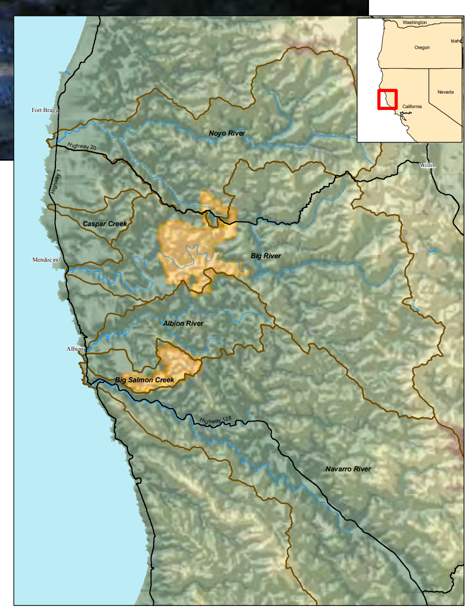
BIG RIVER AND SALMON CREEK FORESTS INTEGRATED RESOURCE MANAGEMENT PLAN

A project of The Conservation Fund in partnership with the State Water Board, State Coastal Conservancy and the Wildlife Conservation Board



AUGUST 2009

Cover photograph: Big River, Mendocino County, California
Photo by Chris Kelly

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LIST OF ACRONYMS AND ABBREVIATIONS

ARB – (California) Air Resources Board

BF – board feet

CALVEG – California Vegetation (U.S. Forest Service)

DFG – California Department of Fish and Game

CAL FIRE – California Department of Forestry and Fire Protection

CCAR – California Climate Action Registry

CESA – California Endangered Species Act

CNDDB – California Natural Diversity Data Base

CRT – Carbon Reduction Ton

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

ELZ – Equipment Limitation Zone

EMAP – Environmental Monitoring and Assessment Program (US EPA)

EPA – Environmental Protection Agency

ESA – U.S. Endangered Species Act

FPR – California Forest Practice Rules

FPS – Forest Projection and Planning System

FSC – Forest Stewardship Council

GIS – Geographic Information System

GRF – Garcia River Forest

IRMP – Integrated Resource Management Plan

LTO – licensed timber operator

LWD – large woody debris

MBF – thousand board feet

MMBF – million board feet

MOU – Memorandum of Understanding among The Conservation Fund, the State Water Board, the California State Coastal Conservancy and the Wildlife Conservation Board dated October 5, 2006

NCRWQCB – North Coast Regional Water Quality Control Board

NPS – Non-Point Source

NSO – northern spotted owl

RPF – registered professional forester

SCC – State Coastal Conservancy

SFI – Sustainable Forestry Initiative

SPAP – Stewardship Permit Access Program

SRF – State Revolving Fund

SWRCB – State Water Resources Control Board

TCF – The Conservation Fund (also referred to as "the Fund")

THP – timber harvest plan

TMDL – total maximum daily load

USFWS – U.S. Fish and Wildlife Service

WCB – Wildlife Conservation Board

WDR – Waste Discharge Requirement (SWRCB)

WLPZ – Watercourse and Lake Protection Zone (Forest Practice Rules)

1. EXECUTIVE SUMMARY

1.1 PROJECT OVERVIEW

The Big River and Salmon Creek Forests were acquired in November 2006 by The Conservation Fund (the Fund) in partnership with the State Water Board, the State Coastal Conservancy, the Wildlife Conservation Board and the David and Lucile Packard Foundation. The project is part of the Fund's North Coast Forest Conservation Initiative that seeks to demonstrate that large, under-stocked tracts 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.[1]

As set forth in a Memorandum of Understanding among the State Water Board, the California State Coastal Conservancy and the Wildlife Conservation Board (MOU) attached as Appendix A, the "purposes for the acquisition and subsequent management of the [Forests] are (a) to ensure the permanent protection of the [Forests] from subdivision, residential and commercial development, mining, …, water diversion, and conversion to non-forest uses, and (b) protect, restore and enhance water quality and salmonid habitat, improve forest structure and increase natural diversity, provide a sustainable harvest of forest products, and, where appropriate, provide public access…" The MOU further provides that the Fund will prepare a forest and water quality management and restoration plan (Plan).

This Plan is intended to fulfill the requirements of the MOU by describing integrated management activities that will in time satisfy the purposes of the acquisition as set forth in the MOU. Principal management activities that will be implemented to achieve these purposes are described in detail under the following headings: Streams and Roads, Forest Management and Community Involvement, as well as in Sections 4 (Management Goals and Measures) and 5 (Community Use and Involvement).

The preparation of the Plan has been aided significantly by work previously done by the Fund and its partners to prepare the Garcia River Forest Integrated Resource Management Plan (August 2006). While there are significant differences between the current condition of the Big River and Salmon Creek Forests and the Garcia River Forest (GRF), including stocking levels[2] and the financial obligations incurred in acquiring the Forests,[3] there is also much in common with the ultimate management objectives of the GRF. Consequently, many of the principles and strategies contained in the GRF Integrated Resource Management Plan (IRMP) have therefore been adapted for this Plan.

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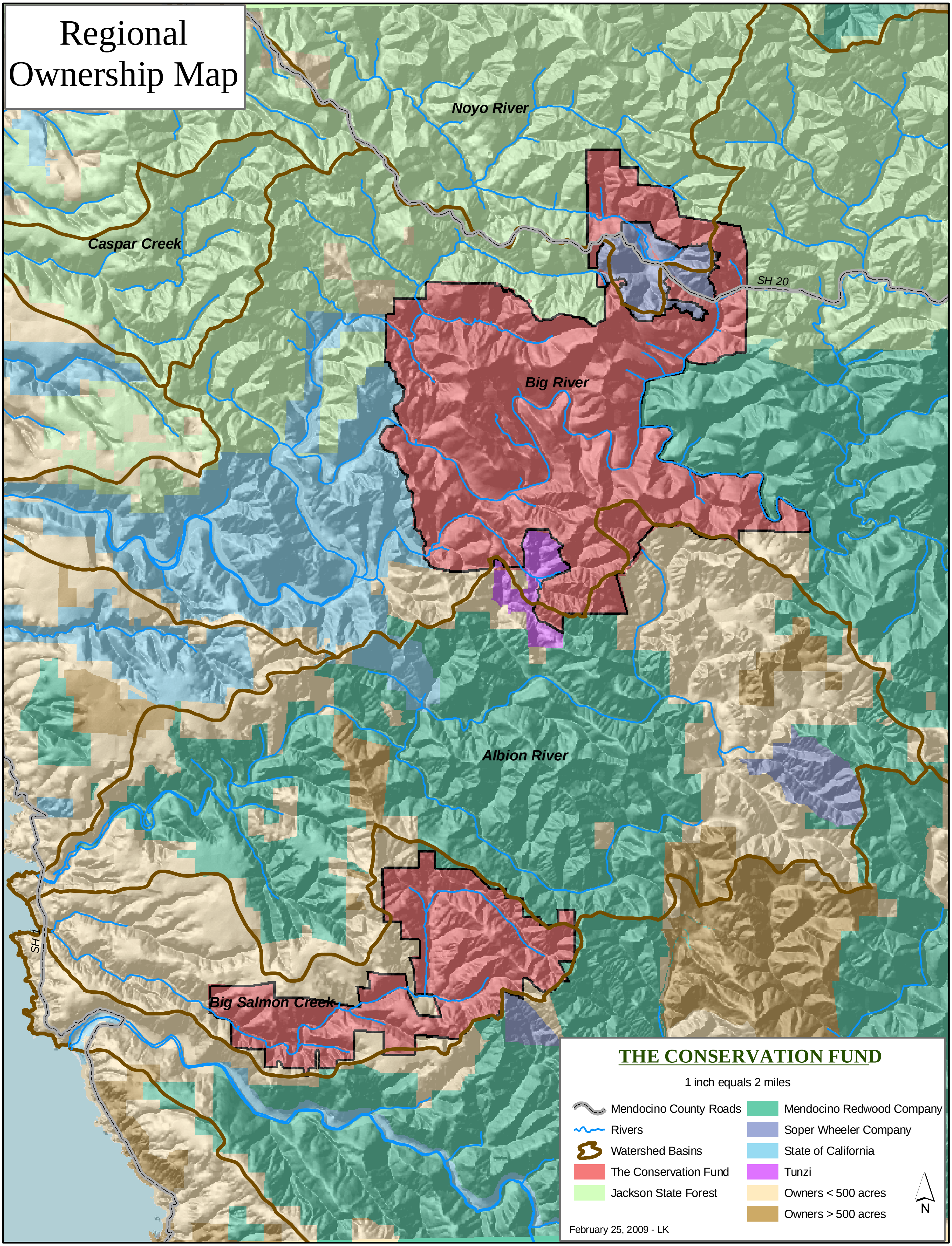
[1] The strategic rationale for this approach to forest conservation is described in detail in *Conservation Prospects for the North Coast: A Review and Analysis of Existing Conservation Plans, Land Use Trends and Strategies for Conservation on the North Coast of California* (The Conservation Fund, 2005) at pages 144 et seq.

[2] Average current conifer stocking on the GRF is approximately 8,000 board feet per acre, compared with approximately 23,000 board feet per acre on the Forests. See Section 3.3.

[3] As part of the $48,500,000 purchase price paid for the Forests, the Fund borrowed $25,000,000 from the State Revolving Fund, a low-interest loan program administered by the State Water Board to address point and non-point water quality objectives. The scheduled annual loan payments of $1.54 million fully amortize the loan over a period of 20 years. The source of repayment is intended to come from net revenues from harvest operations as described in this Plan.


The Conservation Fund
North Coast Forest
Conservation Program
Washington
Idaho
Oregon
Nevada
California
Fort Bragg
Highway 20
Noyo River
Willits
Highway 1
Caspar Creek
Big River
Mendocino
Albion River
Albion
Big Salmon Creek
Highway 128
Navarro River
THE CONSERVATION FUND
1 inch equals 4 miles
TCF Ownership
Watershed Basins
Highways
Rivers
N
February 25, 2009 - LK

Regional Ownership Map



1.2 OVERVIEW OF FOREST CHARACTERISTICS AND CONDITIONS

The Big River Forest (approximately 11,770 acres) is located within the middle portion of the Big River watershed and contains tributaries including Little North Fork, Two Log Creek and Laguna Creek, as well as a central portion of the main stem of Big River. It adjoins Big River State Park and Jackson Demonstration State Forest; together these properties comprise the largest block of connected protected land entirely within Mendocino County. Salmon Creek is a relatively small coastal watershed in Northern California, with the entire drainage area lying within eight miles of the coast. The Salmon Creek Forest (approximately 4,250 acres) encompasses 51 percent of its watershed. Please see the Location Map (Figure 1) and Regional Ownership Map (Figure 2).

Big River and Salmon Creek are high priority refugia watersheds identified in the 2004 "Recovery Strategy for California Coho Salmon." The Forests combined include 34 miles of Class I watercourse, 41 miles of Class II watercourse, associated riparian habitats, four major sub-basins currently supporting coho, and an array of additional sensitive species. The size and locations of the Forests provide significant contributions to the integrity and ecological viability of their respective watersheds and the larger ecoregion.

The Forests are typical of the north coast of California, dominated by native conifers (primarily redwood and Douglas-fir) and adapted to the steep slopes and heavy rainfall common to the region. The Forests are richly productive and support significant wildlife, including many imperiled species, such as coho salmon, steelhead trout, and northern spotted owls. The majority of the Forest has been harvested at least twice since the arrival of European settlers around the turn of the 20th century. Some of the forest stands are 80 years old, but most are much younger—the result of significant harvesting in the 1950s through the current day. At 23,000 board feet per acre (23 mbf/acre), the timber inventory on the Forests is depleted compared to historic levels but is considerably better than much of the timberland in the region (including the Garcia River Forest). And because of its unique properties and appearance, redwood is still one of the most valuable lumber species in the world.

