, the Wildlife Conservation Board, and TNC. Public access is required as a condition of state funding - providing that it is consistent with the protection of natural resources, long-term restoration and enhancement, and sustainable forest management. Public access is permitted but not required by the conservation easement, which also specifically prohibits the use of off-road motorized equipment or vehicles of any kind for recreational purposes. The easement also limits recreational facilities and stipulates that if public access activities, "…authorized or unauthorized, are jeopardizing water quality, aquatic habitat, or sensitive plant habitats, Grantor and Grantee shall cooperate to immediately halt the activity and determine what long-term controls are appropriate to protect those features from damage (TNC 2004)."

The opportunities for managed public access are extensive, ranging from public participation in habitat restoration, research, and monitoring to demonstrations of sustainable forestry and other best management practices; other opportunities include supervised and unsupervised pedestrian trail access in turn enabling a host of passive recreational activities. Public access also presents management challenges ranging from safety and emergency response issues to off-road vehicles to detrimental impacts to natural resources and management costs. In addition, it is uncertain how much demand there is for these opportunities.

Given the opportunities and challenges, public access on the GRF will be developed incrementally, beginning with supervised access as described below, and over time piloting an unsupervised public trail on an appropriate portion of the Property which may be expanded to other areas.

A. GOALS AND OBJECTIVES

PULIC ACCESS GOAL

It is our goal to provide a range of high quality public access opportunities that can be reasonably managed by TCF and that are consistent with the protection of natural resources, long-term restoration and enhancement, and active forest management. These opportunities range from research, education, & demonstrations to participation in restoration to unsupervised pedestrian trail access.

PUBLIC ACCESS OBJECTIVES

- Provide on-site demonstrations of sustainable forest management and other best management practices.
- Provide opportunities for public participation in research, education, and restoration projects.

- Provide a volunteer-based, guided public access program (modeled after the LandPaths program, described below).
- Establish unsupervised trail access on an appropriate portion of the Property; evaluate the feasibility of expanding this access to other areas.
- Evaluate and establish, as appropriate, a junior hunt program in collaboration with existing managing associations such as the California Deer Association.

B. RECOMMENDATIONS

RECOMMENDED GUIDELINES

The following is a list of recommended guidelines for managing public access:

- Provide guided walks to reduce impacts on roads, riparian areas, and other sensitive habitats.
- Limit access and use in special management areas during certain times to reduce impacts on sensitive species and their habitats.
- During forest operations, restrict access in those areas to guided demonstrations only.
- Restrict special access by neighbors and others (horseback riding, hunting).
- Suspend access during rainy season to prevent erosion and the spread of forest pathogens.

RECOMMENDED ACTIONS

In light of the public access goals, opportunities, and challenges, the following long- and short-term actions are recommended:

Short Term:

- Implement opportunities for student and volunteer restoration, research, and monitoring projects (see section on research, education, demonstration).
- Schedule regular guided activities – birding, exotic plant mapping and/or removal, riparian planting with watershed coordinator Craig Bell, sediment inventory methodology with Pacific Watershed Associates or others, interpretive walks, annual picnic.
- Develop a volunteer-based program to research, coordinate, provide and advertise guided public access. Potential partnerships include Anderson Valley Land Trust, Redwood Coast Land Conservancy, Audubon, and CNPS. Evaluate potential for self guided walking and biking tours for implementation on a trial basis.
- Continue to implement fire hazard measures (guidelines issued with access permits, coordination with local fire department and CDF, and participation in the aerial flight program).
- Continue to collaborate with Mendocino Redwood Company to prevent vehicular access from Garcia main stem.

Long Term:

- Evaluate and implement, as appropriate, a commercial hunting lease/license program, and/or a junior hunt program.
- Establish unsupervised trail access on an appropriate portion of the Property; evaluate the feasibility of expanding this access to other areas.
- Develop and implement a specific hot springs management plan.
- Until development of volunteer-run guided walks and/or the piloting of unsupervised pedestrian trail access, public access will be limited to scheduled activities such as upcoming sediment inventory workshops, riparian plantings coordinated by Craig Bell, and scheduled tours to be announced. As public access is developed over time, impacts including management costs are evaluated, and the desires of user groups are more clearly understood, this public access plan will be revised accordingly.

Figure 8: Community members touring Jack's Opening THP area (photo by Jenny Griffin, June 2006).

C. MODEL DAY-USE PERMIT PROGRAM[13]

LandPaths (Land Partners Through Stewardship) was founded as a non-profit in 1996 to oversee permitted public access to the 3,400-acre Willow Creek addition to Sonoma Coast State Beach. With seed funds provided by the California Coastal Conservancy, LandPaths was able to open Willow Creek to the public with only ten percent of the funds required for a traditional state park; donations and volunteers are essential.

Willow Creek day-use permits are available at no cost to all who apply; they are issued with provisions ranging from hours of operation to prohibited activities and attendance at an approved orientation. Applications must be completed annually. After attending an annual orientation and being issued a permit, users may hike, unsupervised, along designated trails

[13] http://www.landpaths.org

between sunrise and sunset. Maps and trail information are provided, as well as many volunteer opportunities including assisting with trail design and maintenance, school programs and other forms of environmental education, monitoring, and various restoration projects.

IV. ADAPTIVE MANAGEMENT AND INFORMATION SYSTEMS

A. ADAPTIVE MANAGEMENT

Adaptive management is the process of continually adjusting management in response to new information, knowledge or technologies (Holling 1978, Walters 1986, Walters and Holling 1990). Adaptive management recognizes that unknowns and uncertainty exist in the course of achieving any natural resource management goals. The complexity and interconnectedness of ecological systems, combined with technological and financial limitations, make a complete understanding of all the components and linkages virtually impossible. Not only is our knowledge incomplete, but the systems themselves are constantly changing through both natural and human caused mechanisms, making the effort to comprehend ecosystem dynamics and foretell their trajectories even more challenging (Gunderson et al. 1995). Uncertainty will always be a part of the management of ecosystems, and adaptive management provides a mechanism by which uncertainty can become, "the currency of decision making instead of a barrier to it" (Walters 1986).

Sound implementation and the ultimate success of this project will depend in large part on the commitment made to adaptive management, where research and monitoring are given a high priority, and new information is constantly gathered to feed back into the basic data management system and all future plans. This plan identifies two information streams for adaptive management: 1) monitoring of indicators of viability for conservation targets; and 2) restoration effectiveness monitoring. Each of the proposed indicators for monitoring viability of conservation targets and restoration effectiveness will need to be evaluated by the following criteria:

- Cost efficiency - getting the most information for the least cost should be a high priority;
- High yield of useful information - information is useful for as many applications and across as broad a range of spatial scales as possible;
- Engagement of stakeholders – TCF, TNC and regional and local stakeholders need to be directly engaged in the implementation and monitoring to facilitate education, and timely application of information to management direction;
- Quality control - data collection and management should be designed so that quality control standards are applied evenly and effectively across all data collection points and efforts;
- Scientific defensibility and credibility - designs for data collection, quality control efforts, and data analysis techniques meet rigorous research standards, have the involvement of research, and should be peer-reviewed;
- Timely yield of information - the monitoring program must yield information for management in a timely manner.

B. INFORMATION SYSTEMS

Adaptive management relies on the constant gathering of new information which is fed back into the basic data management system and all future plans. The database manager (to be

determined) will report key findings to the planning team on at least an annual basis, and will also coordinate maintenance of a constantly updated data management system that is always available for making forecasts, guiding management decisions, and providing a current information base that can support plan reviews or amendments in the future.

GRF data (primarily GIS) is currently held by both NCRM and TNC. The Klamath Resource Information System project carried out for the Garcia River (KRIS Garcia) also contains much of the public baseline data; it might be adapted for continuing use by TCF at a low cost because of previous investments by the Sonoma County Water Agency (IFR, 2003).

TCF will solicit and review various proposals for data management early in 2006, and NCRM and TNC continue to maintain databases in the meanwhile.

C. MONITORING METRICS AND APPROACH

Acquisition of the Property represents a unique opportunity to develop new approaches to enhancing biodiversity while allowing for sustainable harvest of timber. The IRMP will guide progress toward the ultimate goals of the project to protect significant natural, ecological, and aesthetic values and to develop and implement a model of sustainable forestry practices – ultimately creating an example of landscape-level forest conservation.

A fundamental aspect of fulfilling these goals is the establishment of a set of measurable conservation objectives and viability thresholds for key components of biodiversity. Such site-based planning has begun for the Property. TCF, TNC, and a suite of science advisors including the University of California Cooperative Extension, the University of California at Davis Watershed Sciences Center, and local forestry and watershed science consultants, have crafted a vision for the Property and undertaken a science-based viability assessment of conservation targets.

As described in Section II, "Ecological Reserve System and Conservation Targets," five targets that are indicative of threats to and viability of the biodiversity of interest at the Forest were identified including: redwood/Douglas-fir forest, anadromous fish bearing streams, oak woodlands/grasslands, non-riverine freshwater wetlands and northern spotted owl. The over 80 conservation targets that occur at the site are too numerous to individually assess during site conservation planning or to monitor in the long term. However, by nesting targets, the focal targets selected can represent and capture all other conservation targets at the site, as well as all relevant levels of biodiversity organization and spatial scales.

Once conservation targets had been determined, the factors that must be maintained to ensure the long-term viability of the targets were identified, including structure, composition, interactions, and abiotic and biotic processes. Because these factors are often hard to measure directly, indicators of the factors were selected. Monitoring of conservation targets will include regular assessment and tracking of indicators that must be maintained to ensure the long-term viability of the targets.

For example, for the anadromous fish bearing stream target, water quality was chosen as a key factor that must be maintained above a certain threshold to ensure the long-term viability of the target. Indicators of water quality, such as water temperature and percent fines less than 0.85mm

in size in potential spawning sites on Class I watercourses will be assessed to monitor and evaluate the effects of management actions on the anadromous fish bearing stream target. Tables 16 through 20 below list the indicators that will be monitored at the Forest. Additional indicators under consideration for monitoring are given below each table.

TABLE 16
INDICATORS FOR ANADROMOUS FISH BEARING STREAMS CONSERVATION TARGET

Factor	Indicator
Water quality	Percent fines less than 0.85mm in size in potential spawning sites on Class I watercourses
Water quality	Percent fines less than 6.5mm in size in potential spawning sites on Class I watercourses
Water quality	Mean weekly average water temperature in Class I watercourses
Habitat features	Mean pool shelter rating in Class I watercourses
Habitat features	Primary pool frequency on Class I watercourses
Habitat features	Riparian canopy cover in Class I watercourses

Also under consideration for monitoring for the anadromous fish bearing stream target: number of anthropogenic migration barriers on Class I watercourses; mean V* (pool sediment volume) in 3rd order streams with gradients between one and four percent; estimated annual deliverable sediment rate; LWD (instream) in Class I watercourses; LWD (potential) in Class I watercourses; abundance of steelhead juveniles in Inman, Signal, North Fork, and Garcia mainstem; abundance of coho juveniles in Inman, Signal, North Fork, and Garcia mainstem; redd counts (adult spawner survey) on all Class I watercourses; turbidity monitoring of Inman Creek.

TABLE 17
INDICATORS FOR REDWOOD/DOUGLAS-FIR
FOREST CONSERVATION TARGET

Factor	Indicator
Characteristic spatial structure	Average tree size percent of Property [by area] where average stem > 24" dbh)
Characteristic spatial structure	Canopy closure
Characteristic spatial structure	Canopy structure
Habitat features	Coarse woody debris
Habitat features	Snags
Areal extent	Area of contiguous forest with specified minimum habitat values

Also under consideration for monitoring for the redwood/Douglas-fir forest target: presence and aerial extent of invasive species that can significantly change systems.

TABLE 18
INDICATORS FOR OAK WOODLAND/GRASSLAND CONSERVATION TARGET

Factor	Indicator
Disturbance regime	Area of contiguous forest with specified minimum habitat values
Species composition/ dominance	Presence of invasive species that can significantly change systems
Species composition/ dominance	Areal extent of invasive species that can significantly change systems
Species composition/ dominance	Some metric of Douglas-fir invasion
Areal extent	Patch size oak woodland
Areal extent	Patch size grassland

Also under consideration for monitoring the oak woodland/grassland target: coarse woody debris; snags; and oak stage classes present in characteristic abundance.

TABLE 19
INDICATORS FOR NON-RIVERINE FRESHWATER SYSTEMS CONSERVATION TARGET

Factor	Indicator
Buffer and landscape context	Percent of wetland with buffer
Biotic structure	Invasive plant species richness
Biotic structure	Native plant species richness
Areal extent	Area of functional wetlands including springs, seeps, and marshes
Non-riverine wetland spatial distribution and abundance	Number of functional wetlands including seeps, springs and marshes

Also under consideration for monitoring the non-riverine freshwater systems**:** wetlands with adequate buffer; organic matter accumulation; and vertical structure.

TABLE 20
INDICATORS FOR NORTHERN SPOTTED OWL CONSERVATION TARGET

Factor	Indicator
Biotic interactions	Barred owl presence/absence
Presence/abundance of characteristic species	Northern spotted owl abundance
Presence/abundance of characteristic species	Number of activity centers

Also under consideration for monitoring the northern spotted owl target: northern spotted owl nest initiation (percent population breeding).

EFFECTIVENESS MONITORING OF RESTORATION ACTIVITIES

The effectiveness of specific restoration activities will be monitored at least qualitatively pre- and post-restoration, and quantitatively pre- and post-restoration where possible. Qualitative protocols from CDFG's *California Coastal Salmonid Restoration Monitoring and Evaluation Program Interim Restoration Effectiveness and Validation Monitoring Protocols* (Collins 2003) will be followed to monitor restoration activities. Additionally, permanent photo plots will be established to monitor aquatic restoration activities following CDFG's protocols (Collins 2003). Baseline data will be collected at least one season before restoration activities commence.

Where warranted and feasible, quantitative monitoring will be implemented to assess the impact of restoration activities. Quantitative protocols are also outlined in CDFG's *California Coastal Salmonid Restoration Monitoring and Evaluation Program Interim Restoration Effectiveness and Validation Monitoring Protocols* (Collins 2003). Instream habitat protocols are to be used when instream habitat improvements are to be made (i.e. install structures, install gravel, or remove structures), or when streambank stabilization activities are undertaken (i.e. deflect streamflow, bioengineering, armoring). Riparian protocols are to be used when riparian planting or exotic vegetation control is undertaken. Upland erosion control protocols will be used when slope stabilization and erosion control (soil engineering, bioengineering, upland fuels management) are to be implemented, when gully repairs (channel modification, bioengineering, armoring) are to be made, or when road upgrading or road decommissioning (road surfacing, drainage improvements, partial decommissioning, full road decommissioning) is undertaken.

A variety of monitoring will occur in addition to that described above. For example, the Garcia River TMDL requires monitoring the effectiveness of sediment control efforts implemented for sites identified in the forthcoming Baseline Data Inventory. At the Property, this will be accomplished by: 1) monitoring of erosion repairs performed by TCF; 2) monitoring road system infrastructure; and 3) monitoring of the Site-Specific Management Plan to protect aquatic resources and water quality concerns.

Additional voluntary monitoring is expected to include: voluntary instream monitoring (see Table of Proposed Instream Monitoring, below); monitoring associated with certification with the Forest Stewardship Council and Sustainable Forestry Initiative; monitoring the "Forest Inventory" (43 permanent plots, originally installed in 1994, re-located and re-measured in 2005, to be re-measured every 10 years); monitoring "Forest Carbon" to help measure climate change (permanent plots at which to inventory species, size, densities, biomass and carbon, measured in 2005, to be re-measured every X years); and THP-related monitoring (three-year road monitoring for erosion control is standard, as is NSO monitoring for 1-2 years prior to operating in a THP).

Concerning voluntary instream monitoring, The "*Action Plan for the Garcia River Watershed Sediment TMDL"* notes that:

> "Monitoring is intended to provide information regarding the effectiveness of sediment control efforts in attaining the Numeric Targets over time. Instream and hillslope monitoring parameters, monitoring protocols, and frequency of monitoring are described in Table 4-6. Instream and hillslope monitoring by landowners (except for the Sediment Delivery Site monitoring described in the Erosion Control Plan, above) is on a voluntary basis. NCRWQCB staff will coordinate instream monitoring efforts of the landowners, other regulatory agencies, academic institutions, and members of the public and shall set a goal of establishing at least one instream monitoring point in each of the twelve Planning watersheds in the Garcia River watershed. In addition, Regional Water Board staff will work together with the University of California Cooperative Extension to assist landowners in developing voluntary monitoring plans."

Table 21 below summarizes proposed voluntary instream monitoring at the GRF. It is the recommendation of this Plan that a meeting of representatives of the Regional Water Board, TCF, TNC, other interested Garcia watershed landowners (including Mendocino Redwood

Company), Mendocino County Resource Conservation District, CDFG, and UC Cooperative Extension be convened in 2006 to collaboratively review and develop voluntary monitoring plans in the most effective, efficient, and affordable manner possible.

MONITORING PLAN

While a credible first iteration of our monitoring approach and priorities is given in the section above, this does not constitute a comprehensive monitoring plan. As part of our commitment to adaptive management, research and monitoring will be given a high priority, and new information gathered through monitoring will be fed back into the basic data management system. This plan identifies two information streams for adaptive management: 1) monitoring of indicators of viability for conservation targets; and 2) restoration effectiveness monitoring. A coordinated effort between TCF and TNC will be required to generate a more explicit, comprehensive monitoring plan incorporating these elements, that is cost efficient, timely, yields useful information, engages local stakeholders, and is scientifically defensible and credible. The process of generating such a monitoring plan will begin this year.

TABLE 21
PROPOSED VOLUNTARY INSTREAM MONITORING

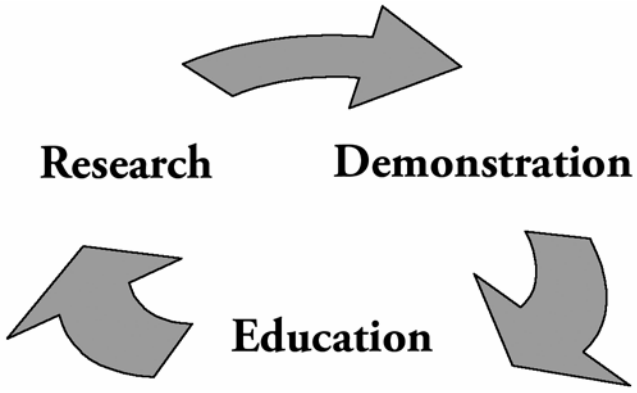
SUGGESTED IN GARCIA TMDL		PROPOSED AT GARCIA RIVER FOREST			
PARAMETER	**NUMERIC TARGET**	**CONSERVATION TARGET**	**FACTOR**	**INDICATOR**	**GRF MONITORING PLAN**
Temperature (not listed in TMDL recommendations)	n/a	Anadromous Fish Bearing Streams	Water quality	Mean weekly average water temperature in Class I watercourses	Permanent hobo temps/remote thermographs, locations to be determined. Collect annually, mid June through mid September.
Migration barriers on Class I watercourses	Zero human-caused barriers	Anadromous Fish Bearing Streams	Habitat features	presence/absence	Barrier surveys underway 2005-2006 via two DFG grants (PWA and Craig Bell); follow-ups in first 20 years or so when legacy jams are being treated.
Embeddedness on Class I watercourses	Improving trend over rolling 10 year period	Anadromous Fish Bearing Streams	Habitat features	(degree)	Embeddedness surveyed by DFG 2004; to be continued every 5-10 years pending available funding.
Percent fines < 0.85 mm on Class I watercourses	<14 percent	Anadromous Fish Bearing Streams	Water quality	% fines less than 0.85mm in size in potential spawning sites on Class I watercourses	Bulk sediment samples collected at Whitlow 2004; permanent stations to be determined.
Percent fines < 6.5 mm on Class I watercourses	<30 percent	Anadromous Fish Bearing Streams	Water quality	% fines less than 6.5mm in size in potential spawning sites on Class I watercourses	Bulk sediment samples collected at Whitlow 2004; permanent stations to be determined.
Primary pool frequency in Class I watercourses	Primary pools covering 40 percent of the length of the watercourse	Anadromous Fish Bearing Streams	Habitat features	Primary pool frequency on Class I watercourses	Habitat typing (completed by DFG, 2004; to be monitored at 10 year intervals pending available funding).
V* in 3rd order streams with slopes between 1 percent and 4 percent	<0.21 mm (mean) <0.45 mm (max)	Anadromous Fish Bearing Streams	Habitat features	(pool depth to sediment ratio)	Not currently monitored but under consideration
Median particle size diameter (d50) in 3rd order stream with slopes between 1 and 4 percent	>69 mm (mean) >37 mm (min)	Anadromous Fish Bearing Streams	Habitat features	(particle size)	Not currently monitored but under consideration

Large woody debris in Class I , II, and III watercourses	Improving trend over rolling 10 year period	Redwood/Douglas-fir Forest	Habitat features	Coarse woody debris	Habitat typing (DFG) included instream shelter component -- repeat every 5-10 years pending available funding; 2005-2006 LWD surveys underway by C. Bell and PWA per DFG grants.
Width-to-depth ratio in Class I, II, and III watercourses	Improving trend over rolling 10 year period (Rosgen system)	Anadromous Fish Bearing Streams	Habitat features	(width to depth ratio)	Collected on Class I streams during DFG Habitat Typing 2004; to be monitored at 10 year intervals by DFG pending available funding.
Thalweg profile in Class I, II, and III watercourses	Increasing variability around the mean	Anadromous Fish Bearing Streams	Habitat features	(profile)	
Open Stream Channel: Inman, Signal and Hathaway	0 percent open stream channel	Anadromous Fish Bearing Streams	Habitat features	Riparian canopy cover in Class I watercourses	Photo interpretation with new flights approx. every 10 years (1:24,000 res. or better) and/or habitat typing
Open Stream Channel: Pardaloe, Larmour, Whitlow, and Blue Waterhole and North Fork	<1 percent open stream channel	Anadromous Fish Bearing Streams	Habitat features	Mean pool shelter rating in Class I watercourses	Photo interpretation with new flights approx. every 10 years (1:24,000 res. or better) and/or habitat typing
Open Stream Channel: Rolling Brook	<3 percent open stream channel	Redwood/Douglas-fir Forest	Characteristic spatial structure	Canopy closure	Photo interpretation with new flights approx. every 10 years (1:24,000 res. or better) and/or habitat typing
Open Stream Channel: Graphite, Beebe	<6 percent open stream channel	Redwood/Douglas-fir Forest	Characteristic spatial structure	Canopy closure	Photo interpretation with new flights approx. every 10 years (1:24,000 res. or better) and/or habitat typing

D. RESEARCH, EDUCATION AND DEMONSTRATION

The GRF project represents a unique opportunity to address many questions that have been plaguing researchers, restorationists and managers of redwood lands for a number of years. The opportunity to apply active management to a large contiguous parcel of land without the traditional overarching economic expectations provides TCF and its partners a chance to address issues regarding forest restoration, fisheries, wildlife and timber inventory recovery in a transparent fashion unparalleled by past industrial ownerships. The Research, Demonstration and Education (R, D & E) program for the Forest project is not only an opportunity for TCF and its partners to learn, but a chance to share that knowledge with others interested in the recovery of California's redwood forest systems.

The combined research, demonstration and education programs provide an iterative process by which each component will compliment others. Each component will also help TCF and partners remain true to the mission of the project.



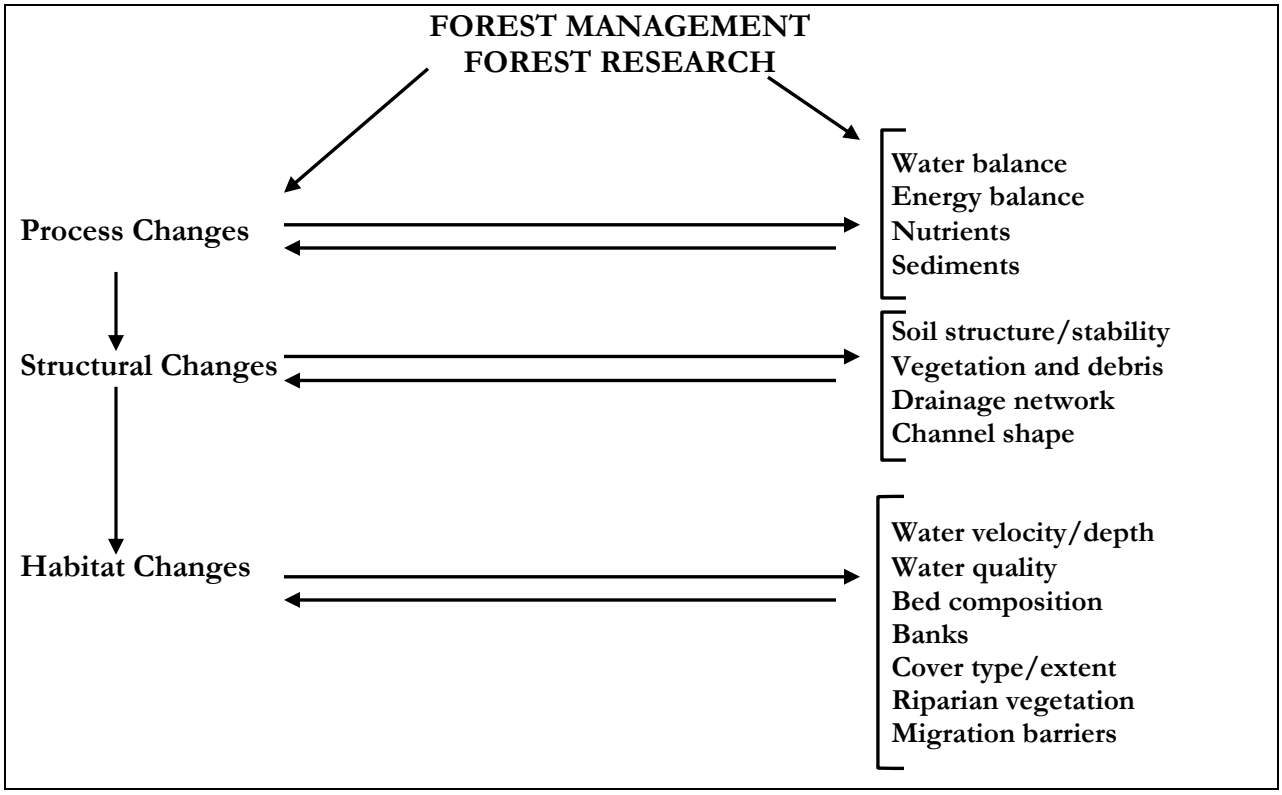
The targeted audience for the R, D & E programs include other non-industrial ownerships in the redwood region, other conservation organizations that have identified complex questions regarding how management can achieve both ecologic and economic considerations, the surrounding community that has raised concerns about balancing environmental protections with economic stability, and finally TCF, which through this acquisition has assumed a leadership role in sustainable forestry.

RESEARCH

Both basic and applied research has potential application for the project (Fig. 5). The Property lends itself to researchers who are interested in working in coastal redwood ecotypes addressing an unlimited set of basic research questions including: carbon management issues, fish and wildlife topics, genetics, nutrient, soil, hydrological and ecological cycles and processes.

Applied research can be used to assist practitioners and others interested in redwood forest management to develop suitable approaches for this and other sites. Topics of applied research potentially include the development of indicators to evaluate forest ecosystem health, social and economic benefits, forest productive capacity, soil and water resources, and addressing issues relative to legal and institutional frameworks.

FIGURE 9
CONCEPTUAL REPRESENTATION OF HOW FOREST RESEARCH CAN BE INCLUDED INTO A MULTI-DISCIPLINARY APPROACH OF FOREST MANAGEMENT TO ADDRESS SPECIFIC TOPICS (ADAPTED FROM NOSS, 2000)



DEMONSTRATION

The demonstrative component of the R, D & E program is the clarifying aspect of our educational agenda. Demonstrations provide a real time opportunity for people to "absorb" complex subject matter in a tangible setting as opposed to a lecture in a sterile indoor venue as well as providing invaluable feedback on the content of presentations themselves.

Examples of demonstration projects that will be considered for incorporation into the IRMP include:

- Shift from younger to older age classes of trees;
- Recovery of old forest characteristics;
- Shift from simplified secondary forests to structurally complex, multi-aged stands;
- Recovery of natural fire cycles and other aspects of natural disturbance regimes;
- Eradication or effective control of exotic/noxious plants through canopy management and other methods;

- Minimizing site disturbance and other management choices through forest planning;
- Shift from prescription based forestry toward performance based actions;
- Illustrate how the forest industry transition from corporate to non-profit ownership can achieve both environmental and economic objects;
- Identification and remediation of in-stream habitat conditions inhibiting recovery of anadromous fish;
- Incorporation of ecological reserves within the matrix of the working landscape;
- Recovery of historic oak/conifer ratios; and
- Development of management guidelines to define the role, purpose and management of the Ecological Reserve Network.

Simply conserving forest acreage will not achieve ecological objectives if management practices continue to erode timber, wildlife and soil resources (Fairfax et al. 2005). The GRF project represents an evolutionary step in our understanding of conserving working landscapes; a step that recognizes the important link between ownership, funding tactics and alternative management scenarios that in combination achieve conservation of forest systems. The demonstration program is intended to assist others trying to achieve sustainable management goals by providing leadership and guidance through example.

EDUCATION

In a community that has embraced an attitude of "*Our Forests our Future,"* the broader educational component of the triad will focus on providing on-site and virtual access to information and progress being made with the project. Arguably, the entire project is a learning exercise as TCF and partners explore innovative approaches to a complex and challenging set of circumstances and issues.

It is the goal of the education element, over time, to involve members of the community who can support instruction and outreach activities. Conceivably, future outreach strategies could include docent programs, newsletters, tours and field trips.

In time, a web-based approach may well include a calendar of upcoming events and other notices, a "blog" web page allowing community interactions and discussions in a real time environment, and a home page wherein interested community members and others can access a number of topics.

Certainly, the site lends itself for organized and formal workshops to allow practitioners and other interested in "hands-on" training e.g. the training workshop on the *STAR* Worksheet (a method of assessing road-related sediment) by Jack Monschke that is scheduled for Winter 2006. As an example, this workshop will enable participants to accurately document erosion problems on the spot, furthering our TMDL efforts and increasing management efficiency.

Proposed Strategy

- Develop a web site that provides timely updates regarding:
  - Management actions
  - Educational events
  - Policy statements
  - Contact information
- Post the IRMP on the web site to provide review by community members and other interested persons.
- Develop an action plan to identify and implement annual educational and informational tours.

IMPLEMENTATION

As with any inspiration success can only be measured through realization and application. In order to achieve the lofty goals and objectives established by this section financial support is crucial. In order to sustain a comprehensive research, demonstration and educational program a level of financial certainty will need to be built into the program. To that end, a model implementation strategy will include components such as: 1) a financial base from which to plan projects on a multi-year basis; 2) a research and demonstration review team to assure project quality and investigator accountability; 3) a system that archives project results for retrieval and distribution; and 4) a mechanism to identify and award financial support for projects.

Possible mechanisms to realize the needs of such a program may include: 1) an endowment fund (built from timber receipts, grants and awards, etc) that provides annual dividends for program support; 2) a competitive grants program to attract institutional faculty and their students; and 3) contractual agreements that address specific projects and issues.

Though highly ambitious, the R, D and E element of this plan recognizes the needs and desires of those interested in managing highly altered and degraded coastal forest systems. It is our intent to design and implement a program that meets our needs and the needs of the redwood community.

E. PLAN REVISION PROCESS

Consistent with our adaptive management approach as well as requirements of state funding and the conservation easement, this management plan will be updated periodically, not less than every ten years, to reflect the condition of the Property as it changes over time and as management activities are implemented.

Local experts, advisors, and community members will be included in the revision process, as is the case with this first plan. Revisions and/or amendments will be provided to the Coastal Conservancy and TNC for review prior to adoption.

V. PROJECT FINANCING

A. PURCHASE FUNDING

Funding for the purchase of the Property was provided by grants of public funds from the State Coastal Conservancy and the Wildlife Conservation Board. In addition, TCF sold a conservation easement to TNC. Final sources and amounts are as follows:

California Coastal Conservancy	$6,000,000
Wildlife Conservation Board	$4,000,000
The Conservation Fund	$4,500,000[14]
The Nature Conservancy Easement	$3,500,000
Total	**$18,000,000**

B. CONSERVATION EASEMENT

The Coastal Conservancy Grant Agreement and the conservation easement provide that TCF shall prepare a forest management plan for the Property not later than December 31, 2005. The conservation easement restricts in perpetuity certain uses that are incompatible with the Easement Purposes cited below, including subdivision, development, mining and agricultural conversion, among other things.

The conservation easement specifies the following "Easement Purposes:"

- Restore and protect a productive and relatively natural coastal California forest ecosystem;
- Protect fish and wildlife habitat associated with this ecosystem, in particular the oak woodlands, serpentine grasslands, and redwood/Douglas-fir forest, and spawning habitat for coho salmon and steelhead trout;
- Protect significant water resources, springs and the water quality thereof;
- Maintain the capacity of the Property for productive forest management, including the long-term sustainable harvest of high quality forest products, contributing to the economic vitality of the state and region in a manner that does not impair the Conservation Values or the other Easement Purposes;
- Maintain the use of the Property for outdoor recreation;
- Maintain at least 35 percent of the Property as a permanent ecological reserve network (the "Ecological Reserve Network"), which shall include oak woodlands, grasslands, riparian areas and other areas with unusually high Conservation Value; and

[14] This amount includes a $2.5M private foundation loan. Principal and deferred interest are due December 2007; timber harvest revenues are not considered a source of repayment.

- Prohibit any use of the Property that will impair, degrade or damage the Conservation Values of the Property (collectively, the "Easement Purposes").

In addition, the conservation easement specifies the following "performance goals" for the Property:

- Significantly increase the inventory of commercial conifer volume in fifty years while permitting the removal of timber at a rate considerably less than growth during that period;
- Respectfully maintain the vegetative diversity of the Property by maintaining Oak Woodlands and Serpentine Grasslands as designated in a map in the Easement Documentation Report and by not seeking to completely exclude native hardwoods from sites managed for conifer growth and harvest;
- Conserve and improve the habitat conditions for northern spotted owl, marbled murrelet, coho salmon, and steelhead trout by increasing the forest inventory, late seral conditions, including large trees, structural diversity, high canopy closure and the maturity of the riparian forests;
- Maintain the highest possible, commercially feasible standards for road layout, construction and maintenance so as to minimize the impacts on water quality riparian habitat and the Ecological Reserve Network; and
- Designate and maintain at least 35 percent of the Property as an Ecological Reserve Network.

The conservation easement provides for two, five-acre improvement areas on the Property, one for an environmental education and/or research center, and one for a single-family residence to provide on-site management of the property, subject to a variety of siting and construction restrictions to minimize potential adverse impacts on conservation values of the Forest. Whether and where these facilities will be constructed has not been determined at this time.

C. PROJECT BUDGET AND STAFFING

An operating budget based on projections of annual costs and net revenues will be developed after completion of one or two THPs and the property-wide road sediment inventory currently underway by Pacific Watershed Associates. This will be included as an amendment or update to this Plan

GLOSSARY

ANADROMOUS: fish that leave freshwater and migrate to the ocean to mature then return to freshwater to spawn (e.g. salmon, steelhead)

BF: Board feet--measure of wood volume 1"x12"x12"

BANKFULL WIDTH: width of the channel at the point at which overbank flooding begins

BASAL AREA: area in square feet of all conifer stems on an acre

BASIN: see watershed

BASIN PLAN: the Water Quality Control Plan for the North Coast Region

BOLE: trunk of a merchantable size tree

CALWATER: set of standardized watershed boundaries for California

CANOPY: overhead branches and leaves of streamside vegetation

CANOPY COVER: vegetation that projects over a stream

CANOPY DENSITY: percentage of the sky above the stream screened by the canopy of plants

CLASS I STREAM: watercourse with fish present

CLASS II STREAM: watercourse providing aquatic habitat for non-fish species

CLASS III STREAM: watercourse with no aquatic life present, but capable of sediment transport

COBBLE: stream substrate particles between 2.5 - 10 inches (64 - 256 mm) in diameter

CONIFER: softwood, cone-bearing tree species suitable for commercial timber production (e.g. redwood, Douglas-fir).

CONIFEROUS: any of various mostly needle-leaved or scale-leaved, chiefly evergreen, cone-bearing gymnospermous trees or shrubs such as pines, spruces, and firs

CONSERVATION EASEMENT: a legal agreement between a landowner and a qualified conservation organization that restricts usage rights of the property, such as real estate development, commercial, and industrial uses

CONSERVATION TARGETS: species and/or habitat types that are indicative of threats to and the viability of the biodiversity of interest

CORD: measure of fuel-wood volume -- a stacked cord occupies 128 cubic feet (4'x4'x8'), and contains about 85 cubic feet of solid wood

COVER: anything providing protection from predators or ameliorating adverse conditions of streamflow and/or seasonal changes in metabolic costs, such as instream cover, turbulence, and/or overhead cover, for the purpose of escape, feeding, hiding, or resting

CROP TREE: a tree that has been selected for future timber harvest on which we will focus growth and subsequent increases in volume and value.

CRYPTOS (Cooperative Redwood Yield Project Timber Output Simulator): a computer program that can model stand growth in redwood forests, including the effects of partial harvests

CWHR (California Wildlife Habitat Relationships): a system developed by CDFG to model the interactions between wildlife species and their habitats

DBH: "diameter at breast height" (tree diameter in inches, measured outside bark 4 1/2' above ground level)

DEBRIS: material scattered about or accumulated by either natural processes or human influences

DEBRIS JAM: log jam -- accumulation of logs and other organic debris

DEBRIS LOADING: quantity of debris located within a specific reach of stream channel, due to natural processes or human activities

DEPOSITION: the settlement or accumulation of material out of the water column and onto the streambed, occurring when the energy of flowing water is unable to support the load of suspended sediment

DISSOLVED OXYGEN (DO): concentration of oxygen dissolved in water, expressed in mg/l or as percent saturation, where saturation is the maximum amount of oxygen that can theoretically be dissolved in water at a given altitude and temperature

ECOLOGICAL RESERVE NETWORK: designated special treatment areas that are intended to protect features of high ecological value and supports large-scale ecological processes

EMBEDDEDNESS: the degree that larger particles (boulders, rubble, or gravel) are surrounded or covered by fine sediment, usually measured in classes according to percentage of coverage of larger particles by fine sediments

EROSION: the group of natural processes, including weathering, dissolution, abrasion, corrosion, and transportation, by which material is worn away from the earth's surface

FILL: a) the localized deposition of material eroded and transported from other areas, resulting in a change in the bed elevation; b) the deliberate placement of (generally) inorganic materials in a stream, usually along the bank

FINE SEDIMENT: fine-grained particles in stream banks and substrate defined by diameter, varying downward from 0.24 inch (6 millimeters)

FISH HABITAT: the aquatic environment and the immediately surrounding terrestrial environment that, combined, afford the necessary biological and physical support systems required by fish species during various life history stages

FLUVIAL: relating to or produced by a river or the action of a river. Situated in or near a river or stream.

GEOGRAPHIC INFORMATION SYSTEM (GIS): A computer system for capturing, storing, checking, integrating, manipulating, analyzing, and displaying data related to positions on the Earth's surface. Typically, a GIS is used for handling maps of one kind or another. These might be represented as several different layers where each layer holds data about a particular kind of feature (e.g. roads). Each feature is linked to a position on the graphical image of a map.