The Forests are well situated for continued forest management— there is good road infrastructure, relatively high site productivity, and a mixture of mature forest and rapidly growing young stands. That said, only about half the property currently is able to support a commercial timber harvest, many of the roads and stream crossings will need upgrading in the next twenty years, and two invasive weeds are widely established. The properties are excellent candidates for long-term restoration because, despite over 100 years of industrial timber management, there is still viable aquatic habitat, a high diversity of plant communities (including riparian forests, pygmy forest, coastal redwood forest, well-stocked riparian areas, and mixed hardwood/conifer forest), and sensitive plant and animal species including coho salmon and steelhead trout.

1.3 STREAMS AND ROADS

Like most large timberland tracts in the region, the Forests have been managed for industrial timber production for several decades. According to the *Nonpoint Source Program Strategy and Implementation Plan, 1998 – 2013* (NPS 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 overstory 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."[4]

The Big River watershed is listed by the State Water Resources Control Board (SWRCB) as having impaired water quality due to sediments and/or temperature in accordance with Section 303(d) of the federal Clean Water Act. In addition, both the Big River and Big Salmon Creek watersheds are designated as "Critical Coastal Areas," or specially-designated land areas of the California coast where government agencies and other stakeholders have agreed to improve or protect exceptional coastal water quality from the impact or threat of nonpoint source pollution through the implementation of specific management measures.

While past forest management has been a significant contributing cause of impairment of North Coast water bodies (primarily because of poorly designed and maintained legacy roads), there is broad agreement that preventing fragmentation of large tracts of coastal forests and implementing management measures relating to sediment reduction through improved road maintenance and sustainable forest practices is the most feasible means of enhancing water quality in the Region.

There are four principal management strategies that will be used to address the protection and enhancement of water quality:[5]

1. Prohibit subdivision, development and conversion to non-forest uses. These objectives have been largely met by the acquisition of the Forests and the perpetual restrictions set forth in the MOU.

2. Address potential sediment delivery through comprehensive road assessments, site prioritization, and property-wide rehabilitation treatments. All sites with the potential to

[4] 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…."

[5] The NPS Implementation Plan identifies 12 management measures relating to forestry. These measures are described in detail in the California Nonpoint Source Pollution Encyclopedia. *See* www.swrcb.ca.gov/nps/docs/encyclopedia/forestry.pdf

deliver sediment in excess of ten cubic yards to a watercourse will be identified, mapped, and prioritized by the end of 2010 (Salmon Creek) and 2012 (Big River). Remediation measures for priority sites will be developed and implemented with monies raised from private and public sources including the Department of Fish and Game's Fisheries Restoration Grant Program and net revenue from forest operations, and should be completed in 10 years (Salmon Creek) and 15 years (Big River) from the completion of assessments. This focus on treating high priority sites will be in addition to the annual maintenance and road upgrades normally required as part of individual timber harvest plans.

3. Practice principally uneven-age selection silviculture to maintain mature timber stands across the Forests with minimal openings, thereby reducing the potential hydrologic impacts of even-aged management, which studies at Caspar Creek[6] have linked to temporary increases in peak flows, sediment yields, and ambient temperature.

4. Increase riparian protection by increasing canopy retention across all classes of streams beyond the levels required under the California Forest Practice Rules (FPR).

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[6] For the past three decades, researchers from the Pacific Southwest Research Station's Redwood Sciences Laboratory in Arcata, California, and the California Department of Forestry and Fire Protection, Jackson Demonstration State Forest near Fort Bragg, have been studying the effects of logging northern California watersheds. Their findings have identified the extent and nature of hydrologic, erosion, and sedimentation impacts of logging operations on watersheds in this area. See http://www.fs.fed.us/psw/topics/water/caspar/

1.4 FOREST MANAGEMENT

The forest management policies and strategies described in this Plan are derived in part from the GRF Integrated Resource Management Plan and the interim management policies prescribed in the MOU. The interim management policies in the MOU related to forestry are to:

- Reduce annual, property-wide harvest levels between 40 and 50 percent below the levels allowed under the Forest Practice Rules in effect at the time of the purchase of the Forests as established in the appraisal (Appraisal Associates, 2006).
- Use single tree or small group selection as the primary silvicultural prescription, with the recognition that other harvest methods such as commercial thinning and variable retention prescriptions may be necessary to achieve the project purposes described in the MOU.
- Establish riparian buffers that are wider than required under the Forest Practice Rules.

Several factors on the Forests (and on coastal Mendocino County forestland in general) complicate sustainable forest management, including a predominance of steep slopes, relatively low volumes of merchantable timber, well-established hardwood competition, a short operating season, limited markets for products, and complex regulation. All of these factors increase the cost of operations and decrease operating margins. The Fund is only able to adopt the relatively low-intensity forest management measures described in this Plan because of its ability to access the emerging market for carbon credits and the financial subsidy inherent in the grants and low interest loans used to acquire the Forests.

The principal forest management practices set forth in this Plan are as follows:

- Use primarily uneven-aged single tree selection silviculture (or “transition” if current stocking will not meet the requirements for selection). In some situations, variable retention harvests (that retain large trees and habitat features) may be used to rehabilitate conifer sites dominated by hardwoods or in the unlikely case of salvage harvests. Group selection or variable retention will likely be used on Douglas-fir sites. All harvests will encourage natural regeneration and retain and develop critical wildlife habitat features, such as snags, downed wood, and trees of significant size.
- Generate revenue sufficient to repay the State Water Board loan and cover annual costs of operations and, to the extent feasible, re-invest in restoration and enhancement measures described in Section 4.
- Harvest at levels significantly less than growth rates over the next few decades to increase timber inventory and carbon storage. The projected average annual harvest of 4.65 million board feet is under 1.5 percent of inventory and is expected to result in at least a 34 percent increase in standing inventory over the next two decades.
- Establish increased riparian buffers to improve riparian habitat conditions and water quality protection by increasing the canopy retention requirements for all classes of streams.

- Maintain certification under the Forest Stewardship Council and Sustainable Forestry Initiative standards and report carbon sequestration increases through the California Climate Action Registry.

Figure 1: Sustainable Forest Management Certification Audit in Big River, May 6, 2007 (Jenny Griffin photo)

1.5 COMMUNITY USE AND INVOLVEMENT: PUBLIC ACCESSS

The Fund will provide a range of opportunities for community use and involvement 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 demonstration to participation in restoration projects and unsupervised pedestrian and equestrian access.

To foster community involvement and support, the Fund provides guided tours of areas intended for timber harvests, road improvement and restoration projects, and native plants, as well as tours tailored for youth education. These programs familiarize the public with sustainable management methods and goals and build community partnerships. In addition, the Fund is developing an access program to allow unsupervised pedestrian and equestrian public access on designated roads, while emphasizing the public's role as stewards of the Big River and Salmon Creek Forests.

Figure 2: Mike Stephens, NSO Biologist, Speaking to Stakeholders on a Tour of the Fund's RiverBends THP, April 2007 (Jenny Griffin photo)

2. Project Introduction and Purpose of Plan

2.1 Project Rationale

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. For decades, timber harvesting has been the predominant land use in the region and much of the coastal watersheds in Mendocino and Humboldt counties continue to be held in large blocks of industrial timberland. These large forest tracts were assembled over the last century, as the predecessors of the current owners acquired and aggregated many smaller parcels from homesteaders and others emigrating to the cities during the early to mid-twentieth century. As a consequence, these forests typically are comprised of many smaller parcels most of which are eligible for certificates of compliance, thus enabling the subdivision of these large holdings without the significant permitting and environmental oversight that usually is required to subdivide land.

Until recently, the economic value of these smaller parcels and alternative uses has not been competitive with the value of continued timber production, and they were largely ignored. But inventory depletion, the cost of regulation and the increasing value of land for "higher and better uses" has led some forestland owners to sell or look to "higher and better uses" that may yield a greater financial return. As a result, rural residential and recreational use subdivisions and vineyard conversions are increasingly common on the North Coast.

The conversion and subdivision of coastal forests in Mendocino County presents a serious threat to the ecological integrity of these coastal watersheds and the aquatic and terrestrial habitat they provide for a rich suite of natural communities and sensitive species. The fragmentation of these large forest tracts also threatens the future viability of a sustainable timber economy in the region. More than 40 percent of California's annual timber revenue comes from Mendocino and Humboldt counties; in 2007 the value of harvests in these two counties was more than $190 million. The forest products industry is "extremely important" to many local economies in the Northern California "timber counties," generating about 13 percent of the personal income and 16 percent of the jobs.[7]

Several State resource agencies have recognized the importance of preventing fragmentation of large forest tracts in the region. The California Department of Fish and Game's Recovery Strategy for Coho Salmon specifically recommends "Encouraging 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."[8] California Department of Forestry and Fire Protection has underscored the need to "recognize the continued importance of large scale unfragmented ownerships in the working landscape … and examine if state policies can be improved to assure both private and public benefits of large unfragmented holdings" (CAL FIRE, 2003). Finally, the State Water Resources Control Board's Nonpoint

[7] See, e.g., *Forestry, Forest Industry, and Forest Products Consumption in California*, Laaksonen-Craig and Goldman UC Davis Publication 8070.
[8] See, generally, The *Recovery Strategy for California Coho Salmon* prepared by the Department of Fish and Game.

Source Program Strategy and Implementation Plan, 1998 – 2013 identifies several management measures related to silvicultural and agricultural activities that can enhance water quality.

While the benefits of protecting large tracts of forestland are clear, the means of achieving their protection is less obvious. The traditional approach of public acquisition and preservation of forestlands cannot alone get the job done: 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 public purchases on the local economy and tax base.

In response to this dilemma, The Conservation Fund launched its North Coast Forest Conservation Initiative in 2004 with the acquisition of the Garcia River Forest. With this purchase, the Fund sought to test the hypothesis that large tracts of depleted coastal forest can be protected from fragmentation and conversion and returned to sustainable timber production and ecological vitality through the use of innovative financing and patient management by a nonprofit organization in partnership with private and public agencies and community stakeholders. At the GRF since 2004, the Fund has:

- Developed the GRF Integrated Resource Management Plan;
- Received regulatory approval for four timber harvest plans, two of which have been completed by local logging contractors with logs sold to local mills;
- Achieved certification under Forest Stewardship Council, Sustainable Forestry Initiative, and California Climate Action Registry, including installation of a new forest inventory system;
- Completed property-wide watershed assessments, largely funded by DFG;
- Completed implementation of the first major road upgrading and decommissioning project (Inman Creek Phase 1), with three more major restoration projects to be completed in 2009 and 2010;
- Initiated a long-term stream monitoring system drawing on DFG's aquatic habitat typing, continued instream temperature monitoring, the EPA's Environmental Monitoring and Assessment Program (EMAP) and DFG's regional salmon spawning survey; and
- Provided dozens of opportunities for public participation through THP tours, field visits, and public meetings.

With the purchase of the Big River and Salmon Creek Forests, the Fund, working with the State Water Board, the California Coastal Conservancy and the Wildlife Conservation Board seeks to extend this innovative approach to protect and restore two additional commercial forest tracts in the Big River and Salmon Creek watersheds. While our broad goals for the Forests are similar in many respects to those reflected in the GRF IRMP, there are important differences as well. These differences include the use of a State Revolving Fund loan to acquire the Forests[9] (the repayment

[9] This project represents an innovative and efficient use of the State Revolving Fund. The Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program adopted by the State Water Board and the California Environmental Protection Agency (NPS Implementation and Enforcement Policy) clearly recognizes the need for innovation and experimentation:

of which is intended to come from timber harvest revenues), the different timber stocking and age class distributions of the merchantable timber, and a higher density of residential development in the vicinity of the Forests. In addition, the emergence of a seemingly robust market for greenhouse gas emission reductions associated with improved forest management may significantly affect the means and rate of attainment of our principal management objectives.

Figure 3: Big River Forest, 2008 (Matthew Gerhart photo)

Much is known about the MPs [management measures] that most effectively prevent and control polluted runoff. Less is understood about the alternative alliances and management structures – the third-party programs – that most efficiently and effectively will result in the watershed or industry-wide actions need to control NPS statewide. In addition to the public and private financial resources dedicated to this purpose, this effort will require a conscious willingness to experiment, evaluate and adapt management approaches that will support and bring us closer to … controlling NPS pollution…. NPS Implementation and Enforcement Policy, page 16.

The use of the SRF to enable the Fund to acquire the Forests and implement TMDL and nonpoint source strategy objective is precisely the kind of innovation intended by the NPS Implementation and Enforcement Policy.

2.2 Project Financing

The Forests were acquired by the Fund in November of 2006 for $48,500,000, with funds from the following sources:

State Revolving Fund (SRF) loan	$25,000,000[10]
California State Coastal Conservancy grant	7,250,000
Wildlife Conservation Board grant	7,250,000
David and Lucile Packard Foundation loan	5,000,000[11]
The Conservation Fund equity	4,000,000
Total:	$48,500,000

The SRF loan is intended to be repaid from revenues derived from timber harvests consistent with the implementation of the interim management measures specified in the MOU and, ultimately, this Plan. The harvest levels were established with reference to an appraisal prepared for the Fund by Mr. Gene Forsburg, a Registered Professional Forester and licensed real estate appraiser, dated May 13, 2006. Mr. Forsburg concluded that management of the Forests by a likely buyer that was interested in maximizing returns while complying with the California Forest Practice Rules (FPR) would generate net annual harvestable volumes of approximately 80,500 board feet per year (for the first two decades) and annual net revenues of approximately $3,750,000.

To determine the amount that could be borrowed from the SRF and repaid through harvest revenues consistent with the purposes set forth in the MOU, the Fund developed the following forest management guidelines which were expected to achieve the desired habitat protection and water quality enhancement goals:

- Apply uneven-aged management using primarily single tree selection.
- Harvest, on average, less than 35 percent of standing conifer volume per entry.
- Limit harvest re-entry to ten years or greater.
- Limit harvest in riparian areas.

Prior to acquisition, the Fund retained Forest Systems Management Company, LLC, a forestland investment firm that evaluates forestland investments, to apply these guidelines to the Forests'

[10] The State Revolving Fund (SRF) is a low-interest loan program established under the Clean Water Act and administered by the State Water Board to fund water quality projects. Capitalization for the SRF comes from periodic federal appropriations, 20 percent State matching funds and loan repayments that revolve back into the SRF. Interest rates are 50 percent of the State's general obligation bond rate, with loan repayments over periods as long as 20 years. Traditionally, the SRF has been used to fund construction of publicly owned wastewater treatment facilities and related infrastructure. However, SRF loan funds also can be used to address non-point source pollution issues, including those related to silviculture, such as increased sediment loading and water temperature, as is the case with this project. The low interest rate and relatively long loan maturity make the SRF an ideal financing mechanism for protecting and restoring depleted forestlands when used in combination with equity and grant funding.

[11] This program related loan bears interest at 2.0% and must be repaid on the following schedule: $1,000,000 by 12/31/09; $1,500,000 by 12/31/10 and $2,500,000 by 12/31/12. The loan is unsecured and is not intended to be repaid from timber revenue from the Forests.

timber inventories and age-class distributions to determine the resulting annual harvest volumes. This spatially explicit harvest-scheduling analysis included modeling harvests over the 20-year SRF loan repayment period. From this study (Forest Systems, May 2006), the Fund concluded that a 45 percent reduction from the levels allowed under the California Forest Practice Rules to approximately 4.65 million board feet per year should, in average market conditions, yield a cash flow of approximately $2,000,000, which is sufficient to service the annual SRF payments of $1.54 million and other operating expenses of the Forests.

Since the initial purchase of the Forests in 2006, the California Climate Action Registry (CCAR) and the California Air Resources Board (ARB) have adopted a rigorous set of protocols for verifying and crediting greenhouse gas emission reductions associated with forest management projects that reduce harvest levels below those otherwise permitted by the Forest Practice Rules (Forest Protocol). These “carbon offsets,” known as Carbon Reduction Tons or “CRTs” can, once verified and credited, be sold on the voluntary market to entities and individuals that desire to reduce their “carbon footprint” or who are anticipating a regulatory obligation to reduce their emissions.

CCAR and ARB’s adoption of the Forest Protocol has stimulated an active market for CCAR forest-based carbon offsets. Beginning in 2008, the Fund has donated or contracted to sell more than 630,000 CRTs generated by its Garcia River Forest project to eight different counterparties for delivery through 2012. These sales constitute the entire projected volume of the Garcia River Forest (less a reserve amount) through 2012. The Fund has recently received verification of the 2007 and 2008 CRTs for the Forests. The income derived from these sales could significantly and positively affect the rate of attainment of the project purposes outlined in the MOU.

2.3 Principal Management Goals

As with the Fund's work on the Garcia River Forest, the Big River/Salmon Creek project seeks to balance the ecological needs of coastal forests with the economic imperatives of ownership, management and restoration, as generally described in the MOU. This Plan presents our vision of what this balance looks like and how we will attain it over the coming decades.

This Plan identifies and describes in detail the following specific management goals consistent with the general project purposes set forth in the MOU:

- Improve ecological conditions by protecting and enhancing water quality.
- Improve ecological conditions by protecting and enhancing terrestrial and aquatic habitat on the Forests,
- Generate sufficient revenue to cover SRF loan and the Packard loan payments (the latter from non-timber revenue, such as the sale of carbon offsets, and only after the accrued SRF obligations are fulfilled), property taxes, on-site maintenance, management, and restoration projects.
- Develop and implement conservation-based forest management greenhouse gas reduction projects under the California Climate Action Registry's Forest Project Protocol version 2.1.
- Practice continual improvement through adaptive management based on monitoring of water quality and forest health against specific objectives described in the Plan.
- Support the local business community by utilizing local contractors and suppliers.
- Involve the local community by seeking input on management of the Forests, including review of this Plan and timber harvest plans implemented under the Plan, and providing compatible public access, educational, and recreational opportunities.

As with the Garcia River Forest, particular emphasis will be placed on achieving water quality enhancement and anti-degradation objectives by a) permanently protecting the Big River and Salmon Creek Forests from subdivision, residential and commercial development, forestland conversion and agricultural intensification, and b) implementing remediation, protection and restoration measures to address sediment pollution problems and associated impacts resulting from historic and current forest management in the North Coast Region, including measures identified in the *Strategy for Implementing State Revolving Fund for Expanding Use Projects* (Strategy), the *Nonpoint Source Program Strategy and Implementation Plan, 1998 – 2013* (NPS Implementation Plan) and the *Big River Total Maximum Daily Load for Sediment* developed by the US EPA, Region IX in December, 2001 (Big River TMDL), as adopted by the North Coast Water Board in *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). Successful implementation of these measures will also achieve important state objectives related to recovery of coho salmon and steelhead trout.[12]

[12] See, generally, The *Recovery Strategy for California Coho Salmon* prepared by the Department of Fish and Game.

2.4 Plan Requirements

As set forth in the MOU, the State Coastal Conservancy (SCC) and Wildlife Conservation Board (WCB) Approvals require the Fund to "prepare a forest management and restoration plan, plan sustainable harvests which eventually will fund the repayment of loans taken to purchase and/or manage the [Forests, and] the implementation of forest management and restoration plan, and provide public access." The State Water Board approval requires that the Fund "develop a water quality management and restoration plan…. This plan will explain the measures the [Fund] will implement to correct and prevent deterioration of the watersheds due to past, current and proposed future management practices, and how performance and benefits of the Project will be measured." The MOU contemplates that the Fund may fulfill these requirements by preparing a single plan that conforms to the respective conditions and requirements of the Approvals. This Plan fulfills in a single document the foregoing conditions and requirements as specified in the MOU.

2.5 Plan Revisions

Consistent with the principles of an adaptive management approach, the Plan will be updated periodically, not less than every ten years, to reflect the condition of the Forests as they change over time and as management activities are implemented. Local experts, advisors, agency staff, and community members will be included in the revision process. Revisions and/or amendments will be provided to the SWB, SCC and WCB for review prior to adoption.

2.6 Adaptive Management

Adaptive management is the process of continually adjusting management in response to new information, knowledge or technologies (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. In addition, 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 attainment of the project purposes described in the MOU will depend in part on the commitment made to adaptive management, where research and monitoring are given a high priority, and new information is 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 implementation benchmarks established for Streams and Roads, Forest Management, and Community Involvement described in this Plan; and 2) monitoring the effectiveness of achieving the implementation benchmarks on selected ecological conditions (principally water quality and forest inventory and structure). Each of the proposed indicators for monitoring viability of conservation and restoration effectiveness will need to be evaluated by the following criteria:

- Cost efficiency – getting the most information for the least cost;
- Quality control – data collection and compilation has accepted quality control standards and can be applied consistently 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 standards commonly used by the relevant regulatory agencies; and
- Timely yield of information – the monitoring program must yield information for management in a timely manner.

3. Setting and Current Conditions

3.1 Project Orientation

3.1.1 Property Locations

The Big River and Salmon Creek Forests are located in the coastal mountain range of southwestern Mendocino County roughly centered between the Highway 1 and Highway 101 corridors. The Big River Forest (approximately 11,770 acres) adjoins Big River State Park and Jackson State Demonstration Forest and is located within the middle portion of the watershed; its tributaries include Little North Fork, Two Log Creek and Laguna Creek, as well as a portion of the main stem of Big River. The property is accessed by Highway 20 on the north and Comptche-Ukiah Road on the south.