GRADIENT: the slope of a streambed or hillside -- for streams, gradient is quantified as the vertical distance of descent over the horizontal distance the stream travels

GRAVEL: substrate particle size between 0.08 - 2.5 inches (2 - 64 mm) in diameter

GULLY: deep ditch or channel cut in the earth by running water after a prolonged downpour

HABITAT: the place where a population lives and its surroundings, both living and nonliving; includes the provision of life requirements such as food and shelter

HABITAT TYPE: a land or aquatic unit, consisting of an aggregation of habitats having equivalent structure, function, and responses to disturbance

HARDWOOD: non-conifer trees (e.g. tanoak, madrone, live oak, black and white oaks)

HERBACEOUS: non-woody seed plant (e.g. grass)

HYDROGRAPHIC UNIT: a watershed designation at the level below Hydrologic Region and above Hydrologic Sub-Area

INDICATORS: measurable reflections of conservation target health such as structure, composition, interactions, and abiotic and biotic processes; these must be maintained to ensure the long-term viability of conservation targets

INGROWTH: volume increase due to pre-merchantable timber attaining size where board foot volume can now be measured (e.g. 10-12" dbh)

INSTREAM COVER: areas of shelter in a stream channel that provide aquatic organisms protection from predators or competitors and/or a place in which to rest and conserve energy due to a reduction in the force of the current

INTERMITTENT STREAM: a stream in contact with the ground water table that flows only at certain times of the year when the ground water table is high and/or when it receives water from springs or from some surface source such as melting snow in mountainous areas. It ceases to flow above the streambed when losses from evaporation or seepage exceed the available stream flow. Seasonal.

LARGE WOODY DEBRIS (LWD): a large piece of relatively stable woody material having a diameter greater than 12 inches (30 centimeters) and a length greater than 6 feet (2 meters) that intrudes into the stream channel. Large organic debris.

LATE SERAL, LATE SUCCESSIONAL: having biological characteristics and functions similar to old growth forests.

LIMITING FACTOR: environmental factor that limits the growth or activities of an organism or that restricts the size of a population or its geographical range

LOP: to sever branches and trunks of cut trees so resulting slash will lie close to the ground

MAINSTEM: the principal, largest, or dominating stream or channel of any given area or drainage system

MEAN ANNUAL INCREMENT (MAI): The average annual growth rate of a forest stand, determined by dividing stand volume (including partial harvests) by stand age. Culmination of mean annual increment occurs at the age when MAI is greatest, and determines the optimal rotation age for maximizing long term yields in evenaged management.

MERCHANTABLE:sound conifer trees at least 10" in diameter

MERCHANTABLE SPECIES: commercial conifer timber species being purchased by local sawmills, including redwood, Douglas-fir, grand fir, western hemlock, sitka spruce, and bishop pine

NET VOLUME: tree volume remaining after deducting unmerchantable and cull material

OLD GROWTH: trees older than 175 years.

PLUGS: seedling stock grown in nursery styrofoam containers.

POLES: trees 4"-11" dbh

PRE COMMERCIAL THINNING: cutting in a pre-merchantable conifer stand (2-10"dbh) to reduce unwanted trees and improve growth on remaining trees

REDD: a spawning nest made by a fish, especially a salmon or trout

REGENERATION: renewal of a tree crop, either by planting or natural seeding

RELEASE: freeing a tree (usually a conifer) from competition by cutting growth (usually a hardwood) surrounding or overtopping it

RESIDUAL GROWTH: mature trees (often of lower quality) left after original logging

RIFFLE: a shallow area extending across a streambed, over which water rushes quickly and is broken into waves by obstructions under the water

RILL: an erosion channel that typically forms where rainfall and surface runoff is concentrated on slopes. If the channel is larger than one square foot in size, it is called a gully.

RIPARIAN: pertaining to anything connected with or immediately adjacent to the banks of a stream or other body of water

RIPARIAN AREA: the area between a stream or other body of water and the adjacent upland identified by soil characteristics and distinctive vegetation. It includes wetlands and those portions of floodplains and valley bottoms that support riparian vegetation.

RIPARIAN VEGETATION: vegetation growing on or near the banks of a stream or other body of water on soils that exhibit some wetness characteristics during some portion of the growing season

RUBBLE: stream substrate particles between 2.5 and 10 inches (64 and 256 millimeters) in diameter

SALMONID: fish of the family *Salmonidae*, including salmon, trout, chars, whitefish, ciscoes, and grayling

SAPLINGS: trees 1"-4" dbh

SCOUR: localized removal of material from the stream bed by flowing water -- the opposite of fill

SECOND GROWTH TREES: established as seedlings after original old-growth logging (also called young-growth)

SEDIMENT: fragmented material that originates from weathering of rocks and decomposition of organic material that is transported by, suspended in, and eventually deposited by water or air, or is accumulated in beds by other natural phenomena

SEEDLINGS: trees less than 1" dbh

SERAL STAGES: the series of relatively transitory plant communities that develop during ecological succession from bare ground to the climax stage

SILVICULTURE: the care and cultivation of forest trees; forestry

SITE CLASS, SITE INDEX: When used in relation to stocking regulations, it means one of the site classes or indexes listed in Forest Practice Rules 14 CCR 1060. When used in relation to growth modeling, it usually refers to the site system developed by Krumland and Wensel for the CRYPTOS growth simulator.

SITE INDEX: productive capacity of an area to grow trees, based on height of dominant trees at given age; often expressed as a numeral from I (very good site) to V (poor site)

SKID TRAIL: temporary road for tractor/skidder travel to logging landing

SLASH: branches and other residue left on a forest floor after the cutting of timber

SMOLT: Juvenile salmonid one or more years old that has undergone physiological changes to cope with a marine environment, the seaward migration stage of an anadromous salmonid.

SNAG: dead standing tree

SPAWNING: to produce or deposit eggs

STAND TABLE: graph which shows the number of trees of each diameter class per acre

STAND: tree community sharing characteristics which can be silviculturally managed as a unit

STOCKING: number, or density, of trees in a given area

STREAM CORRIDOR: A stream corridor is usually defined by geomorphic formation, with the corridor occupying the continuous low profile of the valley. The corridor contains a perennial, intermittent, or ephemeral stream and adjacent vegetative fringe.

STUMPAGE: net value of standing timber to owner, exclusive of logging or trucking costs

SUBSTRATE: material (silt, sand, gravel, cobble, etc.) that forms a stream or lakebed

SUSTAINABLE: "Development or resource use that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland 1987)

SUSTAINED YIELD PLAN: yield that a forest can continually produce at a given intensity of management

THALWEG: the line connecting the lowest or deepest points along a streambed

THIN FROM BELOW: selective removal of intermediate and/or suppressed conifers from the understory to allow more space for remaining trees.

THRIFTY: describes a healthy and fast-growing tree.

UNDERCUT BANK: a bank that has had its base cut away by the water action along man-made and natural overhangs in the stream

V*: measures of percent sediment filling of a stream pool with deposits such as silt, sand, and gravel compared to the total volume

VEXAR: plastic mesh tube used to protect young trees from animal browsing

WATERSHED: Total land area draining to any point in a stream, as measured on a map, aerial photograph or other horizontal plane. Also called catchment area, watershed, and basin.

WATERSHEDS WITH THREATENED OR IMPAIRED VALUES: any planning watershed where populations of anadromous salmonids that are listed as threatened, endangered, or candidate under the State or Federal Endangered Species Acts with their implementing regulations, are currently present or can be restored.

WETLAND: an area subjected to periodic inundation, usually with soil and vegetative characteristics that separate it from adjoining non-inundated areas

WHITE WOODS: grand fir and hemlock.

WORKING FOREST: forest managed for or including timber production

YARDER: logging machine which uses a suspended cable to lift logs

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APPENDIX A: ASSESSOR PARCEL NUMBERS

APN	Section(s)	Township	Range	APN Acres
2649030	31	T13N	R15W	40
2649040	33	T13N	R15W	99
2649062	32	T13N	R15W	4
2649070	32	T13N	R15W	194
2649077	31	T13N	R15W	225
2649078	31	T13N	R15W	125
2649079	31	T13N	R15W	165
2650019	34	T13N	R15W	40
2650025	34	T13N	R15W	200
2719109	3	T12N	R16W	160
2719110	3	T12N	R16W	41
2719111	3	T12N	R16W	120
2719112	3	T12N	R16W	255.81
2719113	2, 3	T12N	R16W	160
2719114	2	T12N	R16W	130.4
2719115	2	T12N	R16W	148.1
2719116	2	T12N	R16W	40
2719117	2	T12N	R16W	267
2719118	2	T12N	R16W	40
2720102	1	T12N	R16W	48
2720103	1	T12N	R16W	140.7
2720104	1	T12N	R16W	200.5
2720105	1	T12N	R16W	209.5
2720106	1	T12N	R16W	219
2728102	11	T12N	R16W	37.9
2728106	11	T12N	R16W	272
2728107	11	T12N	R16W	156
2728108	11	T12N	R16W	152
2728109	12	T12N	R16W	70
2728110	12	T12N	R16W	90
4901020	3	T12N	R14W	160
4902033	10	T12N	R14W	40
4902034	10	T12N	R14W	120
13319007	27	T13N	R16W	35
13320016	34	T13N	R16W	40
13320017	34	T13N	R16W	160
13320018	34	T13N	R16W	160
13322003	26	T13N	R16W	80
13323001	35	T13N	R16W	40
13323003	36	T13N	R16W	280
13323009	35	T13N	R16W	160
13323010	35	T13N	R16W	40
13323011	35	T13N	R16W	240

Apn	Section(s)	Township	Range	APN Acres
13323012	35	T13N	R16W	160
14101020	6	T12N	R15W	240
14101021	5,6	T12N	R15W	280
14101022	6,7	T12N	R15W	200
14101023	5,6	T12N	R15W	280
14101024	5	T12N	R15W	230
14101025	5,7,8	T12N	R15W	160
14101026	5	T12N	R15W	160
14101027	4,5	T12N	R15W	160
14101028	7,8	T12N	R15W	160
14101029	8	T12N	R15W	160
14101031	4	T12N	R15W	240
14101032	4	T12N	R15W	80
14101033	4	T12N	R15W	60
14101034	4	T12N	R15W	240
14101035	9	T12N	R15W	160
14101036	9	T12N	R15W	160
14101038	4	T12N	R15W	60
14101039	4	T12N	R15W	120
14102018	3	T12N	R15W	60
14102019	2,3	T12N	R15W	165
14102020	2	T12N	R15W	28
14102021	3,10	T12N	R15W	240
14102022	2,3	T12N	R15W	160
14102023	2,3,11	T12N	R15W	160
14102024	2,11	T12N	R15W	190
14102025	2,11	T12N	R15W	210
14102026	11,12	T12N	R15W	80
14102027	3	T12N	R15W	60
14102028	2,3	T12N	R15W	125
14103017	6	T12N	R14W	71.52
14103019	6	T12N	R14W	30
14103020	5	T12N	R14W	10
14103021	5	T12N	R14W	24
14103023	5	T12N	R14W	80
14103025	6	T12N	R14W	40
14103028	6	T12N	R14W	160
14103029	5	T12N	R14W	80
14103030	5	T12N	R14W	160
14103031	4,5	T12N	R14W	160
14103032	5	T12N	R14W	160
14103033	4	T12N	R14W	195
14103034	4	T12N	R14W	160
14103035	6	T12N	R14W	160
14103036	4	T12N	R14W	160

Apn	Section(s)	Township	Range	APN Acres
14103037	5	T12N	R14W	107
14103038	4	T12N	R14W	12
14104004	9	T12N	R14W	40
14104012	18	T12N	R14W	40
14104013	7	T12N	R14W	200
14104014	8	T12N	R14W	80
14104015	8	T12N	R14W	160
14104016	8	T12N	R14W	160
14104017	7	T12N	R14W	200
14104018	7,18	T12N	R14W	160
14104019	7,8	T12N	R14W	160
14104020	8,9	T12N	R14W	160
14104021	7,18	T12N	R14W	200
14104022	18	T12N	R14W	160
14104023	8,17,18	T12N	R14W	160
14104024	17	T12N	R14W	120
14104025	17	T12N	R14W	120
14104026	16	T12N	R14W	160
14104027	18	T12N	R14W	120
14104028	18	T12N	R14W	80
14104029	17	T12N	R14W	160
14104030	17	T12N	R14W	160
14104031	16	T12N	R14W	160
14104032	9	T12N	R14W	160
14104033	9	T12N	R14W	160
14104034	9	T12N	R14W	40
14104035	16	T12N	R14W	160
14104036	9	T12N	R14W	120
14105002	14	T12N	R15W	200
14105004	14	T12N	R15W	80
14105015	13,14	T12N	R15W	160
14105016	15	T12N	R15W	160
14105017	15	T12N	R15W	160
14105018	22	T12N	R15W	160
14105019	22	T12N	R15W	160
14105020	22	T12N	R15W	200
14105021	22,23	T12N	R15W	240
14105022	23	T12N	R15W	160
14105023	23	T12N	R15W	160
14105024	24	T12N	R15W	120
14105025	23	T12N	R15W	80
14105026	15,22	T12N	R15W	200
14105027	13,23,24	T12N	R15W	160
14106018	20	T12N	R15W	160
14106036	16	T12N	R15W	280

Apn	Section(s)	Township	Range	APN Acres
14106037	16	T12N	R15W	160
14106038	21	T12N	R15W	160
14106039	21	T12N	R15W	160
14106040	21	T12N	R15W	160
14107011	29	T12N	R15W	210
14107013	28	T12N	R15W	160
14107014	28	T12N	R15W	160
14107015	28	T12N	R15W	40
14107016	28	T12N	R15W	190
14107017	28	T12N	R15W	40
14118004	25	T12N	R15W	162.27
14118006	34	T12N	R15W	40
14118015	27	T12N	R15W	200
14118016	27,34	T12N	R15W	210
14118017	27	T12N	R15W	160
14118018	26	T12N	R15W	80
14118019	26	T12N	R15W	160
14118020	26	T12N	R15W	160
14118021	26	T12N	R15W	160
14118022	34	T12N	R15W	160
14118023	27	T12N	R15W	40
14118024	26,35	T12N	R15W	160
14118025	34	T12N	R15W	40
14118026	35	T12N	R15W	80
14118027	35,36	T12N	R15W	240
14118028	35,36	T12N	R15W	200
14118029	27	T12N	R15W	160
14119004	21	T12N	R14W	240
14119006	30	T12N	R14W	37.84
14119007	30	T12N	R14W	80
14119026	19	T12N	R14W	40
14119027	19	T12N	R14W	80
14119028	20	T12N	R14W	160
14119029	19	T12N	R14W	120
14119030	19	T12N	R14W	160
14119031	19	T12N	R14W	160
14119032	19,20	T12N	R14W	160
14119033	20,29	T12N	R14W	160
14119041	20	T12N	R14W	160
14119042	20,21	T12N	R14W	155
			Total *	**24167.54**

*Note: Acreage based on Assessor parcel data is often inconsistent with more accurate GIS data due to the use of actual surveyed section lines for GIS data. Discussions with the Mendocino County Assessor's Office indicate that Assessor parcel data could be revised to better reflect the true orientation of section lines and resulting section acreage; however, this would be a lengthy process. Note the use of more accurate GIS-generated acreage figures throughout this plan.

APPENDIX B:
JACK MONSCHKE WATERSHED MANAGEMENT
GARCIA RIVER FOREST PROJECT
OVERVIEW AND PRELIMINARY ACTION PLAN
FEBRUARY 27, 2005

The following report by Jack Monschek Watershed Management is organized into the following sections:

I. Introduction
II. Methodology
- Office-based review
- Field survey

III. Major Erosion Hazard Risks
- Diversion potential from roads
- Debris slide potential from road and landing fill
- Culverts on non-permanent roads
- Streambank failures and slides
- Instream-stored sediment

IV. The Data – General and Specific Information by Watershed, Tables, and Maps
V. Road Guidelines
VI. Observations on Potential Reserve Areas
VII. Some Funding Thoughts
VIII. Conclusion

Appendix A – General and Specific Information by Watershed
Appendix B – Preliminary Erosion Inventory by Watershed
Appendix C – Summary of Estimated Sediment Volumes and Costs
Appendix D – The Maps[1]

- Map 1 - Sediment Delivery Sites (including sub-watershed units and roads surveyed during field review)
- Map 2 - Suggested Road Decommissioning and New Construction Sites
- Map 3 - Road Crossings: Sensitivity Zones 4 & 5 and Landslide Areas
- Map 4 - Shallow Landslide Hazard Model

[1] TCF Note: a mass wasting zone map is included in this appendix. Other maps, some hand-drawn, are on file at TCF and TNC offices.

I. Introduction

The purpose of this Overview is to present a broad summary of current conditions in the Garcia River Forest Watershed, with special emphasis on potential sediment delivery risks. It is intended to provide information that will guide The Conservation Fund's staff in developing an action plan for reduction of sediment delivery in the Garcia River Forest. It also provides a framework from which a Total Maximum Daily Load (TMDL) strategy can be developed. Although specific and general recommendations and ideas for management are presented, this report should be considered a beginning. All information presented should be subject to further peer and field review.

II. Methodology

This Overview is the result of the following procedures:

A. Office-based review of existing documents to identify major sediment delivery sites/erosion hazards.

The goal of the office-based review was to identify sites to be visited for further analysis in the field. Approximately 320 sites were identified during office-based review. This process involved several steps:

1. Careful analysis of 2004 air photos with two objectives:
    - Identification of specific sites for field-truthing review. Areas that looked "suspicious" were mapped on a topography map of the project and visited during field review.
    - Obtaining a general "feel" for the sediment delivery hazards of the watershed.

2. Comparative photo analysis relating current and historical air photos to determine in a general sense what changes are occurring over time in the watershed.

3. Review of Geology Maps and Sensitivity Zone Maps (CFL SYP) to map those areas identified as having the greatest risk for erosion and sediment delivery. All sites where roads cross moderate and high sensitivity zones and all areas indicated as "translational/rotational slide areas" were carefully mapped on the topo map for future field review (See Map 3).

4. Review of other documents. All other relevant data gleaned from the existing documents was either mapped or noted. This data included very specific erosion hazard site information from the Garcia River Watershed Enhancement Plan (1992) in the North Fork Garcia, and various notes from numerous sources.

B. Field review to survey a cross-section of road types and stream systems throughout the entire property, with particular focus on problem sites that were identified during office-based review.

Because time for field review for this Overview was limited to 8 person days, the goal was to cover as much ground as efficiently as possible, recording relevant data. Areas surveyed during field review are highlighted on Maps 1 and 2. The property was divided into seven sub-

watershed areas (see Map 1), based on the Coastal Forest Lands (CFL) [previous ownership] Watershed Map, as follows:

1. **Inman Creek**
2. **Signal Creek**
3. **Hot Springs**
4. **Graphite Creek**
5. **Blue Water Hole**
6. **North Fork Garcia**
7. **Whitlow and Lamour Creek**

Data recorded at each potential sediment delivery site included:

- Site location (mapped by hand on rough field maps)
- Estimated sediment delivery (estimated volume in cubic yards of potential sediment delivery)
- Estimated priority (the importance of timely mitigation)
- Estimated cost of implementation
- Photos (digital photos of critical sites)

These rough estimations were made based on years of experience in watershed inventory using an abbreviated form of the STAR Sediment Delivery Worksheet System.

During field review over 220 of the sites identified during office-based review were visited, and 22 new sites were also discovered. (Mitigation of all identified sites is not required for TMDL compliance, however documentation of all sites is important for long-term management.) It is estimated that over 30% of the roads and over 40% of the high priority sites on the property were observed. (Because of the office-based identification of high priority sites, the focus was on areas that had a higher concentration of high priority potential sediment delivery sites.) Using the data collected, projections can be made about the number of sediment delivery sites over the entire property. However, although this information can be useful in developing an action plan, it is strongly recommended that inventory be completed throughout the entire Garcia River Forest in order to insure that all major sediment delivery sites are identified in order to prepare prioritized restoration plans for the watershed.

III. Major Erosion Hazard Risks in the Garcia River Forest

The following five major sediment delivery categories have been identified in the Garcia River Forest:

- Diversion potential from roads
- Debris slide potential from road and landing fill
- Culverts on non-permanent roads

(These first three are directly related to management)

- Streambank failures and slides
- Instream-stored sediment

Diversion Potential from Roads

It has been well documented that on the timberlands of northwest California and specifically the Garcia, diversions of streams by roads and the resulting gullies have been a major source of sediment delivered to fish bearing streams (Manglesdorf, Hagans and Weaver, Monschke, etc.) It is also accepted that this land-management-caused sediment delivery is one of the easiest and most cost- effective sources of potential sediment delivery to reduce.

Many of the sites visited during the field inventory for this project were either caused by past diversions or have adjacent gullies that are a result of past diversions. Although most of the roads in the Garcia Forest were storm-proofed by previous owners, there are segments of roads identified that need diversion-proofing (and more will certainly be identified during a complete inventory). It is commendable that the current landowners are taking a positive approach to road maintenance and upgrades.

Part V of this Overview discusses Road Maintenance, Upgrades, and Decommissioning, with specific guidelines for reducing diversion potential and other road related problems.

Debris Slide from Road and Landing Fill

No recent (last five years) debris slides/torrents were identified during air photo review of the property; however, the Garcia Watershed has not experienced above average rainfall or a major flood storm during this time period. Many road segments passing through high and medium sensitivity zones (See Map 3) were visited during field review and none of these had recent debris slides that delivered sediment to a Class I stream. There were also sites identified that were not located in high or medium sensitivity zones that still have a high potential to deliver in a major storm event. These sites (along with others identified during a complete sediment inventory of the property) should be high priority for restoration as funding allows.

Unfortunately, the Shalstab (Shallow Landslide Hazard) Map (Map 4) was not available during the office-based review, so it was not used to locate potential high priority sites to visit during field review. Two recent debris slides were observed during field review which were not identified by sensitivity zone mapping, but which were in areas rated as high risk for shallow landsliding on the Shalstab Map. This indicates the importance of utilizing the Shalstab Map in future inventories to help identify areas where road drainage, fill and/or cuts could have a higher potential to trigger debris slides.

Culverts on Non-Permanent Roads

The sediment delivery potential of culverts on non-permanent roads was first identified as a problem in the Garcia Watershed in the 1989 Post-Harvest Report (Monschke) for the previous landowners. When plugged culverts go unnoticed (as is common on non-permanent, seasonal and infrequently used roads), major diversions and sediment delivery are the result.

Field review of a variety of seasonal roads determined that this is still a problem, although perhaps not as large a problem as anticipated. The practice of mitigating problem crossings on Timber Harvest Plans (THP's) by using oversized culverts on temporary road spurs (and even occasionally on skid trails) was generally discontinued in the early 1990's, and none were discovered during the overview inventory. There were, however, culverts on seasonal roads that do not receive routine maintenance, and it can be anticipated that a complete sediment inventory will recommend replacing many of these culverts with armored fords or dips. It was encouraging

to observe that armored fords and dips instead of culverts had been installed on roads of some late 90's THP's.

Streambank Failures and Slides

A major source of sediment on north coast streams comes from stream bank failures and slides. The TMDL process determined that this is not directly management-caused. However, it can be argued that most stream bank failures are indirectly caused by aggradation in streams, which is a direct result of past management practices. In either case, the important thing is to identify sediment sources and develop strategies to reduce them. Restoring failing stream banks is often the most cost-effective means of reducing sediment and has the added benefit of restoring canopy in the riparian zones and improving fish habitat. Public funding is often available for this type of work.

The largest potential sediment delivery sites identified during field review for this project were streambank failures. In the data spreadsheets and tables (See Appendices B and C) these streambank sites were listed under the category of "Abandoned Roads" for several reasons: this overview is focused on road-related sediment delivery and TMDL compliance, the sites are related to abandoned roads, and for ease of presentation. However, these sites could be separated from the road sites for purposes of grant writing or for other reasons if necessary.

Instream-stored sediment

An often-overlooked source of sediment, which can also be cost-effective to treat, is instream-stored sediment. The Garcia River Watershed Enhancement Plan (Monschke and Caldon, 1992) identifies specific stream reaches on the North Fork Garcia where this is a problem. It was observed during the major flood storms of January and March 1995 that severe downcutting occurred on some of these stored sediment reaches in the North Fork Garcia (Monschke 1996).

During current field review two sites were visited where restoration projects in the 1990's had removed large quantities of instream-stored sediment, and both sites have responded well. Several other instream-stored sediment sites on Graphite and Inman Creek where no restoration work has occurred were also visited; removal of sediment and other restoration measures at these sites could improve stream conditions as well as fish habitat if funding and permits could be obtained.

IV. The Data – General and Specific Information by Watershed, Tables and Maps

The summarized data generated by this Overview of the Garcia River Forest, both general and specific, is included in Appendices A, B and C of this report:

Appendix A presents summarized data organized on spreadsheets by sub-watershed, which includes general geological information, stream overviews, road information (both permanent and seasonal/temporary), and some site-specific information. This is a synthesis of knowledge from past experience working in the Garcia River Forest and from current field review for this project.

Appendix B is a listing by watershed of low to high priority sites identified during sediment inventory. During eight person-days of field review over 220 sites were visited representing a cross-section of the property. No information was recorded for many sites, which had either

been mitigated in the past using "best management practices" (BMP's) or had less than 10 cubic yards of potential sediment. During field review information was recorded at 138 sites which included the erosion characteristics of each site: potential sediment delivery, estimated cost of mitigation, and estimated prioritization of each site. Of these sites, approximately 99 sites rated as low to high priority after final review. These sites are included in Appendix B and identified on Map 1.

Appendix C consists of two tables which compile and summarize the site-specific data in Appendix B. Table I includes estimated sediment volumes and costs by watershed. Table II shows estimated sediment volumes and costs by road type.

The data found in the lower rows of Table I and II can be used as a rough estimate of potential sediment delivery sites over the entire property. In Table I, the projections are calculated using the estimated coverage of initial inventory in each watershed. In Table II, the projections are calculated assuming that property wide, 30% of the low and medium priority sites have been identified and 45% of the high priority sites have been identified. Again, it is important to note that these projections are very approximate at this time.

Some specific comments on the Tables:

The most critical and obvious product of Table I is the number of high priority sites in the Inman Creek Watershed. Prospective mitigation in the Inman Watershed may account for nearly one-third of all mitigation over the entire property. On Table II, it is interesting to note the high cost of mitigation and potential sediment savings on abandoned roads. This represents large instream sites, which were listed under "Abandoned Roads" (see page 6, paragraph 1). Mitigation of these sites will not be required for TMDL compliance, but work at such sites often provides the most cost-effective sediment-saving projects.

The most important recommendation at this stage is to investigate funding opportunities for further assessment and implementation projects as soon as possible. As soon as assessment begins, implementation proposals can be prepared with the data gathered.

Maps:
The following maps have been submitted along with this Overview:

- Map 1 – Sediment Delivery Sites (including sub-watershed units)
  Potential sediment delivery sites described in Appendix B are noted and numbered by sub-watershed. Roads surveyed during field review are highlighted.

- Map 2 – Suggested Road Decommissioning and New Construction Sites (including roads surveyed during field review)

- Map 3 – Road Crossings: Sensitivity Zones 4 & 5 and Landslide Areas
  This map shows all road segments that cross landslide areas and high sensitivity zones based on past CFL data. It was digitally prepared using previously generated GIS layers.

- Map 4 – Shallow Landslide Hazard (SHALSTAB) Map
  This map is computer generated using shallow landslide stability software. The program uses slope steepness, runoff concentration, geologic strata, and other factors to predict the potential for shallow landslides.

V. Road Guidelines

One of the objectives of this Overview is to identify roads in the Garcia River Forest that need maintenance, upgrades and closures (and possibly new construction to facilitate better management of the property as a whole).

Maintenance:
Ideally, road maintenance should only be necessary on a yearly basis on permanent roads. Seasonal and temporary roads, which are less frequently used, should be storm-proofed so that they only need maintenance when reopened for future harvest or other management objectives. To date this ideal has not been achieved in the GRF, and this field survey identified roads of all types in need of maintenance.

Critical factors in road maintenance include checking culverts in the fall and throughout the winter during large storm events to ensure that water can flow freely through the inlet, and grading road surfaces with a crown, out-slope, rolling dips, or a combination of all three. In addition, although modern road building guidelines often suggest the elimination of inboard ditches, there are certain situations where they are imperative, and wherever there are inboard ditches, they must be maintained to reduce diversion potential and erosion of the road surface. The overall shape of the road and the amount of traffic should determine the interval of time between grading. A properly shaped road will require less maintenance over time and deliver much less sediment into the watercourse. The maintenance schedule presented in NCRM's road report is a good start but should be adapted as improvements are made and new information is acquired.

Everyone who works in the Garcia River Forest should be encouraged to develop the hands-on skills needed to identify and address erosion problems along the roads. Early identification of potential erosion can greatly reduce sediment production and damage to the road system.

Specific examples of road segments in need of maintenance are:

- The road running parallel to the Garcia River in the Hot Springs Sub-watershed, where a high percentage of waterbars are failing due to motorcycle traffic in the dry months. Fortunately, the soil in this area is rocky, reducing susceptibility for erosion.

- Site 16/Whitlow & Lamour, where a culvert near the north end of Inman Creek Road (Whitlow Creek Watershed) is plugged and diverting to another overburdened culvert crossing.

Road Upgrades
The general philosophy for road upgrades should stress reshaping the road to reduce the amount of fill, both at crossings and on steep slopes, especially those identified as high risk using either

the Shalstab or Sensitivity Zone maps. This includes berm-removal and out-sloping to reduce the size of the road prism. To eliminate fill and potential sediment delivery, crossings should be dipped and follow the contour whenever possible. The challenge of this work is to achieve a balance between long-term sediment reduction and access for timber harvest equipment. This is best accomplished by tapping into the knowledge and experience of equipment operators, foresters, loggers and Conservation Fund representatives as road upgrade projects continue. It is also recommended that crossing upgrades should emphasize rock-armored critical dips rather than replacing culverts to 100-year storm standards. This said, it is always important remain open to a variety of management options since every site is unique.

Permanent Roads

Most of the crossings on the permanent roads surveyed appear to be functioning well and should withstand large storm events. For this reason it is recommended that maintenance priorities should be to install rock-armored critical dips where diversion potential still exists, and to reshape roads to improve drainage. This is a much more cost-effective sediment reduction strategy than upgrading all culverts to 100-year storm standards.

A good example of this approach is the rolling dips installed on Graphite Road during the summer of 2004. Similar projects could take place on all permanent roads when funding is available. Rolling dips are a relatively new development in road drainage, and constructing dips with the proper shape requires a skilled operator. Traffic and sediment buildup often reduce the effective drainage of rolling dips, making it important to construct dips with an out-slope steep enough to maintain proper drainage over time. It is crucial to develop a long-term partnership with equipment operators who are capable of developing the necessary skills and who take pride in stewardship of the land.

Seasonal and Temporary Roads

Most of the crossings on seasonal and temporary roads surveyed are functioning well at this time. However, due to lack of winter maintenance these sites pose a greater risk for future sediment delivery. Crossings on these roads should be diversion-proofed and armored with rock. Where feasible, culverts should be removed and replaced with armored fords.

Road Closures

Projects to decommission roads have a wide range of possibilities. In most cases it is not possible or cost-effective to completely return the land to its natural geography. The most crucial aspects in road closure are correcting the drainage patterns and reducing perched fill. It is critical in all types of road closures to excavate stream crossings. In steeper terrain near drainages, large quantities of perched fill should be removed from the edge of the road creating an out-sloped surface with no drainage concentration. In lower grade terrain, a decommissioned road can be sufficiently drained with large dips. Generally, roads near creeks, especially those that dead-end, should be considered for closure.

From a sediment standpoint, road closure has a long-term benefit, but the short-term effects can be negative due to an increase in disturbed soil. Road decommissioning also has many disadvantages from a management perspective including reduced logging options and limited accessibility for fire protection. Where feasible, decommissioned roads could be left open to ATV access and cost-effectively maintained by a small rubber-tracked bobcat, which would allow more cost-effective management of these areas for non-timber harvest objectives like fisheries and other habitat restoration.

VI. Potential Reserve Areas

The areas suggested by NCRM as potential "reserve" areas are logical choices.
The area recommended for a reserve in the Inman Creek watershed provides a very diverse habitat with a combination of grass prairie, oak woodland, and coniferous forest. Thus, there are extensive "edge lands" between different vegetation types, which are known to be diverse in both flora and fauna. The potential loss of timber volume in this reserve is also relatively low due to the high percentage of grass and oak woodlands compared to the rest of the Garcia Forest. Creating a reserve in this area would allow a large number of poorly constructed roads to be decommissioned rather than upgraded for future harvest. Finally, it would reduce management impacts on the watershed with what some professionals believe is the highest potential for future Coho habitat on the property.

The area recommended in the Signal Creek Watershed was the site of a fire in the mid-1990's, and it will be interesting to observe and study this area over time. As a result of the fire, there is minimal timber available for harvest in the near future in this area, thus selecting this area as a reserve would have a lower economic impact. In addition, it would allow the decommissioning of numerous roads near streams that would no longer be needed for timber harvest.

An ideal vision of a reserve system for the Garcia River Forest, however, would be much more complex. It would include some larger blocks, but would also contain corridors to create connectivity. These corridors would include wide buffers for streams and other sensitive or unstable areas. Scientific justification for reserve components should be further investigated to determine the optimal size and related positioning to provide the most beneficial habitat for a variety of wildlife. Much of the property could function as a reserve if lower-impact management practices are used in the Garcia River Forest.

VII. Finally, Some Funding Thoughts:

Based on the field data collected, at the level of roughest approximations, it could be estimated that $1,000,000 could mitigate the most important sediment delivery sites in the Garcia River Forest. This amount of funding/mitigation is NOT required for TMDL compliance, but represents the estimated cost of treating all projected medium and high priority sediment delivery sites.

An important positive factor in terms of funding costs is the availability of on-site rock, which is critical to cost-effective implementation and is often used as a funding match for agency grants.

Finally, it is important to note that all cost estimates ventured in this Overview assume that all contractors and equipment operators involved in implementation projects would be experienced, conscientious, and efficient.

VIII. Conclusion

The most important overall recommendation for the Garcia River Forest is that a sediment inventory be completed for the entire property. Overall, the information gathered for this overview shows encouraging trends toward lower sediment delivery potential in much of the

Garcia River Forest, with the exception of the Inman Creek Sub-Watershed, where it is recommended that both inventory and mitigation of potential sediment sources be expedited. Aside from Inman Creek, upgrading the main access roads appears to be the highest priority. Other sites should be mitigated when outside funding is available or when they are identified on future timber harvest plans.

JMWM APPENDIX A: GENERAL AND SPECIFIC INFORMATION BY WATERSHED

	Permanent Roads:					**Seasonal/Temporary Roads:**			
	Road Drainage and Diversion Potential of Crossings	**Road Densitiy in High and Moderate Sensitivity Zones**	**Road Densitiy in Unstable Areas**	**Road Density in WLPZ**	**General Road Prism Width**	**Road Drainage and Diversion Potential of Crossings**	**Road Densitiy in High and Moderate Sensitivity Zones**	**Road Densitiy in Unstable Areas**	**Road Density in WLPZ**
Inman Creek	Poorly drained with high diversion potential	Moderate	High	Low	Wide	Poorly drained	Moderate	High	High
Signal Creek	Moderate drainage and diversion potential	High	Low	High	Narrow	Well drained	High	Low	High
Hot Springs	N/A	N/A	N/A	N/A	N/A	Moderate drainage and diversion potential	High	Low	Low
Graphite Creek	Well drained with low diversion potential	Moderate	Moderate	Moderate	Wide	Well drained with low diversion potential	Moderate	Moderate	Moderate
Blue Water Hole	Well drained with low diversion potential	Moderate	Low	Low	Narrow	Well drained	Moderate	Low	Moderate
North Fork	Well drained with low diversion potential	High	Moderate	Low	Narrow (except Graphite)	Well drained	Moderate	Moderate	Low
Whitlow and Lamour Creek	Well drained with low diversion potential	Moderate	Moderate	Moderate	Wide	Well drained	Low	Moderate	Low

JMWM APPENDIX A, CONTINUED

	Specific Site Information
Inman Creek	Many Opportunities for instream restoration exist in this watershed with at least four high priority sites identified in this preliminary investigation. A considerable amount of instream sediment is present due to unstable geology, bad management practices, and low gradient of the stream which has not allowed this sediment to flush out of the system.
Signal Creek	It would be benificial to decomission significant portions of the road network located within the WLPZ. A significant volume of fill is perched directly over the creek, especially noticable at a site 9. The possible construction of short stretches of mid-slope or ridge road could greatly increase the length of WLPZ road available to decommission without severly limiting management options.
Hot Springs	The main seasonal road in the northern area of the watershed should be reshaped to reduce diversion potential, and many past diversion gullies were identified. No preliminary inventory was completed in the southern part of this watershed area.
Graphite Creek	Rocky parent material lowers the potential for large sediment delivery along the segment of Hollow Tree Road running near the Garcia River. The segment of road connecting Hollow Tree road to the Airforce Station was upgraded with commendable management practices. Well placed culverts with no diversion potential and armored fords were identified.
Blue Water Hole	Three crossings with significant sediment delivery potential were located on a mid-slope seasonal road. The smallest of these sites had an undersized culvert with evidence of recent plugging.
North Fork	Roads in this watershed are in relatively good shape because it was closely scrutinzed during the 1990s by both regulatory agencies and environmental groups. However, there is a narrow and unstable segment of Olson Gulch Road draining into Fishing Resort Creek that poses a problem for sediment delivery and access. A high volume of instream sediment is stored in the lower two miles of the North Fork and should be considered for fisheries restoration. Also a few large logjams in the upper reaches of the watershed have captured sediment and have signifcant erosion potential.
Whitlow and Lamour Creek	Hollow Tree Road is well drained through this area. However, the portion of Inman Creek Road in the Whitlow Creek watershed has significant sediment delivery potential. Also some seasonal roads in the eastern portion of this area have drainage problems.

JMWM APPENDIX A, CONTINUED

	Geological Information:			Stream Overview:		
	General Soil Type	**General Slope Gradient**	**Soil Erosion Potential**	**Stream Gradient**	**Instream Sediment Storage**	**Further Evaluation of Streambank and Fisheries**
Inman Creek	Unstable soils cause earth flow and creep and supports praire and oak woodland	Moderate	High	Low	High	Large debris slides along the streambank are constantly bleeding sediment into the system and a significant volume of instream sediment is being mobilized every winter. Due to the low gradient, this watershed offers prime habitat for Coho if restored.
Signal Creek	High quality permeable soils	Moderate to High	Low	Moderate to High	Low	No large active debris slides were identified that are bleeding significant sediment into the system. A higher volume of stored sediment is evident in one tributary with lower gradient and may provide Coho habitat if restored.
Hot Springs	High quality permeable soils with some rocky soils	High to Moderate	Low	High gradient (except for Garcia River)	Low (except for Garcia River)	Numerous stream bank slides are contributing sediment to the watershed, but the rocky nature of the material is less harmful to fish. This stretch of the Garcia River should be further evaluated for fisheries restoration.
Graphite Creek	High quality permeable soils with some rocky soils	Moderate to High	Low	High gradient (except for Garcia River)	Low (except for Garcia River)	Numerous stream bank slides are contributing sediment to the watershed, but the rocky nature of the material is less harmful to fish. This stretch of the Garcia River should be further evaluated for fisheries restoration.
Blue Water Hole	High quality permeable soils	Moderate to High	Moderate	Moderate	Moderate	No large active debris slides were identified that are bleeding significant sediment into the system.
North Fork	High quality permeable soils (except near Jack's Opening)	High to Moderate	Low	Moderate to High	Moderate	No large active debris slides were identified that are bleeding significant sediment into the system. A natural fish barrier on the North Fork prohibits anadromous fish access to much of the watershed.
Whitlow and Lamour Creek	High quality permeable soils and unstable soils to the northeast of Phelps Ridge	Moderate to High	Low (except area near Phelps Ridge)	Low	High	No large active debris slides were identified that are bleeding significant sediment into the system. Whitlow Creek has potential to be restored for Coho habitat.