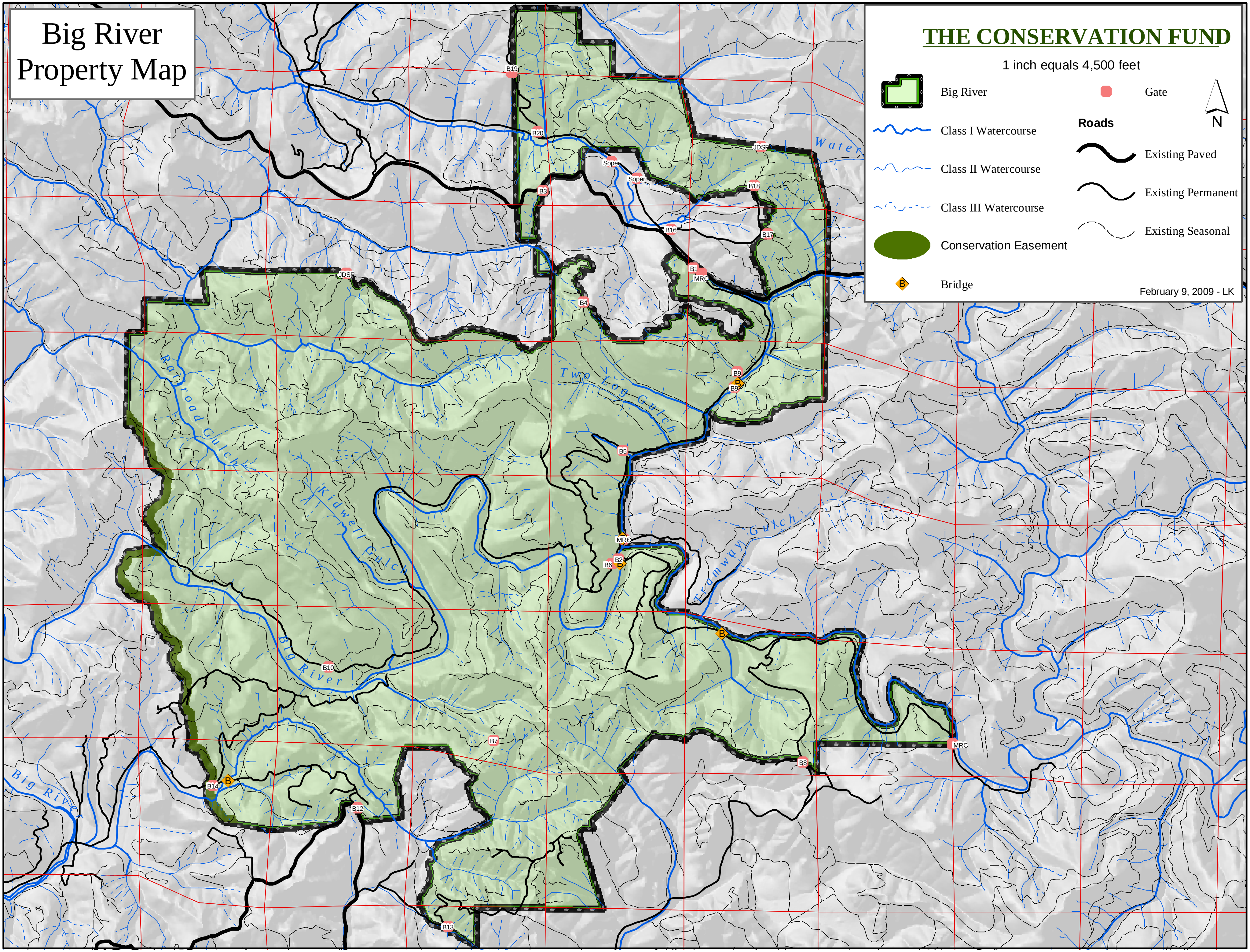
Big Salmon Creek is a relatively small coastal watershed in Northern California, with the entire drainage area lying within eight miles of the coast (Figure 2-2). The Salmon Creek Forest (approximately 4,250 acres) encompasses 51 percent of its watershed and is situated between and accessed by Albion Ridge and Navarro Ridge Roads.

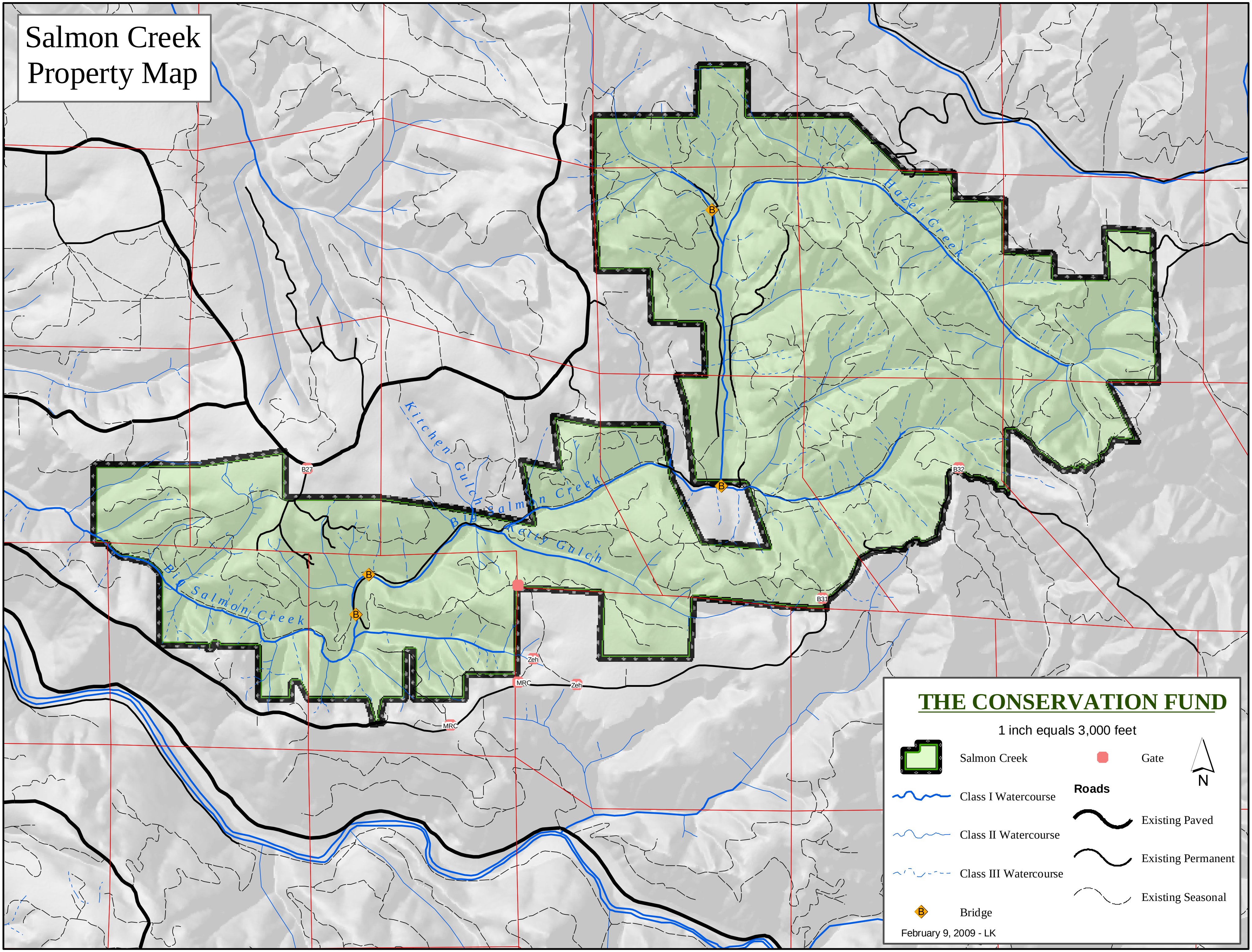
3.1.2 Neighbors and Adjacent Lands

The Big River Forest is adjacent to Big River State Park (which contains the 8.3-mile estuary), Mendocino Woodlands State Park, and Jackson State Demonstration Forest. Other permanently protected lands in the watershed include Montgomery Woods State Reserve.

The five largest property owners in the watershed are private forest landowners and a state-owned forest; together, Mendocino Redwood Company, Jackson State Demonstration Forest, Pioneer Resources, The Conservation Fund, and Weger Holdings own 83 percent of the watershed. Thirty-one property owners (with ownership ranging from 160 to 3,760 acres) own another 14 percent of the land, and the rest is in scattered private residences (NCRWQCB, 2005). Other than the town of Mendocino at the mouth of Big River, there is relatively little human occupation in the watershed, with only scattered ranches and residences. Most of the smaller parcels are in the upper or east end of the basin and are dominated by annual grasslands.

The Salmon Creek Forest encompasses 51 percent of the Salmon Creek watershed (4,250 of 8,602 acres). Fifty-three percent of the watershed is under active forest management, eight percent is under agricultural use, and small private ownerships make up the remainder (Green Info Network, 2006). Mendocino Redwood Company lands border a majority of the north and east boundaries of the Salmon Creek Forest (included in MRC's “Albion Inventory Block”). Most of the smaller parcels and residences are concentrated on the coastal terrace ridges to the south and north of Salmon Creek.


Big River
Property Map
THE CONSERVATION FUND
1 inch equals 4,500 feet
Big River
Class I Watercourse
Class II Watercourse
Class III Watercourse
Conservation Easement
Bridge
Gate
Roads
Existing Paved
Existing Permanent
Existing Seasonal
N
February 9, 2009 - LK
Railroad Gulch
Kidwell Gulch
Two Log Gulch
Tramway Gulch
Big River
Big Riv
Water
B19
B20
B3
Soper
Soper
JDSF
B18
B16
B17
B1
MRC
B4
JDSF
B9
B9
B5
MRC
B2
B6
B10
B7
B14
B12
B13
B8
MRC


Salmon Creek Property Map
Hazel Creek
Kitchen Gulch
Big Salmon Creek
Nelly's Gulch
Big Salmon Creek
B27
B32
B31
Zeh
MRC
Zeh
MRC
THE CONSERVATION FUND
1 inch equals 3,000 feet
Salmon Creek
Gate
N
Roads
Class I Watercourse
Existing Paved
Class II Watercourse
Existing Permanent
Class III Watercourse
Existing Seasonal
Bridge
February 9, 2009 - LK

3.1.3 Physiographic Setting

3.1.3.1 Big River

The Big River drains a 116,000-acre (181 square mile) watershed located in the northern California Coast Range in western Mendocino County, entering the Pacific Ocean at the town of Mendocino, about 10 miles south of Fort Bragg. The Big River Basin extends 24 miles to the east, to within three miles of Willits and Highway 101. It drains primarily from east to west, sharing ridges with the Noyo River and Caspar Creek basins to the north, the Eel River watershed to the east, and the Little, Albion and Navarro River watersheds to the south.

Elevations within the Big River Basin range from sea level at the mouth to 2,836 feet at Irene Peak, five miles south of Willits. The basin’s topography is diverse along its length, varying from flat estuarine environments and uplifted marine terraces to rugged mountains with high relief in the eastern portion.

3.1.3.2 Salmon Creek

The Big Salmon Creek watershed drains an approximately 8,600-acre (over 13 square miles) watershed located in the northern California Coast Range in western Mendocino County, grading into the Pacific Ocean through coastal plains one-half mile south of the village of Albion and the Albion River, and approximately 16 miles south of the city of Fort Bragg. The Big Salmon Creek Basin drains east to west and extends approximately 8.5 miles to the east, sharing ridges to the north with the Albion River Watershed and to the south with the Navarro River Watershed.

Elevations within the Big Salmon Creek Basin range from sea level at the mouth to 1,000 feet at Albion Ridge to the north. The basin’s topography varies from its flat estuarine environment to uplifted marine terraces to moderate to steep slopes in eastern portions.

3.1.3.3 Climate

Big River and Salmon Creek are forested watersheds with a coastal-influenced climate in the lower half of the drainage. Located within the Oregonian Biotic Province, the watersheds have a Mediterranean climate, characterized by a pattern of low-intensity rainfall in the winter and cool, dry summers with coastal fog. Mean annual precipitation is 40 inches at Fort Bragg near the western margin of the watershed and 51 inches at Willits to the east. About 90 percent of this precipitation generally falls between October and April with the highest average precipitation in January.

3.1.3.4 Geology

The regional geologic landscape of the Big River and Salmon Creek properties were shaped by the tectonic collision of the Farallon and North American plates during the Mesozoic and early to middle Tertiary periods (Steinbuck, 2008). Tectonic forces mixed these sediments with other less common rock types as subduction continued; subsequent metamorphism and accretion to the western margin of North America resulted in what geologists collectively refer to as the Franciscan Complex (Blake and Jones, 1981). Geologic mapping conducted in the region indicates that the Big River and Salmon Creek properties are solely underlain by the coastal belt Franciscan complex (Kilbourne, 1983a). The coastal belt Franciscan consists of arkosic sandstone and andesitic greywacke sandstone that underwent low-grade metamorphism as a result of subduction. Shear strength of the exposed bedrock is highly variable and dependent upon the local structure, bedding, and lithology.