JMWM APPENDIX B: PRELIMINARY EROSION INVENTORY BY WATERSHED

Preliminary Erosion Inventory for Blue Water Hole Watershed Area

Site #	Site Location	Road Classification	Site Classification	Estimated Site Priority	Estimated Delivery Potential (yds^3)	Estimated Cost to Implement	Proposed Implementation
12	Blue Water	Seasonal	Culvert Crossing	10	600	$3,000	Armor Critical Dip/Excavate Channel
13	Blue Water	Seasonal	Culvert Crossing	5	150	$1,500	Replace Culvert with Armored Ford
14	Blue Water	Seasonal	Culvert Crossing	10	300	$1,000	Armor Critical Dip
15	Blue Water	Seasonal	Culvert Crossing	10	800	$2,500	Armor Critical Dip
16	Blue Water	Seasonal	Culvert Crossing	15	500	$2,500	Replace Culvert with Armored Ford
16b	Blue Water	Seasonal	Road Drainage	8	1000	$10,000	Reshape Road
				TOTALS:	**3350**	**$20,500**	

Preliminary Erosion Inventory for Hot Springs Watershed Area

Site #	Site Location	Road Classification	Site Classification	Estimated Site Priority	Estimated Volume of Delivery (yds3)	Estimated Cost to Implement	Proposed Implementation
1	Hot Springs	Seasonal	Road Drainage	10	2000	$20,000	Reshape Road
2	Hot Springs	Seasonal	Culvert Crossings	10	500	$3,000	Armor Critical Dips
3	Hot Springs	Seasonal	Culvert Crossing	5	150	$1,500	Armor Critical Dip
4	Hot Springs	Seasonal	Culvert Crossings	8	500	$5,000	Armor Critical Dips
5	Hot Springs	Seasonal	Culvert Crossing	3	150	$2,000	Armor Critical Dip
6	Hot Springs	Seasonal	Culvert Crossing	5	150	$2,000	Armor Critical Dip

Site #	Site Location	Road Classification	Site Classification	Estimated Site Priority	Estimated Volume of Delivery (yds3)	Estimated Cost to Implement	Proposed Implementation
7	Hot Springs	Seasonal	Pulled Crossing	3	200	$3,000	Excavate Crosssing
8	Hot Springs	Seasonal	Fill Crossings	8	500	$3,000	Excavate Crossings/Install Ford
9	Hot Springs	Abandoned	Stream Erosion	5	400	$4,000	Handwork to Stabilize Failing Road Fill
10	Hot Springs	Seasonal	Pulled Crossing	3	300	$4,000	Excavate Crossings/Install Ford
11	Hot Springs	Abandoned	Culvert Crossing	8	150	$2,000	Armor Critical Dip
12	Hot Springs	Abandoned	Fill Crossing	2	100	$1,500	Armor Critical Dip
13	Hot Springs	Abandoned	Culvert Crossing	8	200	$2,000	Armor Critical Dip
14	Hot Springs	Abandoned	Culvert Crossing	8	200	$2,000	Armor Critical Dip
				TOTALS:	**5500**	**$55,000**	

Preliminary Erosion Inventory for Graphite Creek Watershed

Site #	Watershed Designation	Road Classification	Site Classification	Estimated Site Priority	Estimated Volume of Delivery (yds3)	Estimated Cost to Implement	Proposed Implementation
1	Graphite	Permanent	Road Drainage	15	500	$1,500	Reshape Road
2	Graphite	Seasonal	Landing Fill	8	200	$1,000	Excavate Perched Landing Fill
3	Graphite	Abandoned	Stored Sediment	8	1500	$20,000	Redefine Channel
				TOTALS:	**2200**	**$22,500**	

JMWM APPENDIX B, CONTINUED

Preliminary Erosion Inventory for Inman Creek Watershed

Site #	Site Location	Road Classification	Site Classification	Estimated Site Priority	Estimated Delivery Potential (yds3)	Estimated Cost to Implement	Proposed Implementation
1	Inman Creek	Permanent	Culvert Crossing	10	500	$1,000	Armor Critical Dip
2	Inman Creek	Permanent	Culvert Crossing	10	500	$2,000	Armor Critical Dip
3	Inman Creek	Permanent	Culvert Crossing	15	1000	$1,000	Armor Critical Dip
4	Inman Creek	Permanent	Culvert Crossing	15	500	$2,500	Replace Culvert and Armor Critical Dip
5	Inman Creek	Permanent	Culvert Crossing	10	500	$2,000	Armor Critical Dip
6	Inman Creek	Permanent	Culvert Crossing	10	500	$2,000	Armor Critical Dip
7	Inman Creek	Permanent	Culvert Crossing	10	500	$2,000	Armor Critical Dip
8	Inman Creek	Permanent	Culvert Crossing	10	300	$1,000	Armor Critical Dip
9	Inman Creek	Permanent	Culvert Crossing	10	300	$1,000	Install Rolling Dips
10	Inman Creek	Permanent	Culvert Crossing	10	1000	$12,000	Replace Culvert
11	Inman Creek	Permanent	Culvert Crossing	8	300	$1,500	Armor Critical Dip
12	Inman Creek	Permanent	Culvert Crossing	10	400	$1,500	Install Rolling Dips
13	Inman Creek	Seasonal	Stored Sediment	10	1000	$8,000	Excavate to Define Stream Channel
14	Inman Creek	Seasonal	Landing Fill	10	1000	$8,000	Excavate to Define Stream Channel
15	Inman Creek	Abandoned	Fill Crossings	8	3000	$30,000	Excavate 20 Crossings or Install Fords
16	Inman Creek	Abandoned	Debris Slide	20	10000	$30,000	Modify Channel to Stabilize Toe of Slide
17	Inman Creek	Abandoned	Debris Slide	8	3000	$5,000	Armor Left Bank with Rip Rap
18	Inman Creek	Abandoned	Debris Slide	8	800	$5,000	Armor Left Bank with Rip Rap
19	Inman Creek	Abandoned	Crossing	4	200	$2,000	Modify Channel to Stabilize Bank
20	Inman Creek	Abandoned	Stream Erosion	6	400	$4,000	Handwork - Bionengineering Structure
21	Inman Creek	Abandoned	Pulled Crossings	1	80	$800	Excavate Crossings/Install Fords
22	Inman Creek	Abandoned	Stored Sediment	20	10000	$12,000	Stabilize Failing Knickpoint
				TOTALS:	**35780**	**$134,300**	

JMWM APPENDIX B, CONTINUED

Preliminary Erosion Inventory for North Fork Garcia Watershed Area

Site #	Site Location	Road Classification	Site Classification	Estimated Site Priority	Estimated Delivery Potential (yds3)	Estimated Cost to Implement	Proposed Implementation
1	North Fork	Abandoned	Pulled Crossings	4	200	$2,000	Plant Willow in Stream
2	North Fork	Seasonal	Culvert Crossing	5	200	$2,000	Armor Critical Dip
3	North Fork	Seasonal	Culvert Crossing	4	100	$1,000	Armor Critical Dip
4	North Fork	Seasonal	Culvert Crossing	4	100	$1,000	Armor Critical Dip
5	North Fork	Seasonal	Culvert Crossing	4	100	$1,000	Armor Critical Dip
6	North Fork	Seasonal	Culvert Crossing	4	100	$1,000	Armor Critical Dip
7	North Fork	Seasonal	Blown Crossing	5	50	$1,000	Armor Critical Dip
8	North Fork	Permanent	Culvert Crossing	8	200	$1,000	Armor Critical Dip
9	North Fork	Permanent	Debris Slide	10	500	$2,000	Reshape Road - Future Problem Site
10	North Fork	Permanent	Culvert Crossing	5	300	$1,500	Armor Critical Dip
11	North Fork	Permanent	Culvert Crossing	10	500	$1,500	Armor Critical Dip
12	North Fork	Permanent	Road Drainage	8	1500	$15,000	Reshape Roads
				TOTALS:	**3850**	**$30,000**	

JMWM APPNDIX B, CONTINUED

Preliminary Erosion Inventory for Signal Creek

Site #	Site Location	Road Classification	Site Classification	Estimated Site Priority	Estimated Volume of Delivery (yds3)	Estimated Cost to Implement	Proposed Implementation
1	Signal Creek	Permanent	Road Drainage	4	100	$1,000	Reshape Road
2	Signal Creek	Permanent	Culvert Crossing	10	1000	$5,000	Replace Culvert
3	Signal Creek	Permanent	Culvert Crossing	5	300	$1,500	Armor Critical Dip
4	Signal Creek	Permanent	Culvert Crossing	5	300	$1,500	Armor Critical Dip
5	Signal Creek	Seasonal	Culvert Crossing	8	300	$2,000	Armor Critical Dip
6	Signal Creek	Seasonal	Culvert Crossing	5	300	$1,500	Armor Critical Dip
7	Signal Creek	Seasonal	Culvert Crossing	5	300	$1,500	Armor Critical Dip
8	Signal Creek	Seasonal	Culvert Crossing	4	200	$800	Armor Critical Dip
9	Signal Creek	Seasonal	Debris Slide	10	2000	$4,000	Handwork to Stabilize Toe of Slide
10	Signal Creek	Seasonal	Culvert Crossing	5	300	$3,000	Excavate Crossings/Install Ford
11	Signal Creek	Seasonal	Culvert Crossing	8	400	$3,000	Excavate Crossings/Install Ford
12	Signal Creek	Seasonal	Road Drainage	4	4000	$40,000	Decommission Two Mile Length of Road
13	Signal Creek	Seasonal	Pulled Crossing	2	100	$1,000	Handwork to Stabilize Failing Road Fill
14	Signal Creek	Seasonal	Fill Crossings	8	500	$5,000	Excavate Crossings/Install Ford
15	Signal Creek	Permanent	Fill Crossing	5	75	$800	Install Armored Ford
16	Signal Creek	Permanent	Fill Crossing	3	75	$800	Install Armored Ford
17	Signal Creek	Permanent	Road Drainage	5	400	$4,000	Reshape Road
18	Signal Creek	Abandoned	Culvert Crossing	5	100	$1,000	Install Armored Ford
19	Signal Creek	Abandoned	Pulled Crossing	3	50	$800	Excavate Crossings/Install Ford
20	Signal Creek	Permanent	Three Culverts	8	500	$3,000	Armor Three Critical Dips
21	Signal Creek	Abandoned	Two Fill Crossings	4	200	$2,000	Excavate Crossings/Install Fords
22	Signal Creek	Abandoned	Fill Crossing	3	100	$1,000	Excavate Crossings/Install Ford
23	Signal Creek	Permanent	Culvert Crossing	5	120	$1,000	Armor Critical Dip
24	Signal Creek	Instream	Log Jam	4	300	$3,000	Modify Debris Jam
				TOTALS:	**12020**	**$88,200**	

JMWM APPENDIX B, CONTINUED

Preliminary Erosion Inventory for Whitlow and Lamour Creek Area

Site #	Watershed Designation	Road Classification	Site Classification	Estimated Site Priority	Estimated Delivery Potential (yds3)	Estimated Cost to Implement	Proposed Implementation
1	Lamour Creek	Permanent	Culvert Crossing	2	250	$5,000	Replace Crossing and Armor Dip
2	Lamour Creek	Seasonal	Culvert Crossing	8	300	$800	Armor Critical Dip
3	Lamour Creek	Seasonal	Culvert Crossing	8	300	$800	Armor Critical Dip
4	Lamour Creek	Seasonal	Culvert Crossing	12	500	$2,000	Armor Critical Dip
5	Lamour Creek	Seasonal	Culvert Crossing	8	300	$800	Armor Critical Dip
6	Lamour Creek	Seasonal	Culvert Crossing	8	300	$800	Armor Critical Dip
7	Whitlow Creek	Seasonal	Culvert Crossing	5	300	$2,000	Define Channel Above Crossing
8	Whitlow Creek	Permanent	Culvert Crossing	10	500	$2,000	Armor Critical Dip
9	Whitlow Creek	Permanent	Culvert Crossing	5	500	$1,500	Armor Critical Dip/Excavate Channel
10	Whitlow Creek	Permanent	Road Drainage	8	1000	$10,000	Reshape Road
11	Whitlow Creek	Seasonal	Landing Fill	4	250	$5,000	Excavate to Define Stream Channel
12	Whitlow Creek	Seasonal	Fill Crossing	5	50	$500	Excavate Crossing/Install Ford
13	Whitlow Creek	Permanent	Culvert Crossing	10	300	$500	Armor Critical Dip
14	Whitlow Creek	Permanent	Culvert Crossing	8	300	$800	Install Armored Ford
15	Whitlow Creek	Permanent	Culvert Crossing	8	300	$800	Armor Critical Dip
16	Whitlow Creek	Permanent	Culvert Crossing	8	500	$2,500	Armor Critical Dip
17	Whitlow Creek	Permanent	Culvert Crossing	12	300	$1,500	Excavate Inlet and Armor Critical Dip
18	Whitlow Creek	Permanent	Culvert Crossing	8	300	$2,000	Armor Critical Dip
				TOTALS:	**6550**	**$39,300**	

JMWM APPENDIX C: SUMMARY OF ESTIMATED SEDIMENT VOLUMES AND COSTS

TABLE I

Estimated Sediment Volume and Cost by Watershed

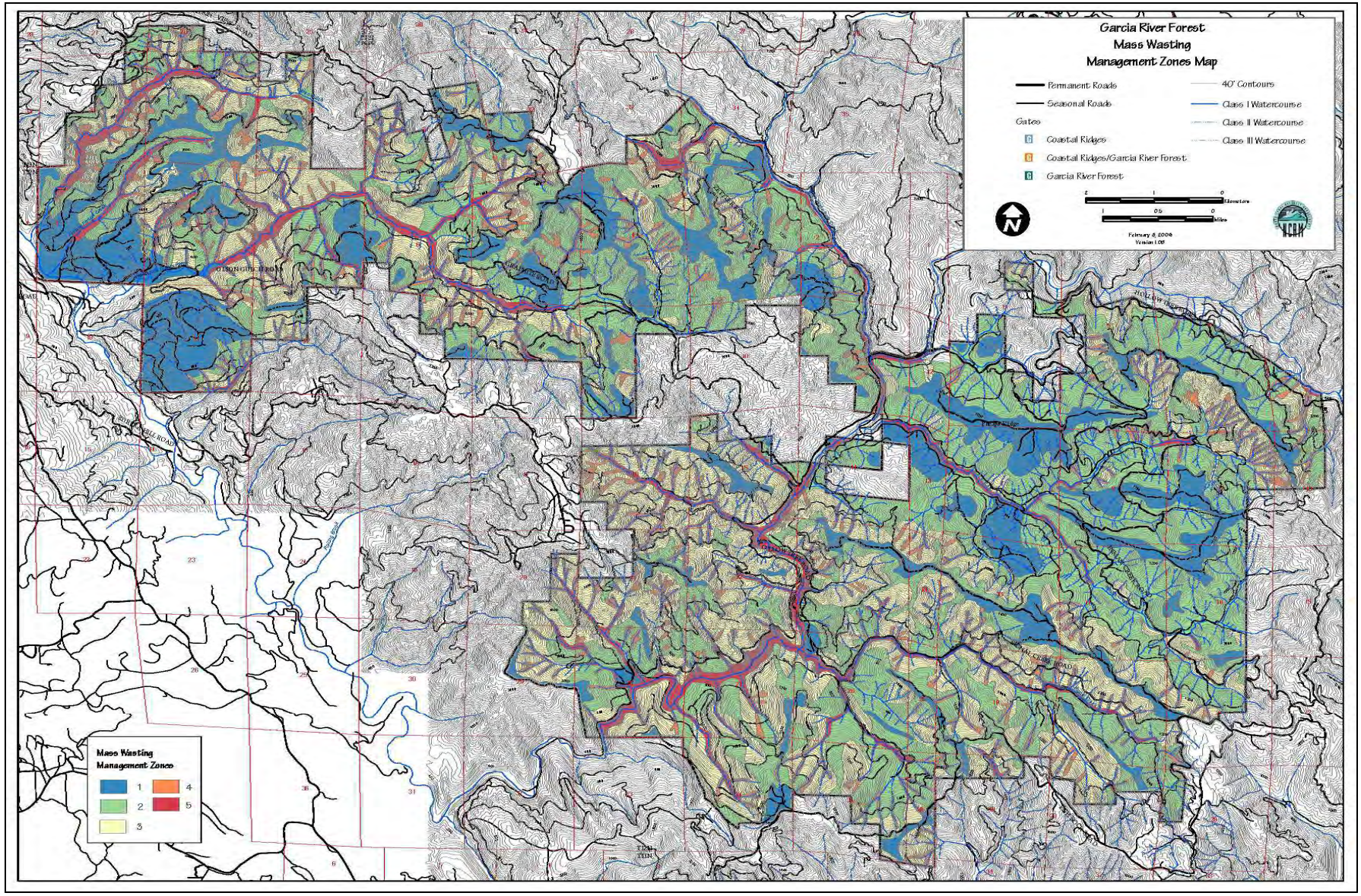
SPECIFIC DATA FOR EACH WATERSHED	Inman Creek	Signal Creek	Hot Springs	Graphite Creek	Blue Water Hole	North Fork	Whitlow and Lamour Creek	PROPERTY TOTALS
Estimated Percentage of Coverage	35%	50%	40%	40%	30%	20%	50%	~35%
Number of High Priority Sites Identified	17	2	2	1	4	2	0	**28**
Estimated Delivery Potential of Identified Sites (yds^3)	35780	12020	5500	2200	3350	3850	6550	**69250**
Estimated Cost to Mitigate Identified Sites	$134,300	$88,200	$55,000	$22,500	$20,500	$30,000	$39,300	**$389,800**
Estimated Cost Effectiveness for Mitigating Identified Sites ($/$yd^3$)	3.8	7.3	10.0	10.2	6.1	7.8	6.0	**6**
Delivery Potential of Projected Sites (yds^3)	102229	24040	13750	5500	11167	19250	13100	**189035**
Total Cost to Mitigate Projected Sites	$383,714	$176,400	$137,500	$56,250	$68,333	$150,000	$78,600	**$1,050,000**

JMWM APPENDIX C, CONTINUED

TABLE II
Estimated Sediment Volume and Cost by Road Type

High Priority on Seasonal Roads	High Priority on Temporary Roads	Total High Priority	Medium and Low Priority on Permanent Roads	Medium and Low Priority on Seasonal Roads	Medium and Low Priority on Temporary Roads	Total Medium and Low Priority	TOTAL ALL PRIORITY
10	3	31	15	38	16	69	100
9200	21500	40300	7320	12150	5780	25550	65850
$54,000	$62,000	$158,000	$55,200	$108,500	$59,100	$225,800	$383,800
23	7	70	50	125	53	228	297
21160	49450	92690	24820	41196	19598	86631	179321
$126,900	$145,700	$371,300	$165,600	$325,500	$177,300	$677,400	$1,050,000

JMWM APPENDIX D: MASS WASTING ZONE MAP



APPENDIX C: SOIL TYPES AND DESCRIPTIONS

Descriptions from Rittiman, C, and T. Thorson, 2002. *Soil Survey of Mendocino County, California, Western Part.* Natural Resources Conservation Service. Available online: http://www.ca.nrcs.usda.gov/mlra02/wmendo/

I. Primary Timber Soils

Yellowhound-Kibesillah complex (235, 236, 237) 9,982 acres.
The soil phase 235 occurs on slopes 50 to 75%, phase 236 occurs on slopes 9 to 30%, and phase 237 occurs on slopes 30 to 50%. This map unit is on hills and mountains. The vegetation is mainly Douglas-fir, redwood, and tanoak. Elevation ranges from 200 to 2,000 feet.

This unit is about 45 percent Yellowhound gravelly loam and 35 percent Kibesillah very gravelly loam. The Yellowhound and Kibesillah soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Ornbaun and Zeni soils and small areas of soils that have been drastically altered by logging activities. Also included are small areas that have slopes of 30 to 50 percent or 75 to 99 percent. Included areas make up about 20 percent of the total acreage of the unit. The percentage varies from one area to another.

The Yellowhound soil is deep to bedrock and is well drained. It formed in material derived from sandstone. Typically, the surface is covered with a mat of leaves and twigs about 1 inch thick. Permeability is moderate in the Yellowhound soil. Available water capacity is low. The effective rooting depth is limited by bedrock at a depth of 40 to 60 inches. Surface runoff is very rapid, and the hazard of water erosion is very severe if the surface is left bare.

The Kibesillah soil is moderately deep to bedrock and is well drained. It formed in material derived from sandstone. Typically, the surface is covered with a mat of leaves and twigs about 1/2 inch thick. Permeability is moderate in the Kibesillah soil. Available water capacity is very low. The effective rooting depth is limited by bedrock at a depth of 20 to 40 inches. Surface runoff is very rapid, and the hazard of water erosion is very severe if the surface is left bare.

This unit is used for timber production or as watershed.

Douglas-fir, redwood, and tanoak are the main tree species on this unit. Sugar pine commonly occurs on this unit in the southern part of the survey area. On the basis of a 100-year site curve, the mean site index for Douglas-fir is 140 on the Yellowhound soil and 109 on the Kibesillah soil. The potential annual production from a fully stocked stand of Douglas-fir is 630 board feet per acre on the Yellowhound soil and 335 board feet per acre on the Kibesillah soil. On the basis of a 100-year site curve, the mean site index for redwood is 135 on the Yellowhound soil and 109 on the Kibesillah soil. Trees of limited extent include Pacific madrone and canyon live oak.

The main limitations affecting the harvesting of timber are the slope and the hazard of erosion. When timber is harvested, the slope limits the use of wheeled and tracked equipment in skidding operations. Cable yarding systems generally cause less disturbance of the soil. Revegetation of exposed subsoil is difficult on these soils; however, it generally is not needed for control of surface erosion because of the large amount of coarse fragments. Roads may fail and landslides may occur following deep soil disturbance in the steeper areas. Rock for construction of roads generally is available in areas of this unit. Rocks and loose soil material may slide onto roads. This hazard increases the need for road maintenance.

Seedling establishment and plant competition are concerns affecting the production of timber. The droughtiness of the upper 24 inches reduces the seedling survival rate, especially on south- and southwest-facing slopes. Movement of loose surface material can also reduce the seedling survival rate. Reforestation can be accomplished by planting Douglas-fir and redwood seedlings on the Yellowhound soil and planting Douglas-fir seedlings on the Kibesillah soil. If seed trees are present, natural reforestation of cutover areas by Douglas-fir occurs infrequently. Redwood can regenerate by sprouting after cutting. These sprouts seldom provide optimum stocking. When openings are made in the canopy, invading brushy plants that are not controlled can prevent the establishment of seedlings.

Among the common forest understory plants are buckbrush, blueblossom ceanothus, tanoak, and California huckleberry. Canyon live oak occurs primarily on south-facing slopes.

Woodin-Yellowhound complex (231, 232) 4,872 acres
The soil phase 231 occurs on slopes 50 to 50%, while phase 232 occurs on slopes 50 to 75 %. This map unit is on hills and mountains. The vegetation is mainly Douglas-fir and tanoak on the Woodin soil and Douglas-fir and redwood on the Yellowhound soil. Elevation ranges from 600 to 2,500 feet.

This unit is about 50 percent Woodin extremely gravelly sandy loam and 25 percent Yellowhound gravelly loam. The Woodin and Yellowhound soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used. Included with these soils in mapping are small areas of Maymen, Ornbaun, Zeni, Kibesillah, and Pardaloe soils and small areas of soils that have been altered by skid trails, landings, and roads.

The Woodin soil is moderately deep to bedrock and is well drained. It formed in material derived from sandstone. The surface layer is very dark brown extremely gravelly sandy loam about 6 inches thick. Permeability is moderate in the Woodin soil. Available water capacity is very low. The effective rooting depth is limited by bedrock at a depth of 20 to 40 inches. Surface runoff is rapid, and the hazard of water erosion is severe if the surface is left bare.

The Yellowhound soil is deep to bedrock and is well drained. It formed in material derived from sandstone. Typically, the surface is covered with a mat of leaves and twigs about 1 inch thick. Permeability is moderate in the Yellowhound soil. Available water capacity is low. The effective rooting depth is limited by bedrock at a depth of 40 to 60 inches. Surface runoff is rapid, and the hazard of water erosion is severe if the surface is left bare.

This unit is used for limited timber production or as watershed.

Douglas-fir, canyon live oak, redwood, and tanoak are the main tree species on this unit. Sugar pine is common on this unit in the southern part of the survey area. Trees of limited extent include Pacific madrone. On the basis of a 100-year site curve, the mean site index is 97 for Douglas-fir on the Woodin soil. On the basis of a 100-year site curve, the mean site index is 140 for Douglas-fir and 135 for redwood on the Yellowhound soil. The potential annual production from a fully stocked stand of Douglas-fir is 245 board feet per acre on the Woodin soil and 660 board feet per acre on the Yellowhound soil. This potential production is rarely achieved, however, because of the inherent tendency of the soils to produce understocked stands. Estimates of the potential annual production for sugar pine and redwood have not been made because these species are widely scattered.

The main limitations affecting the harvesting of timber are the slope and the low volume of commercial species. Because of these limitations, harvesting of trees is generally not feasible on this unit. Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding systems generally cause less disturbance of the soil in the steeper areas. Rock for construction of roads is generally available in areas of this unit. Revegetation of exposed subsoil is difficult on this unit; however, it generally is not needed for control of surface erosion because of the large amount of coarse fragments. Rocks and loose soil material may slide onto roads. This hazard increases the need for road maintenance.

Seedling establishment is a concern affecting the production of timber. Droughtiness in the upper 24 inches reduces the seedling survival rate, especially on south- and southwest-facing slopes. Plantings on the Woodin soil frequently fail because of the very low available water capacity. Reforestation can be accomplished by planting Douglas-fir, sugar pine, and redwood seedlings on the Yellowhound soil.

Among the common forest understory plants are canyon live oak on the Woodin soil and California huckleberry and bracken fern on the Yellowhound soil.

Ornbaun-Zeni Complex (130, 131) 3716 acres

The soil phase 130 occurs on slopes 9 to 30%, while phase 131 occurs on slopes 30 to 50%. The Ornbaun-Zeni is the third most common soil type found on the GRF. It underlies a wide range of slopes and aspects.

This complex is a combination soil type, with such intricately intermingled components that it is not practical to separately map them.

The Ornbaun soil is a fine-loamy, mixed, isomeric Ultic Haplustalf that forms 40 to 45% of this complex. Derived from sandstone, this is a forest soil capable of growing commercial quality Douglas-fir and redwood. It is a deep, well-drained loam, with an effective rooting depth of 40 to 60 inches. Surface runoff is medium to very rapid, permeability is moderate and the erosion hazard is moderate to severe under bare soil conditions. Available water-holding capacity is high.

The Zeni soil is a fine-loamy, mixed, isomesic Ultic Haplustalf that forms 40% of this complex. Like the Ornbaun soil, it is also derived from sandstone, but it is a shallower soil. It is moderately deep, with an effective rooting depth of 20 to 40 inches. The Zeni soil has a

low or moderate available water holding capacity. Runoff, permeability and erosion are similar to the Ornbaun soil.

Douglas-fir, Redwood, tanoak and Pacific madrone are the main tree species that occur on this soil complex. For a fully stocked Douglas-fir stand on the Ornbaun soil, the potential annual production is 770 board feet per acre; on the Zeni soil, it is 525 board feet. On the basis of a 100 year curve, mean site index for redwood is 152 on the Ornbaun soil and 130 feet on the Zeni soil (Site III). .

Steepness of slope, erosion hazard and seasonal soil wetness are the main soil limitations to timber harvest. These concerns can be ameliorated by restricting tractor use on steep slopes and limiting tractor use to existing and stable trails. Where topography permits, cable yarding can be employed to reduce soil disturbance. Use of equipment when the soil is wet produces ruts, compacts the soil, and can damage tree roots. Waterbars and/or mulch cover are essential to prevent rill and gully erosion on skid trails, roads and steep cut and fill slopes. Roads are dusty when dry. During operations, all truck roads will be treated as often as necessary to maintain a relatively dust-free surface to reduce dust build-up.

Plant competition is a concern in the production of timber on this soil. Regeneration of conifers can be delayed due to invasion of brush in canopy openings. Given the high canopy retention level post-harvest, significant brush invasion will be minimized. Additionally, inter-planting of Douglas-fir and redwood seedlings will help augment natural regeneration.

Dehaven-Hotel complex (135) 1780 acres
This map unit is on hills, primarily on slope 50 to75 %. The vegetation is mainly redwood and Douglas-fir. Elevation ranges from 10 to 800 feet.

This unit is about 45 percent Dehaven gravelly loam and 35 percent Hotel very gravelly loam. The Dehaven and Hotel soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Tramway and Irmulco soils and small areas of shallow soils. Also included are small areas of soils that have been altered by skid trails, landings, and roads and small areas that have slopes of 30 to 50 percent or 75 to 99 percent. Included areas make up about 20 percent of the total acreage of the unit. The percentage varies from one area to another.

The Dehaven soil is deep to bedrock and is well drained. It formed in material derived from sandstone. Typically, the surface is covered with a mat of leaves and twigs about 2 inches thick. Permeability is moderate in the Dehaven soil. Available water capacity is low. The effective rooting depth is limited by bedrock at a depth of 40 to 60 inches. Surface runoff is very rapid, and the hazard of water erosion is very severe if the surface is left bare.

The Hotel soil is moderately deep to bedrock and is well drained. It formed in material derived from sandstone. Typically, the surface is covered with a mat of leaves and twigs about 2 inches thick. Permeability is moderate in the Hotel soil. Available water capacity is

low. The effective rooting depth is limited by bedrock at a depth of 20 to 40 inches. Surface runoff is very rapid, and the hazard of water erosion is very severe if the surface is left bare.

This unit is used for timber production or as watershed.

Redwood and Douglas-fir are the main tree species on this unit. On the basis of a 100-year site curve, the mean site index for redwood is 153 on the Dehaven soil and 123 on the Hotel soil. The potential annual production from a fully stocked stand of redwood is 1,325 board feet per acre on the Dehaven soil and 880 board feet per acre on the Hotel soil. On the basis of a 100-year site curve, the mean site index for Douglas-fir is 183 on the Dehaven soil and 156 on the Hotel soil. Trees of limited extent include grand fir, tanoak, and canyon live oak.

The main limitations affecting the harvesting of timber are the slope and the hazard of erosion. When timber is harvested, the slope limits the use of wheeled and tracked equipment in skidding operations. Cable yarding systems generally cause less disturbance of the soil. Revegetation of exposed subsoil is difficult on this unit; however, it generally is not needed for control of surface erosion because of the large amount of coarse fragments. Roads may fail and landslides may occur following deep soil disturbance in the steeper areas. Rock for construction of roads generally is available in areas of this unit. Rocks and loose soil material may slide onto roads. This hazard increases the need for road maintenance.

Plant competition is a concern affecting the production of timber. When openings are made in the canopy, invading brushy plants that are not controlled can delay the establishment of seedlings. Reforestation can be accomplished by planting redwood and Douglas-fir seedlings. Natural reforestation by redwood sprouts and Douglas-fir seed trees provides variable stocking results. Both overstocked and understocked areas are common. Movement of loose surface material can reduce seedling survival rates in the steeper areas.

II. Secondary Timber Soils

Vandamme-Irmulco-Tramway complex (224) 723 acres
This map unit is on hills, primarily on slopes 50 to 75%. The vegetation is mainly redwood and Douglas-fir. Elevation ranges from 80 to 800 feet.

This unit is about 30 percent Vandamme loam, 30 percent Irmulco loam, and 15 percent Tramway loam. The three soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used. Included with these soils in mapping are small areas of Dehaven and Hotel soils and small areas of soils that have been altered by skid trails, landings, and roads. Also included are small areas that have slopes of less than 50 percent or more than 75 percent. Included areas make up about 25 percent of the total acreage of the unit. The percentage varies from one area to another.

The Vandamme soil is deep and well drained. It formed in material derived dominantly from sandstone. Typically, the surface is covered with a mat of leaves and twigs about 1 inch thick. Permeability is moderately slow in the Vandamme soil. Available water capacity is moderate or high. The effective rooting depth is 40 to 60 inches. Some roots penetrate to a

greater depth by following fractures in the bedrock. Surface runoff is very rapid, and the hazard of water erosion is severe if the surface is left bare.

The Irmulco soil is deep and well drained. It formed in material derived dominantly from sandstone. Typically, the surface is covered with a mat of leaves and twigs about 1 inch thick. Permeability is moderate in the Irmulco soil. Available water capacity is moderate or high. The effective rooting depth is 40 to 60 inches. Some roots penetrate to a greater depth by following fractures in the bedrock. Surface runoff is very rapid, and the hazard of water erosion is severe if the surface is left bare.

The Tramway soil is moderately deep and is well drained. It formed in material derived dominantly from sandstone. Typically, the surface is covered with a mat of leaves and twigs about 2 inches thick. Permeability is moderate in the Tramway soil. Available water capacity is low or moderate. The effective rooting depth is 20 to 40 inches. Some roots penetrate to a greater depth by following fractures in the bedrock. Surface runoff is very rapid, and the hazard of water erosion is severe if the surface is left bare.

This unit is used for timber production or as watershed.

Redwood and Douglas-fir are the main tree species on this unit. On the basis of a 100-year site curve, the mean site index for redwood is 165 on the Vandamme soil, 165 on the Irmulco soil, and 141 on the Tramway soil. The potential annual production from a fully stocked stand of redwood is 1,545 board feet per acre on the Vandamme and Irmulco soils and 1,460 board feet per acre on the Tramway soil. On the basis of a 100-year site curve, the mean site index for Douglas-fir is 179 on the Vandamme soil, 191 on the Irmulco soil, and 161 on the Tramway soil. Trees of limited extent include grand fir, western hemlock, tanoak, and Pacific madrone.

The main limitations affecting the harvesting of timber are the slope, the hazard of erosion, and seasonal wetness. When timber is harvested, the slope limits the use of wheeled and tracked equipment in skidding operations. Cable yarding systems generally cause less disturbance of the soil. Unless adequate plant cover or water bars are provided, steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying. Harvesting systems that lift logs entirely off the ground minimize the disturbance of the protective layer of duff. Roads are dusty when dry. Surface treatment may be desirable during periods of heavy use.

Establishing plant cover on steep cut and fill slopes reduces the hazard of surface erosion. Roads may fail and landslides may occur following deep soil disturbance. In areas where the subsoil is exposed along roads, gullies form readily where water flow is concentrated. Unsurfaced roads and skid trails are slippery when wet. They may be impassable during rainy periods. Suitable surfacing of roads is needed for use during wet seasons. Rock for construction of roads generally is not available in areas of this unit.

Plant competition is a concern affecting the production of timber. When openings are made in the canopy, invading brushy plants that are not controlled can delay the establishment of seedlings. Reforestation can be accomplished by planting redwood and Douglas-fir seedlings. Natural reforestation by redwood sprouts and Douglas-fir seed trees provides variable stocking results. Both overstocked and understocked areas are common.

Among the common forest understory plants are rhododendron, California huckleberry, swordfern, and trillium.

Pardaloe-Woodin complex (190,191) 356 acres
The soil phase 190 occurs on slopes 50 to 75%, while phase 191 occurs on slopes 30 to 50 %. This map unit is on hills and mountains. The vegetation is mainly Douglas-fir and tanoak.

This unit is about 45 percent Pardaloe very gravelly loam and 30 percent Woodin extremely gravelly sandy loam. The Pardaloe and Woodin soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used. Included with these soils in mapping are small areas of Maymen, Casabonne, and Wohly soils and small areas of soils that have been altered by skid trails, landings, and roads. Also included are small areas that have slopes of 30 to 50 percent or 75 to 99 percent. Included areas make up about 25 percent of the total acreage of the unit. The percentage varies from one area to another.

The Pardaloe soil is deep to bedrock and is well drained. It formed in material derived from sandstone. Typically, the surface layer is pink very gravelly loam about 11 inches thick. Permeability is moderate in the Pardaloe soil. Available water capacity is low. The effective rooting depth is limited by bedrock at a depth of 40 to 60 inches. Surface runoff is very rapid, and the hazard of water erosion is very severe if the surface is left bare.

The Woodin soil is moderately deep to bedrock and is well drained. It formed in material derived from sandstone. Permeability is moderate in the Woodin soil. Available water capacity is very low. The effective rooting depth is limited by bedrock at a depth of 20 to 40 inches. Surface runoff is very rapid, and the hazard of water erosion is very severe if the surface is left bare.

This unit is used for timber production or as watershed.

Tanoak, canyon live oak, and Douglas-fir are the main tree species on this unit. On the basis of a 100-year site curve, the mean site index for Douglas-fir is 122 on the Pardaloe soil and 97 on the Woodin soil. The potential annual production from a fully stocked stand of Douglas-fir is 455 board feet per acre on the Pardaloe soil and 245 board feet per acre on the Woodin soil. This potential production is rarely achieved, however, because of the inherent tendency of these soils to produce understocked stands.

The main limitations affecting the harvesting of timber are the slope and the hazard of erosion. When timber is harvested, the slope limits the use of wheeled and tracked equipment in skidding operations. Cable yarding systems generally cause less disturbance of the soil. Revegetation of exposed subsoil is difficult on this unit; however, it generally is not needed for control of surface erosion because of the large amount of coarse fragments. Roads may fail and landslides may occur following deep soil disturbance in the steeper areas. Rock for construction of roads is generally available in areas of this unit. Rocks and loose soil material may slide onto roads. This hazard increases the need for road maintenance.

Seedling establishment is a concern affecting the production of timber. Reforestation can be accomplished by planting Douglas-fir and ponderosa pine seedlings on the Pardaloe soil. The high soil temperature and low content of soil moisture during the growing season result in a high seedling mortality rate, especially on south- and southwest-facing slopes. Movement of loose surface material can reduce the seedling survival rate in the steeper areas. Plantings on the Woodin soil frequently fail because of the very low available water capacity.

Among the common forest understory plants are canyon live oak, hairy manzanita, and iris.

Irmulco-Tramway complex (172, 174) 329 acres
The soil phase 172 occurs on slopes 9 to 30%, while phase 174 occurs on slopes 50 to 75 %. This map unit is on hills. The vegetation is mainly redwood and Douglas-fir. Elevation ranges from 10 to 800 feet.

This unit is about 45 percent Irmulco loam and 35 percent Tramway loam. The Irmulco and Tramway soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.
Included with these soils in mapping are small areas of Vandamme, Dehaven, and Hotel soils and small areas of soils that have been altered by skid trails, landings, and roads.

The Irmulco soil is deep to weathered bedrock and is well drained. It formed in material derived from sandstone. Typically, the surface is covered with a mat of leaves and twigs about 1 inch thick. Permeability is moderate in the Irmulco soil. Available water capacity is high. The effective rooting depth is limited by weathered bedrock at a depth of 40 to 60 inches. Surface runoff is very rapid, and the hazard of water erosion is very severe if the surface is left bare.

The Tramway soil is moderately deep to weathered bedrock and is well drained. It formed in material derived from sandstone. Typically, the surface is covered with a mat of leaves and twigs about 2 inches thick. Permeability is moderate in the Tramway soil. Available water capacity is low. The effective rooting depth is limited by weathered bedrock at a depth of 20 to 40 inches. Surface runoff is very rapid, and the hazard of water erosion is very severe if the surface is left bare.

This unit is used for timber production or as watershed.

Redwood and Douglas-fir are the main tree species on this unit. On the basis of a 100-year site curve, the mean site index for redwood is 165 on the Irmulco soil and 141 on the Tramway soil. On the basis of a 100-year site curve, the mean site index for Douglas-fir is 191 on the Irmulco soil and 161 on the Tramway soil. The potential annual production from a fully stocked stand of redwood is 1,545 board feet per acre on the Irmulco soil and 1,130 board feet per acre on the Tramway soil. Trees of limited extent include tanoak, grand fir, Pacific madrone, western hemlock, and red alder.

The main limitations affecting the harvesting of timber are the slope, the hazard of erosion, and seasonal wetness. When timber is harvested, the slope limits the use of wheeled and tracked equipment in skidding operations. Cable yarding systems generally cause less

disturbance of the soil. Unless adequate plant cover or water bars are provided, steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying. Harvesting systems that lift logs entirely off the ground minimize the disturbance of the protective layer of duff. Establishing plant cover on steep cut and fill slopes reduces the hazard of surface erosion. Roads may fail and landslides may occur following deep soil disturbance in the steeper areas. Roads are dusty when dry. Surface treatment may be desirable during periods of heavy use. Unsurfaced roads and skid trails are slippery when wet. They may be impassable during rainy periods. Suitable surfacing of roads is needed for use during wet seasons. Rock for construction of roads generally is not available in areas of this unit.

Plant competition is a concern affecting the production of timber. When openings are made in the canopy, invading brushy plants that are not controlled can delay the establishment of seedlings. Reforestation can be accomplished by planting redwood and Douglas-fir seedlings. Natural reforestation by redwood sprouts and Douglas-fir seed trees provides variable stocking results. Both overstocked and understocked areas are common.

Among the common forest understory plants are swordfern, rhododendron, California huckleberry, and oxalis.

Casabonne-Wohly complex (120) 237 acres
This map unit is on hills and mountains, primarily on slopes 30-50%. The vegetation is mainly Douglas-fir and tanoak. Elevation ranges from 700 to 4,000 feet.

This unit is about 55 percent Casabonne gravelly loam and 30 percent Wohly loam. The Casabonne and Wohly soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used. Included with these soils in mapping are small areas of Pardaloe and Woodin soils and small areas of soils that have been altered by skid trails, landings, and roads.

The Casabonne soil is deep to bedrock and is well drained. It formed in material derived from sandstone. Typically, the surface is covered with a mat of leaves and twigs about 1/2 inch thick. Permeability is moderate in the Casabonne soil. Available water capacity is moderate or high. The effective rooting depth is limited by bedrock at a depth of 40 to 60 inches. Surface runoff is rapid, and the hazard of water erosion is severe if the surface is left bare.

The Wohly soil is moderately deep to weathered bedrock and is well drained. It formed in material derived from sandstone. Typically, the surface is covered with a mat of leaves and twigs about 1/2 inch thick. Permeability is moderate in the Wohly soil. Available water capacity is low. The effective rooting depth is limited by weathered bedrock at a depth of 20 to 40 inches. Surface runoff is rapid, and the hazard of water erosion is severe if the surface is left bare.

This unit is used for timber production or as watershed.

Douglas-fir, tanoak, and Pacific madrone are the main tree species on this unit. On the basis of a 100-year site curve, the mean site index for Douglas-fir is 144 on the Casabonne soil

and 118 on the Wohly soil. The potential annual production from a fully stocked stand of Douglas-fir is 665 board feet per acre on the Casabonne soil and 420 board feet per acre on the Wohly soil.

The main limitations affecting the harvesting of timber are the slope, the hazard of erosion, and seasonal wetness. Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding systems generally cause less disturbance of the soil in the steeper areas. Disturbance of the protective layer of duff can be minimized by the careful use of either wheeled or tracked equipment or cable yarding systems. Unless adequate plant cover or water bars are provided, steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying. Establishing plant cover on steep cut and fill slopes reduces the hazard of erosion.

Using wheeled and tracked equipment when the soils are wet produces ruts, compacts the surface, and can damage the roots of trees. Roads on this unit are dusty when dry. Surface treatment may be desirable during periods of heavy use. Unsurfaced roads and skid trails are slippery when wet and may be impassable during rainy periods. Suitable surfacing of roads is needed for use during wet seasons. Rock for construction of roads generally is not available in areas of this unit.

Plant competition is a concern affecting the production of timber. When openings are made in the canopy, invading brushy plants that are not controlled can prevent the establishment of seedlings. Reforestation can be accomplished by planting Douglas-fir and ponderosa pine seedlings. If seed trees are present, natural reforestation of cutover areas by Douglas-fir occurs infrequently. The high soil temperature and low content of soil moisture during the growing season cause a high seedling mortality rate, especially in areas of the Wohly soil on south- and southwest-facing slopes.

Among the common forest understory plants are bracken fern, blue wild rye, and perennial bromes and fescues.

Big River loamy sand (107) 37 acres
This very deep, well drained sandy loam soil is on flood plains, primarily on slopes less than 5 %. It formed in alluvium derived from sandstone. The vegetation is mainly redwood. Elevation ranges from 10 to 125 feet.

Included with this soil in mapping are small areas of Cottoneva soils and areas of Riverwash. These included areas make up about 20 percent of the total acreage of the unit. The percentage varies from one area to another.

Permeability is moderately rapid in the Big River soil. Available water capacity is moderate. The effective rooting depth is more than 60 inches. Surface runoff is slow, and the hazard of water erosion is slight if the surface is left bare. This soil is frequently flooded for brief periods from December through April.

This unit is used mainly for timber production or wildlife habitat. A few areas are used for recreation.

Redwood is the main tree species on this soil. On the basis of a 100-year site curve, the mean site index for redwood is 188. The potential annual production from a fully stocked stand of redwood is 2,050 board feet per acre. Trees of limited extent include red alder.

The main limitation affecting the harvesting of timber is the seasonal wetness. Ponding limits the use of equipment to dry periods. Unsurfaced roads and skid trails are soft when wet. They may be impassable during rainy periods. Suitable surfacing of roads is needed for use during wet seasons. Rock for construction of roads generally is not available in areas of this unit.

Plant competition is a concern affecting the production of timber. When openings are made in the canopy, invading brushy plants that are not controlled can delay the establishment of planted seedlings. Reforestation can be accomplished by planting redwood seedlings. After it is cut, redwood may regenerate by sprouting, thereby providing adequate stocking.

Among the common forest understory plants are oxalis, swordfern, western thimbleberry, starflower, and trillium.

APPENDIX D: WILDLIFE HABITAT RELATIONSHIP SPECIES SUMMARY REPORT

CALIFORNIA WILDLIFE HABITAT RELATIONSHIPS SYSTEM
Supported by:
CALIFORNIA INTERAGENCY WILDLIFE TASK GROUP
and maintained by the
CALIFORNIA DEPARTMENT OF FISH AND GAME
Database Version: 8.0

SPECIES STATUS CODES:

I=Introduced	3=CA Endangered	7=CA Species of Special Concern	11=BLM Sensitive
N=Native	4= CA Threatened	8=Fed Proposed Endangered	12=USFS Sensitive
1=Fed Endangered	5= CA Fully Protected	9=Fed Proposed Threatened Candidate	13=CDF Sensitive
2=Fed Threatened	6= CA Protected	10=Fed Candidate	14=Harvest

Note: Any given status code for a species may apply to the full species or to only one or more of its subspecies.

ID	SPECIES NAME	STATUS
A002	NORTHWESTERN SALAMANDER	
A004	CALIFORNIA GIANT SALAMANDER	
A048	PACIFIC GIANT SALAMANDER	
A005	SOUTHERN SEEP SALAMANDER	6, 7, 12
A006	ROUGH-SKINNED NEWT	
A007	CALIFORNIA NEWT	7
A008	RED-BELLIED NEWT	
A012	ENSATINA	7, 11, 12
A020	BLACK SALAMANDER	
A021	CLOUDED SALAMANDER	
A022	ARBOREAL SALAMANDER	
A014	CALIFORNIA SLENDER SALAMANDER	
A026	TAILED FROG	6, 7
A032	WESTERN TOAD	
A039	PACIFIC CHORUS FROG	
A040	RED-LEGGED FROG	2, 6, 7, 12
A043	FOOTHILL YELLOW-LEGGED FROG	6, 7, 12
A046	BULLFROG	14
R004	WESTERN POND TURTLE	6, 7, 11, 12
R022	WESTERN FENCE LIZARD	
R023	SAGEBRUSH LIZARD	11
R036	WESTERN SKINK	7 11
R039	WESTERN WHIPTAIL	
R040	SOUTHERN ALLIGATOR LIZARD	
R042	NORTHERN ALLIGATOR LIZARD	
R046	RUBBER BOA	4 6 12
R048	RINGNECK SNAKE	12
R049	SHARP-TAILED SNAKE	
R051	RACER	
R053	STRIPED RACER	2 4 6
R057	GOPHER SNAKE	

R058	COMMON KINGSNAKE	
R059	CALIFORNIA MOUNTAIN KINGSNAKE	6, 7 12
R060	LONG-NOSED SNAKE	
R061	COMMON GARTER SNAKE	1 3 5 6 7
R062	WESTERN TERRESTRIAL GARTER SNAKE	
R078	PACIFIC COAST AQUATIC GARTER SNAKE	
R076	WESTERN RATTLESNAKE	
B042	AMERICAN WHITE PELICAN	7
B043	BROWN PELICAN	1 3 5
B046	BRANDT'S CORMORANT	
B044	DOUBLE-CRESTED CORMORANT	7
B047	PELAGIC CORMORANT	
B051	GREAT BLUE HERON	13
B052	GREAT EGRET	13
B057	CATTLE EGRET	
B058	GREEN HERON	
B059	BLACK-CROWNED NIGHT HERON	11
B108	TURKEY VULTURE	
B070	GREATER WHITE-FRONTED GOOSE	14
B071	SNOW GOOSE	14
B075	CANADA GOOSE	14
B074	BRANT	14
B067	TUNDRA SWAN	
B076	WOOD DUCK	14
B085	GADWALL	14
B087	AMERICAN WIGEON	14
B079	MALLARD	14
B082	BLUE-WINGED TEAL	14
B084	NORTHERN SHOVELER	14
B080	NORTHERN PINTAIL	14
B077	GREEN-WINGED TEAL	14
B110	OSPREY	7 13
B111	WHITE-TAILED KITE	5
B113	BALD EAGLE	2 3 5 13
B114	NORTHERN HARRIER	7
B115	SHARP-SHINNED HAWK	7
B116	COOPER'S HAWK	7
B117	NORTHERN GOSHAWK	7 , 12, 13
B119	RED-SHOULDERED HAWK	
B123	RED-TAILED HAWK	
B124	FERRUGINOUS HAWK	7 11
B125	ROUGH-LEGGED HAWK	
B126	GOLDEN EAGLE	5 7 11 13
B127	AMERICAN KESTREL	
B128	MERLIN	7
B129	PEREGRINE FALCON	3 5 13
B131	PRAIRIE FALCON	7
B133	RING-NECKED PHEASANT	14
B136	RUFFED GROUSE	7 14
B134	BLUE GROUSE	14
B138	WILD TURKEY	14
B141	MOUNTAIN QUAIL	14

B140	CALIFORNIA QUAIL	14		
B149	AMERICAN COOT	14		
B151	BLACK-BELLIED PLOVER			
B629	PACIFIC GOLDEN-PLOVER			
B154	SNOWY PLOVER	2	7	
B156	SEMIPALMATED PLOVER			
B158	KILLDEER			
B162	BLACK OYSTERCATCHER			
B166	LESSER YELLOWLEGS			
B168	WILLET			
B170	SPOTTED SANDPIPER			
B172	WHIMBREL			
B173	LONG-BILLED CURLEW	7		
B176	MARBLED GODWIT			
B177	RUDDY TURNSTONE			
B178	BLACK TURNSTONE			
B179	SURFBIRD			
B183	WESTERN SANDPIPER			
B185	LEAST SANDPIPER			
B648	BAIRD'S SANDPIPER	7		
B649	PECTORAL SANDPIPER			
B191	DUNLIN			
B196	SHORT-BILLED DOWITCHER			
B197	LONG-BILLED DOWITCHER			
B213	MEW GULL			
B214	RING-BILLED GULL			
B215	CALIFORNIA GULL	7		
B216	HERRING GULL			
B217	THAYER'S GULL			
B220	WESTERN GULL			
B221	GLAUCOUS-WINGED GULL			
B227	CASPIAN TERN			
B229	ELEGANT TERN	7		
B231	COMMON TERN			
B233	FORSTER'S TERN			
B237	COMMON MURRE			
B239	PIGEON GUILLEMOT			
B240	MARBLED MURRELET	2, 3		13
B247	RHINOCEROS AUKLET	7		
B250	ROCK DOVE			
B251	BAND-TAILED PIGEON	14		
B255	MOURNING DOVE	14		
B260	GREATER ROADRUNNER			
B262	BARN OWL			
B263	FLAMMULATED OWL			
B264	WESTERN SCREECH OWL			
B265	GREAT HORNED OWL			
B267	NORTHERN PYGMY OWL			
B269	BURROWING OWL	7	11	
B270	SPOTTED OWL	2,7, 11, 12, 13		
B699	BARRED OWL			
B273	SHORT-EARED OWL	7		

B274	NORTHERN SAW-WHET OWL		
B276	COMMON NIGHTHAWK		
B277	COMMON POORWILL		
B702	CHIMNEY SWIFT		
B281	VAUX'S SWIFT	7	
B282	WHITE-THROATED SWIFT		
B287	ANNA'S HUMMINGBIRD		
B289	CALLIOPE HUMMINGBIRD		
B291	RUFOUS HUMMINGBIRD		
B292	ALLEN'S HUMMINGBIRD		
B293	BELTED KINGFISHER		
B294	LEWIS' WOODPECKER		
B296	ACORN WOODPECKER		
B299	RED-BREASTED SAPSUCKER		
B302	NUTTALL'S WOODPECKER		
B303	DOWNY WOODPECKER		
B304	HAIRY WOODPECKER		
B305	WHITE-HEADED WOODPECKER		
B307	NORTHERN FLICKER	3	
B308	PILEATED WOODPECKER		
B309	OLIVE-SIDED FLYCATCHER		
B311	WESTERN WOOD-PEWEE		
B317	HAMMOND'S FLYCATCHER		
B318	DUSKY FLYCATCHER		
B320	PACIFIC-SLOPE FLYCATCHER		
B321	BLACK PHOEBE		
B323	SAY'S PHOEBE		
B326	ASH-THROATED FLYCATCHER		
B333	WESTERN KINGBIRD		
B410	LOGGERHEAD SHRIKE	1	7
B554	PLUMBEOUS VIREO		
B415	CASSIN'S VIREO		
B417	HUTTON'S VIREO		
B418	WARBLING VIREO		
B345	GRAY JAY		
B346	STELLER'S JAY		
B348	WESTERN SCRUB-JAY	7	
B350	CLARK'S NUTCRACKER		
B353	AMERICAN CROW	14	
B354	COMMON RAVEN		
B337	HORNED LARK	7	
B338	PURPLE MARTIN	7	
B339	TREE SWALLOW		
B340	VIOLET-GREEN SWALLOW		
B341	NORTHERN ROUGH-WINGED SWALLOW		
B342	BANK SWALLOW	4	
B343	CLIFF SWALLOW		
B344	BARN SWALLOW		
B356	MOUNTAIN CHICKADEE		
B357	CHESTNUT-BACKED CHICKADEE		
B358	OAK TITMOUSE		
B360	BUSHTIT		

B361	RED-BREASTED NUTHATCH	
B362	WHITE-BREASTED NUTHATCH	
B363	PYGMY NUTHATCH	
B364	BROWN CREEPER	
B366	ROCK WREN	
B367	CANYON WREN	
B368	BEWICK'S WREN	
B369	HOUSE WREN	
B370	WINTER WREN	
B373	AMERICAN DIPPER	
B375	GOLDEN-CROWNED KINGLET	
B376	RUBY-CROWNED KINGLET	
B377	BLUE-GRAY GNATCATCHER	
B380	WESTERN BLUEBIRD	
B381	MOUNTAIN BLUEBIRD	
B382	TOWNSEND'S SOLITAIRE	
B385	SWAINSON'S THRUSH	
B386	HERMIT THRUSH	
B389	AMERICAN ROBIN	
B390	VARIED THRUSH	
B391	WRENTIT	
B393	NORTHERN MOCKINGBIRD	
B398	CALIFORNIA THRASHER	2
B411	EUROPEAN STARLING	
B404	AMERICAN PIPIT	
B407	CEDAR WAXWING	
B425	ORANGE-CROWNED WARBLER	
B426	NASHVILLE WARBLER	
B430	YELLOW WARBLER	7
B435	YELLOW-RUMPED WARBLER	
B436	BLACK-THROATED GRAY WARBLER	
B437	TOWNSEND'S WARBLER	
B438	HERMIT WARBLER	
B460	MACGILLIVRAY'S WARBLER	
B461	COMMON YELLOWTHROAT	7
B463	WILSON'S WARBLER	
B467	YELLOW-BREASTED CHAT	7
B471	WESTERN TANAGER	
B482	GREEN-TAILED TOWHEE	
B483	SPOTTED TOWHEE	7
B484	CALIFORNIA TOWHEE	2 3
B487	RUFOUS-CROWNED SPARROW	7
B489	CHIPPING SPARROW	
B495	LARK SPARROW	
B497	SAGE SPARROW	2 7
B499	SAVANNAH SPARROW	3 7
B501	GRASSHOPPER SPARROW	
B504	FOX SPARROW	
B505	SONG SPARROW	7
B506	LINCOLN'S SPARROW	
B798	WHITE-THROATED SPARROW	
B799	HARRIS'S SPARROW	

B510	WHITE-CROWNED SPARROW	
B509	GOLDEN-CROWNED SPARROW	
B512	DARK-EYED JUNCO	7
B475	BLACK-HEADED GROSBEAK	
B477	LAZULI BUNTING	
B809	INDIGO BUNTING	
B519	RED-WINGED BLACKBIRD	
B520	TRICOLORED BLACKBIRD	7 11
B521	WESTERN MEADOWLARK	
B524	BREWER'S BLACKBIRD	
B528	BROWN-HEADED COWBIRD	
B532	BULLOCK'S ORIOLE	
B536	PURPLE FINCH	
B537	CASSIN'S FINCH	
B538	HOUSE FINCH	
B539	RED CROSSBILL	
B542	PINE SISKIN	
B543	LESSER GOLDFINCH	
B544	LAWRENCE'S GOLDFINCH	
B545	AMERICAN GOLDFINCH	
B546	EVENING GROSBEAK	
M001	VIRGINIA OPOSSUM	14
M003	VAGRANT SHREW	7
M005	FOG SHREW	
M006	ORNATE SHREW	7, 8
M010	WATER SHREW	
M011	MARSH SHREW	
M012	TROWBRIDGE'S SHREW	
M015	SHREW-MOLE	
M017	COAST MOLE	
M018	BROAD-FOOTED MOLE	7
M021	LITTLE BROWN MYOTIS	
M023	YUMA MYOTIS	11
M025	LONG-EARED MYOTIS	11
M026	FRINGED MYOTIS	11
M027	LONG-LEGGED MYOTIS	11
M028	CALIFORNIA MYOTIS	
M030	SILVER-HAIRED BAT	
M031	WESTERN PIPISTRELLE	
M032	BIG BROWN BAT	
M033	WESTERN RED BAT	12
M034	HOARY BAT	
M037	TOWNSEND'S BIG-EARED BAT	7, 11, 12
M038	PALLID BAT	7, 11, 12
M039	BRAZILIAN FREE-TAILED BAT	
M045	BRUSH RABBIT	1 3 14
M049	SNOWSHOE HARE	7
M051	BLACK-TAILED JACKRABBIT	7 14
M052	MOUNTAIN BEAVER	1 7
M055	YELLOW-PINE CHIPMUNK	
M059	SONOMA CHIPMUNK	
M056	YELLOW-CHEEKED CHIPMUNK	

M057	ALLEN'S CHIPMUNK	
M072	CALIFORNIA GROUND SQUIRREL	
M075	GOLDEN-MANTLED GROUND SQUIRREL	
M077	WESTERN GRAY SQUIRREL	14
M078	EASTERN FOX SQUIRREL	14
M079	DOUGLAS' SQUIRREL	14
M080	NORTHERN FLYING SQUIRREL	7 12
M081	BOTTA'S POCKET GOPHER	
M105	CALIFORNIA KANGAROO RAT	7 11
M112	AMERICAN BEAVER	14
M113	WESTERN HARVEST MOUSE	
M117	DEER MOUSE	7
M119	BRUSH MOUSE	
M120	PINON MOUSE	
M127	DUSKY-FOOTED WOODRAT	1 7
M128	BUSHY-TAILED WOODRAT	
M140	BLACK RAT	
M141	NORWAY RAT	
M142	HOUSE MOUSE	
M129	WESTERN RED-BACKED VOLE	
M132	CALIFORNIA RED TREE VOLE	7
M134	CALIFORNIA VOLE	1 3 7
M136	LONG-TAILED VOLE	
M137	CREEPING VOLE	
M143	WESTERN JUMPING MOUSE	
M144	PACIFIC JUMPING MOUSE	7
M145	COMMON PORCUPINE	
M146	COYOTE	14
M147	RED FOX	4 12 14
M149	GRAY FOX	14
M151	BLACK BEAR	14
M169	NORTHERN SEA-LION	2 6
M170	CALIFORNIA SEA-LION	6
M171	HARBOR SEAL	6
M173	NORTHERN ELEPHANT SEAL	5 6
M152	RINGTAIL	5
M153	RACCOON	14
M154	AMERICAN MARTEN	7 12
M155	FISHER	7 12
M156	ERMINE	14
M157	LONG-TAILED WEASEL	14
M160	AMERICAN BADGER	14
M161	WESTERN SPOTTED SKUNK	7 14
M162	STRIPED SKUNK	14
M165	MOUNTAIN LION	7
M166	BOBCAT	14
M176	WILD PIG	14
M177	ELK	14
M178	FALLOW DEER	14
M181	MULE DEER	14

Total Number of Species: 341

APPENDIX E: CALIFORNIA NATIVE PLANT SOCIETY SEARCH RESULTS

California Native Plant Society's
Inventory of Rare and Endangered Plants of California

CNPS Plants by Scientific Name
Plants Known to Occur Within GRF Quadrangles

Scientific/Common Name	CNPS	R-E-D	State	Federal
ABRONIA UMBELLATA SSP. BREVIFLORA "pink sand-verbena"	1B	2-3-2	None	None
AGROSTIS BLASDALEI "Blasdale's bent grass"	1B	3-2-3	None	None
ASTRAGALUS AGNICIDUS "Humboldt milk-vetch"	1B	3-3-3	CE	None
CALYSTEGIA PURPURATA SSP. SAXICOLA "coastal bluff morning-glory"	1B	2-2-3	None	None
CAMPANULA CALIFORNICA "swamp harebell"	1B	2-2-3	None	None
CAREX CALIFORNICA "California sedge"	2	3-1-1	None	None
CAREX LYNGBYEI "Lyngbye's sedge"	2	2-2-1	None	None
CAREX SALINIFORMIS "deceiving sedge"	1B	2-2-3	None	None
CASTILLEJA MENDOCINENSIS "Mendocino coast Indian paintbrush"	1B	2-2-2	None	None
CUPRESSUS GOVENIANA SSP. PIGMAEA "pygmy cypress"	1B	2-2-3	None	None
ERIGERON SUPPLEX "supple daisy"	1B	3-2-3	None	None
FRITILLARIA RODERICKII "Roderick's fritillary"	1B	3-3-3	CE	None
GILIA CAPITATA SSP. PACIFICA "Pacific gilia"	1B	2-2-2	None	None

GLYCERIA GRANDIS "American manna grass"	2	3-1-1	None	None
HEMIZONIA CONGESTA SSP. LEUCOCEPHALA "Hayfield tarplant"	3	?-?-3	None	None
HESPEREVAX SPARSIFLORA VAR. BREVIFOLIA "short-leaved evax"	2	2-2-1	None	None
HORKELIA MARINENSIS "Point Reyes horkelia"	1B	3-2-3	None	None
HORKELIA TENUILOBA "thin-lobed horkelia"	1B	2-2-3	None	None
LASTHENIA CONJUGENS "Contra Costa goldfields"	1B	3-3-3	None	FE
LASTHENIA MACRANTHA SSP. BAKERI "Baker's goldfields"	1B	2-2-3	None	None
LASTHENIA MACRANTHA SSP. MACRANTHA "perennial goldfields"	1B	2-2-3	None	None
LILIUM MARITIMUM "coast lily"	1B	2-3-3	None	None
LYCOPODIUM CLAVATUM "running-pine"	2	2-1-1	None	None
SIDALCEA MALACHROIDES "maple-leaved checkerbloom"	1B	2-2-2	None	None
SIDALCEA MALVIFLORA SSP. PURPUREA "purple-stemmed checkerbloom"	1B	2-2-3	None	None

APPENDIX F: VEGETATION HABITAT TYPES

The source of the following Wildlife Habitat Relationship (WHR) types and descriptions is the California Wildlife Habitat Relationships System, Data Base Version 7.0., 1999, California Department of Fish and Game and Interagency Wildlife Task Group, Sacramento, California. *http://www.dfg.ca.gov/whdab/html/wildlife_habitats.html*

Habitat Patch Type	I. Representative Acreage on GRF Property
Annual Grassland (AGS)	357
Coastal Scrub (CSC)	121
Coastal Oak Woodland (COW)	9
Douglas Fir (DFR)	2,234
Mixed Chaparral (MCH)	103
Montane Hardwood-conifer (MHC)	1,417
Montane Hardwood (MHW)	4,054
Redwood Forest (RDW)	15,131
Non-forest	10
A. Sub-Totals:	23,435
Fee Portion in Point Arena Watershed:	344
Total Acreage:	**23,780**

HABITAT DESCRIPTIONS

ANNUAL GRASSLAND

Composition. Introduced annual grasses are the dominant plant species in this habitat. These include wild oats, soft chess, ripgut brome, red brome, wild barley, and foxtail fescue. Common forbs include broadleaf filaree, redstem filaree, turkey mullein, true clovers, bur clover, popcorn flower, and many others. California poppy, the State flower, is found in this habitat. Perennial grasses, found in moist, lightly grazed, or relic prairie areas, include purple needlegrass and Idaho fescue. Vernal pools, found in small depressions with a hardpan soil layer, support downingia, meadowfoam, and other species (Parker and Matyas 1981). Species composition is also related to precipitation (Bartolome et al. 1980). Perennial grasses are more common on northern sites with mean annual rainfall greater than 150 cm (60 in). Soft chess and broadleaf filaree are common in areas with 65-100 cm (25-40 in) of rainfall, and red brome and redstem filaree are common on southern sites with less than 25 cm (10 in) of precipitation (Bartolome et al. 1980).

COASTAL SCRUB

Composition-- No single species is typical of all Coastal Scrub stands. As with structure, composition changes most markedly with progressively more xeric conditions from north to south along the coast. With the change from mesic to xeric sites, dominance appears to shift from evergreen species in the north to drought-deciduous

species in the south. Variation in coastal influence at a given latitude produces less pronounced composition changes. Two types of northern Coastal Scrub are usually recognized. The first type (limited in range) occurs as low-growing patches of bush lupine and many-colored lupine at exposed, oceanside sites. The second and more common type of northern Coastal Scrub usually occurs at less exposed sites. Here coyotebush dominates the overstory. Other common overstory species are blue blossom ceanothus, coffeeberry, salal, bush monkeyflower, blackberry, poison-oak and wooly sunflower. Bracken fern and swordfern are dominant in the understory; common cowparsnip, Indian paintbrush, yerba buena and California oatgrass are typically present (Heady et al. 1977). Around Half Moon Bay, western hazelnut, Pacific bayberry, and sagebrush are also present (Mayfield and Shadle 1983).

COASTAL OAK WOODLAND

Composition. Composition of both overstory trees and understory of coastal oak woodland varies and reflects the environmental diversity over which this habitat occurs. In the North Coast Range south to Sonoma County, coast live oak often does not dominate. Where Oregon white oak,California black oak, canyon live oak, madrone and interior live oak dominate, the habitat is generally considered Montane Hardwood (MHW).

From Sonoma County south, the coastal oak woodlands are usually dominated by coast live oak.In many coastal regions, coast live oak is the only overstory species. In mesic sites, trees characteristic of mixed evergreen forests mix with coast live oak, such as California bay, madrone, tanbark oak, and canyon live oak. On drier, interior sites, coast live oak mixes with valley oak, blue oak, and foothill pine.

Typical understory plants in dense coast live oak woodlands are shade tolerant shrubs such as California blackberry, creeping snowberry, toyon, and herbaceous plants such as bracken fern, California polypody, fiesta flower, and miner's lettuce. In drier areas where oaks are more widely spaced, the understory may consist almost entirely of grassland species with few shrubs, a\though a diversity of shrubs can occur under and between the trees with a sparse herbaceous cover. Where coast live oak woodlands intergrade with chaparral, species such as greenleaf manzanita, chamise, gooseberries, currants, and ceanothus species form the understory. Where the habitat intergrades with coastal scrub, typical understory species are bush monkeyflower, coyote brush, black sage, and California sagebrush.

DOUGLAS-FIR

Composition-- Overstory composition varies with soil parent material, moisture, topography, and disturbance history. Dry steep slopes on metamorphic and granitic parent materials are dominated by canyon live oak. Less rocky, dry soils support Douglas-fir, tanoak, and Pacific madrone in association with sugar pine, ponderosa pine, black oak, and canyon live oak. Deep mesic soils support an overstory of Douglas-fir with a tanoak-dominated understory. Wettest sites include Pacific yew and, less consistently, Port-Orford cedar. On ultrabasic derived soils, Douglas-fir attains less dominance and is replaced by Port-Orford cedar on mesic sites to the extreme northwest (Stein 1980a) and open stands of Jeffrey pine, incense cedar, sugar pine, knobcone pine, and western white pine on more xeric sites (Whittaker 1960, Whittaker 1961, Rockey et

al. 1966, Mize 1973, Sawyer et al. 1977). In the southern and eastern extent if the type, ponderosa pine becomes a major codominant with Douglas-fir, and cover of black oak increases (Waring and Major 1964, Sawyer et al. 1977). In the absence of fire or other disturbance, western hemlock may occur as a codominant with Douglas-fir and tanoak at the western extent of the type in areas transitional to redwood forest (Sawyer et al. 1977). The shrub layer is typically composed of canyon live oak, Oregon-grape, California blackberry, dwarf rose, and poison-oak (Franklin and Dyrness 1973). Mesic sites support vine maple, California hazel, salal, and Pacific rhododendron (Sawyer et al. 1977). On sedimentary soils, the principal understory shrubs are California huckleberry, snowbrush ceanothus, salal, and Oregon-grape. Ultrabasic soils support a shrub layer of huckleberry oak, shrub tanoak, California-laurel, California buckthorn, and Brewer oak (Whittaker 1960). Forbs and grasses include Pacific trillium, western swordfern, insideout flower, broad-leaf starflower, deervetch vanillaleaf, American deervetch, princes pine, common whipplea, California honeysuckle, American trailplant, whitevein shinleaf, western rattlesnake plantain, Sierra fairy bells, bracken fern, western fescue, common beargrass, and hartford oniongrass (Franklin and Dyrness 1973, Sawyer et al. 1977). Mize (1973), Simpson (1980), and Laidlaw-Holmes (1981) discuss understory composition in relation to parent material and soil moisture.

MIXED CHAPARRAL

Composition-- Mixed Chaparral is a floristically rich type that supports approximately 240 species of woody plants (Oruduff 1974). Composition changes between northern and southern California and with precipitation regime, aspect, and soil type. Dominant species in cismontane Mixed Chaparral include scrub oak, chaparral oak, and several species of ceanothus and manzanita. Individual sites may support pure stands of these shrubs or diverse mixtures of several species. Commonly associated shrubs include chamise, birchleaf mountain mahogany, silk-tassel, toyon, yerba-santa, California buckeye, poison-oak, sumac, California buckthorn, hollyleaf cherry, Montana chaparral-pea, and California fremontia. Some of these species may be locally dominant. Leather oak and interior silktassel are widely distributed on cismontane serpentine soils, and chamise and toyon may be abundant on these soils. Shrubs such as Jepson, coyote, and dwarf ceanothus and serpentine manzanita are local serpentine endemics (Cheatham and Haller 1975, Thorne 1976, Hanes 1977). Incense-cedar, knobcone pine, Coulter pine, and Digger pine frequently are found in Mixed Chaparral on serpentine soils (Thorne 1976).

Shrub live oak, desert ceanothus, and desert bitterbrush are examples of shrubs found in Mixed Chaparral only on transmontane slopes (Cheatham and Haller 1975, Thorne 1976, Hanes 1977, and Zabriskie 1979). However, many species found in cismontane stands are also common on desert-facing slopes. Examples include bigberry manzanita, chamise, birchleaf mountain mahogany, California fremontia, and several species of ceanothus.

MONTANE HARDWOOD-CONIFER

Composition-- Common associates in MHC are ponderosa pine, Douglas-fir, incense-cedar, California black oak, tanoak, Pacific madrone, Oregon white oak, and other localized species. Species composition varies substantially among different

geographic areas.
In the north coast, California black oak, Oregon white oak, golden chinquapin, and canyon live oak are commonly found with white fir, Douglas-fir, and ponderosa pine (Parker and Matyas 1981). In the Klamath Mountains and north coast from the Oregon border to Marin County, Oregon white oak, tanoak, Pacific madrone, red alder, Douglasfir, western red cedar, western hemlock, ponderosa pine, sugar pine, and knobcone pine are common (Küchler 1977, McDonald 1980(Is it a or b Lit Cite), Parker and Matyas 1981). In the northern interior, California black oak, bigleaf maple, Pacific madrone, and tanoak are common with ponderosa pine, white fir, incense-cedar, Douglas-fir, and sugar pine forming the overstory. In the northern Sierra Nevada, common associates include California black oak, bigleaf maple, white alder, dogwood, Douglas-fir, incense-cedar and ponderosa pine. In the southern Sierra Nevada, common associates include California black oak, black cottonwood, canyon live oak, Jeffrey pine, Douglas-fir, ponderosa pine, sugar pine, incense-cedar, and localized areas of giant sequoia (Küchler 1977, Parker and Matyas 1981). In the central coast, common associates include coast live oak, big leaf maple, Pacific madrone, tanoak, canyon live oak, Coulter pine, coastal redwood and, to a lesser extent, California black oak and ponderosa pine. In the northern central coast, Douglas-fir is found; while in the southern areas, bigcone Douglas-fir occurs. In the Tehachapi, transverse and peninsular ranges of Southern California, common associates include canyon live oak, Pacific madrone, coast live oak and, to a lesser extent, California black oak, ponderosa pine, sugar pine, and incense-cedar (Thorne 1976, Küchler 1977, Parker and Matyas 1981).

MONTANE HARDWOOD
Composition-- In the Coast Range and Klamath Mountains, canyon live oak often forms pure stands on steep canyon slopes and rocky ridge tops. It is replaced at higher elevations by huckleberry oak (Parker and Matyas 1980)(No 1980 Lit Cite only 1979 and 1981.). At higher elevations, it is scattered in the overstory among ponderosa pine, Coulter pine, California white fir, and Jeffrey pine, the latter on serpentine and peridotite outcrops. Middle elevation associates are Douglas-fir, tanoak, Pacific madrone, California-laurel, California black oak, and bristlecone fir. Knobcone pine, Digger pine, Oregon white oak, and coast live oak are abundant at lower elevations. Understory vegetation is mostly scattered woody shrubs (manzanita, mountain-mahogany, poisonoak) and a few forbs.

REDWOOD
Composition-- The redwood habitat is a composite name for a variety or mix of conifer species that grow within the coastal influence zone <50 km (31 mi) from the coast. In the north coast region of California (within 4 km (2.5 mi) of the coast), the Redwood habitat (RDW) consists of Sitka spruce, grand fir, redwood, red alder, and Douglas-fir. Western redcedar and western hemlock are also associates but seldom comprise the major portion of a stand. Redwood becomes dominant along coastal areas approximately 4 to 16 km (2 to 10 mi) from the ocean where Douglas-fir, red alder, and grand fir are its major associates. Further inland, Douglas-fir becomes dominant with tan oak and madrone as the major associates (Becking 1968, Zinke 1977).
The southern extension of the RDW is similar in physiognomy but varies in species

composition. Redwood is dominant along the coast, with Douglas-fir as its common associate; tan oak and madrone are also major constituents of the habitat. Other contributing tree species are Bishop pine, Monterey pine, sugar pine, Jeffrey pine, Port-Orford cedar, California bay, Oregon ash, and big-leaf maple. These species are present in response to soil or microclimate conditions.

Understory composition is diverse and varies along a north-south/east-west gradient. Important species are sword fern, deer fern, chainfern, Andrew beadlily, barberry salal, coast rhododendron, California huckleberry, California red huckleberry, coast fireweed creambush oceanspray, salmonberry, poison-oak, western thimbleberry, cascara buckthorn, coyotebush, Scotchbroom, blueblossom ceanothus, snowbrush ceanothus, Idaho fescue, and western fescue.

APPENDIX G: RARE PLANT SURVEY

Editor's Note: To protect rare plants identified in this report, specific locations have been deleted.

A Survey of the Vascular Plants on the Garcia River Forest, Mendocino County, California- with Special Emphasis on the Rare and Endangered Species

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September 29, 2005

For:
The Nature Conservancy
California Regional Office, North Coast Project

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Introduction and Methodology

A survey of the vascular plants with special emphasis on the rare and endangered species was conducted on the Garcia River Forest. The purpose of the survey was to document the occurrence of rare species and their habitat and to provide a comprehensive list of the vascular plants species. Along with species occurrences other spatially explicit data was collected at numerous sites representing the diverse suite of vegetation types and plant communities on the property. Full descriptions of habitat and species associations along with recommendations to avoid impact are provided for the five rare species documented.

Pre-survey:

Prior to field surveys a list of rare plant species and plant communities with potential to occur on the 23,780-acres of the study area were developed from materials provided by The Nature Conservancy along with a 9-quad search of the California Natural Diversity Data Base (CNDDB)and the California Native Plant Society Electronic Inventory. None of these species had been confirmed to occur on the property.

Images of all potentially occurring rare species were obtained from various on-line sources including CalPhotos, USDA Flower-Finder and the Missouri University Herbarium. Additional investigations were made using the following references: The Jepson Manual: Higher Plants of California (Hickman), The Intermountain Flora (Cronquist et al. 1986), Flora of the Pacific Northwest (Hitchcock and Cronquist 1973), and the CNPS Iventory of Rare and Endangered Plants (2001).