Landslides, both natural and related to past management, occur within the Big River and Salmon Creek Forests and are widespread within the Franciscan complex across the Coast Range Mountains. Large deep-seated landslides (e.g. translational-rotational landslides) have occurred on both the Big River and Salmon Creek properties and are generally characterized by a very slow moving slide mass and deep slide plane extending well into bedrock. A majority of the shallow landslides (e.g. debris slides and flows) occur on slopes over 65 percent and are concentrated on steep streamside slopes along the outside of meander bends along the mainstems of Big River and Salmon Creek and their larger tributaries. Recent unconsolidated channel deposits composed primarily of sand, silt and gravel are exposed along the active channels on both the Big River and Salmon Creek properties.

3.1.3.5 Soils

The soils formed from the Franciscan complex are generally well drained loams and sandy clay loams. Due to the high annual precipitation, soil fertility is high and well suited to growing timber. Formed from the weathering of sedimentary rock, colluvial soils blanket a majority of the hillslopes across the Coast Range Mountains. The Natural Resource Conservation Service *Soil Survey of Mendocino County* depicts the following 13 distinct soil complexes in the Big River and Salmon Creek properties:

- Irmulco-Tramway complex
- Dehaven-Hotel complex
- Vandamme loam
- Vandamme-Irmulco complex
- Ornbaun-Zeni complex
- Glenblair gravelly loam
- Threechop-Ornbaun complex
- Boontling loam
- Big River loamy sand
- Carlain loam
- Quinliven-Ferncreek complex

- Ferncreek sandy loam
- Shinglemill-Gibney complex

Thickness of the overlying colluvial soil can be highly variable. Generally, colluvium is thin along ridges and upper sideslopes (typically one to two feet), and thick (as much as five to ten feet) within deep swales and local depressions. For more information on soils see Appendix C, Geology and Soils.

3.1.4 Regulatory Setting

There are wide ranges of federal and state statutes that affect the management of the Forests. The principal statutes are summarized below.

Table 3-1: Federal and State Environmental Statutes with Significant Influence on Forest Management

Statute	***Federal/State***	***Agency Authority***
California Coastal Act	State	California Coastal Commission
California Endangered Species Act	State	California Department of Fish & Game
California Environmental Quality Act	State	All State Agencies
Clean Water Act	Federal	U.S. Environmental Protection Agency, U.S. Army Corps of Engineers
Coastal Zone Management Act	Federal	National Oceanic and Atmospheric Administration, California Coastal Commission
Endangered Species Act	Federal	U.S. Fish & Wildlife Service
Porter-Cologne Water Quality Act	State	State Water Resources Control Board
Z'Berg-Nejedly Forest Practice Act	State	California Department of Forestry and Fire Protection

Other federal laws that affect the use of land and natural resources include the Clean Air Act, Resources Planning Act, Antiquities Act, Wilderness Act, and Organic Act.

The federal *Endangered Species Act* (ESA) establishes a process by which animal and plant species can be listed for federal protection. That protection limits any activity that may result in a "taking" – causing death to one or more individuals of that species either through direct action (such as hunting) or indirect action (such as destruction of its habitat). A species may be listed as "threatened" or "endangered," depending on the level of peril and the status of the remaining population, and an "endangered" designation carries a greater degree of protection. The U.S. Fish and Wildlife Service (USFWS) has authority for enforcement of the ESA.

The *California Endangered Species Act (CESA)* is the state law that complements the federal ESA; it is enforced by DFG. Many of the protected species in the North Coast – including northern spotted owl and coho salmon – are listed under both federal and state acts, and thus are protected by both federal and state agencies.

The state *Z'berg Nejedly Forest Practice Act* was passed in 1973 to ensure sustainable and environmentally appropriate forestry in California. The California Board of Forestry and Fire Protection promulgate rules to implement the law. Over time, the legislature has passed many laws increasing its scope and detail. The Board has done likewise with the regulations. The process to permit timber harvest now involves a multi-agency review involving four state agencies and two or more federal agencies, depending on the location and issues involve. Other permits from other agencies – both state and federal – are often required.

The federal *Clean Water Act establishes* the broadest framework for water quality regulations, including the protection of wetlands. The *Porter-Cologne Water Quality Act* is the state corollary. Regulatory authority is coordinated between federal and state agencies, primarily the U.S. Environmental Protection Agency (USEPA) and the State Water Resources Control Board (SWRCB). The U.S. Army Corps of Engineers has permitting authority under Section 404(d) of the Clean Water Act, which regulates discharges (dredging and fill) into U.S. waters, including wetlands. Section 303(d) of the Clean Water Act describes the regulation of "impaired water bodies," a designation given a water body that fails to meet specific water quality standards. Each state is required to maintain a list of impaired water bodies and to develop "Total Maximum Daily Loads" (TMDLs) for each impaired water body, to address both point and nonpoint sources of pollution. An implementation plan, also known as an action plan, identifies a program for implementing the necessary pollution load reduction requirements to meet water quality standards. While not strictly a requirement of the TMDL as described by the Clean Water Act and associated regulations, the action plan is required under the State Porter-Cologne Water Quality Control Act. In California, there are 509 water bodies listed as impaired; 28 of these are within the North Coast Region. The North Coast Regional Water Quality Control Board (NCRWQCB) is charged with developing most TMDLs in the region.

Many of the *TMDLs* in the North Coast are focused on sediment and temperature pollution, both of which generally are generated from nonpoint sources such as stormwater run-off and erosion from roads, especially logging roads and unpaved rural residential roads. Poor timber harvest practices can impact stream health by causing loss of riparian vegetation and increased sedimentation. Beneficial uses of the Big River listed by the NCRWQCB (Watershed Planning Chapter, 2005) include:

- Commercial and sport fishing
- Cold freshwater habitat
- Migration of aquatic organisms
- Spawning, reproduction, and early development; and
- Estuarine Habitat.

The Water Quality Control Plan for the North Coast Region (Basin Plan) also includes the following beneficial uses within the Big River watershed: municipal water supply, agricultural water supply, industrial water supply, groundwater replenishment, freshwater replenishment, navigation, water contact recreation (REC-1), non-contact water recreation (REC-2), warm freshwater habitat, wildlife habitat, rare/threatened/endangered species, and aquaculture.

The Big River watershed was listed under the Clean Water Act Section 303(d) List of Impaired

Waterbodies for excessive sedimentation and subsequent anadromous salmonid habitat loss. The U.S. EPA established the Big River TMDL for Sediment on December 20, 2001.

Additionally, although not a regulatory listing, the Big River is listed on the National Rivers Inventory, a list of potential wild, scenic, and recreational river areas within the United States. The river is listed for five outstandingly remarkable values: scenery, recreation, fish, wildlife, and history (NPS 2004).

Figure 4: Big River, August 2008 (Matthew Gerhart photo)

3.2 Watershed Conditions

3.2.1 Water Quality Overview

The Big River and Salmon Creek Forests lands have 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 “historical 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 LWD [large woody debris]; decreased DO [dissolved oxygen] concentrations; increased instream organic matter; and decreased stream-bank stability….”[13]

Past and potentially current forest management practices have been identified as a principal source of sediments in the Redwood Region. According to the NPS Implementation Plan, “silviculture 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 forestlands. For example, (1) sediment concentrations can increase due to accelerated erosion, (2) water temperatures can increase due to removal of overstory 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.”

While past forest management has been a significant contributing cause of impairment of North Coast water bodies, there is broad agreement that preventing fragmentation of large tracts of coastal forests and implementing management measures relating to road maintenance and sustainable forest practices is the most feasible means of enhancing water quality in the Region. These measures are described in detail in Section 4.

Water Quality Regulatory Oversight

Until recently, Regional Water Board staff planned to add TMDL implementation strategies for the Albion River Watershed, along with the Big, Noyo, and Ten Mile Rivers, as an Action Plan to the Basin Plan. However, staff has determined that sediment waste discharge reduction and attainment of water quality standards may be more effectively achieved without amending the Basin Plan and by addressing all sediment impaired water bodies in the North Coast Region through the TMDL Implementation Policy for Sediment Impaired Receiving Waters.

Until such time as the TMDL is completed by the U.S. EPA, activities in Big River must comply with the Waste Discharge Requirement (WDR), R1-2004-0030, set forth by the Regional Water Quality Control Board on June 23rd 2004 designed to make timber harvest conform to the Basin Plan.

[13] Id at 3.8. *See also* Big River TMDL at page 11, 12.

The Salmon Creek watershed has not been listed by the U.S. EPA but activities within the watershed are regulated by the State Water Resources Control Board and are subject to the requirements of the Waste Discharge Requirement, R1-2004-0030. The necessary components of the WDR are:

- Inventory of controllable sediment sites.
- A time schedule for implementation of prevention and minimization management. measures from all controllable sediment discharge sites within the project area.
- Inspection plan depending on activities proposed.
- Report of inspection results and any corrective action taken.

The California Department of Fish and Game oversees and regulates instream or near stream activities such as Class I and II stream crossings, gravel extraction and water drafting. Individual permits are required for each watercourse crossing and water drafting sites.

3.2.2 Stream Conditions

3.2.2.1 Big River

Big River drains an approximately 180-square mile watershed located in the northern California Coastal Range in western Mendocino County. The Big River Forest contains approximately 11 miles of mainstem Big River and 13 miles of tributaries with habitat attributes conducive to salmonid production. Vegetation is primarily conifer forest comprised of coast redwood (*Sequoia sempervirens*) and Douglas-fir (*Pseudotsuga menziesii*). The primary constituents of the riparian canopy are coast redwood, Douglas-fir, red alder (*Alnus rubra*) and willow (*Salix* sp.), all of which are nearly continuous throughout the stream network. Streambed gradient is generally low (two percent or less) throughout the mainstem reaches. The regional climate is characterized as Mediterranean with wet, mild winters and dry summers. Rainfall averages 55 to 65 inches annually.

The entire Big River watershed support runs of coho salmon and steelhead trout. Chinook have been reported occasionally, but presently there are no significant runs (Downie et al, 2006). Historical anecdotes indicate that Big River supported significant populations of coho and steelhead with an associated recreational and local commercial fishery. By the 1950s agency reports indicated that the populations were depleted and in serious decline. The Big River Basin has been listed as a temperature- and sediment-impaired waterbody, and as such considerable literature has been generated regarding stream conditions and their historical context. The summer water temperatures in the mainstem are unsuitable for rearing salmonids, whereas most of the perennial tributaries are within suitable limits for rearing salmonids (Campbell Timberland Management, 2008).

Big River Aquatic History

Before the European settlement of the Mendocino area and subsequent logging operations in the basin, Big River likely hosted three species of anadromous Pacific salmonids: coho, steelhead, and possibly to a lesser extent Chinook salmon. Presently the watershed still supports coho and steelhead in reduced numbers compared to presumed prehistoric populations; based on studies conducted in the nearby Noyo basin (Gallagher and Wright, 2007), a small population of Chinook salmon may persist in Big River, however their presence is undocumented.

Logging began in the watershed in the 1850s, with early loggers using animals such as oxen to skid logs down to the river where they were moved downstream to the mill by high water flows (see photos below). Railroad logging began in the mid-1880s, but the railroad never extended all of the way downstream to the mill. The logs were dropped into the estuary at the “rail dump” a few miles upstream, then floated to the “boom” and then to the mill. The mill operated from about the mid-1850s to the late 1930s. The rail line was constructed throughout the estuary and lower basin and essentially terminated in Laguna Gulch and the East Branch of the Little North Fork. Up stream of the lower areas serviced by the rail line, logs were moved to the mill by the use of hydrologic force in the practice known as splash dam logging. Splash dam logging consisted of a series of dams constructed in sequence; when the stored water capacity and stream flow was sufficient, the dams were sequentially “tripped” or released to allow a whitewater torrent to mobilize the logs down-channel, eventually arriving at the mill. This method of transport was employed throughout the upper basin and all major tributaries. The history of this practice in Big River is well documented by W. F. Jackson in *Big River was Dammed* (1991). During this era, timber was generally dragged downslope with cables powered by “steam donkeys” or oxen, either directly to the mainstem channel or by gulch-running tramways that brought logs to the channel.