Scott Kelly of North Coast Resource Management provided aerial photographs of the study area as well as a valuable road map. In conjunction with these The Garcia River Soil Map (12/17/04), soil series information (USDA, NRCS), The Garcia River Vegetation Map (9/28/04), Garcia River Forest Permanent Timber Plots map (3/29/05) and Garcia River

Forest Draft Reserve Components map (2/25/05) all provided by The Nature Conservancy provided resources for the development of a survey strategy.

The study area was visited initially April 5-7, 2005 to gain on site familiarity with access, road conditions, vegetation types, and plant communities to determine an effective survey strategy. Because of weather related delays this first trip was combined with the beginning of surveys.

Survey Strategy

Surveys were conducted on the following dates:

April 5,6 and 7, 2005
April 28 and 29, 2005
May 12 and 13, 2005
May 23 and 24, 2005
June 6 and 7, 2005
June 27 and 28, 2005
August 10 and 11, 2005

The surveys were floristic in nature and took into account all vascular plant species encountered. Areas with relatively good access and high potential to support CNPS List species 1B and 2 were prioritized. Because of the diverse suite of vegetation types and habitat indicated by the 2002 CALVEG map we concentrated our efforts particularly in the eastern portion of the property which included sites on and off of Inman Creek and Signal Creek roads. We employed various sampling strategies depending on the topography and extent of homogenous vegetation types.

April and May surveys concentrated on grasslands and associated meadows and seeps in addition to adjacent coniferous and hardwood forest because of the number of species with CNPS List 1B and List 2 status such as *Lasthenia burkei, Lasthenia conjugens, Layia septentrionalis, Limnanthes bakeri* and *Navarretia leucocephala ssp bakeri.* Many of the

large grasslands had no passable road access and required cross-country travel by foot. We were rewarded for these efforts by finding a singular serpentine outcrop on a remote patch of grassland off Signal Cr. Road along with other areas of ridgetop mesic grasslands. By traversing across different vegetation types we were able to collect valuable habitat information on plant community structure and composition as well as phenology to assist us in follow-up surveys for later blooming plants.

Early surveys also concentrated on forested areas where 7species of CNPS List 1B and List 2 status plants have the potential to occur *(Boschniakia hookeri, Castilleja mendocinensis, Erythronium revolutum, Lilium maritimus, Mitella caulescens, Pleuropogon hooverianus,* and *Sidalcea malachroides*). Because of the extensive expanse of forested land on the Garcia River Property we referred to the February 2005 Garcia River Forest Draft Reserve Components map prepared for the Nature Conservancy to determine sampling points which would reflect a range of forest composition and canopy.

We also referred to the map provided by Jennifer Carah of permanent timber plots in order to provide under-story composition information as was requested. Due to the similarity and limited number of species in several of the points sampled we found it more productive to seek sampling points that represented the diversity of vegetation types and plant communities found on the property. Many transects were along roads, especially Olson Gulch Road, where disturbance caused by road cuts often resulted in the greatest diversity of species in forested areas.

Surveys in June concentrated on the western portion of the Garcia River Property and included sites off of Olson Gulch and Graphite roads and a return trip creating an east-west transect via Signal Creek Road to the eastern edge of the property. Surveys focused on North Coast coniferous forest areas and meadows, seeps, marshes and riparian areas. While continuing to look for the aforementioned species in meadows and seeps, late season rare taxa became the focus of our surveys *(Campanula californica, Carex saliniformis, Carex californica, and Glygeria grandis*) where sampling included the most western portion of the property along the Garcia River. A search for broadleaved upland forest and North Coast

coniferous forest species (especially CNPS List 1B plant, *Astragalus agnicidus*) was conducted throughout the entire east-west transect.

The last survey in August included a return to east side grasslands and broadleaved upland forests as well as an extensive search of a remote portion of the Garcia River riparian corridor on the western side of the property. A search of grasslands for List 4 tarweeds, *Hemizonia congesta ssp. calyculata* and *H. congesta ssp tracyi*, was conducted on the way to a remote stock pond located during earlier surveys to inspect for the List 2 *Potamogeton epihydrus ssp. nuttallii*. Seeps along Inman Road were revisited to survey for the List 2: *Sanguisorba officinalis* , *Lycopodium clavatum* and aforementioned seep and marsh species. Forested areas were inspected for *Usnea longissima*. The Garcia River was surveyed along a 2 mile long transect from below bridge #6 downstream to the west. This diverse habitat of hot, dry, steep, south facing slopes and cool, steep, north facing slopes had the potential to support riparian and ledge dwelling species so our survey focused particularly on List 3: *Erigeron bioletti*; List 4: *Lilium rubescens*; List 2: *Mitella caulescens, Glyceria grandis* and *Potamogeton epiihydrus ssp. nuttallii,* and List1B: *Pleuropogon hooverianus*.

Data Collection and Organization

The majority of established GPS plots represented unique vegetation types or plant communities which merited full species lists and descriptions of site characteristics. Each point was chosen for its unique representation of soil, aspect, vegetation and cover as well as the potential for occurrence of rare plant species with consideration for critical blooming periods. In addition to these points a variety of other stops were made at sites where new species were added to the inventory.

Digital photos were taken at each plot center and labeled with the plot ID. Other pertinent information was collected at each site including soil moisture status, patterns of disturbance, community structure, presence of springs and other relevant data.

Thirty-five sites were geo-referenced using a Trimble GeoExplorer GPS unit and differentially corrected from an established base station. Data dictionary attributes of each

plot included plot ID, slope, aspect and altitude. All field data ie., species occurrences, selected attributes, habitat type, and plot number were entered in an Access database.

The Vegetation and Flora of the Garcia River Forest

Vegetation

The Garcia River Forest occurs primarily within the Outer North Coast subregion (NCoRO) of Northwestern California which is characterized by high rainfall and summer fog supporting redwood, mixed-evergreen, and mixed-hardwood forests. Several vegetation types are represented across the property and reflect a decreasing moisture gradient from west to east. The western section of the property is typical of the NCoRO subregion and is comprised largely of Douglas-fir (*Psuedotsuga menziesii*) and Redwood (*Sequoia sempervirens*), which either share or are the sole dominant in most stands and typically associated with both Tanoak (*Lithocarpus densiflora*) and Madrone (*Arbutus menziesii*). Barbour and Major (1988) and Sawyer and Keeler-Wolf (1995) describe these forest vegetation types and their associated species in detail.

At the far eastern end of the property patches of grassland, mixed-hardwood forest, and serpentine habitat, surrounded by redwood/Douglas-fir forest provide a mosaic of diverse vegetation types. The area is more typical of the Inner North Coast Ranges (NCoRI) subdivision which is characterized by lower rainfall, little or no summer fog and in general vegetation types adapted to dryer conditions.

The forks and tributaries of the Garcia River, North Fork Garcia River, Olsen Gulch Creek, Blue Waterhole Creek, Inman Creek, and Signal Creek, along with numerous seep meadows provide an abundance of riparian and wetland habitat.

The transition from a more summer fog influenced forest to the dyer interior forests and woodlands can first be detected traveling west to east along the Olsen Gulch Road at the edge of the summer fog belt where coastal understory species such as Forget-Me-Not (*Myosotis latifolia*), Velvet Grass (*Holcus lanatus*), Sweet Grass (*Hierochloe occidentalis*), and Wax Myrtle (Myrica californica) become less conspicuous. The understory loses its lush

character and species richness is markedly less. Western Hemlock (*Tsuga heterophylla*) appears to gain importance in the transition region while Red Alder (*Alnus rubra*) becomes increasing confined to canyon bottoms and eventually replaced by White Alder (*A. rhombifolia*).

Eight major vegetation/habitat types can be recognized across the Garcia River Forest. The most conspicuous are the redwood/Douglas-fir stands that dominate the western 2/3 of the property, transitioning into a mosaic of conifer/mixed hardwood/grassland landscape to the east. Wetland and serpentine habitat, outcrops and cliffs, and patches of shrubland represent a fraction of the area surveyed but contribute significantly to the overall plant diversity of the property, as well as providing habitat for two rare species.

Number of Taxa Associated with Vegetation Types

	Total	**Exotics**	**Rare Species**
Mixed Hardwood	232	58	0
Redwood/Douglas-fir	184	28	2
Grassland (mesic & xeric)	163	55	2
Riparian	121	25	0
Roadcuts, Cliffs, Outcrops	115	21	1
Wet Seep	93	23	1
Serpentine Habitat	65	12	0
Ceanothus Shrubland	49	11	0

Douglas-Fir/Redwood Forest

A closed coniferous forest comprised largely of Douglas-fir (*Psuedotsuga menziesii*) and Redwood (*Sequoia sempervirens*) covers much of the Garcia River Forest property. Common trees associated with this forest include Pacific Madrone (*Arbutus menziesii*),

Tanoak (*Lithocarpus densiflorus*), and Interior Live Oak (*Quercus chrysophylla*). Chinquapin (*Chrysolepis chrysophylla*) and Sugar Pine (*Pinus lambertiana*) become more important further to the east and on south and southwest facing slopes, whereas Western Hemlock (*Tsuga heterophylla*) is more prevalent at the western end of the property.

Forest management practices and various site characteristics have produced a variety of stands in many different stages of regrowth and as a result plant composition varies considerably from site to site. Forested slopes with some topographic and soil heterogeneity such as rocky knolls, terraces, or patches of thin fragmented shales support rich mixed coniferous forests with well-developed shrub and herbaceous canopies.

At the eastern end of the property conditions are generally dryer and *Quercus spp.* along with other hardwoods gain importance in the tree canopy (Plot MF-45). In addition to several conifer and hardwood species, Interior Live Oak (*Q. chrysolepis*) and California Nutmeg (*Torreya californica*) can be conspicuous at the mid tree canopy level. The herbaceous canopy of these diverse forests often contains a variety of native woodland grasses such as Elmer's Fescue (*Festuca elmeri*), Hardford's Melic (*Melica hardfordii*), Smooth Trisetum (*Trisetum canescens*), and Woodland Brome (*Bromus laevipes*) along with a rich compliment of native forbs.

Species poor sites (Plots MF-25, MF-51) appear to be associated with closed canopies and heavy accumulation of forest litter. In such sites Huckleberry (*Vaccinium ovatum*) may be the only conspicuous plant in the understory.

<u>Common Species Associated with the Douglas-fir / Redwood Forest</u>

Tree Canopy

Abies grandis	Grand Fir
Arbutus menziesii	Pacific Madrone
Chrysolepis chrysophylla	Chinquapin
Lithocarpus densiflorus	Tanoak
Pinus lambertiana	Sugar Pine
Pseudotsuga menziesii	Douglas-Fir
Quercus agrifolia	Coast Live Oak

Quercus chrysolepis	Canyon Live Oak
Quercus garryana	Oregon Oak
Quercus kelloggii	Black Oak
Quercus parvula var. shrevei	Shreve Oak
Sequoia sempervirens	Redwood
Tsuga heterophylla	Western Hemlock
Umbellularia californica	California Bay

Shrub Canopy

Baccharis pilularis	Coyote Brush
Ceanothus incanus	Coast Whitethorn
Corylus cornuta var. californica	Hazlenut
Lathyrus vestitus var. vestitus	Hillside Pea
Lonicera hispidula var. vacillans	Honeysuckle
Polystichum munitum	Western Sword Fern
Pteridium aquilinum var. pubescens	Bracken Fern
Rhododendron occidentale	Western azalea
Rosa gymnocarpa	Wood Rose
Rubus leucodermis	Western Rasberry
Toxicodendron diversilobum	Poison Oak
Vaccinium ovatum	California honeysuckle
Woodwardia fimbriata	Giant Chain Fern

Herbaceous Canopy

Carex globosa	
Elymus glaucus ssp. glaucus	Blue Wild Rye
Festuca occidentalis	Western Fescue
Galium californicum	California Bedstraw
Hieracium albiflorum	Hawkweed
Madia madioides	Woodland Tarweed
Melica geyeri	Geyer’s Oniongrass
Melica hardfordii	
Osmorhiza chilensis	Sweet Cicely
Pentagramma triangularis	Goldenback Fern
Polygala californica	California Milkwort
Sanicula crassicaulis	Gamble Weed
Viola ocellata	Western Heart’s Ease
Whipplea modesta	Yerba de Selva

Grasslands

The upper Inman Creek watershed consists of a mosaic of mixed coniferous forest, hardwood forest and woodland, and grassland. Areas of grassland vary in size and the largest complex is well over a100 ha and occurs across varied terrain encompassing a ridgetop, south-facing slopes, spur ridges and gullies. The larger grassland areas (GR1 and GR2,) represent both natural clearings and converted forest land that have been used for pasturing livestock in the past. Grassland plots GR1 and GR2 are more coastal in species composition than the smaller grassland areas further east and support high densities of Annual and Sweet Vernal Grass (*Anthoxanthum aristatum, A. ordoratum*). Small, isolated grasslands (GR3) surrounded by hardwood forest and woodland show fewer sign of disturbance and are rich in native grass and forb species.

Grassland species composition changes with disturbance history, aspect, topographic relief, and soil moisture status, yet there is considerable species overlap between mesic and xeric grasslands. Dryer, south-facing slopes are typically dominated by exotic annual grasses such as Wild Oat (*Avena barbata*), European Silver Hairgrass (*Aira caryophyllea*), Hedgehog Dogtail (*Cynosurus echinatus*), Nitgrass (*Gastridium ventricosum*), and Ripgut Grass (*Bromus diandrus*), but the native grasses, Blue Wild Rye (*Elymus glaucus*), California Brome (*Bromus carinatus var. carinatus*), and Purple Needle Grass (*Nassella pulchra*) are often common as well and patchy in occurrence.

Outcrops are generally hotspots for native species providing refuge in exotic dominated fields for species such as Idaho Fescue (*Festuca idahoensis*), One-sided Bluegrass (*Poa secunda ssp. secunda*), Annual Fescue (*Vulpia microstachys spp.),* Bird's Foot Fern (*Pellea mucronata var. mucronata*), and many other native forbs and grasses.

Native plant diversity is high on partially shaded, undisturbed west and east-facing slopes where communities consist almost entirely of native grass species such as *F. idahoensis*, California Oatgrass (*Danthonia californica*), *N. pulchra*, and Bent Grass (*Agrostis pallens*).

Mesic grasslands of northerly aspects are lush in comparison but not as species rich as east and west-facing slopes and are typically represented by Bracken Fern (*Pteridium aquilinum var. pubescens*), *A. pallens, F. idahoensis, N. pulchra,* and *D. californica*.
Dense stands of *D. californica* indicate seasonally wet grasslands and are often associated with seeps and springs. Plot name "Buckwest Meadow" in the upper Inman watershed is a typical *Danthonia* mesic grassland, where the rare Santa Cruz Clover (*Trifolium buckwestiorum*) was found along with more than 50 other native and exotic grass and forb species.

Wetlands

The major wetlands occurring on the Garcia River Forest are the riparian areas draining the upper Garcia River watershed. Other wetland types include seeps or meadows characterized by low but prolonged water discharge rates.

Riparian

The main branch of the Garcia River near the western end of the property is quite wide (10-15m) supporting dense Red Alder (*Alnus rubra*) and Sitka Willow (*Salix sitchensis*) with mature Redwood (*Sequoia sempervirens*) along the banks. The Torrent Sedge (*Carex nudata*) grows in large, conspicuous tussocks next to boulders in the main stream channel. In flatter areas along silty terraces and gravel bars several native and exotic species occur such as *Scirpus microcarpus, Cyperus eragrostis,* Mugwort (*Artemsia douglasiana),* Durango Root (*Datisca glomerata*), *Equisetum* spp., Velvet Grass (*Holcus lanatus),* Rabbit's Foot Grass *(Polypogon monspeliensis*), Cocklebur (*Xanthium strumarium*), and *Setaria viridis*. In shady recesses and alcoves along the rivers edge the vegetation is very lush and Streamside Orchid (*Epipactis gigantea*), Leopard Lily (*Lilium pardalinum*), Lady Fern (*Athyrium filix-femina*), and Five Finger Fern (*Adiantum aleuticum*) are common.

Further east and higher into the upper reaches of the main forks and tributaries of the watershed, stream channels narrow and become more rocky, gradients increase, and the character of the vegetation changes. White Alder (*Alnus rhombifolia*) along with Large-leaf

Maple (*Acer macrophyllum*) dominate the riparian zone replacing Red Alder. Elk Clover (*Aralia californica*), Giant Chain Fern (*Woodwardia fimbriata*), and Western Azalea (*Rhododendron occidentalis*) are common species filling in the voids among mossy covered rocks.

Wet Seeps

Depressions or channels cut along the inboard side of roads intercept and hold water moving down slope creating wetland habitat. Roadside seeps are generally linear features common throughout the Garcia Forest Property and support largly cosmopolitan wetland taxa such as *Carex* spp., *Juncus* spp., *Typha* spp., *Equisetum* spp., and *Salix* spp. Common species include *Carex bolanderi, C. deweyana var. leptopoda, Cyperus eragrostis, Juncus bolanderi, J. effuses var. pacificus, J. balticus,* Hedge Nettle (*Stachys ajugioides var. rigida*), Bolander's Water Starwort (*Callitriche heterophylla var. bolanderi*), and Loosestrife (*Lythrum hyssopifolium*).

Plot "Wetland-1" located above the Garcia River Hotsprings is a terrace/seep system with small depressions holding water. It is a large non-linear wetland with a well-developed herbaceous and shrub layer. *Carex aquatilis var. dives*, a plant of at least seasonal standing water, occurs here along with the rare Swamp Pea (*Lathyrus palustris*) which is treated in more detail in the rare plant section of this report.

Mixed Hardwood Forest and Woodland

The upper Inman Creek Watershed in the dryer, eastern portion of the property supports large stands of mixed hardwood forest and woodland surrounded by grassland and mixed coniferous forest. These forests contain a variety of hardwood species in addition to Douglas fir and have a well-developed grass understory. They include species from adjacent grassland and Redwood/Douglas-fir forest and are the most species rich vegetation type on the Garcia River Forest.

Plot "MH-1" is representative of this forest type and shows little sign of disturbance from logging or grazing. Hardwood trees include Oregon Oak (*Quercus garryana*), Shreve Oak (*Q. parvula var. shrevei*), Canyon Live Oak (*Q. chrysolepis*), Valley Oak (*Q. lobata*), Pacific Madrone (*Arbutus menziesii*), and Buckeye (*Aesculus californica*). The shady understory supports many native bunchgrasses such as California Fescue (*Festuca californica*), *Melica hardfordii, M. geyeri, Bromus laevipes,* and *Trisetum canescens*.

Serpentine Habitat

The only substantial area of serpentine is located in the Inman Creek watershed (see Plot "Inman Serpentine") and consists of a reddish ultramafic outcrop approximately 2ha in size composed largely of serpentinite, derived from Franciscan Formation ophiolites of Mesozoic age. The outcrop itself is very sparse in plant cover but supports a rich suite of species found nowhere else on the property. A band of serpentine influenced grassland lies adjacent to the outcrop which in turn is surrounded by a mixed coniferous forest of Douglas-Fir, Redwood, and Pacific Madrone.

Species restricted to the outcrop include *Minuartia douglasii, Claytonia exigua ssp. exigua, Eriogonum luteolum*, Turpentine Weed (*Trichostema laxum), Microseris douglasii, Vulpia microstachys var. ciliata,* Indian's Dream (*Aspidotis densa*), and Blue-eyed Mary (*Collinsia parviflora*). Additional species are restricted to the adjacent serpentine grassland and include *Hordeum brachyantherum ssp. californicum* and *Trifolium albopurpureum var. dichotomum*.

In addition to these the site is rich in other native bunch grasses including California Fescue (*Festuca California*), Western Fescue (F. occidentalis), and California Oat Grass (*Danthonia californica*). Many serpentine indicator taxa such as Cream Cups (*Platystemon californicum*), *Sidalcea diploscypha,* Gold Fields (*Lasthenia californica*), *Lotus wrangelianus,* and *Lomatium utriculatum* are also present.

Some roadcuts (Plot "Serpentine Outcrop") in the central portion of the property have serpentine rocks and support the CNPS List 3 plant, *Erigeron biolettii*.

Ceanothus Shrubland

True areas of chaparral do not exist on the Garcia River Forest as evidenced by the absence of chamise and other chaparral shrublands typically dominated by *Quercus* spp., *Manzanita* spp., and fire-adapted species of *Ceanothus*. However, there are areas (Plot SC-1) of Blue Blossum (*Ceanothus thyrsiflorus*) and Coast Whitethorn *(C. incanus*) shrubland on the property and their establishment is likely related to logging disturbance and thus transitional to Douglas-Fir / Redwood forest.

The largest area of shrubland occurs on a south-facing slope in the upper Signal Creek watershed and is characterized by dense thickets of Coast Whitethorn, Sticky Monkey Flower (*Mimulus aurantiacus*), and California Broom (*Lotus scoparius*). Grasses common in small clearings among the shrubs include *Melica hardfordii*, Western Fescue (*Festuca occidentalis*), and Purple Needlegrass (*Nassella pulchra*).

The Flora

The vascular flora of the Garcia River Forest is represented by at least 504 species in 277 genera and 78 families. Nomenclature adopted here and used throughout this report follows that of the Jepson Manual (Hickman 1993). Thirty-one families are monospecific containing only one taxon. About 20 percent of the flora is comprised of exotic species and over half of these are included in the Poaceae, Asteraceae, and Fabaceae. The exotic monocots are represented entirely by the grass family (35).

Floristic Summary of the Garcia River Forest

Taxonomic Group	Native	Exotic	Total
Fern and Fern Allies	21	0	21
Conifers	8	0	8
Dicots	281	71	352
Monocots	88	35	123
Total	404	106	504

The ten largest families and the number of exotic and native taxa in each

Family	Natives	Exotics	Total Taxa
Poaceae	35	35	70
Asteraceae	41	17	58
Fabaceae	29	11	40
Scrophulariaceae	20	3	23
Liliaceae	17	0	17
Rosaceae	10	6	16
Cyperaceae	16	0	16
Ericaceae	14	0	14
Lamiaceae	12	2	14
Apiaceae	8	3	11

Rare Plant Survey Results:

The rare plant survey conducted on the Garcia River forest between April and August 2005 focused on 35 special status plants with the potential to occur in this area. During the course of the survey the following plants were located:

List 1B: Santa Cruz Clover (*Trifolium buckwestiorum*) 3 locations

List 2: Marsh Pea (*Lathyrus palustris*) 1 location

List3: Streamside Daisy (*Erigeron biolettii*)	2 locations
List 4: Bristly Linanthus (*Leptosiphon acicularis*)	1 location
White-Flowered Rein Orchid (*Piperia candida*)	1 location
Cal. Code of Reg. 15380: Long-beard Lichen (*Usnea longissima*)	1 location

Two of these listed species, Santa Cruz Clover and Marsh Pea represent range extentions and were not included in the pre-survey data base search for potential special status plants. The Santa Cruz Clover population is a range extension of approximately 40 miles north of the most northerly reported population. The Marsh Pea occurrence represents a range extension of approximately 100 miles south of the most southerly reported population (CNPS 2001).

In the course of our survey one other occurrences was recorded which bears further investigation. This occurrence is that of a gooseberry (*Ribes sp.*) that can only be accurately identified by the color of flowers or mature fruits. We had neither. Further study will be required to determine if the gooseberry is Victor's Gooseberry (*Ribes victoris*: CNPS List 4) or Menzies Gooseberry (*Ribes menziesii*). GPS readings were made at the site.

Voucher specimens were collected from populations where it was determined that no negative impact would result.

1) Voucher specimens were collected for two populations of the Santa Cruz Clover and the third population was determined to be too small to advise collecting.
2) No voucher specimens were collected for the Marsh Pea because a single head of flowers was observed at the time of the survey.
3) No voucher specimen was collected for the White-flowered Rein Orchid because only 4 stems were observed making this an extremely restricted population.
4) One voucher specimen was collected for the Streamside Daisy and used for purposes of lab identification.
5) One voucher specimen was collected for Bristly Linanthus.

6) One voucher specimen was collected for the Long-beard Lichen for purposes of confirming identification.

A California Native Species Field Survey Form was filed and submitted to the California Natural Diversity Data Base, California Department of Fish and Game for all special status plant occurrences during the course of this survey.

Rare Plant Occurrences on the Garcia River Forest

Santa Cruz Clover, *Trifolium buckwestiorum* Isely

Santa Cruz Clover is an annual herb and a member of the Legume Family, *Fabaceae*. It is a California Native Plant Society (CNPS) List 1B plant: rare, threatened or endangered in California and elsewhere.

CNPS R-E-D code: 3-3-3:
Rarity 3: One to several highly restricted occurrences or present in such small numbers that it is seldom reported.
Endangerment 3: Seriously endangered in California
Distribution 3: Endemic to California
Santa Cruz clover has no state or federal listings.

Known Range: The known range of the Santa Cruz Clover has previously been restricted to Monterey, Santa Cruz and Sonoma counties. The Garcia River Forest occurrence is approximately 40 air miles north of the most northerly known occurrence in Sonoma County. This species is known from about 10 very small occurrences; only one fully protected, others are threatened by land clearing and non-native plants (CNPS 2001).

Siting #1: The Santa Cruz clover was located May 23, 2005

The gently sloping opening is approximately 30m x 20m with a moist seep making up about 15% of the area and was the location for *T. buckwestiorum.* The population covered an area about 10m x 5m with approximately 50 individuals. Approximately 85% of which were flowering.

Visible Disturbances or Possible Threats: The site is along a little used though passable spur road with no presently visible endangerment. However if logging and associated road widening were resumed, the placement of a log landing, staging area or turn-around in this area could eliminate this population.

Site Quality and Associate species: The quality of the site is good. The gradually sloping grassy opening is a dry spring meadow with moist depressions on the southern side nearest the road. Currently a mosaic of native and non-native grasses dominate the opening with a complement of both native and non-native forbs. The moist seep is combination of native and non-native wetland species dominated especially by *Trifolium* spp. The soil types in this area is # 245, a combination of Yorkville-Yorktree-Squawrock which support mainly annual grasses and forbs on the Yorkville and Squawrock soils and hardwoods on the Yorktree soil.

Native grasses include: California brome (*Broumus carinatus),* bentgrass (*Agrostis pallens),* California oatgrass (*Danthonia California),* and blue wildry (*Elymus glaucus ssp. glaucus).* Non-native grasses include: quakingrass (*Briza minor),* slender wildoat (*Avena barbata),* soft chess (*Bromus hordaceus),* ripgut brome (*Bromus diandrus),* hedgehog dogtail (*Cynasurus echinatus),* common velvet grass *(Holus lanatus),* silver European hairgrass (*Aira caryophylla),* and *Vulpia bromoides*.

Intermixed within the grasses are both native and non-native forbs. The natives include: valley tassels *(Castilleja attenuata),* ookow (*Dichelostemma congestum),* native carrot (*Daucus pusillus),* true baby-stars (*Linanthus bicolor),* miniature lotus (*Lotus micranthus),* threadstem madia (*Madia exigua),* western buttercup (*Ranunculus occidentalis),* and blue-eyed grass (*Sisyrichium bellum).* The non-natives include: long-beaked storksbill (*Erodium*

botrys), goose grass (*Galium aparine),* wall bedstraw (*Galium parisiense),* cut-leaf geranium (*Geranium dissectum*), doves-foot geranium *(Geranium molle),* smooth cat's-ears *(Hypochaeris glabra),* blue flax *(Linum bienne*), sheep sorrel (*Rumex acetosella*), and Hedge Parsley (*Torilis arvensis).*

The genus *Trifolium* is broadly represented on the site by 7 species. Dryer site species include *T. bifidum* and *T. willdenovii.* Plants of moist soils and lower lying depressions include *T. depauperatum, T. barbigerum, T. varigatum, T. microdon* and *T. buckwestiorum.*

Moist depressions include a variety of introduced and native species including *Pogogyne zizipharoides*, yampa (*Perideridia kelloggii), Lotus purshianus, Juncus patens, J. tenuis*, and coyote mint, (*Mentha pulegium).*

Surrounding the site is a mixed coniferous and hardwood forest. To the west Redwood/Douglas-fir and tanoak dominate while to the east, south and north a forest of Douglas fir (*Pseudotsuga menziesii*), madrone (*Arbutus menziesii)* and oak (*Quercus sp*.) as well as coyote brush (*Baccharis pilularis*) and manzanita (*Arctostaphylos spp.)* are evident.

Recommendation: A protection buffer of 100 feet surrounding the opening and a road block or gate to eliminate or ensure limitation of traffic on the spur road would provide protection from vehicular disturbance. Monitoring for potential increases in invasive species especially, coyote mint, common velvet grass and smooth cat's ears will reflect the possibility of endangerment by the encroachment of exotics.

Siting #2: The Santa Cruz Clover was located on a moist roadside on May 23, 2005 in a roadside seep on Inman Road within the mixed hardwood, redwood, Douglas fir forest. The area is a flat, partially shaded portion of the roadbed dipping towards an inboard ditch. The population was comprised of approximately 25 individuals scattered over a 5m x 10m area. Approximately 85% of plants were flowering.

Visible Disturbances and Possible Threats: The location of this population on a roadbed makes it vulnerable to any increase in traffic, road grading, road widening or maintenance of any kind.

Site Quality and Associated Species. The quality of the site is fair. Compacted soils on the road surface seem to be responsible for reduced leaf and flower size in some individuals. Larger individuals were found closer to the ditch. The soil type is #245, Yorkville-Yorktree-Squawrock Complex, the same type mentioned in siting #1.
Associated species include: Tomcat Clover (*Trifolium willdenovii)* and *T. bifidum.*

Recommendation: This population could sustain if it can be protected from road widening, road grading or any increase in road traffic, Further monitoring is recommended to ascertain whether this population continues to be viable and increases over a 5 year period or is too small to maintain viability.

Siting #3: Santa Cruz Clover was located June 6, 2005 in a moist roadside seep on Graphite Road.

Ten plants were observed, all flowering.

Site Quality and Associated Species: The quality of the site is fair. Soils on the road surface are compacted and the population is very small. The soil types in this area are #245 Yorkville-Yorkville-Squawrock**,** corresponding with those at site #1 and #2. The grassland includes a mosaic of native and non-native grasses and forbs such as Sweet Vernal Grass (*Anthoxanthum odoratum*), Winecup Clarkia (*Clarkia purpurea ssp. quadrivulnera),* Harvest Brodiaea (*Brodiaea elegans*), California Oat Grass (*Danthonia californica),* Hedgehog Dogtail (*Cynosurus echinatus),* and Soft Chess (*Bromus hordeaceus*).

Recommendation: This population is marginal and its viability over the long term may be in question. Any road work or maintenance will need to be curtailed in the small area of the population and care given not to change the hydrology of this small site. The viability of his population may also be in question particularly due to its apparent isolation from other populations.

Marsh Pea *(Lathyrus palustris)*

Marsh Pea, a member of the Legume Family (Fabaceae) is a California Native Plant Society (CNPS) list 2 plant: rare, threatened or endangered in California but more common elsewhere.

CNPS R-E-D code: 2-2-1
Rarity 2: A limited number of occurrences in California, occasionally more if each occurrence is small.
Endangerment 2: Fairly endangered in California
Distribution1: More or less widespread outside of California.
Marsh pea has no state of federal listings.

Known Range: The known range for the Marsh Pea has previously been restricted to areas near the coast in Del Norte and Humboldt counties. According to the CNPS on line inventory (6^{th} edition) the Garcia River occurrence is approximately 100 miles south of the most southerly known occurrence in the southwestern corner of Humboldt County. The range of this plant extends northward into Oregon, Washington, British Columbia and Alaska

Siting: The Marsh Pea was located April 24, 2005 in a forest bog in the North Coast coniferous forest on a relatively flat shelf on an otherwise steep north-facing mountainside above the Garcia River (UTM) The bog is approximately 30m x 30m and the Marsh Pea was found in approximately 30% of the bog. The population covered an area of about 5m x 15m. The Marsh Pea is a long trailing plant that clambers up through surrounding vegetation. In all, 14 stems were found. Plants were approximately 5% in flower and 95% in bud.

Visible Disturbances or Possible Threats: The site lies is an area which serves as pass through between a maintained road and the hot springs site. Though the property is secured with locked gates the historic popularity of the hot springs may still draw trespassers on foot or all-terrain vehicles. The area has been harvested for timber historically, but the wetland habitat remains vulnerable to traffic of any kind and most particularly to the resumption of logging activity.

Site Quality and Associated Species: The quality of the site is good. The wooded seasonal bog is in a Redwood/Douglas fir forest. Its partially open canopy creates areas of sunshine and shade over saturated and somewhat inundated soils. The dryer edges supports shrubs and trees and under story plants, while the wetter areas are dominated by rushes and sedges. The marsh pea was found twinning up through shrubs in saturated soil. The general soil type in the area is 235-Yellowhound-Kibesillah complex with characteristic moderate permeability and low available water capacity however the soil and conditions present at the site give rise to a bog-like habitat.

Plants In the wetter part of the bog include: *Juncus effusus, Juncus patens, Carex athrostachya*, *Carex aquatilis* var. *dives, Carex hardfordii*, Giant Horsetail (*Equisetum telmateia var. braunii)*, Musk Monkeyflower (*Mimulus moschatus)*, and Marsh Baccharis (*Baccharis douglasii).*

Plants of the dryer shadier edges include California Blackberry (*Rubus ursinus)*, Creeping Snowberry (*Symphoricarpos mollis)*, Wood Strawberry (*Fragaria vesca)*, Sword Fern (*Polystichum munitum)*, Goosegrass (*Galium aparine)*, Bittercress (*Cardamine oligosperma)*, Lady Fern (*Anthyrium filix-femina)* and Fetid Adders's Tongue (*Scoliopus bigelovii)*, along with woody perennials: western azalea (*Rhododendron occidentalis)*, Coyote Bush (Baccharis pilosa), California Myrtle (*Myrica californica)* and California Huckleberry (*Vaccinum ovatum)*. Trees include Redwood and Douglas-fir.

Recommendations: A protection buffer of 100 feet all around the bog would prevent any accidental traffic in the area and provide protection from vehicular disturbance. Future logging plans will need to include protection and avoidance of this area.

Streamside Daisy, *Erigeron biolettii* E. Greene

Streamside Daisy is a perennial and a member of the Sunflower Family (*Asteraceae*). It is a California Native Plant Society (CNPS) List 3 plant: more information about this plant is needed (Review List).

CNPS R-E-D code: ?-?-3
Rarity: unknown
Endangerment: unknown
Distribution: Endemic to California.

Known Range: The known range of Streamside Daisy is from Humboldt County south to Marin Co and eastward to include Solano and Napa counties. According to the CNPS on-line inventory (6th edition) the majority of the known occurrences are in Sonoma and Napa counties. Most collections of this plant are very old and location, rarity and endangerment information are needed.

Siting #1: A population of Streamside Daisy was located on June 28, 2005 on a steep, dry southeast facing road cut with serpentinite rocks on Hollow Tree Road . The road cut supports approximately 50 plants perched on ledges and disintegrating slopes in an area approximately 15 x 100 m. Plants were 50% in flower.

Visible Disturbances or Possible Threats: Talus deposits at the base of the road cut along the road reveal an unstable bank. Road widening or seismic activity could threaten this population. The #235 Yellowhound-Kibesillah Complex which makes up these soils is subject to severe erosion when the surface is left bare. The majority of this roadcut is bare.

Site Quality and Associated Species: The quality of the site is fair with robust individual plants on ledges in steep relatively bare terrain. Above the road cut is a broadleaf mixed coniferous forest which includes Redwood, Douglas-fir, Tanoak (*Lithocarpus densiflorus)*, Canyon Live Oak (*Quercus chrysolepis)*, *Ceonothus foliosus*, Madrone (*Arbutus menziesii)*, and Manzanita (*Arctostaphylos spp*.) The road cut consists of a few small trees and shrubs perched on rocky outcrops and these include Big-leaf Maple (*Acer macrophylla)*, Douglas-fir, Madrone, and Ocean Spray (*Holodiscus discolor)*. Herbs and ferns occupy small crevices in the varied terrain. These include a Stonecrop (*Sedum spathulifolium)*, Indian Pink (*Silene*

californica), Goldback Fern (*Pentagramma triangularis),* and Sword Fern (*Polystichum imbricans).*

Recommendations: Protection can best be rendered by minimizing disturbance to this road cut. In the forest above the road cut a protection buffer of 100 ft would reduce the possibility of further erosion.

Siting #2: Streamside Daisy was located on Aug 11, 2005 along the Garcia River

. This part of the river is a deeply cut canyon and the forest above is a redwood/Douglas-fir/tanoak forest. The steep canyon walls support the Streamside Daisy on sandstone outcrops and bedrock crevices. The population was intermittent along the one half mile stretch of river. Plants were approximately 80% in flower; 20% fruiting. Approximately 200 plants were observed.

Visible Disturbances or Possible Threats: There are no visible disturbances however road building upslope on these soils would likely cause landslides in the steeper areas.

Site Quality and Associate Species: The quality of the site is excellent. Streamside Daisy occurs on both sides of the river on the drier, more exposed south facing side and on the moister, shadier north facing side. Where these differing conditions give rise to different associations of species Streamside Daisy thrives in a range of conditions.
On the south side of the river Streamside Daisy occurs in sandstone on dry exposed banks and associated species include Red Keckiella (*Keckiella corymbosa),* Indian Pink (*Silene californica),* Ocean Spray (*Holodiscus discolor),* Zauschneria (*Epilobium canum ssp. latifolium*) and Toyon (*Heteromeles arbutifolia).*

On the north side of the river Streamside daisy grows on boulders lining the side of the river with Red Alder (*Alnus rubra*), Sitka Willow (*Salix sitchensis*), Alumroot (*Heuchera micrantha*) and *Boykinia occidentalis.* The soils along this part of the river are #135-Dehaven-Hotel Complex. The Dehaven soil is deep to bedrock and formed in a material derived from sandstone. The Hotel soil is also derived from sandstone.

Recommendation: Disturbance from road building and tree removal on this steep terrain could cause landslides which could severely impact populations of *E. biolettii*. A protection buffer of 100 feet back from the river is recommended.

Bristly Linanthus, *Leptosiphon acicularis* (Greene) Jeps.

(synonym: *Linanthus acicularis*)

Bristly Linanthus is an annual herb and a member of the Phlox Family (*Polemoniaceae*). It is a California Native Plant Society (CNPS) List 4 plant: limited distribution (Watch List).

CNPS R-E-D code: 1-2-3
Rarity 1: Rare but found in sufficient numbers and distributed widely enough that the potential for extinction is low at this time.
Endangerment 2: Fairly endangered in California
Distribution #: Endemic to California
Bristly Linanthus has no state or federal listing.

Known range: According to the CNPS on-line inventory (6th edition) the known range for Bristly Linanthus in the North Coast counties extends from Humboldt County in the north to San Mateo County in the south and inland to Lake, Napa, Alameda and Contra Costa counties. East of the Coast Range populations have been located in both Butte and Fresno counties. The habitat for this plant is chaparral, cismontane woodland, coastal prairie and valley and foothill grassland.

Siting: Bristly Linanthus was located June 7, 2005 east of Blue Waterhole Creek, This part of the creek represents the northeast property boundary of the Garcia River Forest. The population is located . No UTM was recorded. In the 10m x 10m area inspected approximately 25 individuals were

observed. The grassland was approximately 5ha and likely supported a larger population. Approximately 25 % of plants observed were in bud and 75% flowering.

Visible Disturbances or Possible Threats: No visible disturbances.

Site Quality and Associated Species: The quality of the site is good and contains grassland and oak woodlands on a steep west facing slope. Species associated with the oak woodland are: Oregon Oak (*Quercus garryana var. garryana*), Shreve Oak *(Quercus parvula var. shrevei*), California Bay (*Umbellularia californica*) and Douglas-fir. Under the canopy species include: Pacific Pea (*Lathryrus vestitus*), Woodland Madia (*Madia madioides*), Soaproot (*Chlorogalum pomeridianum*) Iris (*Iris sp*.), Milkwort (*Polygala californica*), *Melica geyeri, Festuca subulata, Aster radulinus* and Pennyroyal *(Mentha pulegium*). The opening was dominated by non-native grasses which include: Hedgehog Dogtail (*Cynosurus echinatus*) and Orchard Grass (*Dactylus glomerata*).

Recommendations: Additional surveys are needed in similar grassland habitat in this vicinity to determine if *L. acicularis* occurs on the Garcia River Forest.

White-flowered Rein Orchid, *Piperia candida* R. Morgan & J. Ackerman

White-flowered Rein Orchid is a member of the Orchid Family (*Orchidaceae*) and a California Native Plant Society (CNPS) List 4 plant: limited distribution (watch-list).

CNPS R-E-D code: 1-1-1:
Rarity 1: Rare but found in sufficient numbers and distributed widely enough that the potential for extinction is low at this time.
Endangerment 1: Not very endangered in California
Distribution 1: more or less widespread outside California.

White flowered rein orchid has no state or federal listing.

Known Range: The known range of the White-flowered Rein Orchid in California is on the west coast known to occur south of the San Francisco Bay Area in Santa Cruz and San Mateo counties. Its northern range begins in Sonoma County and extends northward up through northwestern California occurring in Mendocino, Humboldt, Trinity, Del Norte and Siskiyou counties. The range continues into Oregon and Washington.

Siting: A small population of White-flowered Rein Orchid was located on June 7, 2005 on a North facing slope in a disturbed roadside area on Olsen Gulch Road (UTM). After a thorough search only 4 stems were found, all flowering.

Visible Disturbances or Possible Threats: The area of occurrence had been previously disturbed by road construction and logging. Directly above the population was a stand of dead Tanoak which appeared to have been treated with herbicide. Active forest management practices seem to be occurring in this area and the human activity makes this small population extremely vulnerable to extirpation. White-flowered Rein Orchid seems to adapt to some disturbance but how much is unknown.

Site Quality and Associate Species: The quality of the site is poor. White-flowered rein orchid was found growing at the foot of a dry cut bank above the roadway on a north facing slope. Plants growing on the road cut include: Pacific Starflower (*Trientalis latifolia),* Redwood Sorrel (*Oxalis oregana)* and a Western Hemlock (*Tsuga heterophylla)* sapling. The area above the road cut was dominated by Redwood and Douglas-fir.

Recommendation: This small area could be physically protected from roadside disturbance by a few large rocks lining the roadside where the population has been found. Future logging plans will need to include protection and avoidance of this area. Monitoring for potential increases in population would be recommended.

Long-beard Lichen *Usnea longissima* Ach.

Long-bearded lichen is in a category of non-listed plants that qualify for consideration under 14 Cal. Code Reg. 15380.

Known Range: Alaska to California, W. Cascades

Siting: The Long-beard lichen was located on August 10, 2005 on Inman Road in a Redwood, Douglas Fir forest. It was growing in a single Douglas Fir tree on a northwest slope on the lower side of a road cut (UTM

). No other occurrences were visible in the area.

Visible disturbances and possible threats: Due to the extreme isolation of this occurrence any disturbance to the host tree and the area surrounding it would threaten this population. According to Macrolichens of the Pacific Northwest, McCune and Geiser, 2000, "*U. longissima* is threatened or extirpated throughout most of its world range…Its highly local distributions suggest dispersal limitations that will impede its recovery from disturbances to its habitat."

Site Quality and Associate Species: The quality of the site is poor with only a single Douglas-fir serving as host species. This tree was sparsely garlanded with the long pendulous lichen though Douglas-fir trees were within 10m of the host tree. The northwest facing slope above the deep Inman Creek drainage is exposed to cool, moist, onshore, up canyon air flows. The components of the forest include: Douglas-fir Redwood, Tanoak, Madrone, and California Huckleberry (*Vaccinium ovatum*).

Recommendation: "U. longissima is one of the most pollution-sensitive lichens. Its presence can be used as an indication of pure air, just as its disappearance indicates deteriorating air quality" (Lichens of North America, Brodo, Sharnoff and Sharnoff, 2000). Protection from air pollution will largely be accomplished by the large contiguous preserve of which it is a part however localized aggravations from heavy equipment use may be detrimental to the

health of this population. At least a 100 m protection buffer is recommended to prevent disturbance to the forest composition, airflow or canopy composition all of which may be factors in the marginal success of this vestigial population.

Exotic Species on the Garcia River Forest

The exotic flora of the Garcia River Forest consists of 110 species and is represented largely by the Poaceae, Asteraceae, and Fabaceae. Many of the more conspicuous exotics are associated with the roads that traverse the property and represent severely disturbed habitat. Two species, Jubatagrass (*Cortaderia jubata*) and French Broom (*Genista monspessulana*) are on the California Invasive Plant Council (Cal-IPC) List A-1 (Most Invasive Wildland Pest Plants: Widespread) and were observed along the roadways. These species, once established, have the potential to displace native species.

Jubatagrass occurs in dense patches along the upper portion of the Olson Gulch Rd near Gate 23 where it is associated with disturbed areas such as landings and clearings along the road. Other occurrences were observed along Signal Creek Road. A large patch of French Broom occurs along the Hollow Tree road between the intersections of Graphite Road and the Eureka Hill Road. This population is also associated with a portion of road that has been widened. Because of their invasive potential and close proximity to the road efforts should be made to control the spread of these plants

Besides the two invasive species mentioned above other conspicuous exotic plants include a whole suit of annual grasses which have become naturalized and are stable components of grassland communities.

The western portion of the property has sizable infestations of Forget-me-Not (*Myosotis latifolia*) along the Olson Gulch road where it crosses the main fork of the Garcia River. This species along with foxglove (*Digitalis purpurea*) are the most conspicuous exotics species associated with redwood forest.

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Potential Special Status Plant Species of the Garcia River Forest

Based on a search of the California Native Plant Society's (CNPS) Inventory of Rare and Endangered Plants of California (6th edition)

Scientific Name **Common Name**	**Status: Federal/State /CNPS**	**Flowering period**	**Habitat and notes**
Astragalus agnicidus Humboldt Milk Vetch	-/-/1B	June-Sept	Disturbed areas of Broadleaved upland forest, NC coniferous forest . Not seen during surveys
Astragulus breweri Brewer's Milk Vetch	-/-/4	April-June	Chaparral, cismontane woodland, meadows and seeps. Not seen during surveys
Astragalus rattanii var rattanii Rattan's Milk Vetch	-/-/4	April-July	Gravelly stream banks and sand bars of chaparral, cismontane woodland, coniferous forest. Not seen during surveys.
Boschniakia hookeri Small Groundcone	-/-/2	April-August	Open areas and shrubby places of NC coniferous forest. Not seen during surveys
Campanula californica Swamp Harebell	-/-/1B	June-October	Meadows and seeps, freshwater marshes of NC coniferous forest. Not seen during surveys.
Carex californica California Sedge	-/-/2	May-August	Meadows, seeps, margins of marshes and swamps. Present to west of northern portion of property. Not seen during surveys
Carex saliniformis Deceiving Sedge	-/-/1B	June	Coastal scrub, meadows and seeps. Present to west of northern portion of property. Not seen during surveys
Castilleja mendocinensis Mendocino Coast Indian Paintbrush	-/-/1B	April-August	Coastal scrub. Probably too far from coast. Not seen during surveys.
Cypripedium montanum Mountain Lady's Slipper	-/-/4	March-August	Moist areas and dry slopes of broadleaved and NC coniferous forests. Not seen during surveys.
Erigeron biolettii **Streamside Daisy**	-/-/3	June-August	Dry slopes, rocks, ledges above rivers in NC coniferous forests**. Two populations found during surveys**

Scientific Name **Common Name**	**Status: Federal/State /CNPS**	**Flowering period**	**Habitat and notes**
Erythronium revolutum Coast Fawn Lily	-/-/2	March-June	Streambanks and wet places of broadleaved upland and NC coniferous forests. Not found during surveys.
Fritillaria biflora var biflora Roderick's Fritillary	Considered but rejected	March-May	Valley or foothill grassland. Not found during surveys.
Glyceria grandis American Manna Grass	-/-/2	June-August	Meadows and seeps, marshes and swamps, streambanks Has been seen west of North Fork portion of the property . Not seen during surveys.
Hemizonia congesta ssp. calyculata Mendocino Tarplant	-/-/4	July-November	Cismontane woodland, valley and foothill grassland. Not seen during surveys.
Hemizonia congesta ssp. tracyi Tracy's Tarplant	?/?/4	May-October	Openings in lower montane and NC coniferous forests, grasslands. Not seen during surveys.
Horkelia tenuiloba Thin-lobed Horkelia	-/-/1B	May-July	Sandy soils of broadleaved upland forest, chaparral. Has been sighted at eh junction of Iverson and Fish Rock Rds. (Smith and Wheeler 1992) Not seen during surveys
Lathenia burkei Burke's Goldfields	FE/SE/1B	April-June	Meadows and seeps, vernal pools. Not seen during surveys.
Lasthenia conjugens Contra Costa Goldfields	FE/-/1B	March-June	Cismontane woodland, valley and foothill grassland, vernal pools. Believed to be extirpated from Mendocino Co., historically found in the Pt Arena quad (CNDDB 2004) Not seen during surveys.
Lathyrus palustris **Marsh Pea**	-/-/2	March-August	Moist meadows, streambanks and lakeshores in lowland zone; infrequent, scattered in coastal Alaska, BC to N. California. Previously known only as far south as Humboldt Co. **One population found during survey.**

Scientific Name **Common Name**	**Status: Federal/State /CNPS**	**Flowering Period**	**Habitat and notes**
Layia septentrionalis Colusa Layia	-/-/1B	April-May	Sandy and serpentine area of chaparral, cismontane woodland, valley and foothill grassland. Not seen during surveys.
Lilium maritimum Coast Lily	-/-/1B	May-July	Broadleaved upland forest, coastal scrub, freshwater marshes and swamps. NC coniferous forests. Not seen during surveys.
Lilium rubescens Redwood Lily	-/-/4	June-August	Gaps in broadleaved upland forests and lower montane coniferous forests, dry soils in chaparral. Not seen during surveys.
Limnanthes bakeri Baker's Meadowfoam	-/SR/1B	April-May	Meadows, seeps, marshes, valley and foothill grassland, vernal pools . Not seen during surveys
Linanthus latisectus Broad-leaved Linanthus	-/-/4	April-June	Broadleaved upland forest, cismontane woodland. Not seen during surveys.
Leptosiphon acicularis *(Synonym: Linanthus acicularis)* **Bristly Linanthus**	-/-/4	April-July	Chaparral, cismontane woodland, valley and foothill grassland. **One population seen during survey just outside property boundary**.
Lycopodium clavatum Running Pine	-/- /2	July-August	Marshes and swamps, moist ground in NC coniferous forest. Not found during surveys.
Mitella caulescens Leafy-stemmed Miterwort	-/-/2	May-July	Wet shaded areas in broadleaved upland forest, 2000-5600 ft. Unlikely to occur due to elevation. Not seen during surveys.
Navarretia leucocephala ssp bakeri Baker's Navarretia	-/-/1B	May-July	Wet areas lower montane coniferous forest, valley and foothill grassland.; meadows, seeps and vernal pools. Not seen during surveys.
Piperia candida **White-flowered Rein Orchid**	-/-/4	May-September	Open to shaded sites in broadleaved upland forest, lower montane coniferous forest. **One population found during surveys**.

Scientific Name **Common Name**	**Status: Federal/State /CNPS**	**Flowering Period**	**Habitat and notes**
Pityopus californicus California Pinefoot	-/-/4	May-August	Broadleaved upland forest, lower montane and NC coniferous forests. Not seen during surveys. This plant does not produce a flowering stalk every year.
Pleuropogon hooverianus North Coast Semaphore grass	-/SR/1B	May-August	Broadleaved upland forest, meadows and seeps, freshwater marshes and swamps, NC coniferous forests vernal pools and redwood groves. Not seen during surveys.
Potamogeton epihydrus ssp. nuttallii Nuttall's Pondweed	-/-2	July-August	Shallow freshwater marshes, ponds and streams. Not seen during surveys.
Sanguisorba officinalis Great Burnet	-/-/2	July-October	Broadleaved upland forest, meadows and seeps, marshes and swamps, NC coniferous forest, riparian scrub, often serpentinite. Not seen during surveys.
Sidalcea malachroides Maple-leaved Checkerbloom	-/-1B	April-August	Broadleaved upland forest, coastal scrub, NC coniferous forest. Not found during surveys
Trifolium buckwestiorum **Santa Cruz Clover**	-/-/1B	April-October	Wet areas of cismontane woodland, lower montane coniferous forest, valley and foothill grassland; meadows and seeps**.** Previously known only as far north as Sonoma county. **Three populations found during surveys.**
Usnea longissima **Long-beard Lichen**	SM/-/-	Year round	On various trees and shrubs in open, well ventilated forest**. One population found during surveys.**

Status: FE: Federally listed as endangered.
SE: State listed as endangered.
SR: State listed as rare.
SM: US Fish and Wildlife Service-survey and management species qualifying for consideration under 14. Cal.Code Reg. 15380.
L1B: CNPS list of plants rare, threatened, or endangered in California and elsewhere.

L1A: CNPS list of plants presumed extinct in California.
L2: CNPS list of plants rare, threatened or endangered in California, but more common elsewhere.
L3: CNPS list of plants about which more information is needed.
L4: CNPS list of plants of limited distribution- a watch list.

Vascular Plants of the Garcia River Forest, Mendocino County, California.				
Plant surveys conducted by Kerry Heise and Geri Hulse-Stephens, April - August, 2005				
Nomenclature follows the Jepson Manual, Higher Plants of California, Hickman, 1993.				
Exotic species followed by an asterix have the potential to become invasive.				
Rare plants in bold: List 1B = Plants rare, threatened, or endangered in Calif. and elsewhere; List 2 = Rare,				
threatened, or endangered in Calif., but more common elsewere; List 3 = A review list, plants needing more				
information; List 4 = A watch list, plants of limited distribution.				
Abundance: 1 = rare, single or few occurrences with few individuals; 2 = infrequent; 3 = common;				
4 = widespread and abundant, often forming dense stands.				
Total Taxa = 504				
Family	Scientific Name	Common Name	Exotic	Abundance
LYCOPHYTA - Spike Mosses and Club Mosses				
Selaginellaceae - Spike-Moss family (1 taxon)				
	Selaginella wallacei			2
SPHENOPHYTA - Horsetails				
Equisetaceae - Horsetail Family (4 taxa)				
	Equisetum arvense	Common Horsetail		2
	Equisetum hyemale ssp. affine	common scouring rush		2
	Equisetum laevigatum	smooth scouring rush		2
	Equisetum telmateia ssp. braunii	Giant Horsetail		3
PTEROPHYTA - Ferns and other non-seed plants				
Pteridaceae - Brake Fern Family (7 taxa)				
	Adiantum aleuticum	five-finger fern		2
	Adiantum jordanii			3
	Aspidotis californica			2

	Aspidotis densa	Indian's dream		2
	Pellaea andromedifolia	Coffee Fern		2
	Pellaea mucronata var. mucronata	Bird's Foot Fern		2
	Pentagramma triangularis ssp. *triangularis*	Goldenback Fern		3
Polypodiaceae - Polypody Family (2 taxa)				
	Polypodium californicum	California Polypody		2
	Polypodium glycyrrhiza	Licorice Fern		2
Dennstaedtiaceae - Bracken Fern Family (1taxon)				
	Pteridium aquilinum var. pubescens	Bracken Fern		3
Dryopteridaceae -Wood Fern Family (5 taxa)				
	Athyrium filix-femina	Lady Fern		2
	Cystopteris fragilis	Fragile Fern		1
	Dryopteris arguta			2
	Polystichum imbricans ssp. imbricans			2
	Polystichum munitum	Western Sword Fern		3
Blechnaceae -Deer Fern Family (1 taxon)				
	Woodwardia fimbriata	Giant Chain Fern		3
CONIFEROPHYTA - Conifers				
Pinaceae - Pine Family (6 taxa)				
	Abies grandis	grand fir		2
	Pinus lambertiana	sugar pine		2
	Pinus muricata	bishop pine		1
	Pinus ponderosa	Ponderosa Pine		2
	Pseudotsuga menziesii	Douglas Fir		4
	Tsuga heterophylla	western hemlock		3
Taxaceae - Yew Family (1 taxon)				
	Torreya californica			2
Taxodiaceae -Bald Cypress Family (1 taxon)				
	Sequoia sempervirens	Coast Redwood		4
ANTHOPHYTA - Dicotyledones (Dicots)				
Aceraceae - Maple Family (Sapindaceae) 2 taxa				

	Acer circinatum	Vine Maple		2
	Acer macrophyllum	Big Leaf Maple		2
Anacardiaceae - Sumac Family (1 taxon)				
	Toxicodendron diversilobum	Poison Oak		3
Apiaceae - Carrot Family (11 taxa)				
	Anthriscus caucalis	Bur-chervil	x	2
	Conium maculatum	Poison hemlock		2
	Daucus pusillus	Rattlesnake Weed		3
	Lomatium utriculatum			2
	Osmorhiza chilensis	Sweet Cicley		3
	Perideridia kelloggii	Yampah		3
	Sanicula arctopoides	Footsteps of Spring		2
	Sanicula bipinnatifida	Purple Sanicle		2
	Sanicula crassicaulis	Gamble Weed		2
	Torilis arvensis	Japanese Hedge Parsley	x	3
	Torilis nodosa	Knotted Hedge Parsley	x	2
Araliaceae - Ginseng Family (2 taxa)				
	Aralia californica	Elk Clover		2
	Hedera helix	English Ivy	x*	2
Aristolochiaceae - Pipevine Family (1 taxon)				
	Asarum caudatum	Wild-Ginger		1
Asteraceae - Aster Family (58 taxa)				
	Achillea millefolium	Yarrow		3
	Adenocaulon bicolor	Trail Plant, Silver Arrow		2
	Agoseris grandiflora	Grand Mountain Dandelion		2
	Agoseris heterophylla			2
	Agoseris sp.			1
	Anaphalis margaritacea	Pearly Everlasting		2
	Arnica discoidea			2
	Artemisia douglasiana	Mugwort		2

	Aster radulinus	Broad-leafed Aster		2
	Baccharis douglasii	Marsh Baccharis		2
	Baccharis pilularis	Coyote Brush		3
	Carduus pycnocephalus	Italian Thistle	x*	2
	Centaurea melitensis	Napa Thistle, Tocalote	x*	2
	Centaurea solstitialis	Yellow Star-Thistle	x*	2
	Chrysanthemum segetum	Corn Chrysanthemum	x	2
	Cirsium occidentale var. venustum	Venus Thistle		2
	Cirsium vulgare	Bull Thistle	x	2
	Conyza canadensis	horseweed		2
	Conyza floribunda		x	2
	Crepis vesicaria ssp. taraxacifolia			1
	Erechtites minima	Fireweed	x	3
	Ericameria arborescens	Golden Fleece		3
	***Erigeron bioletti*i(List 3)**	Streamside Daisy		2
	Eriophylum confertiflorum var confertiflorum	Golden-yarrow		3
	Eriophyllum lanatum var. arachnoideum	Common Wooly Sunflower		2
	Filago californica			2
	Filago gallica		x	2
	Gnaphalium canescens ssp. beneolens			2
	Gnaphalium luteo-album		x	2
	Gnaphalium palustre			2
	Gnaphalium purpureum			2
	Gnaphalium ramosissimum	Everlasting		2
	Helenium puberulum			2
	Hieracium albiflorum	Hawkweed		3
	Hypochaeris glabra	Smooth Cat's Ear	x	3
	Hypochaeris radicata	Hairy Cat's Ear	x	3
	Lactuca saligna	Willow Lettuce	x	2
	Lagophyylla ramosissima ssp ramosissima			2

	Lasthenia californica	Goldfields		3
	Madia exigua	Litter Tarweed		3
	Madia gracilis	Slender Tarweed		3
	Madia madioides	Woodland Tarweed		3
	Malacothrix floccifera			2
	Micropus californicus	Slender Cottonweed		3
	Microseris douglasii ssp douglasii			1
	Petasites frigidus var palmatus	coltsfoot		2
	Psilocarphus brevissimus var. brevissimus	dwarf woolly-heads		2
	Rafinesquia californica	California chicory		1
	Silybum marianum	milk vetch	x	2
	Solidago californica	California goldenrod		2
	Soliva sessilis		x	2
	Sonchus asper	Prickly sow thistle	x	2
	Stephanomeria elata			2
	Stephanomeria exigua ssp. exigua			2
	Taraxacum officionalis	California dandelion	x	2
	Tolpis barbata		x	2
	Wyethia angustifolia	narrow-leaf mules ears		2
	Xanthium strumarium	cocklebur		2
Berberidaceae - Barberry Family (3 taxa)				
	Achlys californica	vanilla leaf		3
	Berberis nervosa	Barberry		2
	Vancouveria planipetala	Redwood Ivy		3
Betulaceae - Birch Family (3 taxa)				
	Alnus rhombifolia	White Alder		4
	Alnus rubra	red alder		4
	Corylus cornuta var. californica	Hazelnut		3
Boraginaceae - Borage Family (7 taxa)				
	Amsinckia menziesii var. intermedia	Rancher's Fireweed		2
	Cryptantha flaccida			2

	Cynglossum grande	Hound's Tongue		3
	Myosotis discolor	Blue Scorpion Grass	x	2
	Myosotis latifolia	forget-me-not		3
	Plagiobothrys nothofulvus	Popcorn Flower		3
	Plagiobothrys sp.			1
Brassicaceae- Mustard Family (8 taxa)				
	Arabis glabra var. glabra	Tower Mustard		2
	Barbarea orthoceras	Winter Cress		2
	Cardamine californica	milk maids		2
	Cardamine oligosperma			3
	Erysimum capitatum ssp. capitatum	Western Wallflower		1
	Raphanus raphanistrum	jointed charlock	x	2
	Rorippa nasturtium-aquaticum	water cress		2
	Sisymbrium officinale	Hedge Mustard	x	2
Callitrichaceae - Water Starwort Family (2 taxa)				
	Callitriche heterophylla var. bolanderi	Bolander's Water-Starwort		1
	Callitriche marginata			1
Campanulaceae - Bluebell Family (3 taxa)				
	Campanula prenanthoides	California Bedstraw		2
	Campanula scouleri	scouler's harebell		1
	Githopsis specularioides			1
Caprifoliaceae - Honeysuckle Family (4 taxa)				
	Lonicera hispidula var. vacillans	Honeysuckle		3
	Lonicera interrupta	Chaparral Honeysuckle		2
	Sambucus mexicana	Blue Elderberry		2
	Symphoricarpos mollis	Creeping Snowberry		3
Caryophyllaceae - Pink Family (7 taxa)				
	Cerastium glomeratum	Mouse-ear Chickweed	x	2
	Minuartia douglasii			2
	Petrorhagia dubia		x	3

	Sagina decumbens ssp. occidentalis	pearlwort		2
	Silene californica	Indian Pink		2
	Silene gallica	Windmill Pink	x	2
	Stellaria nitens	shining chick-weed		1
Celastraceae - Staff Tree Family (1 taxon)				
	Euonymus occidentalis	western burning bush		2
Chenopodiaceae - Goosefoot Family (1 taxon)				
	Chenopodium bothrys	Jerusalem oak	x	2
Convolvulaceae - Morning-Glory Family (1 taxon)				
	Calystegia purpurata ssp purpurata			2
Cornaceae - Dogwood Family (1 taxon)				
	Cornus nuttallii	Mountain Dogwood		2
Crassulaceae - Stonecrop Family (1 taxon)				
	Sedum spathulifolium			2
Cucurbitaceae - Gourd Family (1 taxon)				
	Marah oreganus	coast manroot		2
Datiscaceae - Datisca Family (1 taxon)				
	Datisca glomerata	Durango Root		3
Dipsacaceae - Teasel Family (1 taxon)				
	Dipsacus fullonum	wild teasel	x	2
Elatinaceae - Waterwort Family (1 taxon)				
	Elatine sp.			1
Ericaceae - Heath Family (14 taxa)				
	Arbutus menziesii	madrone		4
	Arctostaphylos canescens	hoary manzanita		2
	Arctostaphylos columbiana			2
	Arctostaphylos glandulosa			2
	Arctostaphylos manzanita ssp. glaucescens	common manzanita		2
	Arctostaphylos manzanita ssp. manzanita	common manzanita		3
	Boschniakia strobilacea			1
	Chimaphila menziesii	little prince's pine		1

	Gaultheria shallon	salal		3
	Pyrola picta	white-veined wintergreen		2
	Rhododendron macrophyllum			3
	Rhododendron occidentale	western azalea		3
	Vaccinium ovatum	California huckleberry		4
	Vaccinium parvifolium	red huckleberry		3
Euphorbiaceae - Spurge Family (3 taxa)				
	Chamaesyce serpyllifolia	thyme-leafed spurge		2
	Eremocarpus setigerus	Turkey Mullein		3
	Euphorbia lathyris	gopher plant	x	1
Fabaceae - Pea Family (40 taxa)				
	Astragalus gambelianus	Gambel's Dwarf Locoweed		2
	Genista monspessulana	French Broom	x*	2
	***Lathyrus palustris* (List 2)**			1
	Lathyrus polyphyllus			1
	Lathyrus torreyi			2
	Lathyrus vestitus var. ochropetalus			3
	Lathyrus vestitus var. vestitus	hillside pea		3
	Lotus corniculatus	birdfoot trefoil	x	3
	Lotus humistratus	hill lotus		3
	Lotus micranthus	miniature lotus		3
	Lotus purshianus	Spanish lotus		3
	Lotus scoparius	California broom		3
	Lotus stipularis			1
	Lotus wrangelianus			2
	Lupinus arboreus			2
	Lupinus bicolor	miniature lupine		3
	Lupinus latifolius	broadleaf lupine		2
	Medicago lupulina	black medick	x	2
	Medicago polymorpha	California burclover	x	2

	Melilotus alba	white sweetclover	x	2
	Pickeringia montana var montana	chaparral pea		2
	Trifolium albopurpureum var albopurpureum			2
	Trifolium albopurpureum var dichotomum			2
	Trifolium barbigerum var barbigerum			2
	Trifolium bifidum var bifidum			2
	Trifolium bifidum var decipiens			2
	***Trifolium buckwestiorum* (List 1B)**			1
	Trifolium ciliolatum			3
	Trifolium depauperatum	balloon clover		2
	Trifolium dubium	little hop clover	x	3
	Trifolium microcephalum	maiden clover		3
	Trifolium microdon		x	3
	Trifolium obtusiflorum			2
	Trifolium oliganthum			2
	Trifolium striatum		x	2
	Trifolium subterraneum	subterranean Clover	x	2
	Trifolium varigatum	white-topped clover		2
	Trifolium willdenovii	tomcat clover		3
	Vicia americana	American vetch		2
	Vicia hirsuta		x	3
	Vicia sativa ssp nigra	narrow-leaved vetch	x	3
	Vicia tetrasperma		x	3
Fagaceae - Beech Family (9 taxa)				
	Chrysolepis chrysophylla	chinquapin		3
	Lithocarpus densiflorus	tan oak		4
	Quercus agrifolia	Coast Live Oak		1
	Quercus chrysolepis	Canyon Live Oak		3
	Quercus garryana var. garryana	Oregon Oak, Garry Oak		3
	Quercus kelloggii	Black Oak		3

	Quercus lobata	Valley Oak		3
	Quercus parvula var. shrevei	Shreve oak		2
	Quercus wislizeni	Interior Live Oak		2
Gentianaceae - Gentian Family (3 taxa)				
	Centaurium davyi			2
	Centaurium muehlenbergii			3
	Cicendia quadrangularis			1
Geraniaceae - Geranium Family (4 taxa)				
	Erodium botrys	Broadleaf Filaree	x	2
	Erodium cicutarium	Red-stemmed Filaree	x	2
	Geranium dissectum	Cut-leaf Geranium	x	2
	Geranium molle	Dove-foot Geranium	x	2
Grossulariaceae - Gooseberry Family (3 taxa)				
	Ribes menzisii	canyon gooseberry		2
	Ribes roezlii var. cruentum	Sierra gooseberry		2
	Ribes sp.			1
Hippocastanaceae - Buckeye Family (1 taxon)				
	Aesculus californica	California Buckeye		3
Hydrophyllaceae - Waterleaf Family (9 taxa)				
	Eriodictyon californicum	Yerba Santa		2
	Nemophila heterophylla			2
	Nemophila menziesii var. atomaria	Baby White-eyes		2
	Nemophila menziesii var. menziesii	Baby Blue-eyes		2
	Nemophila parviflora			2
	Nemophila pedunculata			2
	Phacelia bolanderi			3
	Phacelia mutabilis			2
	Phacelia sp.			1
Hypericaceae - St. John's Wort Family (2 taxa)				
	Hypericum concinnum	gold-wire		2
	Hypericum perforatum	Klamath Weed	x*	1

Lamiaceae - Mint Family (14 taxa)				
	Glechoma hederacea	ground ivy	x	2
	Lepechinia calycina	pitcher sage		2
	Melissa officinalis	bee balm		1
	Mentha pulegium	Penny Royal	x*	2
	Monardella villosa ssp. villosa	Coyote Mint		2
	Pogogyne zizyphoroides			1
	Prunella vulgaris var. lanceolata	Self-Heal		2
	Satureja douglasii	Yerba Buena		2
	Scutellaria californica	California Skullcap		2
	Scutellaria tuberosa			1
	Stachys ajugoides var. ajugoides	Hedge Nettle		3
	Stachys ajugioides var rigida	Hedge Nettle		4
	Trichostema lanceolatum	Vinegar Weed		3
	Trichostema laxum	turpentine weed		3
Lauraceae - Laurel Family (1 taxon)				
	Umbellularia californica	California Bay		4
Limnanthaceae - Meadowfoam Family (1 taxon)				
	Limnanthes douglasii ssp. nivea	Snowy Meadowfoam		2
Linaceae - Flax Family (1 taxon)				
	Linum bienne	Common flax	x	3
Lythraceae - Loosestrife Family (1 taxa)	Loosestrife Family (1 taxon)			
	Lythrum hyssopifolium	Loosestrife	x	2
Malvaceae - Mallow Family (1 taxon)				
	Sidalcea diploscypha			3
Moraceae- Mulberry Family (1 taxon)				
	Ficus carica	Edible fig	x	1
Myricaceae- Wax Mytrle Family (1 taxon)				
	Myrica california	California Wax Myrtle		4
Oleaceae - Olive Family (3 taxa)				
	Fraxinus latifolia	Oregon Ash		2

	Fraxinus dipetala	California Ash		1
	Olea europea	Olive	x	1
Onagraceae - Evening Primrose Family (8 taxa)				
	Clarkia concinna	Red Ribbons		1
	Clarkia purpurea ssp. quadrivulnera			3
	Epilobium brachycarpum			2
	Epilobium canum ssp. latifolium	Zauschneria		1
	Epilobium ciliatum ssp. ciliatum	Northern Willow Herb		2
	Epilobium ciliatum ssp. glandulosum			2
	Epilobium densiflorum			2
	Epilobium minutum			2
Oxalidaceae- Oxalis Family (3 taxa)				
	Oxalis albicans ssp. pilosa			2
	Oxais laxa		x	1
	Oxalis oregana	Redwood Sorrel		3
Papaveraceae - Poppy Family (3 taxa)				
	Dicentra formosa	bleeding heart		2
	Eschscholzia californica	California Poppy		3
	Platystemon californicus	Cream Cups		3
Philadelphaceae - Mock Orange Family (1 taxon)				
	Whipplea modesta	Yerba de Selva, Modesty		3
Plantaginaceae - Plantain Family (2 taxa)				
	Plantago erecta			2
	Plantago lanceolata	English Plantain	x	2
Polemoniaceae - Phlox Family (9 taxa)				
	Collomia heterophylla	Varied-Leaf Collomia		2
	Gilia capitata ssp. capitata	Blue Field Gilia		1
	Gilia tricolor ssp. tricolor	Bird's Eye		2
	***Leptosiphon acicularis* (List 4)**	Bristly Linanthus		2
	Linanthus bicolor	Bicolored Linanthus		2

	Linanthus parviflorus			2
	Navarretia intertexta ssp intertexta	Needle-leaved Navarretia		3
	Navarretia squarrosa	Skunkweed		2
	Phlox gracilis	Slender Phlox		2
Polygalaceae - Milkwort Family (1 taxon)				
	Polygala californica	California Milkwort		2
Polygonaceae - Buckwheat Family (7 taxa)				
	Eriogonum luteolum			1
	Eriogonum nudum			2
	Polygonum punctatum	Water Smartweed		2
	Rumex acetosella	sheep sorrel	x	3
	Rumex crispus	curly dock	x	2
	Rumex dentatus		x	2
	Rumex salicifloius	willow dock		2
Portulacaceae - Purslane Family (4 taxa)				
	Claytonia exigua			1
	Claytonia perfoliata	miner's lettuce		2
	Claytonia sibirica	candy flower		2
	Montia parviflora			2
Primulaceae - Primrose Family (3 taxa)				
	Anagallis arvensis	Scarlet Pimpernel	x	3
	Centunculus minimus	chaffweed		1
	Trientalis latifolia	Star Flower		3
Ranunculaceae - Buttercup Family (7 taxa)				
	Aquilegia formosa	Columbine		2
	Delphinium hesperium ssp. hesperium	western larkspur		2
	Delphinium nudicaule	Red Larkspur		3
	Ranunculus californicus	California buttercup		3
	Ranunculus hebecarpus			2
	Ranunculus occidentalis	western buttercup		2
	Ranunculus repens	creeping buttercup		2

Rhamnaceae - Buckthorn Family (9 taxa)				
	Ceanothus cuneatus ssp. cuneatus	Buck Brush		4
	Ceanothus foliosus var foliosus			3
	Ceanothus incanus	coast whitethorn		4
	Ceanothus integerrimus	Deer Brush		3
	Ceanothus thyrsiflorus			3
	Ceanothus velutinus var hookeri	Tobacco Brush		2
	Rhamnus californica	California Coffeeberry		2
	Rhamnus purshiana	cascara		2
Rosaceae - Rose Family (16 taxa)				
	Amelanchier utahensis	Service Berry		2
	Cercocarpus betuloides	Birch-leaf Mt Mahogany		3
	Cotoneaster pannosa		x	1
	Fragaria vesca	Wood Strawberry		2
	Heteromeles arbutifolia	Toyon		3
	Holodiscus discolor	Ocean Spray		3
	Malus sylvestris	Apple	x	1
	Potentilla glandulosa ssp. glandulosa	Sticky Cinquefoil		1
	Prunus avium	Plum	x	1
	Pyrus sp.	Pear	x	1
	Rosa eglantaria	sweet briar	x	2
	Rosa gymnocarpa	Wood Rose		3
	Rubus discolor	Himalayan Blackberry	x	2
	Rubus leucodermis	Western Raspberry		3
	Rubus parviflorus	Thimbleberry		3
	Rubus ursinus	California Blackberry		3
Rubiaceae - Madder Family (6 taxa)				
	Galium aparine	Goose Grass	x	3
	Galium californicum ssp. californicum	California Bedstraw		3
	Galium muricatum	Humboldt Bedstraw		2

	Galium parisiense	Wall Bedstraw	x	2
	Galium porrigens	Climbing Bedstraw		2
	Sherardia arvensis	Field Madder	x	2
Salicaceae - Willow Family (3 taxa)				
	Salix laevigata	Red Willow		2
	Salix lucida ssp lasiandra	shining willow		2
	Salix sitchensis	Sitka willow		4
Saxifragaceae - Saxifrage Family (7 taxa)				
	Boykinia occidentalis			3
	Heuchera micrantha	Alum Root		2
	Lithophragma affine	Woodland Star		2
	Lithophragma heterophylla	Woodland Star		2
	Saxifraga mertensiana	Merten's Saxifrage		2
	Tellima grandifora	fringe cups		2
	Tiarella trifoliata var unifoliata	lace flower		2
Scrophulariaceae - Figwort Family (23 taxa)				
	Castilleja attenuata	valley tassels		2
	Castilleja densiflora	owl's clover		2
	Castilleja wightii			2
	Collinsia parviflora	blue-eyed Mary		1
	Digitalis purpurea	foxglove	x	2
	Keckiella corymbosa	red keckiella		2
	Mimulus aurantiacus	sticky monkey-flower		2
	Mimulus cardinalis	Scarlet Monkey Flower		2
	Mimulus congdonii			1
	Mimulus douglasii			1
	Mimulus guttatus			2
	Mimulus moschatus	musk monkeyflower		2
	Scrophularia californica	California figwort		2
	Scutellaria antirrhinoides	skullcap		1
	Scutellaria tuberosa	skullcap		1

	Synthyris reniformis	snow queen		2
	Tonella tenella			2
	Triphysaria eriantha ssp. eriantha	Butter and Eggs		2
	Triphysaria pusilla			2
	Triphysaria versicolor ssp. versicolor			1
	Verbascum blattaria	moth mullein	x	2
	Verbascum thapsus	woolly mullein	x	2
	Veronica americana	American brooklime		3
Solanaceae - Nightshade Family (2 taxa)				
	Solanum americanum			2
	Solanum xanti			2
Urticaceae - Nettle Family (2 taxa)				
	Urtica dioica ssp gracilis	American stinging nettle		2
	Urtica dioica ssp holosericea	stinging nettle		2
Valerianaceae - Valerian Family (1 taxa)				
	Plectritis brachystemon			2
Verbenaceae - Vervain Family (1 taxon)				
	Verbena lasiostachys var. lasiostachys			2
Violaceae - Violet Family (2 taxa)				
	Viola ocellata	western heart's ease		2
	Viola sempervirens	evergreen violet		3
MONOCOTYLEDONES - The Monocots				
Cyperaceae - Sedge Family (16 taxa)				
	Carex aquatilis var. dives			2
	Carex athrostachya	slender-beaked sedge		2
	Carex bolanderi			2
	Carex deweyana ssp. leptopoda			2
	Carex feta			1
	Carex globosa			3
	Carex gynodynama			2
	Carex hardfordii			2