The practice of splash dam logging likely contributed to the decline of anadromous Pacific salmonids in the watershed due to channel homogenization. Log quantities by the tens of thousands, stored throughout the fluvial network in summer were annually sluiced through the larger channels, essentially scouring the channel of most complexity and roughness elements. Whatever obstructions to log passage that remained were systematically blasted from the channel by crews during summer low flows. The net result is a U-shaped channel with little heterogeneity. Adequate habitat complexity is vital to the survival of anadromous fish, as well as many other aquatic organisms.

In addition to channel simplification, it’s likely that splash dam log drives also widened and decreased the depth of the overall channel, consequently increasing the probability of additional solar radiation to the stream channel and thereby increasing stream temperatures. Excessive water temperature is another well-known factor affecting anadromous salmonids.

Figure 5: Typical Northern California Stream Condition After Historic Logging Operations, Circa 1955 (GP Photo)

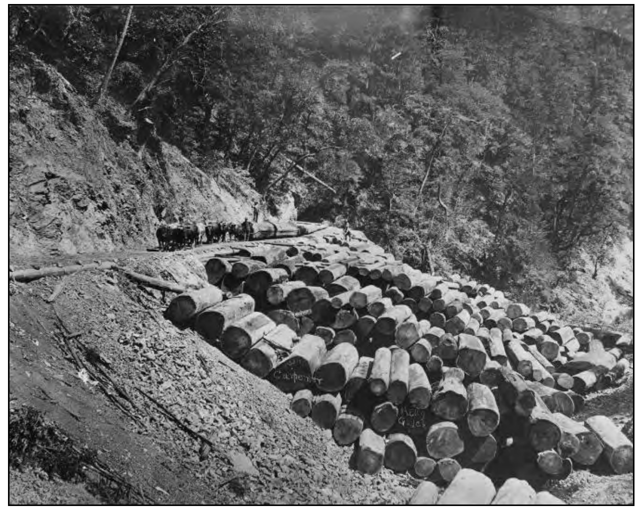


Figure 6: Logs Stored In Stream Channels Awaiting Winter Flows, Circa 1880 (The Robert J. Lee Photographic Collection of The Mendocino County Historical Society)

Figure 7: Log Drive in Big River, Circa 1924 (The Robert J. Lee Photographic Collection of The Mendocino County Historical Society)

Figure 8: Typical Barrier to Fish Passage From Historic Logging Operations, Circa 1955 (GP Photo)

Figure 9: Big River Splash Dam, Circa 1925 (The Robert J. Lee Photographic Collection of The Mendocino County Historical Society)

3.2.2.2 Big Salmon Creek

Big Salmon Creek is a relatively small coastal watershed in Northern California, with the entire drainage area lying within eight miles of the coast. Much of the watershed is presently managed for timber production, and nearly 48 percent of the watershed is owned and managed by The Conservation Fund. Vegetation in the area is primarily conifer forest comprised of coast redwood (*Sequoia sempervirens*) and Douglas-fir (*Pseudotsuga menziesii*). The primary constituents of the riparian canopy are coast redwood, Douglas-fir, and red alder (*Alnus rubra*), which is nearly continuous throughout the stream network. Streambed gradient is generally low (less than two percent) throughout the mainstem reaches. The regional climate is characterized as Mediterranean with wet, mild winters and dry summers.

This watershed has a number of geographic and ecologic features that promote coho and steelhead production, and since the early 1990s studies based on electrofishing surveys and other methods have shown that Big Salmon Creek has supported stable populations of both species (Campbell Timberland Management, 2008). Big Salmon Creek is located within eight miles of the coast and the associated cool marine climate, which moderates stream temperature during the relatively hot Northern California summer.

The low stream gradients with meandering, sinuous channels found at the watershed scale in Big Salmon Creek favor coho salmon in particular. The canopy formed by the coniferous forest type also promotes cooler stream temperatures during the summer and adds a roughness element to stream channels in the form of large woody debris, which further slows stream velocity and increases pool habitat and habitat complexity. Big Salmon Creek has optimal coho habitat conditions and, considering the small drainage area, has had relatively high rates of coho production (Campbell Timberland Management, 2008).

Logging and ranching operations were initiated in the Big Salmon Creek watershed as early as the 1860s. By 1880 a logging railroad had been constructed within the floodplain and linked the coastal mill at the ocean confluence (Whitesboro), with reaches as far upstream as Hazel Gulch. In that period logs were generally skidded downslope to floodplain-based railcars and logging camps, mobilizing soil downslope to the active stream channel. In the upper areas of Hazel Gulch, logs were likely skidded by oxen down the active channel, which had been cribbed or converted to a log skid road to facilitate log transport. Remnants of the cribbing within the active channel still exist in parts of upper Hazel Gulch (small channels were often converted to oxen skid roads by planking logs crosswise to the channel to allow oxen to pull logs downstream).

The present day effects from the railroad era logging practices on fish production are a presumed increased sediment load in the active channel and floodplain. However, the legacy impacts on stored instream bedload, and, consequently, on present day fish production is unknown. The remnants of the railroad grade, which in many areas ran within or adjacent to the floodplain, are presently sloughing off into the watercourse in some areas during peak flow events, increasing sediment delivery into the watercourse.

Figure 10: Remnant Dam Structure on Hazel Gulch, Circa 1998. Although dams were constructed for log and ranch ponds at various locations within the channel, splash dam logging, or stream-based log drives, did not significantly occur in the Big Salmon Creek watershed. Logs were moved to the coast mill by railway. A remnant dam structure can still be observed just above the confluence of Hazel Gulch and West Branch Hazel. (Photo provided by Campbell Timberland Management, LLC)

Late 20th Century Aquatic History

By the 1950s logging was accomplished largely by tractor operations in Big River and Big Salmon Creek. As a consequence, a network of streamside roads and landings was constructed throughout the Forests. Tributary streams were often completely blocked during operations, and the impounded areas were inundated with green logging slash and exposed to direct sunlight, resulting in severe dissolved oxygen deficiencies, high stream temperatures, and corresponding juvenile fish mortality. Upon completion of tractor operations, logging debris was routinely disposed into the watercourse. During this era it was also common to operate tractors within the active channel streambed to facilitate operations.

The impact on fisheries from operations in the 1950s and 1960s was likely severe. The combined effects of: 1) massive sediment delivery into the stream network from tractor yarding and road and landing construction: 2) barriers to adult fish passage (spawners); and 3) direct mortality of rearing juvenile fish most likely had a devastating impact on fish populations.

By the early 1960s DFG recognized the negative impacts to upstream migration from the practice of disposing of large tree boles and logging waste into the stream network, which had three primary aquatic impacts: 1) it prohibited migrating fish to access upstream spawning habitat in winter; 2) it introduced deleterious quantities of sediment to the stream; and 3) it reduced instream dissolved oxygen content in summer from rotting green waste. In addition to the impacts on fish, these practices impacted most endemic aquatic animal species within the watershed, from aquatic macro-invertebrates to amphibians.

Concerns regarding this practice resulted in the institution and initiation of the era of large woody debris removal from Northern California stream networks. Work crews were routinely hired by various state and county agencies to clear streams of large wood. Additionally, DFG instituted policies that mandated stream clearance with tractors by the end of logging operations. The net result of these policies, while well intentioned, was the removal of most instream structure and the straightening of sinuous channels and a secondary negative impact on salmonids after the first setback from the initial logging practices. Many stream sections in Big River and Big Salmon Creek are presently deficient in LWD and have straight (bowling alley) stream reaches that are approximately a tractor blade width wide.

3.2.2.3 Aquatic Species Affecting Management

Big River and Salmon Creek support many other aquatic and semi-aquatic vertebrate species besides fish. Many of these species are completely terrestrial for varying fractions of their life histories, but may use the watercourse for feeding, breeding, and/or rearing, such as the western pond turtle. It is generally agreed that the measures taken to improve salmonid habitat described in Section 4 will benefit all species utilizing riparian and instream habitats. A comprehensive overview of the Big River and Salmon Creek watersheds and aquatic species can be found in the Aquatic Management Plans prepared in 2008 for The Conservation Fund by the fisheries staff at Campbell Timberland Management, attached as Appendices D and E.

Table 3-2: Aquatic Species Observed in Big River and Big Salmon Creek Forests (Campbell Timberland Management, 2006)

Common Name	Species	Listing Status	Comments
Reptiles			
Northern Pacific Pond Turtle	*Actinemys marmorata*	None	Common
Western Aquatic Garter Snake	*Thamnophis couchi*	None	Common
Amphibians			
Coastal (Pacific) Giant Salamander	*Dicamptodon tenebrosus*	None	May hybridize with *ensatus*
Southern Torrent Salamander	*Rhyacotriton variegatus*	California Species of Special Concern (DFG)	
Northwestern Salamander	*Ambystoma gracile*	None	
Rough-skinned Newt	*Taricha granulose*	None	
Red-bellied Newt	*Taricha rivularis*	None	
Coast Range Newt	*Taricha torosa*	California Species of Special Concern (DFG)	
Ensatina (Salamander)	*Ensatina eschscholtzi*	None	
Black Salamander	*Aneides flavipunctatus*	None	
Tailed Frog	*Ascaphus truei*	Threatened (CESA) California Species of Special Concern (DFG)	
Western Toad	*Bufo boreas*	None	
Pacific Treefrog	*Hyla regilla*	None	
Bullfrog	*Rana catesbeiana*	None	Invasive species
Northern Red-legged Frog	*Rana aurora aurora*	California Species of Special Concern (DFG)	
Foothill Yellow-legged Frog	*Rana boylei*	California Species of Special Concern	
Fish			
Pacific Lamprey	*Lampetra tridentate*	None	
River Lamprey*	*Lampetra ayresi*	None	
Western Brook Lamprey*	*Lampetra richardsoni*	None	
Threespine Stickleback	*Gasterosteus aculeatus*	None	Common
Prickly Sculpin	*Cottus asper*	None	Common
Coastrange Sculpin	*Cottus aleuticus*	None	Common
Sacramento Sucker*	*Catostomus occidentalis*	None	

* listed as within the range of these fish species by Moyle (2002), but not observed by CTM staff.

3.2.3 Existing Road Conditions

Both Salmon Creek and Big River Forests have well-developed road systems suitable for continued management using conventional logging equipment. The Salmon Creek Forest has a total of 46 miles of identified truck road with an average density of 7.0 miles of road per square mile. The Big River Forest has a total of 148 miles of identified truck roads with an average density of 8.3 miles of road per square mile. New road construction by the Fund to facilitate timber harvesting is expected to be minimal. There are numerous opportunities to upgrade roads and watercourse crossings to reduce potential sediment delivery as well as to decommission legacy roads, especially near watercourses.

The first major timber harvesting effort in Big River and Salmon Creek occurred in the 1880s and ‘90s when timberland owners used railroads to access remote timber stands. The rails carried equipment such as steam donkeys for yarding and loading logs as well as supplies for the logging crews; however the primary function of the rail was to transport logs to the sawmill. The rail lines were challenged by the steep terrain and generally followed the path of least resistance up stream channels. These initial railroad grades formed the skeleton of the road system in use today. The term “mainline” from railroading is used to describe major haul roads throughout the Forests.