	Carex multicaulis			2
	Carex nudata	Torrent Sedge		3
	Carex sp			1
	Carex tumulicola	Foothill Sedge		2
	Cyperus eragrostis			3
	Eleocharis macrostachya	spikerush		2
	Scirpus koilolepis			2
	Scirpus microcarpus			2
Iridaceae - Iris Family (4 taxon)				
	Iris douglasii	Douglas Iris		2
	Iris macrosiphon			2
	Iris purdyi	Purdy's Iris		2
	Sisyrinchium bellum	Blue-eyed Grass		3
Juncaceae - Rush Family (8 taxa)				
	Juncus bolanderi	Bolander's Rush		3
	Juncus bufonius	Toad Rush		3
	Juncus effusus var. pacificus			3
	Juncus occidentalis			2
	Juncus patens	Common Rush		3
	Juncus tenuis			2
	Juncus xiphioides			2
	Luzula comosa	Wood Rush		2
Liliaceae - Lily Family (17 taxa)				
	Brodiaea elegans ssp. elegans	harvest brodiaea		2
	Calochortus tolmei	Pussy Ears		3
	Chlorogalum pomeridianum	soaproot		2
	Clintonia andrewsiana	clintonia		2
	Dichelostemma capitatum ssp.capitatum	blue dicks		2
	Dichelostemma congestum	ookow		2
	Disporum hookeri	Hooker's fairybell		2
	Fritillaria affinis var. affinis	checker lily		2

	Lilium pardalinum	Leopard Lily		2
	Scoliopus bigelovii	fetid adders tongue		2
	Smilacina racemosa	branched false solomon's seal		3
	Smilacina stellata	star false solomon's seal		3
	Trillium ovatum			2
	Triteleia hyacinthina	white brodiaea		2
	Triteleia laxa	Ithurel's spear		2
	Xerophyllum tenax	bear-grass		3
	Zigadenus fremontii	death camus		3
Orchidaceae - Orchid family (6 taxa)				
	Corallorhiza maculata	spotted coralroot		1
	Corallorhiza sp.			1
	Epipactis gigantea	Streamside Orchid		2
	***Piperia candida* (List 4)**	white flowered piperia		2
	Piperia elongata			2
	Piperia transversa			1
Poaceae - Grass Family (70 taxa)				
	Achnatherum lemmonii	Lemmon's Needle Grass		2
	Agrostis exarata			2
	Agrostis gigantea		x	3
	Agrostis pallens			3
	Aira caryophyllea	silver European hairgrass	x	3
	Aira praecox		x	2
	Anthoxanthum aristatum	annual vernal grass	x	2
	Anthoxanthum ordoratum	sweet vernal grass	x	2
	Aristida oligantha	Prairie Three-awn		2
	Avena barbata	slender wild oat	x	3
	Briza maxima	quaking grass	x	2
	Briza minor		x	2
	Bromus carinatus var. maritimus			2

	Bromus carinatus var. carinatus	California brome		3
	Bromus diandrus	ripgut brome	x	3
	Bromus hordeaceus	soft chess	x	2
	Bromus japonicus		x	2
	Bromus laevipes	Woodland Brome		2
	Bromus madritensis	foxtail chess	x	2
	Bromus madritensis ssp. rubens	Red Brome	x	2
	Bromus sterilis	poverty brome	x	2
	Bromus tectorum	cheatgrass brome	x	1
	Bromus vulgaris			2
	Calamagrostis rubescens	pine grass		1
	Cortaderia jubata	Jubata Grass	x*	3
	Cynosurus cristatus	crested dogtail	x	2
	Cynosurus echinatus	hedgehog dogtail	x	3
	Dactylis glomerata	orchard grass	x	2
	Danthonia californica	California oatgrass		3
	Danthonia pilosa	oatgrass	x	2
	Deschampsia elongata	slender hairgrass		2
	Elymus glaucus ssp. glaucus	blue wildrye		3
	Elymus multisetus	Big Squirrel-tail grass		2
	Festuca arundinacea	Tall Fescue	x	2
	Festuca californica	California Fescue		3
	Festuca elmeri			2
	Festuca idahoensis	Idahoe Fescue		3
	Festuca occidentalis	western fescue		3
	Festuca rubra	Red Fescue		2
	Festuca subulata			2
	Festuca subuliflora			2
	Gastridiium ventricosum	nit grass	x	3
	Hierochloe occidentalis	sweet grass		2
	Holcus lanatus	common velvet grass	x	3

	Hordeum brachyantherum ssp. californicum			1
	Hordium marinum ssp. gussoneanum	Mediterranean barley	x	2
	Hordeum murinum ssp. leporinum	Hare Barley	x	2
	Koeleria macrantha			1
	Lolium multiflorum	Italian ryegrass	x	2
	Melica geyeri			2
	Melica hardfordii			3
	Melica imperfecta			1
	Melica torreyana	Torrey's melic		2
	Nassella lepida			2
	Nassella pulchra	purple needlegrasss		3
	Paspalum dilatatum	dallis grass	x	2
	Phalaris aquatica	harding grass	x	2
	Piptatherum miliaceum	smilo grass	x	2
	Poa howellii			1
	Poa secunda ssp. secunda	One-sided bluegrass		2
	Polypogon interruptus	ditch beard grass	x	2
	Polypogon monspeliensis	annual beard grass	x	2
	Setaria viridis	setaria	x	2
	Taeniatherum caput-medusae	medusahead	x	2
	Trisetum canescens			2
	Vulpia bromoides		x	2
	Vulpia microstachys var ciliata			1
	Vulpia microstachys var. microstachys			2
	Vulpia microstachys var. pauciflora			2
	Vulpia myuros var. hirsuta		x	2
Potamogetonaceae - Pondweed Family (1 taxon)				
	Potamogeton natans	floating-leaved pond weed		1
Typhaceae - Cattail Family (1 taxon)				
	Typha sp.			1

APPENDIX H: BRIDGE CONDITIONS TABLE

Source: NCRM, February 2005

Bridge #	Location	Length	Abutment Type	Running Surface	Maintenance Requirements	Replacement Bridge and Abutment	Replacement Cost
1	Hollow Tree Rd Malliard Property. Unnamed tributary	50’	Log and earth fill	Wood	Check wood deck before hauling logs	44’ double flatcar bridge w/ Log and earth fill	$20,500
2	Hollow Tree Rd Malliard Property. Unnamed tributary	30’	Log and earth fill w/ Monschke blocks	Steel Plate	None	30’ double flatcar bridge w/ Log and earth fill	$20,500
3	Hollow Tree Rd Malliard Property Garcia River Crossing	80’	Laced logs w/ earth backfill	Steel Plate	Monitor log retaining wall for further damage. Pin top log back on wall.	89’ double flatcar w/ concrete abutment w/ earth backfill	$75,000

Bridge #	Location	Length	Abutment Type	Running Surface	Maintenance Requirements	Replacement Bridge and Abutment	Replacement Cost
4	Hollow Tree Rd Garcia River Crossing	100’	Concrete w/ earth backfill	Wood	Wood planks and supports are currently scheduled for replacement. Bridge support structure to be evaluated by civil engineer. 1/20/05	89’ double flatcar w/ concrete abutment w/ earth backfill	$275,000
5	Hollow Tree Rd Blue waterhole Creek Crossing	90’	Brow log with earth fill over logs	Steel Plate	Earth fill under abutments is badly eroded. Repair next summer as part of annual maintenance.	89’ double flatcar w/ pored in place concrete abutment and earth backfill	$75,000
6	Hollow Tree Rd. South Fork Garcia River Crossing	130’	Laced logs w/ earth backfill and I beam framed mid support	Wood	Repairs to wood deck and supports are recommended prior to hauling logs.	130’ custom bridge built on site w/ pored in place concrete abutment and earth back fill	350,000

Bridge #	Location	Length	Abutment Type	Running Surface	Maintenance Requirements	Replacement Bridge and Abutment	Replacement Cost
7	Hot Springs Rd. Signal Creek Crossing	50’	Log and earth fill	Steel Plate	None	44’ double flatcar bridge w/ Log and earth fill	$20,500
8	Olson Gulch Rd Unnamed Tributary	40’	Log and earth fill	Wood	Inspect wood deck prior to hauling logs. Repair as necessary.	44’ double flatcar bridge w/ Log and earth fill	$20,500
9	Olson Gulch Rd Garcia River Crossing	75’	Steel Plate	Steel Plate	Inspect railroad undercarriage prior to hauling. Have civil engineer inspect if doubtful of strength.	89’ double flatcar w/ Monschke block abutment and earth fill	$50,000
10	Olson Gulch Rd. Unnamed Tributary	40’	Log and earth fill		Replace wood deck and supports prior to hauling. May be easier and cheaper to install 60” CMP in lieu of repairing bridge .	44’ double flatcar bridge w/ Log and earth fill	$20,500

Bridge #	Location	Length	Abutment Type	Running Surface	Maintenance Requirements	Replacement Bridge and Abutment	Replacement Cost
11	Upper Signal Creek	53’ flatcar	Rock on west side . Logs on east side	wood	None at this time. Inspect deck prior to hauling.	same	$25,000
12	Big Cheese Road crossing unnamed tributary to Signal Creek	40’ boxcar	Boulders	Good metal deck covered with rock mounted sideways	None at this time	44’ Double flatcar on same footing.	$20,500
13	Graphite Creek	40’ double boxcar	Native with redwood sill logs	Wood	Inspect deck prior to hauling logs	44’ Double flatcar on same footing	$20,500
14	Upper North fork Garcia	53’ flatcar	Laced log abutment	wood	Replace wood surface and supports prior to hauling. Remove bridge and reopen alternate rout out to Graphite road	89’ double flatcar w/ concrete abutment w/ earth backfill	$75,000

Bridge #	Location	Length	Abutment Type	Running Surface	Maintenance Requirements	Replacement Bridge and Abutment	Replacement Cost
15 No picture available	Tributary to North Fork	40’ boxcar with steel deck	earth	Frame needs straitening and welding	remove	None needed	$5,000 to remove $5,000 to repair
16 No Picture available	Olsen Gulch	53’ flatcar.	logs	wood	None at this time. Inspect prior to log hauling.	same	$25,000
17 No Picture available	Unnamed tributary to main stem Garcia	53’ flatcar.	logs	wood	None at this time. Replace deck prior to log hauling.	same	$25,000

APPENDIX I: ROCK PITS

Source: NCRM, September 2004

Garcia River Forest Rock Pits - Draft Description 09/21/04 NCRM					
Pit Number	**Location**	**Size**	**Type of rock**	**Comments**	
1	Hollow Tree Road	1/4 acre	shale	Within 100 feet of a watercourse, requires permit to comply with SMARA	
2	Inman Creek Road	1/5 acre	shale	Within 100 feet of a watercourse, requires permit to comply with SMARA	
3	Big Cheese Road	1/5 acre	shale	Good rock source, pit to be developed	
4	West Hollow Tree Road	1/3 acre	shale	Large raveling cut bank	
5	Graphite Road	1/4 acre	shale	Raveling cut bank near watercourse. Emergency rock only	
6	Olsen Gulch Road	1/5 acre	Boulder Pit	Boulders showing on surface and excavated from road cut. Dig test holes before developing.	
7	Mountian View Road and Graphit Road	1/3 acre	Shale	Good rock source	
8	Mountian View Road 200 feet west of pit 7	1/5 acre	Shale	Undeveloped pit, rock shows on surface	
9	Hollow Tree Road	1/4 acre	Shale	Good rock source, pit to be developed	

The pits listed have been mapped; however, this list is not complete and many more pits exist on unexplored roads and ridges. There are also dozens of small unmapped oportunistic rock pits along road cut banks that yield small quantities of rock. For large road rocking jobs pits will need to be terraced for safety reasons and to facilitate extraction. Currently most pits are not terraced and extraction is restricted to pulling rock off of the bottom and letting the top cave in. There is a shortage of large rock (2'+) available for rip rap. Locating a source of rip rap will be a priority as road upgrades progress.

APPENDIX J: DRAFT ROAD MANAGEMENT PLAN

Source: NCRM, December 2005

Background and Overview

Garcia River Forest encompasses approximately 24,000 acres between Fish Rock Road and Mountain View Road in the Garcia River watershed. The property was acquired by TCF in 2003. The previous landowner conducted minor road maintenance activities and remediation projects; however, the forest land and roads have been essentially resting for the past six years. TCF intends to actively manage the ownership to achieve a host of ecologic, economic, and social goals as detailed throughout the IRMP.

Forest roads contribute sediment to streams. Increased stream sediment can result in cemented gravels reducing salmonids ability to spawn and/or inhibiting fry emergence. High sediment levels can also cause pool filling and associated reduction in pool habitat. Extreme sediment loads can cause stream temperatures to be elevated due to the reduction in stream depth. Near stream roads can also reduce stream shading where the road is very wide or very close to the stream. Reduced stream shading has been shown to be linked to increased water temperature which stresses juvenile salmonids (Flosi et al. 1998, IFR 2003).

The Garcia River is listed as threatened and impaired by the EPA and is on the 303(d) list of impaired waterbodies. Placement of a waterbody on the 303(d) list acts as the trigger for developing a sediment control plan, called a TMDL, for each water body and associated pollutant/stressor on the list.

Past management practices on the property have reduced road related stream sediment. Specifically many bridges and multi-plate culverts have been installed to replace standard culverts on Class I streams. Class II watercourse crossings have been rock armored and new culverts buried to grade. WLPZ roads have been rocked or otherwise improved to reduce stream sedimentation caused by near stream roads. Many other forest roads have also been rocked.

TCF is committed to continuing this trend of road improvement over time and has developed and will continue to refine this road plan to: 1) reduce sediment inputs resulting from the existing road network as well as minimize potential inputs from new roads; 2) develop proactive measures to help reduce stream sedimentation as a result of road runoff in collaboration with regulatory agencies and other partners; 3) develop a timeline for road maintenance, upgrade, conversion and decommissioning activities; and 4) guide and dovetail with development of THPs, restoration projects, monitoring efforts, and other activities throughout the property.

Planned road maintenance will be in conformance with IRMP. TCF's immediate goal is to maintain access by maintaining existing mainline roads which form the core of the road system and provide access for fire suppression, log hauling, wildlife surveys, future road improvement and abandonment projects and other management activities. Secondary roads on the property will be evaluated once we have improved the mainline roads and can effectively access them. It is expected that maintenance and improvements to these secondary roads will primarily be carried out in conjunction with THPs, with the exception of emergency repairs and high priority sites as described previously.

I. Road Management Time Line

It is TCF's long-term goal is to develop a road system which provides access to the property for fire protection, resource surveys, monitoring, harvest planning, research, education, public access, and other

activities while reducing annual maintenance expense. It is expected that forests will be managed with uneven-age silvicultural systems and a 15-20 year re-entry period. The timing and extent of road improvement projects will depend on the availability of funding from a variety of sources, including timber harvests and grant funding. Lower priority projects will generally be done in conjunction with THPs and the timeline will track the overall harvest schedule. As described previously, sites in need of immediate attention will be remediated within the first ten-year period. Projects which require a 1603 stream alteration permit and do not otherwise qualify as an emergency repair will necessarily be conducted in conjunction with THPs.

TCF will use the road inventory system developed by Pacific Watershed Associates and other existing sources as planning tools to evaluate and prioritize sites and to conduct effectiveness monitoring over time.

Road Maintenance and Improvement Guidelines

This section identifies attributes that will determine whether a road should be maintained in its current configuration, reconfigured with dips and out-sloping, or abandoned and possibly replaced. Primary associated objectives and constraints identified during management planning were: 1) improve fisheries and wildlife habitat; 2) provide efficient road access for a variety of activities; 3) consider cost as one factor to be considered among others in evaluating road improvements; and 4) TCF is willing to bear higher management costs that arise from reconfiguring, converting, and/or decommissioning roads.

To reduce sediment delivery from the existing road system, emphasis will be placed on increasing the number of drainage points along roads either by out sloping, constructing additional rolling dips or increased ditch relief (generally the least-preferred option). Reducing the potential for diversion at culverted watercourse crossings is also a high priority. Low gradient (0-4 percent grade) roads will be primarily drained by out sloping with occasional dips or ditch relief as necessary. Higher gradient (5-10+ percent grade) roads will be drained primarily with rolling dips and ditch relief culverts as necessary. It is expected that within a ten year period most roads will be drained by a combination of out sloping with rolling dips. It is recognized, however, that ditch relief culverts cannot be completely abandoned and will be used as drainage structures on roads where blockage is not a problem and in cases where ditch and relief culverts reduce disturbance by eliminating the need for annual waterbarring. Ditches may also be used to reduce saturation of the road or road sub-grade where natural soil moisture is high. Reducing diversion will be implemented in three ways: 1) new culverts and culverts proposed for replacement will be sized to meet 100 year storm events; 2) new or replaced culverts will be installed such that the culvert is installed at stream grade and deep enough that a critical dip can be constructed to provide protection against stream diversions; and 3) a trash rack or stake shall be installed upstream of culverts to catch or turn debris prior to reaching the pipe.

New roads, if any, will be designed with gentle grades where possible, with long rolling dips constructed into the road and outsloped to relieve surface runoff. Where possible watercourse crossings will be designed such that road grades dip below and then climb out of watercourse crossings to eliminate the need for abrupt critical dips. Crossings will be rock fords or temporary crossings on secondary roads which see only periodic activity to reduce maintenance requirements.

"*The Handbook of Forest and Ranch Roads*" (Weaver and Hagans, 1994) will be used as a guideline for all proposed road construction and improvement projects. Specific projects and locations will be mapped and site specific prescriptions for each road point will be included within all plans (restoration plans, THPs, etc.).

II. Road Decommissioning Plan

There are three criteria for determining which roads can be decommissioned. The first is focused on resource protection, primarily sediment reduction. Roads located near (within the WLPZ of) a Class I or Class II stream or constructed on unstable slopes such as active landslides or headwall swales are likely candidates for decommissioning due to their potential contribution to in-stream sediment. Road construction across headwall swales and unstable slopes can result in mass wasting events, delivering large amounts of sediment to the watershed and posing an ongoing maintenance problem from constant bank sloughing which blocks roads, ditches and culverts.

The second criterion is that roads to be decommissioned must not eliminate or substantially reduce access to areas where any of a variety of management activities are anticipated. In the case where a road has been determined to be undesirable due to its location but access is still required the landowner may need to maintain the existing road or find another route. Reconfiguring the road network is a difficult and costly task that will have long-term effects on management activities.

The third criteria is that road decommissiong does not result in the construction of a replacement road that is environmentally unsound. Removing a road from a stream zone with the intent of moving upslope can require a value judgment between a near stream road and a road constructed on steep slopes with multiple watercourse crossings. Road improvement with rock surfacing, rolling dips and oversized culverts or bridge installation is generally the lowest cost alternative compared to relocation. If access is necessary, improving the road will be considered before constructing an alternate route especially if the alternate route results in a poorly located road.

In areas with excess roads it may be desirable to decommission roads or reduce their status to "temporary" to minimize potential sediment delivery and increase growing space. These types of roads are considered to be a low priority if they do not meet the above-mentioned criteria for decommissioning and are generally un-used.

The economics of road decommissioning also contribute to the decision making process.
Some poorly located roads may have to remain in place because they service a larger area with good arterial roads and there is no feasible alternative. Partial decommissioning of a near stream road (the potential sediment delivery sites) can be as effective and more cost efficient than complete decommissioning. The types of roads which will be a priority to evaluate as potential candidates for decommissioning are listed below:

- Roads that parallel watercourses and dead end are the highest priority for decommissiong or repair because of their proximity to streams, their lack of arterial roads, and because they can likely be decommissioned without impact to future management activities.
- Roads crossing unstable areas are deemed to be the second priority for decommissiong because there are fewer roads on unstable slopes than WLPZ roads. Further, the management implications and fieldwork necessary to make an informed decision will delay the decision making process.
- Roads that cross unstable areas or headwall swales are another priority for decommissioning if alternate routes exist to both ends of the subject road. In some cases this can be done with only a minor loss of access and can be accomplished without (much) concern of relocating the road higher up the slope.

- Long-term plans will include decommissioning and replacing or upgrading roads that are poorly located but are necessary in the short term for management activities.

Proper implementation of this plan will reduce the potential for excess runoff and diversions common to forest roads. Over the long-term, the reduction in stream sedimentation will improve salmonid habitat conditions and reduce yearly maintenance costs.

APPENDIX K: CONSERVATION TARGETS

Source: The Nature Conservancy (1/21/05 draft)

CONSERVATION TARGETS	OCCURRENCE AT GRF	NESTED CONSERVATION TARGETS
1ST TIER		
Coho	Yes North Fork 2002 (CDFG 2002), Signal ? (NCRM 2002)	Steelhead, North Coast perennial stream, North Coast river, North Coast headwater stream/intermittant stream
Foothill Yellow-Legged Frog	Yes Inman 95,96 (MRC 2002)	indicator effectiveness uncertain - salamanders and tailed frogs may be better
Non-riverine Freshwater Systems headwater streams, intermittent streams, wetlands, marshes, springs and seeps	Yes need data on wetlands, marshes, springs and seeps	CA red-legged frog, yellow-legged frog, Northwestern pond turtle, 15 potential plant species of special concern
Redwood-Douglas Fir Forest	Yes	NSO, red tree vole, marbled murrelet, coho, steelhead, Cooper's hawk, northern goshawk, sharp-shinned hawk, golden eagle, tailed frog, olive-sided flycatcher, Vaux's swift, hermit warbler, yellow warbler, white-tailed kite, peregrine falcon, bald eagle, pacific fisher, osprey, purple martin, CA red-legged frog, yellow-legged frog, 14 rare potential plant species
Northern Spotted Owl	Yes	red tree vole?, Douglas-fir, redwood
Oak Woodlands-Grasslands	Yes	Oak Woodlands: Cooper's hawk, sharp-shinned hawk, golden eagle, yellow warbler, purple martin, red-legged frog, yellow-legged frog, osprey, 13 potential plant species of special concern. Grasslands: same as OW plus white-tailed kite, peregrine falcon, bald eagle, 8 potential plant species of special concern
2ND TIER		
Steelhead	Yes	coho, North Coast perennial stream, North Coast river, North Coast headwater stream/intermittant stream
Red Tree Vole	Yes	northern spotted owl, Douglas-fir
Tailed Frog	Maybe	steelhead?, coho?, North Coast perennial stream, North Coast river, North Coast headwater stream/intermittant stream
California Red-legged Frog	Maybe	indicator effectiveness uncertain - salamanders and tailed frogs may be better
Coastal Scrub	Yes	*Accipiter cooperii, Aquila chrysaetos, Accipiter striatus, Accipiter gentilis, Contopus cooperi, Chaetura vauxi, Dendroica petechia brewsteri, Elanus leucurus, Falco peregrinus, Pandion haliaetus*
North Coast River	Yes	steelhead, coho, tailed frog, red-legged frog, yellow-legged frog, Northwestern pond turtle
North Coast Perennial Stream	Yes	steelhead, coho, tailed frog, red-legged frog, yellow-legged frog, Northwestern pond turtle

APPENDIX L: AQUATIC RESTORATION BASELINE DATA

Source: The Nature Conservancy

While there is quite a bit of existing data for the Garcia River watershed, the data does not comprehensively describe the conditions in individual tributaries (North Coast Regional Water Quality Control Board [NCRWQCB], 2000). A general picture of the state of the watershed can be gleaned from the existing data, however. Evaluation of the condition of the watershed in the future will require collection of more comprehensive instream data at more regular intervals (NCRWQCB, 2000).

3.1 Channel Type

TABLE 3 – CHANNEL TYPE BY SUBWATERSHED

Subwatershed	**Channel Type** *(CDFG Reference Code and corresponding description)*
Blue Waterhole	F2: entrenched meandering riffle/pool channel on low gradient with high width/depth ratio and boulder dominated substrates
North Fork	predominantly B3 with some F2 and F3. B3: moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools; very stable plan and profile; stable banks and cobble-dominant substrates. F2: channel entrenched, meandering riffle/pool channel on low gradient with high width/depth ratio and boulder-dominant substrates. F3: channel entrenched, meandering riffle/pool channel on low gradients with a high width/depth ratio and cobble-dominant substrates
Signal Creek	B3: channel moderately entrenched, moderate gradient, riffle dominated with infrequently spaced pools, very stable plan and profile, stable banks and cobble dominant substrates
Inman Creek	Predominantly F4 channel type, but some G1. F4: channel entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel dominant substrates. G1: channel entrenched "gully" step-pools with low width/depth ratio on moderate gradients and bedrock dominant substrates
Graphite Creek	G2: channel entrenched "gully" step-pools with low width/depth ratio on moderate gradient
Garcia mainstem	Roughly half B4 channel type, roughly half C3 channel type. B4: channel moderately entrenched riffle dominated channel with infrequently spaced pools, very stable plan and profile, stable banks on moderate gradients with low width /depth ratios and gravel dominant substrates. C3: channel meandering point-bar riffle/pool alluvial channel with broad well defined floodplain on low gradients and cobble dominant substrates

(California Department of Fish and Game [CDFG] 2005)

3.2 Migration barriers

Anthropogenic migration barriers in the Garcia River watershed include shallow and dewatered stream segments due to aggradation, sediment deltas at the mouth of several tributaries, and improperly installed culverts (Environmental Protection Agency [EPA] 1998, NCRWQCB 2000). Specific reports of

migration barriers exist for Signal Creek, Inman Creek, North Fork Garcia River and Graphite Creek, however a comprehensive migration barrier assessment of all Class I watercourses is still needed (Bell 2003, CDFG 2005).

3.3 Water temperature (MWAT)

Maximum weekly average temperature (MWAT) data is available for the mainstem and some of the tributaries of the Garcia River (see table 4 below). However, comprehensive, current data is still needed.

TABLE 4 – MWAT DATA BY WATERSHED

WATERSHED	YEAR	MWAT (°C)
Garcia mainstem at Hot Springs	1994	18.04
Garcia mainstem above Blue Waterhole Creek	1995	23.52
Garcia mainstem above Blue Waterhole Creek	1997	20.7
Garcia mainstem above Blue Waterhole Creek	1998	23.24
Garcia mainstem above Blue Waterhole Creek	1999	22.83
Garcia mainstem above Blue Waterhole Creek	2000	22.59
Garcia mainstem above Blue Waterhole Creek	2001	22.86
Olson Gulch	1995	14.27
Olson Gulch	1996	13.71
Olson Gulch	1997	15.95
Olson Gulch	1998	14.1
Olson Gulch	2000	13.64
North Fork Garcia	1998	14.73
North Fork Garcia	1999	13.68
Whitlow Creek	1999	20.11
Inman Creek	1994	20.42
Inman Creek	1995	19.69
Inman Creek	1999	20.98
Blue Waterhole Creek Reach 1	1994	19.96
Blue Waterhole Creek Reach 1	1995	20.16
Blue Waterhole Creek Reach 1	1996	21.14
Blue Waterhole Creek Reach 1	1997	20.19
Blue Waterhole Creek Reach 1	1998	20.55
Blue Waterhole Creek Reach 1	1999	20.13
Blue Waterhole Creek Reach 1	2000	20.73
Blue Waterhole Creek Reach 1	2001	19.65
Blue Waterhole Creek Reach 2	1994	18.95
Blue Waterhole Creek Reach 2	1995	20.56
Blue Waterhole Creek Reach 2	1996	21.16
Blue Waterhole Creek Reach 2	1997	19.81
Blue Waterhole Creek Reach 2	1998	19.42
Blue Waterhole Creek Reach 2	1999	18.22
Blue Waterhole Creek Reach 2	2000	19.2
Blue Waterhole Creek Reach 2	2001	18.64
Blue Waterhole Creek Reach 3	1995	20.52
Blue Waterhole Creek Reach 3	1996	21.28
Blue Waterhole Creek Reach 3	1997	20.86
Blue Waterhole Creek Reach 3	1998	20.54
Blue Waterhole Creek Reach 3	1999	20.21
Blue Waterhole Creek Reach 3	2000	20.83
Blue Waterhole Creek Reach 3	2001	20.03
Blue Waterhole Creek Reach 4	1994	20.41
Blue Waterhole Creek Reach 4	1995	20.93
Blue Waterhole Creek Reach 4	1996	21.32
Blue Waterhole Creek Reach 4	1997	20.7
Blue Waterhole Creek Reach 4	1998	20.92
Blue Waterhole Creek Reach 4	2000	20.97
Blue Waterhole Creek Reach 4	2001	20.23

(Institutes for Fisheries Research [IFR] 2003, and Maahs and Barber 2001)

3.4 Fine sediment – fines less than 0.85 mm and fines less than 6.5 mm

Fine sediments cause aggradation, burial of large woody debris (LWD) and other structural elements and can compromise habitat quality for anadromous salmonids. Where fines (<0.85 mm) are greater than 14%, embryo development is limited, and where fines (<6.5 mm) are greater than 30%, fry emergence is limited (NCRWQCB 2000). Existing fines data is presented below in table 5, however more comprehensive data is needed.

TABLE 5 – FINES LESS THAN 0.85 MM, AND LESS THAN 6.5 MM

Stream Name	Year	Fines <0.85mm (%)	Fines <6.5mm (%)
Mainstem @ Blue Waterhole Creek	1995	18.2	46.7[1]
Mainstem @ Inman Creek	1994	15.8	51.0[1]
Blue Waterhole	1999	8.4	29.4[4]
Inman Creek – reach 1	1994	16.6	35.75[1]
Inman Creek – reach 2	1994	15.1	34.35[1]
Inman Creek	1995	12.8	36.7[1]
Inman Creek	1999	9.8	41.9[4]
North Fork (lower)	1989	17.3[2]	40.5[3]
	1990	20.9[2]	47.8[3]
	1991	14.1[2]	30.3[3]
North Fork (mid-lower)	1989	13.3[2]	26.9[3]
	1990	15.4[2]	39.1[3]
	1991	15.1[2]	35.8[3]
North Fork (mid)	1989	25.3[2]	35.8[3]
	1990	17.7[2]	31.2[3]
	1991	20.6[2]	42.0[3]
North Fork (mid-upper)	1989	25.9[2]	43.9[3]
	1990	25.7[2]	48.3[3]
	1991	27.0[2]	46.5[3]
North Fork (upper)	1989	26.3[2]	46.7[3]
	1990	27.1[2]	46.7[3]
	1991	31.3[2]	52.2[3]
North Fork	1999	7.5	26.9[4]
Whitlow Creek	1999	9.3	26.1[4]

[1] Actual measurement was for particles less than or equal to 4 mm.
[2] Actual measurement was for particles less than 1 mm.
[3] Actual measurement was for particles less than 4.75 mm.
[4] Actual measurement was for particles less than 5.6 mm
(McBain and Trush 2000, NCRWQCB 2000, IFR 2003)

3.5 Pool Tail Embeddedness

The pool tail embeddedness measures and protocol employed here are those used by the CDFG as described in Flosi et al. (1998). In this protocol cobbles are randomly selected from pool tails and inspected to determine the percent to which they are surrounded or buried by fines. Cobbles are scored 0-25% embedded (score=1), 26-50% embedded (score=2), 51-75% embedded

(score=3), or 76-100% embedded (score=4) (Flosi et al. 1998). Where embeddedness exceeds 25%, spawning is limited (NCRWQCB 2000).

TABLE 6 – POOL TAIL EMBEDDEDNESS BY SUBWATERSHED

Subwatershed	Embeddedness
Blue Waterhole	Of the 42 pool tail-outs measured, 24 had a value of 1 (57%); 5 had a value of 2 (12%); 1 had a value of 3 (2%); 12 had a value of 5 (29%)
North Fork	Of the 78 pool tail-outs measured, 37 had a value of 1 (47.4%); 13 had a value of 2 (16.7%); 7 had a value of 3 (9%); 21 had a value of 5 (26.9%)
Signal Creek	Of the 46 pool tail-outs measured, 16 had a value of 1 (35%); 15 had a value of 2 (33%); 4 had a value of 3 (9%); 11 had a value of 5 (24%)
Inman Creek	Of the 64 pool tail-outs measured, 45 had a value of 1 (70%); 12 had a value of 2 (19%); 3 had a value of 3 (5%); 4 had a value of 5 (6%)
Graphite Creek	Of the 2 pool tail-outs measured, 1 had a value of 1 (50%) and 1 had a value of 2 (50%)
Garcia mainstem	Of the 127 pool tail-outs measured, 75 had a value of 1 (59%); 22 had a value of 2 (17%); 7 had a value of 3 (6%); 23 had a value of 5 (18%)

(CDFG 2005)

3.6 Instream Habitat Types

Instream habitat data was collected by CDFG in 2004 for most of the Class I watercourses on the Garcia River Forest property. CDFG recommends restoration to restore pools when pool frequency is less than 40% of total habitat units (Flosi et al. 1998).

TABLE 7 – INSTREAM HABITAT TYPES BY SUBWATERSHED

Subwatershed	Habitat Types
Blue Waterhole	56% flatwater units, 24% riffle units, and 20% pool units
North Fork	38% riffle units, 37% flatwater units, 14% pool units, and 11% dry units
Signal Creek	56% flatwater units, 31% riffle units, and 10% pool units
Inman Creek	54% flatwater units, 28% pool units, and 18% riffle units
Graphite Creek	56% flatwater units, 42% riffle units, and 2% pool units
Garcia mainstem	46% pool units, 38% flatwater units, and 17% riffle units

(CDFG 2005)

3.7 Pool depth

Impacts to the pools of the Garcia River include: sediment-related reduced pool depth and structure resulting in reduced amounts of rearing habitat, and reduced availability of cover from predators (EPA 1998). Where the average pool depth is less than 3 feet, rearing is limited (NCRWQCB 2000).

TABLE 8 – POOL DEPTH BY SUBWATERSHED

Subwatershed	Pool Depth
Blue Waterhole	27 of the 42 pools (64%) had a residual depth of three feet or greater
North Fork	Forty-two of the 78 pools (54%) had a residual depth of three feet or greater
Signal Creek	Thirty-three of the 46 pools (72%) had a residual depth of two feet or greater
Inman Creek	30% of pools had a residual depth of three feet or greater
Graphite Creek	2 of 2 (100%) pools have a residual depth of three feet or greater
Garcia mainstem	One hundred nineteen of the 126 pools (94%) had a residual depth of three feet or greater

(CDFG 2005)

3.8 Pool Shelter

Pool shelter provides juvenile salmonids protection from predation, reduces water velocities so fish can rest and conserve energy and separates territories and reduces interspecific competition for food resources (CDFG 2005). Pool shelter ratings are figured using the CDFG protocol (Flosi et al. 1998) for each fully-described habitat unit, and calculate a shelter value by multiplying shelter type (LWD, boulder, etc…) and percent cover. Shelter ratings can range from 0-300 and are expressed as mean values by habitat types within a stream.

TABLE 9 –POOL SHELTER BY SUBWATERSHED

Subwatershed	Pool Shelter
Blue Waterhole	42, boulder are the dominant cover type
North Fork	50. boulder are the dominant cover type
Signal Creek	50, boulder are the dominant cover type
Inman Creek	37, boulder are the dominant cover type
Graphite Creek	15, boulder are the dominant cover type
Garcia mainstem	96, boulders are the dominant cover type

(CDFG 2005)

3.9 Fish

Steelhead make up the vast majority of the anadromous salmonids found in the Garcia River watershed today. In 1960 California Department of Fish and Game estimated that there were 2000 coho and 4000 steelhead spawning in the Garcia River watershed. By 1975, CDFG were only catching 0-20 coho a year and 100-200 steelhead a year by creel census (NCRWQCB 2000). Pink salmon and Chinook salmon are believed to be extirpated from the river, however, some pinks have been seen near the estuary in recent years (Craig Bell, personal communication).

TABLE 10 – RECENT FISH SURVEY DATA (1983-2004)

Subwatershed	Steelhead 0+	Steelhead 1+	Steelhead 2+	Steelehead redds (per reach mile)	Coho redds (total)	Coho
Inman						
1995-1996				**2**[2]		
1996	**49**[1]					
1996-1997				**1.7**[2]		
1997					**3**[3]	**1**[3]
1998-1999				**0.9**[2]		
2004	**8**[5]					
Signal						
1987	**96**[1]	**3**[1]				
1995	**168**[1]	**8**[1]				
1995-1996				**8.3**[2]		
1996-1997				**3.1**[2]		
1997					**1**[3]	**4**[3]
2004	**50**[5]	**14**[5]	**1**[5]			
North Fork						
1983	**152**[1]	**35**[1]	**1**[1]			
2002						**Present**[4]

[1] CDFG electrofishing surveys (IFR 2003)
[2] Maahs (1999)
[3] Maahs (1997)
[4] IFR (2003)
[5] CDFG (2005)

3.10 LARGE WOODY DEBRIS (LWD)

While LWD data exists for the Garcia (O'Connor Environmental 2000), disagreements in definitions of what constitutes LWD complicate its utility. O'Connor Environmental defines LWD as wood 4 inches or greater in diameter and 6 feet long, while CDFG defines LWD as wood 12 inches or greater in diameter and six feet long. LWD definitions should be agreed upon before further data collection is undertaken.

TABLE 11 – LARGE WOODY DEBRIS VOLUME BY SUBWATERSHED (LWD = 4 INCH DIAMETER AND 6 FEET IN LENGTH)

Subwatershed	LWD Volume (m^3/km)
North Fork	581.25
Inman Creek	517.136
Blue Waterhole Creek	325.49
Whitlow Creek	78.237

(O'Connor Environmental 2000)

TABLE 12 –LARGE WOODY DEBRIS BY SUBWATERSHED (# OF PIECES PER 100 FEET) (LWD = 12 INCH DIAMETER AND 6 FEET IN LENGTH)

Subwatershed	Large Woody Debris
Blue Waterhole	2 per hundred feet (both in pools).
North Fork	reach 1: 5 per 100 ft (1 riffle, 3 pool, 1 flatwater); reach 2: 13 per 100 ft. (1 riffle, 12 flatwater); reach 3: 6 per 100 feet (3 pool, 3 flatwater)
Signal Creek	5 per 100 ft. (1 riffle, 2 pool, 2 flatwater)
Inman Creek	2 per 100 ft. (1 riffle, 1 pool)
Graphite Creek	7 per 100 ft. (2 riffle, 4 pool, 1 flatwater)
Garcia mainstem	2 pieces per 100 feet (1 pool, 1 flatwater)

(CDFG 2005)

3.11 Sediment Delivery

Five major sediment delivery categories have been identified in the Garcia River Forest:

1. Diversion potential from roads
    - Many segments of road have been storm proofed by previous owners, however, there are more road segments that need diversion-proofing.
2. Debris slide potential from road and landing fill
    - Using air photo analysis, no debris slide or torrents were identified to have taken place within the last five years. This is not unexpected though, as the Garcia watershed has not experienced a major flood event or above average rainfall during this period. In follow up field surveys, however, two debris slides were discovered.
    - Sites with high potential to fail in the event of a major storm were identified.
3. Culverts on non-permanent roads
    - Field review determined that plugged culverts on non-permanent, seasonal and infrequently used roads are a problem at the Garcia River Forest. Plugged culverts can lead to major diversions and sediment delivery.
4. Streambank failures and slides
    - Streambank failures were the largest potential sediment delivery sites identified during field review.
5. Instream stored sediment
    - There were several sites identified where removal of instream sediment could improve instream conditions and fish habitat availability (Monschke 2005).

Tables 13-17 outline sediment delivery potential by watershed, geologic type, and road type, as well as estimated costs to mitigate erosion and sediment delivery.