The majority of the road network within Big River and Salmon Creek and much of the coastal Redwood Region was developed after World War II when logging with tractors became cost effective for timberland and sawmill owners. During the war tractors were used extensively for construction projects at home and overseas and many improvements were made to the machines, which made tractor logging economical and efficient. Tractors allowed timberland owners to access much more ground more quickly than railroads, and truck roads were constructed from the mainline roads to points previously inaccessible by rail.

Because road construction and timber harvest were basically unregulated prior to the Z’berg-Negedly Forest Practice Act of 1973, many roads were constructed within or adjacent to fish bearing streams (Class I streams) or larger seasonal streams (Class II streams). Truck road and tractor road watercourse crossings were commonly constructed by filling watercourses with logs parallel to the stream channel and covering them with dirt (known as “Humboldt” crossings). The Humboldt crossings often failed, depositing large amounts of sediment directly into streams. Humboldt crossings were often simply rebuilt or replaced with under-sized culverts, which were prone to plugging and failing.

The historic construction and use of near-stream roads combined with poorly constructed watercourse crossings is widely known to be the largest single source of sediment input along the North Coast. Rail and road construction, especially when built near the channel, reduced habitat complexity and the ability of the channels to maintain complexity via normal geomorphic processes. Increased sediment loads have caused pool filling and cementing of stream substrate (gravels) as well as causing the stream to be wider, shallower and overall, less complex. Road construction near streams has also reduced overstory canopy. Reduced streamside canopy combined with shallow water has contributed to an increase in stream temperatures. Some of these legacy roads are still in place and are being used in many areas of the Forests.

More recently, the road systems have been expanded and improved to facilitate cable skyline yarding from ridge tops; these new secondary roads have decreased the reliance on some of the older near stream roads. Many permanent and secondary haul roads have been rocked and associated stream crossings have been improved either with bridges or replaced with properly sized and situated culverts. Improved crossings allow free passage of fish and rocked surfaces reduce sediment input caused by accelerated road runoff. The majority of the road system continues to feed into the old “mainline” roads originally constructed for the railroads and upgraded over time, making their complete decommissioning impractical.

The Big River and Salmon Creek roads have been improved over the past decade; many upgrades have been made and the majority of the roads as they now exist are better than average for properties of this size. Road and watercourse crossing maintenance and upgrading will continue to occur to conform to commonly accepted and scientifically verified Best Management Practices, including the *Handbook for Forest and Ranch Roads* by Weaver and Hagans. A Road Management Plan is included in Appendix H, and specific actions drawn from the road management plan to guide road maintenance, construction and decommissioning are described in Section 4.1.1, Road Management.

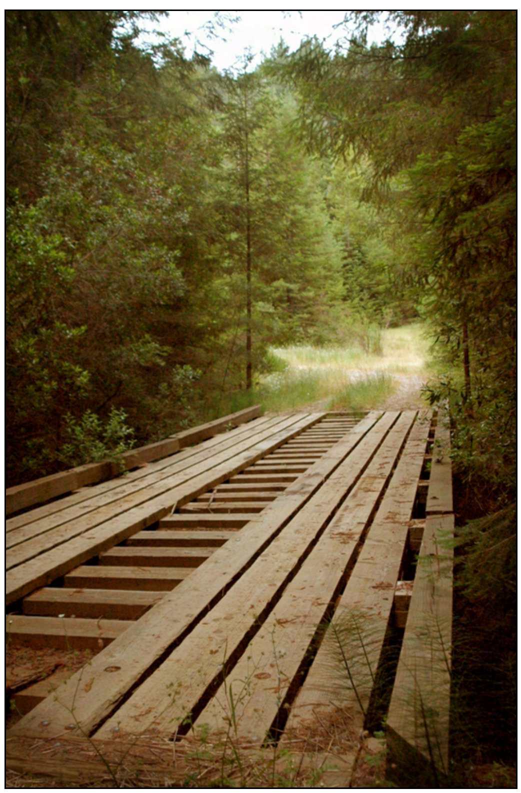


Figure 11: Typical Bridge on Big River, August 2008 (Mathew Gerhart photo)

3.3 Forests and Terrestrial Conditions

3.3.1 Forest Overview

The Big River and Salmon Creek Forests are typical of the north coast of California—dominated by native conifers (primarily redwood and Douglas-fir) and adapted to the steep slopes and heavy rainfall that typify the region. The forests are richly productive and support significant wildlife, including many imperiled species, such as coho salmon, steelhead trout, and northern spotted owls. The majority of the Forest has been harvested at least twice since the arrival of European settlers around the turn of the 20th century. Some of the forest stands are 80 years old, but most are much younger—the result of significant harvesting in the 1950s through the current day. The timber inventory on the Forests is depleted compared to historic levels but is considerably better than the average industrial timberland in the region. And because of its unique properties and appearance, redwood is still one of the most valuable lumber species in the world.

The Forests are well situated for continued forest management—there is good road infrastructure, relatively high site productivity, and a mixture of mature forest and rapidly growing young stands. That said, only about half the Forest currently is able to support a commercial timber harvest, many of the roads and stream crossings will need upgrading in the next twenty years, and two invasive weeds (pampas grass and broom) are widely established. The properties are excellent candidates for long-term restoration because, despite over 100 years of industrial timber management, there is still viable aquatic habitat and a high diversity of plant communities (including riparian forests, pygmy forest, coastal redwood forest, well-stocked riparian areas, and mixed hardwood/conifer forest) in addition to sensitive plant and animal species including coho and steelhead.

3.3.2 Operational Constraints

It is important to understand several key facets of forest management on the Forests (and coastal Mendocino County forestland, in general) that constrain potential forest management operations—especially low-impact ecological silviculture. In no particular order, these include:

- Steep slopes. The steep slopes characteristic of the Coast Range routinely require specialized cable yarding equipment to move logs from the woods to the road system with the minimum of soil disturbance. This style of harvesting operation is considerably more expensive than ground-based (tractor) logging, which is only possible on gentle slopes. In addition, care must be taken to properly identify and protect slopes that have a high potential to fail through a landslide or debris torrent so as to avoid the potential impacts to riparian and aquatic habitats.
- Low volumes. The history of industrial management has resulted in stands that have considerably less merchantable timber volume than desired. This is typically because the young even-aged stands have not had the time to develop more fully

or because uneven-aged stands had much of the valuable timber already removed. Almost all stands are well stocked with conifers that are healthy and growing well—it will just require several decades of patient management and thinning before the forest as a whole develops the desired timber volumes. In the meantime, many silvicultural options are precluded because of the low stocking and/or value.

- Hardwood competition. In some stands the development of the desired characteristics (e.g. closed canopy of large conifers) is hampered by excessive competition from brush and non-merchantable trees. In almost all cases this competition is from native species (e.g. tanoak) that have been allowed to over-colonize because of haphazard past logging practices. Reduction in hardwood competition through manual treatments (sawing) or chemical applications (herbicides) is effective but expensive, with potential safety and environmental concerns. Achievement of our long-term objectives will require that we dedicate the financial and personnel resources to thoughtfully and patiently reduce hardwood competition to levels more closely approximating their natural distribution in the redwood/Douglas-fir forest type.
- Operating season. The high rainfall that helps make the forest so productive also means that harvesting operations basically cease during the rainy season to avoid damage to the road infrastructure and potential delivery of sediment to streams. This means that almost all activities need to be completed during the summer and that logging contractors have a very limited window in which they can support their businesses.
- Limited markets for products. Currently, timber markets are at a cyclical low, although it is expected that the local market will regain modest value in the coming year or two. The number of sawmills in the region purchasing conifer sawlogs has declined on an almost annual basis (although the remaining mills are efficient and well-capitalized). Virtually no markets exist for conifer pulpwood or hardwoods (of any size), which reduces the feasibility of improvement or sanitation type harvests that typically generate low-quality wood in order to improve future stand conditions.
- Complex regulations. The permitting process for timber harvests and associated road usage is time consuming, inefficient and complex. While intended to prevent environmental damage, many of the requirements are very challenging to assess, report, implement, and/or monitor. The Fund budgets six months and $20,000 to $40,000 to prepare and administer a timber harvest plan, which is five to ten times the cost of a similar operation in Oregon or Washington. Enhancements to the regulatory process could free up significant time and money to benefit other projects.

Forest Inventory System

The Fund maintains linked forest inventory and geographic information system (GIS) databases in order to be able to assess, document, and monitor the forest conditions. Much of the data was inherited from the previous owners, Hawthorne Timber Company, its manager Campbell Timberland Management, and its predecessor, Georgia-Pacific Corporation. In the two years since acquiring the properties, the Fund has completed a new stand typing, updated some of the spatial data layers and established over 600 new forest inventory plots. The Forest Planning and Projection System (FPS) software is used to compile and grow the forest inventory in a spatially explicit manner and subject to our specific silvicultural prescriptions.

Recently the Forests have been divided into management compartments that represent logical operating units (sharing a similar road system and/or sub-watershed) of approximately 300 to 700 acres. The compartments have been scheduled for harvest from 2007 to 2027, although determining which individual stands are suitable for harvest (and the type of harvest) will be determined by the field foresters. And to increase our ability to understand and evaluate forest growth and development, we will be installing a system of permanent plots wherein all the trees are individually numbered (and likely mapped) so as to enable the long-term monitoring of growth and mortality of individual trees and at the plot level. This plot information is very important in being able to confirm or calibrate the growth model (although ten years of observation on the permanent plots on the GRF indicate a high degree of accuracy of the growth model).

3.3.3 Current Stand Conditions

There are several ways to describe the current condition of the Forest. It is predominately a redwood and Douglas-fir forest of varying age and canopy closure. The average acre (including Watercourse and Lake Protection Zones and other restricted areas) has 23,438 board feet (net Scribner scale, conifers greater than eight-inch DBH) and 164 square feet of conifer basal area and 46 square feet of hardwood basal area. Some general observations based on the forest inventory and stratification:

- Ninety-one percent of the forest stands are conifer-dominated, eight percent are mixed conifer and hardwood, and less than one percent is hardwood-dominated.
- Hardwood species, primarily tanoak, represent 22 percent of the basal area — significantly higher than is desirable from an ecological or financial perspective.
- Forty-five percent of the forest (by area) is in conifer size class 3 (16-24” DBH) and ten percent is in conifer size class 4 or 5 (24+” DBH).
- The most prevalent strata is RD3M (medium stocked, pole-size, mostly redwood stand), with 18 percent of the acres.
- The average carbon storage is 61 metric tons per acre; the average number of downed logs (>18” diameter) is 6.3 per acre; and the average number of snags or standing dead trees (>18”DBH) is 0.5 per acre.

- Salmon Creek is slightly better stocked than Big River in board feet per acre (25,054 versus 22,637) and conifer basal area per acre (170 versus 162).

As referred to above, the forest stands have been classified based on species, size and canopy closure; Table 3-3 depicts characteristics by strata. While there are no known old growth stands on the property, many of the stand types contain some element of late-seral forest characteristics, such as large snags or decadent overstory trees. The most mature stands (the RD4D and RD5D strata) occur almost exclusively in riparian corridors or spotted owl activity centers and are still at least 50 to 100 years away from achieving late-seral condition.