TABLE 13 – ROAD DENSITY AND DIVERSION POTENTIAL

	Permanent Roads:					Seasonal/Temporary Roads:			
	Road Drainage and Diversion Potential of Crossings	**Road Densitiy in High and Moderate Sensitivity Zones**	**Road Densitiy in Unstable Areas**	**Road Density in WLPZ**	**General Road Prism Width**	**Road Drainage and Diversion Potential of Crossings**	**Road Densitiy in High and Moderate Sensitivity Zones**	**Road Densitiy in Unstable Areas**	**Road Density in WLPZ**
Inman Creek	Poorly drained with high diversion potential	Moderate	High	Low	Wide	Poorly drained	Moderate	High	High
Signal Creek	Moderate drainage and diversion potential	High	Low	High	Narrow	Well drained	High	Low	High
Hot Springs	N/A	N/A	N/A	N/A	N/A	Moderate drainage and diversion potential	High	Low	Low
Graphite Creek	Well drained with low diversion potential	Moderate	Moderate	Moderate	Wide	Well drained with low diversion potential	Moderate	Moderate	Moderate
Blue Water Hole	Well drained with low diversion potential	Moderate	Low	Low	Narrow	Well drained	Moderate	Low	Moderate
North Fork	Well drained with low diversion potential	High	Moderate	Low	Narrow (except Graphite)	Well drained	Moderate	Moderate	Low
Whitlow and Lamour Creek	Well drained with low diversion potential	Moderate	Moderate	Moderate	Wide	Well drained	Low	Moderate	Low

(Monschke 2005)

TABLE 14 – GEOLOGICAL INFORMATION BY STREAM

	Geological Information:			Stream Overview:		
	General Soil Type	**General Slope Gradient**	**Soil Erosion Potential**	**Stream Gradient**	**Instream Sediment Storage**	**Further Evaluation of Streambank and Fisheries**
Inman Creek	Unstable soils cause earth flow and creep and supports praire and oak woodland	Moderate	High	Low	High	Large debris slides along the streambank are constantly bleeding sediment into the system and a significant volume of instream sediment is being mobilized every winter. Due to the low gradient, this watershed offers prime habitat for Coho if restored.
Signal Creek	High quality permeable soils	Moderate to High	Low	Moderate to High	Low	No large active debris slides were identified that are bleeding significant sediment into the system. A higher volume of stored sediment is evident in one tributary with lower gradient and may provide Coho habitat if restored.
Hot Springs	High quality permeable soils with some rocky soils	High to Moderate	Low	High gradient (except for Garcia River)	Low (except for Garcia River)	Numerous stream bank slides are contributing sediment to the watershed, but the rocky nature of the material is less harmful to fish. This stretch of the Garcia River should be further evaluated for fisheries restoration.
Graphite Creek	High quality permeable soils with some rocky soils	Moderate to High	Low	High gradient (except for Garcia River)	Low (except for Garcia River)	Numerous stream bank slides are contributing sediment to the watershed, but the rocky nature of the material is less harmful to fish. This stretch of the Garcia River should be further evaluated for fisheries restoration.
Blue Water Hole	High quality permeable soils	Moderate to High	Moderate	Moderate	Moderate	No large active debris slides were identified that are bleeding significant sediment into the system.
North Fork	High quality permeable soils (except near Jack's Opening)	High to Moderate	Low	Moderate to High	Moderate	No large active debris slides were identified that are bleeding significant sediment into the system. A natural fish barrier on the North Fork prohibits anadromous fish access to much of the watershed.
Whitlow and Lamour Creek	High quality permeable soils and unstable soils to the northeast of Phelps Ridge	Moderate to High	Low (except area near Phelps Ridge)	Low	High	No large active debris slides were identified that are bleeding significant sediment into the system. Whitlow Creek has potential to be restored for Coho habitat.

(Monschke 2005)

TABLE 15 – SITE SPECIFIC INFORMATION BY STREAM

	Specific Site Information
Inman Creek	Many Opportunities for instream restoration exist in this watershed with at least four high priority sites identified in this preliminary investigation. A considerable amount of instream sediment is present due to unstable geology, bad management practices, and low gradient of the stream which has not allowed this sediment to flush out of the system.
Signal Creek	It would be benificial to decomission significant portions of the road network located within the WLPZ. A significant volume of fill is perched directly over the creek, especially noticable at a site 9. The possible construction of short stretches of mid-slope or ridge road could greatly increase the length of WLPZ road available to decommission without severly limiting management options.
Hot Springs	The main seasonal road in the northern area of the watershed should be reshaped to reduce diversion potential, and many past diversion gullies were identified. No preliminary inventory was completed in the southern part of this watershed area.
Graphite Creek	Rocky parent material lowers the potential for large sediment delivery along the segment of Hollow Tree Road running near the Garcia River. The segment of road connecting Hollow Tree road to the Airforce Station was upgraded with commendable management practices. Well placed culverts with no diversion potential and armored fords were identified.
Blue Water Hole	Three crossings with significant sediment delivery potential were located on a mid-slope seasonal road. The smallest of these sites had an undersized culvert with evidence of recent plugging.
North Fork	Roads in this watershed are in relatively good shape because it was closely scrutinzed during the 1990s by both regulatory agencies and environmental groups. However, there is a narrow and unstable segment of Olson Gulch Road draining into Fishing Resort Creek that poses a problem for sediment delivery and access. A high volume of instream sediment is stored in the lower two miles of the North Fork and should be considered for fisheries restoration. Also a few large logjams in the upper reaches of the watershed have captured sediment and have signifcant erosion potential.
Whitlow and Lamour Creek	Hollow Tree Road is well drained through this area. However, the portion of Inman Creek Road in the Whitlow Creek watershed has significant sediment delivery potential. Also some seasonal roads in the eastern portion of this area have drainage problems.

(Monschke 2005)

TABLE 16 – ESTMATED SEDIMENT VOLUME AND COST TO MITIGATE BY WATERSHED

Estimated Sediment Volume and Cost by Watershed

SPECIFIC DATA FOR EACH WATERSHED	Inman Creek	Signal Creek	Hot Springs	Graphite Creek	Blue Water Hole	North Fork	Whitlow and Lamour Creek	PROPERTY TOTALS
Estimated Percentage of Coverage	35%	50%	40%	40%	30%	20%	50%	~35%
Number of High Priority Sites Identified	17	2	2	1	4	2	0	**28**
Estimated Delivery Potential of Identified Sites (yds^3)	35780	12020	5500	2200	3350	3850	6550	**69250**
Estimated Cost to Mitigate Identified Sites	$134,300	$88,200	$55,000	$22,500	$20,500	$30,000	$39,300	**$389,800**
Estimated Cost Effectiveness for Mitigating Identified Sites ($/yd^3$)	3.8	7.3	10.0	10.2	6.1	7.8	6.0	**6**
Delivery Potential of Projected Sites (yds^3)	102229	24040	13750	5500	11167	19250	13100	**189035**
Total Cost to Mitigate Projected Sites	$383,714	$176,400	$137,500	$56,250	$68,333	$150,000	$78,600	**$1,050,000**

(Monschke 2005)

TABLE 17 – ESTIMATED SEDIMENT VOLUME AND COST TO MITIGATE BY ROAD TYPE

Estimated Sediment Volume and Cost by Road Type

SITE SPECIFICATION BREAKDOWN	High Priority on Permanent Roads	High Priority on Seasonal Roads	High Priority on Temporary Roads	Total High Priority	Medium and Low Priority on Permanent Roads	Medium and Low Priority on Seasonal Roads	Medium and Low Priority on Temporary Roads	Total Medium and Low Priority	TOTAL ALL PRIORITY
Number of Identified Sites	18	10	3	31	15	38	16	69	100
Estimated Delivery Potential of Identified Sites (yds^3)	9600	9200	21500	40300	7320	12150	5780	25550	65850
Estimated Cost to Mitigate Identified Sites	$42,000	$54,000	$62,000	$158,000	$55,200	$108,500	$59,100	$225,800	$383,800
Number of Projected Sites	41	23	7	70	50	125	53	228	297
Total Delivery Potential of Projected Sites (yds^3)	22080	21160	49450	92690	24820	41196	19598	86631	179321
Total Cost to Mitigate Projected Sites	$98,700	$126,900	$145,700	$371,300	$165,600	$325,500	$177,300	$677,400	$1,050,000

(Monschke 2005)

Annual total sediment delivery rates were calculated by Calwater Planning Watershed in 1997 by Pacific Watershed Associates (PWA) for the period 1952-1997. They found about half of the total sediment delivery to be due to mass wasting, approximately 35% from fluvial erosion, and approximately 15% from surface erosion. Of the mass wasting component, 60% was found to be from roads, 20% due to timber harvest activities, and 20% was assumed to be natural background sediment delivery. Of the approximately 50% of total sediment delivery due to fluvial and surface processes, 65-75% is thought to be associated with fluvial erosion at road crossings, road gullies, skid trails and on adjacent hillslopes caused by stream diversions and concentrated runoff. The remaining 25-35% is believed to be derived from surface erosion processes such as sheet wash and rill erosion that occur on roads, cutbanks, ditches, skid trails and other bare soil areas (PWA 1997).

TABLE 18 – ANNUAL TOTAL SEDIMENT DELIVERY RATE

Calwater Planning Watershed	**Annual total sediment delivery rate (tons/mi^2/year) 1952-1997**
North Fork	435
Victoria Fork	554
East Eureka Hill	543
North Gualala Mountain	736
Little Penney	588
Inman Creek	300
Signal Creek	312

(PWA 1997)

In a watershed assessment by Euphrat et al. (1998**)** for the Mendocino County Resource Conservation District and the California Department of Forestry and Fire Protection, 447 mass wasting sites were inventoried. Mass wasting sites were inventoried and classified using aerial photos and were not ground truthed, so they caution that their conclusions are tentative. They classified 85% of mass wasting sites as shallow rapid, 11% as debris torrents, and 4% as persistent deep-seated. 60% of the shallow rapid landslides were associated with roads, 22% were associated with timber harvest, and 18% were presumed to be of natural origin. 63% of debris torrents were associated with roads, 16% with harvest, and 11% were inferred to be of natural causes. Roughly one-quarter of active persistent deep-seated landslides appear to be unrelated to management activities (i.e. they are located in areas where no recent management is evident). The remaining three-quarters occur in areas where roads and timber management activities are evident (Euphrat et al. 1998).

3.12 V*

V* is a measure of the in-channel supply of mobile bedload sediment, and is affected by sediment inputs and is related to the quality of fish habitat (NCRWQCB 2000). Where the average V* is > 0.21, stream channel stability is limited (NCRWQCB 2000). V* for the North Fork Garcia River was calculated to be 0.40 in 1993 (Knopp 1993).

3.13 Riparian Canopy Cover

TABLE 19 – RIPARIAN CANOPY COVER BY SUBWATERSHED

Subwatershed	RIPARIAN CANOPY COVER
Blue Waterhole	The mean percent canopy density for the surveyed length of Blue Waterhole Creek was 77%. The mean percentages of hardwood and coniferous trees were 33% and 44%, respectively with 23% percent of the canopy open.
North Fork	The mean percent canopy density for the surveyed length of North Fork Garcia River was 96%. The mean percentages of hardwood and coniferous trees were 81% and 14%, respectively with four percent of the canopy open.
Signal Creek	The mean percent canopy density for the surveyed length of Signal Creek was 95%. The mean percentages of hardwood and coniferous trees were 69% and 26%, respectively, with 5% of the canopy open.
Inman Creek	The mean percent canopy density for the surveyed length of Inman Creek was 87%. The mean percentages of hardwood and coniferous trees were 74% and 14%, respectively with 13% of the canopy open.
Graphite Creek	The mean percent canopy density for the surveyed length of Graphite Creek was 95%. The mean percentages of hardwood and coniferous trees were 77% and 18%, respectively with 5% of the canopy open.
Garcia mainstem	The mean percent canopy density for the surveyed length of Garcia River was 35%. The mean percentages of hardwood and coniferous trees were 21% and 14%, respectively with 65% percent of the canopy open.

(CDFG 2005)

3.14 Vegetation Bank Cover

Removing vegetation from the riparian zone results in increased stream bank erosion due to loss of stream bank stability, loss of the sediment filtering and capture function that riparian vegetation plays, and a reduction in the potential for large woody debris recruitment (EPA 1998).

TABLE 20 – VEGETATION BANK COVER BY SUBWATERSHED

Subwatershed	Vegetation Bank Cover
Blue Waterhole	For the stream reach surveyed, the mean percent right bank vegetated was 38%. The mean percent left bank vegetated was 39%.
North Fork	For the stream reach surveyed, the mean percent right bank vegetated was 46%. The mean percent left bank vegetated was 50%.
Signal Creek	For the stream reach surveyed, the mean percent right bank vegetated was 48%. The mean percent left bank vegetated was 47%.
Inman Creek	For the stream reach surveyed, the mean percent right bank vegetated was 52%. The mean percent left bank vegetated was 57%.
Graphite Creek	For the stream reach surveyed, the mean percent right bank vegetated was 62%. The mean percent left bank vegetated was 97%.
Garcia mainstem	For the stream reach surveyed, the mean percent right bank vegetated was 57%. The mean percent left bank vegetated was 57%.

(CDFG 2005)

APPENDIX M: 2004 ROAD MAINTENANCE PLAN AND IMPLEMENTATION SUMMARY

- December 13, 2004 correspondence to North Coast Regional Water Quality Control Board regarding Garcia River Forest 2004 road maintenance and upgrade plan

- June 21, 2004, correspondence to North Coast Regional Water Quality Control Board summarizing implementation of the Garcia River Forest road maintenance and upgrade plan

June 21, 2004

Chris Kelly
The Conservation Fund
P.O. Box 5326
Larkspur, CA 94977

Dear Mr. Kelly:

This letter describes North Coast Resource Management's interim road maintenance plan for the Garcia River Forest for the 2004 operating season. The Conservation fund has submitted a Statement Of Intent to comply with the Garcia River TMDL's through the implementation of Option 2, letter to RWQCB dated June 10, 2004. A Site Specific Management Plan and an Erosion Control Plan will be prepared in which future maintenance activities and methodologies will be addressed.

For the 2004 operating season our goal is to maintain access through grading and opening existing mainline roads. The target roads were previously identified as necessary primary roads that provide ingress and egress to the property from various strategic points. These roads will form the core of the road system and provide access for fire suppression, log hauling, wildlife surveys, future road abandonment and improvement projects and for other management activities. Additional secondary roads on the property will be evaluated once we have improved the mainline roads and can effectively access them.

Roads will be treated in a manner consistent with "The Handbook For Forest and Ranch Roads" (Pacific Watershed Associates, 1994). We intend to "grade" approximately 18 miles of primary roads. It is our long-term intention to move toward out-sloped roads with a minimum of perched fill and culvert reliance. Our first season of maintenance will start us on the correct path to a road system that is stable and least likely to cause any damage to the watershed. When grading, the operator will remove existing road berms by either side casting or pulling them back onto the road surface as appropriate (again, following PWA Handbook guidelines). On low gradient roads numerous rolling dips will be constructed, inside ditches will be filled, and roads will be out-sloped. Once a road is reshaped and new permanent drainage structures are in place any previously existing ditch relief culverts that are deemed unnecessary will be abandoned in place or they will be removed. It is anticipated that it will take up to three road gradings to complete a road. Since roads will be graded once every two years, it may take six years to completely reshape a road such that rolling dips and out-sloping drain it. As noted in the "Handbook for Forest and Ranch Roads" there will be local situations where inside ditches and ditch relief culverts will be necessary. These areas will be pre-determined in the field by the project supervisor on a case-by-case basis. Road surface drainage will be maintained throughout the transition period by a combination of existing inboard ditches and ditch relief culverts as well as newly constructed rolling dips.

If necessary in the interim, seasonal waterbars may be installed on these primary roads when the existing road drainage, (after grading) is deemed to be inadequate to protect the road and receiving watercourses through the winter period. The term "side casting" as used above refers to a method of removing outside berm -- it is expected that the material will form a thin layer (less than six inches deep) of soil on the outboard slope of the road. The "sidecast" material is not intended to become part of the road running surface. Material will only be sidecast where there is little or no chance that it will be delivered to a watercourse, per PWA guidelines, at the direction of the project supervisor.

This gradual improvement through successive grading is thought to be more desirable than conducting major road reconstruction projects because it reduces the amount of soil exposed by operations each year, thus reducing the likelihood and amount of construction related runoff. This phased approach, following PWA Handbook guidelines, will also help preserve the existing surface rock and reduce the amount of patch rocking required following road reshaping. These factors combined make this methodology the most cost effective because the improvement projects are built into ordinary road maintenance and cost is spread over a few years. Roads to be graded, as described above, include the Graphite Road and the Inman Creek Road for an estimated total of 18 miles, as shown on the enclosed map.

In addition, approximately 27 miles of other core roads will be opened. Opening will consist of removing bank slumps, fallen trees and rocks, etc. During road opening spoils generated will be placed in a stable location to minimize subsequent handling and avoid potential for delivery to a stream. Roads to be opened include the Hollow Tree Road, Signal Creek Road, Olson Gulch Road, Hot Springs Road and Zettler Ridge Road for an estimated total of 27 miles. Exact mileage by road will be reported at the completion of the project.

Following the initial grading, roads will be monitored during the winter of 2004/05 to evaluate the effectiveness of the project. It was proposed during our June 10 site visit that monitoring be accomplished with photos; the existing road conditions will be photo documented either by video or still photos, once completed the roads to be documented in the same manner.

It was further decided during our site visit that reporting yards of sediment saved in relation to general road grading was not practical; instead, roads will be documented by miles of road graded, berm removed and ditch obliterated. Individual point sources such as culvert replacement and road fills will be reported by their location, watershed and yards of sediment saved. Once a more comprehensive road inventory is developed, and funding and permits are secured, culvert replacement and upgrading will occur on these roads as necessary. At that time specific sediment reduction credits would be documented.

One culvert will be replaced on the Inman Creek Road for a sediment savings of approximately 450 cubic yards. The culvert will be replaced with a 24-inch diameter corrugated metal pipe with trash rack. Using the Rational Method for culvert sizing, an 18-inch diameter culvert is specified; however, to help reduce blockages caused by in-stream debris, no culverts less than 24 inches will be used for watercourse crossings. The installation method will be consistent with the PWA Handbook.

All work is to be conducted by Billy Piper, a very experienced equipment operator who lives locally and has completed similar work for other local landowners and is highly recommended. He will be available to start in mid July.

Enclosed is a map showing the core roads identified and proposed for maintenance. I will be in touch with RQWCB staff to let them know when operations are underway so they can observe if they desire, and will of course be in touch with The Conservation Fund on a regular basis.

Please feel free to call me with any questions.

Sincerely,

Scott Kelly
RPF # 2408

cc: Evan Smith, The Conservation Fund
Jenny Griffin, Consultant to The Conservation Fund

December13, 2004

Chris Kelly
The Conservation Fund
P.O. Box 5326
Larkspur, CA 94977

Dear Mr. Kelly:

This letter summarizes implementation of the Garcia River Forest road maintenance plan as described in our previous letter of June 15, 2004.

This letter is the first step towards reporting and monitoring as required by the Garcia River TMDL and generally conforms to the monitoring strategy reached in the field during our initial site visit with the NCRWQCB. As described in the June 15 letter, specifically reporting yards of sediment saved in relation to general road grading was not practical; instead, roads are documented by miles of road graded, berm removed and ditch obliterated. Individual point sources such as culvert replacement and road fills are reported by their location, watershed and yards of sediment saved. Due to the sporadic nature of berm removal and ditch obliteration associated with GRF's phased approach and subsequent difficulty of measuring berm or ditch removed it was decided to report miles of road graded where reshaping the road had been initiated.

Summary of Road Upgrade Activities Conducted Consistent with "The Handbook For Forest and Ranch Roads" (PWA, 1994) as Described in 06/24/04 Correspondence:

ROAD UPGRADE ACTIVITY	**III. QUANTITY**	**IV. NOTES**
Grading	17 miles	
Road opening (primarily brushing and slide removal)	29.3 miles	Five roads described in text below
Rocked rolling dips	40 dips	Graphite Rd.
Rolling Dips	15 dips	Inman Creek Rd.
Culverts abandoned	4	Graphite Rd.
Culverts replaced	1 x 24" CMP	Sediment savings of 450 cu. yds.

ROAD UPGRADE ACTIVITY	QUANTITY	NOTES
Large slide removal	2	Hollow Tree Rd.
Repair of trench failure	1	By ATT on Hollow Tree Rd.

Detail on Road Upgrade Activities:
Garcia River Forest graded 17 miles of road including the entire length of the Graphite road and The Inman Creek Road. Road berm was removed wherever possible either by sidecasting or incorporating the berm material onto the road surface. Rolling dips were placed such that they cut off ditch relief culverts which will facilitate future culvert abandonment projects. Inside ditches were filled where possible but since the majority of the roads still rely on ditches and culverts for drainage implementation of these measures will take considerable time. . Additionally where rolling dips were constructed, they were constructed to intercept the ditch; therefore filling the ditch was not necessary. The ditch has been removed on low gradient roads where drainage is achieved with out-sloping only. Additionally 29.3 miles of other core roads were opened. Little effort was made to reshape those roads although berm was removed where possible. The road miles reported below have been taken directly from the Geographic Information System therefore some minor differences in road mileages occur between this document and our initial Road Management Plan due to differing techniques of measuring road mileage.

The Graphite Road was outsloped and graded to remove outside berms as previously described. Approximately 40 rocked rolling dips were constructed on a two mile stretch of the road between Mountain View Road and the GRF/MRC property line. Within that stretch 4 ditch relief culverts were abandoned by plugging in place. The road is in a transition stage at this point with a mixture of drainage structures including rolling dips, outsloping and ditch relief culverts.

The road will be monitored this winter and those ditch relief culverts which have been successfully cut off by rolling dips will be subsequently abandoned. Photos of road work on Graphite Road are attached.

Nine miles of road were graded on the Inman Creek Road including removal of the outside berm and outsloping the road. Approximately 15 rolling dips were constructed on the south ¼ of the road between Fish Rock Road and Inman Creek. It was felt that there was sufficient native rock and no attempt was made to armor the dips on Inman Creek Road. There was one culvert replacement on the Inman Creek Road which resulted in a sediment savings of approximately 450 cubic yards. The culvert is located in the 5,481 acre Inman Creek Planning Watershed, # 1113.700104. The location is shown on the attached map. Photos are also attached of the culvert replacement.

Where roads pass through adjacent landowners roads were graded for the entire length however improvements to road drainage were limited to those sections of road which are owned and controlled by Garcia River Forest.

Additionally 29 miles of other core roads were opened including: The Lower Blue Waterhole Creek Road (3.6 miles), the Zettler Ridge Road (5.25 miles), the Signal Creek Road (5.42

miles) and the Olsen Gulch Road from Mountian View Road back to the Graphite Road (14.9 miles). Two slides which were partially blocking Hollow Tree road were also removed and the trench failure caused by ATT's fiber optic cable was repaired by ATT subcontractors. Photos attached.

Summary:

This was the first year of this program and we are generally pleased with the results of the work accomplished and the overall approach. It is felt that over time we will be able to shift valuable maintenance dollars from simple road openings to more substantive road improvements and sediment savings.

Please feel free to call with any questions.

Sincerely,

Scott Kelly
RPF # 2408

APPENDIX N: SILVICULTURE DATA
TABLE 1
VOLUME PER ACRE

	Compart-ment Name	Lower North Fork	Upper North Fork	Blue Waterhole	Whitlow	Signal	Mainstem	Hot Springs		
Note: volume per acre by DBH, species & compartment; board feet per acre by DBH										
Species	**Comp. No.**	**1**	**2**	**3**	**4**	**6**	**7**	**8**	**Total**	**% Total**
	Acres	2,037.34	3,336.73	1,440.89	1,469.46	3,009.53	2,044.90	1,980.83	15,319.68	
RW	8-12"	204.32	195.29	258.34	178.49	285.02	166.79	168.05	208.04	0.13
	12-16	521.07	437.17	485.38	453.04	490.43	330.55	404.69	446.05	0.27
	16-20	695.87	567.08	633.75	543.40	714.39	518.56	552.63	603.67	0.37
	20-24	436.55	283.57	328.65	316.66	319.39	271.15	375.47	333.06	0.20
	24+	618.38	361.46	415.89	379.95	571.99	428.68	473.98	464.33	0.28
	RW Subtotal	**2,476.18**	**1,844.57**	**2,122.01**	**1,871.53**	**2,381.23**	**1,715.73**	**1,974.82**	**2,055.15**	**1.25**
DF	8-12	624.38	611.98	540.69	367.90	717.73	588.70	413.46	552.12	0.33
	12-16	977.65	1,106.14	1,087.60	732.37	1,267.85	1,289.79	917.38	1,054.11	0.64
	16-20	425.37	376.66	365.27	263.11	444.41	356.57	319.02	364.34	0.22
	20-24	272.17	203.40	250.48	195.19	341.84	291.14	204.57	251.26	0.15
	24+	489.97	695.46	588.05	632.64	605.15	555.09	835.80	628.88	0.38
	DF Subtotal	**2,789.54**	**2,993.64**	**2,832.10**	**2,191.21**	**3,376.97**	**3,081.28**	**2,690.24**	**2,850.71**	**1.73**
OC (Other Conifer)	8-12	84.65	88.40	71.15	92.91	77.40	43.84	52.37	72.96	0.04
	12-16	154.16	163.65	169.80	138.65	175.36	126.62	123.68	150.28	0.09
	16-20	229.20	298.85	292.93	168.94	334.40	311.21	214.82	264.34	0.16
	20-24	123.24	119.08	134.48	92.90	138.88	105.95	113.40	118.28	0.07
	24+	94.30	90.47	124.52	105.67	131.63	83.67	98.55	104.12	0.06
	OC Subtotal	**685.55**	**760.45**	**792.89**	**599.08**	**857.67**	**671.29**	**602.83**	**709.96**	**0.43**
All	**Total**	**5,951.27**	**5,598.66**	**5,746.99**	**4,661.81**	**6,615.87**	**5,468.31**	**5,267.89**	**5,615.83**	**3.40**
	8-12	913.35	895.68	870.18	639.30	1,080.15	799.32	633.89	833.12	0.50
	12-16	1,652.89	1,706.96	1,742.79	1,324.06	1,933.64	1,746.96	1,445.76	1,650.44	1.00
	16-20	1,350.45	1,242.58	1,291.95	975.45	1,493.20	1,186.34	1,086.48	1,232.35	0.75
	20-24	831.95	606.05	713.61	604.75	800.11	668.24	693.44	702.59	0.43
	24+	1,202.64	1,147.39	1,128.46	1,118.26	1,308.77	1,067.44	1,408.33	1,197.33	0.73

TABLE 2: HARVEST PLAN BY COMPARTMENT

Compartment Number		1	2	3	4	6	7	8	Total (All Non-Reserve)	Annual Allowable Cut
Compartment Name		Lower North Fork	Upper North Fork	Blue Waterhole	Whitlow	Signal	Mainstem	Hot Springs		
Forested Acres		2,037.34	3,336.73	1,440.89	1,469.46	3,009.53	2,044.90	1,980.83	15,319.68	
2005	2005 mbf	11,036.00	18,353.84	8,737.33	8,078.60	18,268.15	12,075.61	9,367.35	85,916.88	
2005	2005 mbf/acre	5.42	5.50	6.06	5.50	6.07	5.91	4.73	5.60	
2006-2015	harvest (decade)	1,931.30	3,211.92	1,529.03	1,413.75	3,196.93	2,113.23	1,639.29	15,035.45	1,503.55
2015	post-harvest	15,195.41	25,271.29	12,030.38	11,123.38	25,153.31	16,626.84	12,897.85	118,298.46	
2015	post-harvest/acre	7.46	7.57	8.35	7.57	8.36	8.13	6.51	7.72	
2016-2025	harvest (decade)	2,483.69	4,130.59	1,966.37	1,818.12	4,111.31	2,717.66	2,108.15	19,335.88	1,933.59
2025	post-harvest	20,491.85	34,079.74	16,223.64	15,000.49	33,920.64	22,422.22	17,393.46	159,532.04	
2025	post-harvest/acre	10.06	10.21	11.26	10.21	11.27	10.96	8.78	10.41	
2026-2035	harvest (decade)	3,992.84	6,640.44	3,161.18	2,922.85	6,609.44	4,368.97	3,389.12	31,084.82	3,108.48
2035	post-harvest	25,929.61	43,123.22	20,528.78	18,981.05	42,921.89	28,372.23	22,009.03	201,865.82	
2035	post-harvest/acre	12.73	12.92	14.25	12.92	14.26	13.87	11.11	13.18	
2036-2045	harvest (decade)	5,704.51	9,487.11	4,516.33	4,175.83	9,442.82	6,241.89	4,841.99	44,410.48	4,441.05
2045	post-harvest	30,993.73	51,545.29	24,538.10	22,688.10	51,304.64	33,913.40	26,307.44	241,290.69	
2045	post-harvest/acre	15.21	15.45	17.03	15.44	17.05	16.58	13.28	15.75	
2046-2055	harvest (decade)	7,393.55	12,296.13	5,853.56	5,412.25	12,238.72	8,090.04	6,275.64	57,559.89	5,755.99
2055	post-harvest	35,213.05	58,562.40	27,878.59	25,776.74	58,288.99	38,530.19	29,888.80	274,138.77	
2055	post-harvest/acre	17.28	17.55	19.35	17.54	19.37	18.84	15.09	17.89	
2056-2065	harvest (decade)	8,794.46	14,625.96	6,962.68	6,437.74	14,557.68	9,622.92	7,464.73	68,466.16	6,846.62
2065	post-harvest	38,256.83	63,624.47	30,288.39	28,004.85	63,327.44	41,860.70	32,472.36	297,835.05	
2065	post-harvest/acre	18.78	19.07	21.02	19.06	21.04	20.47	16.39	19.44	
2066-2075	harvest (decade)	9,755.49	16,224.24	7,723.54	7,141.24	16,148.50	10,674.48	8,280.45	75,947.94	7,594.79

2075	post-harvest	40,013.67	66,546.25	31,679.30	29,290.90	66,235.57	43,783.04	33,963.57	311,512.31	
2075	post-harvest/acre	19.64	19.94	21.99	19.93	22.01	21.41	17.15	20.33	
2076-2085	harvest (decade)	11,403.90	18,965.68	9,028.60	8,347.91	18,877.14	12,478.17	9,679.62	88,781.01	8,878.10
2085	post-harvest	40,617.95	67,551.21	32,157.71	29,733.24	67,235.84	44,444.24	34,476.47	316,216.67	
2085	post-harvest/acre	19.94	20.24	22.32	20.23	22.34	21.73	17.41	20.64	
2086-2095	harvest (decade)	12,185.38	20,265.36	9,647.31	8,919.97	20,170.75	13,333.27	10,342.94	94,865.00	9,486.50
2095	post-harvest	40,617.95	67,551.21	32,157.71	29,733.24	67,235.84	44,444.24	34,476.47	316,216.67	
2095	post-harvest/acre	19.94	20.24	22.32	20.23	22.34	21.73	17.41	20.64	
2096-2105	harvest (decade)	12,185.38	20,265.36	9,647.31	8,919.97	20,170.75	13,333.27	10,342.94	94,865.00	9,486.50
2105	post-harvest	40,617.95	67,551.21	32,157.71	29,733.24	67,235.84	44,444.24	34,476.47	316,216.67	
2105	post-harvest/acre	19.94	20.24	22.32	20.23	22.34	21.73	17.41	20.64	

TABLE 3: CRUISED STANDS DETAIL

STD_ID	VEG. LABEL	COMP NO.	ACRES	ELEV. (ft.)	SLOPE	STEMS	QDBH	BASAL	HEIGHT	CCF	RELD	CUBIC_ ST	CUBIC_ SM	BOARD _SN
Note: see key below for description of headers														
5	MH32	3	61.30	1,160	41	926.00	5.16	134.59	79.62	220.71	59	3,184.55	1,654.81	8,445.85
8	CH21	3	13.78	643	44	843.48	4.76	104.12	75.05	196.83	48	2,313.32	1,292.14	6,320.73
43	MH32	6	313.29	1,139	47	1,260.05	5.07	176.94	66.68	312.29	79	3,387.28	1,245.20	5,825.09
45	CH22	6	225.16	946	57	1,268.64	4.82	160.74	69.19	298.76	73	3,157.16	1,470.52	6,834.51
46	MH22	6	119.74	975	50	1,342.60	5.14	193.25	62.85	353.31	85	3,389.04	1,331.64	5,893.48
72	MH32	6	24.73	827	55	1,282.60	4.68	153.45	60.75	261.68	71	2,742.89	753.83	3,283.27
98	CH31	3	104.39	1,724	62	1,096.72	3.86	89.14	68.69	162.90	45	1,895.35	921.35	4,213.93
107	CH31	4	112.56	1,434	58	809.44	4.73	98.71	67.07	166.12	45	2,085.07	1,074.47	4,936.74
129	DS31	7	2.80	461	68	856.29	4.49	94.16	71.67	165.30	44	2,070.24	1,308.80	6,140.27
140	DR32	7	50.88	381	30	1,354.03	5.23	202.03	77.89	350.13	88	4,344.02	2,447.66	12,097.82
149	RD33	1	9.30	1,323	58	1,774.38	4.54	199.69	83.30	368.17	94	4,204.18	2,274.47	10,209.56
151	RD33	1	0.50	177	39	2,487.67	3.90	206.41	79.04	378.57	105	4,254.44	2,870.34	12,580.01
166	DR31	2	154.98	1,290	60	960.59	3.96	82.14	76.90	157.96	41	1,962.56	1,394.71	6,667.68
167	MH32	2	40.16	2,046	30	1,256.26	4.36	130.42	56.13	233.25	62	2,324.72	784.45	3,250.88
182	DS21	2	102.10	1,599	52	649.63	4.56	73.58	65.76	131.03	34	1,659.45	1,040.58	5,030.79
183	DR22	2	66.51	1,297	37	1,170.25	4.89	152.51	76.04	287.87	69	3,174.99	1,628.84	7,871.96
184	DR31	2	16.28	1,558	42	1,519.28	3.22	86.11	58.07	187.46	48	1,562.78	677.14	2,958.26
186	DS32	2	11.71	1,665	53	1,006.01	4.45	108.71	83.24	206.85	52	2,581.86	1,871.44	8,648.79
225	MH42	8	44.25	1,624	71	919.54	5.89	173.91	64.40	226.90	72	4,036.26	2,358.49	13,125.83
233	MH32	7	25.26	458	61	1,161.70	4.61	134.94	69.67	242.93	63	2,617.18	1,171.94	5,564.65
235	MH41	8	35.14	262	54	2,102.39	2.83	91.67	62.27	184.61	55	1,849.86	529.25	2,306.41
251	MH32	8	46.64	456	56	1,360.76	4.95	181.84	72.65	315.80	82	3,644.06	1,347.23	6,424.17
253	CH32	5	14.39	791	45	1,075.92	5.54	180.29	70.43	291.05	77	3,557.10	1,703.15	7,693.98

KEY TO HEADERS:	
COMP. NO.	Compartment number
ACRES	after subtractions for reserve
QDBH	quadratic mean diameter at breast height
HEIGHT	average height of merchantable trees
CCF	crown competion factor
RELD	relative density
CUBIC_ST	total cubic foot volume per acre
CUBIC_SM	merchantable cubic foot volume per acre
BOARD_SN	net merchantable board foot volume per acre
CLUMP	Clumpiness index (1 = evenly spaced)
M	Merchantable trees only (e.g. MDBH = DBH for merchantable trres only)
CUB_ERR	% +/- error for total cubic foot volume estimate
BRD_ERR	% +/- error for net board foot volume estimate

TABLE 4: PERMENENT PLOT RE-MEASUREMENT DATA

Note: volumes are board feet per acre Scribner for conifers 6.5 inches DBH and larger

Plot	First Measure-ment Date	First Measure-ment Volume	Second Measure-ment Date	Second Measure-ment Volume	Period (years)	Annual Growth (board feet)	Annualized Growth (percent)
110090	1/4/1995	4,467	5/16/2005	6,549	10.4	201	3.7%
120090	1/7/1995	1,159	5/6/2005	5,011	10.3	373	15.3%
150080	2/2/1995	36,308	5/17/2005	52,189	10.3	1,543	3.6%
160080	2/2/1995	0	5/6/2005	5,995	10.3	584	0.0%
170140	1/6/1995	3,294	8/8/2005	5,305	10.6	190	4.6%
170330	8/18/1994	492	5/3/2005	1,346	10.7	80	9.9%
170340	8/18/1994	1,746	5/16/2005	4,743	10.8	279	9.7%
180140	1/6/1995	0	8/8/2005	0	10.6	0	0.0%
190340	7/27/1994	5,855	5/3/2005	15,271	10.8	874	9.3%
190350	7/26/1994	2,712	5/3/2005	13,227	10.8	976	15.8%
200120	1/31/1995	4,621	5/31/2005	10,330	10.3	552	8.1%
210120	1/31/1995	4,843	6/2/2005	11,413	10.3	635	8.7%
210280	12/30/1994	1,693	7/26/2005	2,808	10.6	105	4.9%
220280	12/30/1994	4,731	8/2/2005	8,058	10.6	314	5.2%
220420	2/3/1995	12,642	7/12/2005	15,972	10.4	319	2.3%
230420	2/3/1995	8,240	7/12/2005	15,921	10.4	735	6.5%
250090	1/25/1995	20,603	7/7/2005	39,865	10.5	1,842	6.5%
260090	1/24/1995	4,697	7/5/2005	11,916	10.5	691	9.3%
270350	1/13/1995	3,771	5/11/2005	7,249	10.3	337	6.6%
270360	9/19/1994	15,922	6/3/2005	23,906	10.7	745	3.9%
270390	9/16/1994	19,478	8/10/2005	37,017	10.9	1,608	6.1%
280410	9/15/1994	16,695	6/21/2005	31,389	10.8	1,364	6.0%
280420	9/14/1994	8,613	6/20/2005	18,268	10.8	896	7.2%
280500	12/29/1994	3,911	8/4/2005	11,204	10.6	688	10.4%

290500	12/29/1994	0	8/4/2005	0	10.6	0	0.0%
300310	8/9/1994	1,298	8/3/2005	2,658	11	124	6.7%
300320	8/9/1994	4,089	8/3/2005	15,925	11	1,077	13.2%
320790	12/20/1994	1,004	6/14/2005	1,804	10.5	76	5.7%
330410	8/11/1994	10,739	6/29/2005	19,828	10.9	835	5.8%
330420	8/11/1994	1,356	6/29/2005	4,880	10.9	324	12.5%
330790	12/20/1994	3,033	6/15/2005	5,609	10.5	245	6.0%
370810	12/23/1994	1,159	6/10/2005	2,582	10.5	136	7.9%
380810	12/23/1994	2,283	6/10/2005	4,622	10.5	223	6.9%
470450	12/27/1994	1,292	7/8/2005	3,792	10.5	237	10.8%
480450	12/27/1994	1,158	7/8/2005	1,744	10.5	56	4.0%
510520	12/16/1994	3,030	7/8/2005	3,741	10.6	67	2.0%
520520	12/16/1994	6,789	7/8/2005	10,400	10.6	342	4.1%
550490	12/15/1994	25,389	8/15/2005	40,925	10.7	1,456	4.6%
560490	12/14/1994	17,484	8/15/2005	26,008	10.7	798	3.8%
590650	12/13/1994	17,324	5/6/2005	24,967	10.4	735	3.6%
600650	12/13/1994	1,104	5/6/2005	9,375	10.4	795	22.8%
650540	12/12/1994	12,907	5/5/2005	29,212	10.4	1,567	8.2%
660540	12/6/1994	11,568	5/4/2005	20,516	10.4	859	5.7%
Average		**7,198**		**13,571**	**10.6**	**602**	**6.9%**
Median		**4,089**		**10,330**	**10.6**	**552**	**6.1%**

FIGURE 1: REPRESENTATIVE DIAMETER DISTRIBUTIONS