<u>Key to the Strata Codes on following page:</u>

First two letters are for dominant species:
bare ground (BG)
conifer-hardwood (CH)
grassland (GR)
mixed hardwoods (MH)
pygmy forest (PG)
redwood-Douglas-fir (RD)
tanoak (TO)

Third digit is for size:
1 = 0-8"DBH
2 = 8-16"DBH
3 = 16-24" DBH
4 = 24-32" DBH
5 = >32" DBH

Fourth digit is for canopy closure:
O = Open (0-20%)
L = Low (20-40%)
M = Medium (40-60%)
D = Dense (>60%)

MgC is metric tons of carbon (both live and dead, above and below-ground)

Table 3-3: Key Forest Attributes by Strata *(see previous page for key)*

Big River and Salmon Creek Forests

Strata	Net Acres	# of Stands	BA/acre (all trees)					BA/acre (>8in Trees)					BF/acre (>8in Trees)				MgC/Acre	Standing Dead	Down Dead
			RW	DF	OC	MH	Total	RW	DF	OC	MH	Total	RW	DF	OC	Total	Total	>=18" Trees/Ac	>=18" Pieces/Ac
BG	9.3	2					**0.0**					**0.0**				**0.0**	**0.0**	0.00	0.00
CH2D	473.7	26	113.9	38.7	9.7	84.3	**246.5**	98.1	32.7	7.3	61.8	**199.9**	15934	6364	1222	**23720.3**	**75.1**	0.57	8.57
CH2L	403.6	16	87.0	28.3	6.0	81.1	**202.4**	77.2	18.4	2.7	47.0	**145.2**	9648	2267	297	**12357.5**	**56.4**	0.68	9.00
CH2M	390.4	21	101.6	60.0	6.6	81.6	**249.8**	90.5	50.9	4.0	53.2	**198.7**	15155	10432	855	**26640.9**	**76.1**	0.73	5.63
GR	12.5	2					**0.0**					**0.0**				**0.0**	**0.0**	0.00	0.00
MH2M	58.6	3	56.4	58.8	4.5	80.0	**199.6**	49.7	40.7	3.8	56.5	**150.7**	4682	6227	611	**11670.4**	**60.7**	0.00	15.00
PG	6.9	1					**0.0**					**0.0**				**0.0**	**0.0**	0.00	0.00
RD1D	238.0	7	83.9	48.1	13.6	46.5	**192.1**	73.8	33.9	12.0	20.8	**140.6**	8166	4508	1661	**14476.0**	**53.4**	0.06	23.33
RD1O	1865.4	85	81.8	12.0	5.0	19.4	**118.2**	54.3	4.4	0.4	5.1	**64.3**	4686	762	51	**5563.6**	**27.6**	0.00	4.38
RD2D	399.1	22	117.9	63.3	13.7	41.2	**236.0**	109.2	48.4	9.8	23.3	**190.7**	18456	10149	2060	**30855.6**	**72.8**	0.83	5.00
RD2L	559.9	23	112.4	21.0	6.3	42.9	**182.7**	93.1	8.8	2.2	27.3	**131.4**	11492	1589	421	**13634.1**	**47.6**	0.14	4.38
RD2M	951.1	32	97.6	47.3	13.6	63.3	**221.8**	85.2	37.0	10.5	39.3	**172.0**	11738	5399	1820	**19129.3**	**63.9**	0.39	11.79
RD2O	1446.3	56	78.2	18.3	4.4	25.3	**126.2**	54.6	9.4	1.3	11.3	**76.6**	5510	1738	182	**7507.2**	**31.6**	0.47	4.72
RD3D	1372.6	74	184.1	45.2	9.0	45.5	**283.8**	173.9	39.3	5.9	28.9	**247.9**	30746	9660	1143	**41797.1**	**85.7**	0.65	4.58
RD3L	1538.5	57	100.4	43.2	10.6	50.0	**204.3**	86.1	30.9	6.0	28.9	**151.9**	12243	5260	973	**18627.7**	**59.2**	0.45	8.96
RD3M	2702.0	82	138.6	40.4	7.7	55.4	**242.1**	124.7	35.7	5.3	36.4	**202.2**	21553	8172	994	**30921.3**	**72.2**	0.78	3.17
RD3O	1099.7	39	98.2	26.8	7.2	43.4	**175.7**	80.6	17.5	4.2	20.0	**122.3**	11902	3729	730	**16483.8**	**48.7**	0.43	5.77
RD4D	827.9	60	213.7	58.7	8.0	33.0	**313.4**	203.9	53.4	5.8	19.4	**282.5**	42913	15683	1126	**60003.8**	**101.0**	1.10	9.58
RD4L	125.2	8	159.1	36.9	6.5	34.0	**236.6**	141.4	23.1	5.5	17.6	**187.7**	18918	4603	758	**24466.6**	**68.0**	0.68	3.13
RD4M	435.9	29	187.5	28.2	9.3	35.7	**260.7**	179.2	20.7	6.8	26.4	**233.1**	34044	4551	1158	**39986.4**	**77.4**	0.10	8.44
RD5D	49.7	7	196.9	57.6	9.3	21.4	**285.1**	196.4	24.3	7.8	12.6	**241.1**	47308	4945	1554	**54048.7**	**92.3**	0.00	0.00
TO2D	30.9	2	95.6	34.3	25.6	186.1	**341.7**	60.5	34.2	25.0	181.0	**300.7**	13426	7453	5341	**26521.2**	**117.8**	0.00	0.00
***Total* Weighted Avg**	***14997***	***654***	**120.1**	**35.7**	**8.1**	**45.6**	**209.5**	**104.3**	**27.3**	**4.9**	**27.0**	**163.5**	**16611**	**5801**	**863**	**23438**	**60.6**	**0.50**	**6.26**

3.3.4 Productivity and Site Index

Like much of the North Coast, the Big River and Salmon Creek Forests are extraordinarily productive at growing valuable timber. One common measure of the productivity of the site is its site index, i.e., how tall a tree gets in 50 years (assuming good growing conditions). For the Big River and Salmon Creek Forests the average site index for Douglas-fir is 126 feet and 123 feet, respectively; for redwood it is 105 feet and 104 feet, respectively. This is consistent with most of the Forests being typed as Site Class II, as is reported for the majority of the soil series and the neighboring Jackson Demonstration State Forest. According to the FPS model, the Forests are currently growing 1,338 board feet per acre per year, a biological growth rate of 4.4 percent. This growth rate varies across the property based on stand condition and will change over time as a result of harvest and competition.

3.4 Terrestrial Habitat and Species

3.4.1 Habitat Overview

The Big River and Salmon Creek Forests combined provide vegetation transects along ten miles of Northern California Coastal Forest and include a significant representation of the vegetation types associated with the region. As described previously, the Forests are dominated by the Redwood/Douglas-fir habitat type, which accounts for approximately 80 percent of the land-base. Primary conifer species are coast redwood (*Sequoia sempervirens*) and Douglas-fir (*Pseudotsuga menziesii var. menziesii*). The principal hardwood species is tanoak (*Lithocarpus densiflorus*) with a mixture of madrone (*Arbutus menziesii*), oak (*Quercus*), California laurel (*Umbellularia californica*), and other California hardwoods. On most sites redwood would dominate if vegetation succession were allowed to proceed naturally. Redwood habitats provide food, cover, or special habitat elements for 193 wildlife species including a variety of sensitive species (Marcot, 1979).

In addition to redwood habitat types, riparian, annual grass/forbs, and a small amount of pygmy cypress habitat types occur on the Forests. The table below details habitat types and approximate associated acreage of the Big River and Salmon Creek Forests according to the California Vegetation (CalVeg) system. The CalVeg system is notoriously unreliable at fine-scale classifications, because it is based on remote sensing and a brief snapshot of conditions; for example, much of the area classified as annual grasses are roads and landings that are naturally revegetating. A complete survey of vegetation types has not been made of the Properties. A more detailed description of the habitat types, drawing from visits by botanists Kerry Heise and Geri Hulse-Stephens, is attached as Appendix F.

Table 3-4: California Vegetation Types and Approximate Acreage on Big River and Salmon Creek Forests

Vegetation Type	Approximate Acreage on Big River Tract	Approximate Acreage on Salmon Creek Tract
Annual Grass/Forb	523.16	23.65
Blueblossom Ceanothus	532.93	605.18
Canyon Live Oak	6.23	0
Pacific Douglas-Fir	26.83	0
Pygmy Cypress	0.00	121.54
Red Alder	24.24	11.94
Redwood	38.86	0.00
Redwood / Douglas-Fir	9,526.67	3,706.22
Tanoak (Madrone)	1,157.82	207.70
Acreage subtotals:	11,836.74	4,676.23

3.4.2 Special Status Terrestrial Species

A Rarefind Report (California Natural Diversity Database, or CNDDB) search of the five U.S. Geological Survey 7.5-minute quadrangle maps related to the two properties identifies the occurrence of 38 sensitive plant and animal species, and six community types. The California Native Plant Society predicts the occurrence of 39 rare plants based on a search of the five associated quadrangle maps (Appendix F).

Federally threatened listed species confirmed in the Forests include coho salmon, steelhead trout, and northern spotted owl. Additionally, a murrelet detection in the Big River basin was reported in 2005 by Mad River Biologists, and murrelet presence is suggested by Mendocino Redwood Company radar surveys conducted along the Albion and Navarro Rivers, adjacent to Salmon Creek (Campbell Timberland Management, pers. Communication, 2006). Ten sensitive animal species have been confirmed as occurring on the Properties, shown below. Of these, the northern spotted owl is the best understood, is believed to be the most imperiled, and is intended to benefit from our management actions; it is described in more detail below.

Table 3-5: Confirmed Rare, Threatened, Endangered, Sensitive and Species of Concern (Campbell Timberland Management, 2006)

Species	**Listing Status**	**Big River Detection**	**Salmon Creek Detection**
Cooper's hawk (*Accipiter cooperii*)	DFG: CSC	X	
Northern spotted owl (*Strix occidentalis* ssp. *caurina*)	FT CAL FIRE: Sensitive	X	X
Osprey	DFG: CSC CAL FIRE: Sensitive	X	
Vaux's swift (*Chaetura vauxi)*	DFG: CSC	X	X
Northern red-legged frog (*Rana aurora aurora)*	DFG: CSC	X	X
Tailed frog (*Ascaphus truei)*	DFG: CSC		X
Southern seep/torrent salamander (*Rhyacotriton variegates)*	DFG: CSC		X
Western pond turtle (*Clemmys marmorata* ssp. *marmorata*)	DFG: CSC	X	
Steelhead (*Oncorhynchus mykiss*) – Central California Coast Evolutionary Significant Unit	FT	X	X
Coho salmon (*Oncorhynchus kisutch)* – Central California Coast Evolutionary Significant Unit	SE FE	X	X

Listing Status Codes:

FE= Federally Endangered, FT=Federally Threatened; SE = State Endangered

DFG: CSC = California Species of Concern

CAL FIRE: Sensitive (Board of Forestry warrants these species special protection during timber harvest operations)

A Botanical Resource Assessment was conducted for the Big River and Salmon Creek Forests in 2007 and 2008 and is attached as Appendix F. The Big River and Salmon Creek Forests host rich botanical resources. The preliminary inventory of vascular flora of the Big River Forest is represented by at least 317 species in 203 genera and 68 families. The preliminary inventory of vascular flora of the Salmon Creek Forest is represented by at least 234 species in 159 genera and 62 families. Twelve special status plants and two special status communities were identified on the Properties. Eighty-eight invasive plants on Big River Forest and 49 on Salmon Creek Forest were identified and prioritized throughout six distinct vegetation types, and 35 bryophytes and 12 lichens have been identified to date.

3.4.3 Northern Spotted Owl

The northern spotted owl range is north of the San Francisco peninsula throughout the coastal and inland ranges of California and throughout the coastal and Cascade mountain ranges of Oregon and Washington to southern British Columbia. The Redwood Region accounts for only about nine percent of the northern spotted owl's range. Five northern spotted owl activity centers are located on the Big River Forest and five are located on the Salmon Creek Forest, with additional activity centers located on neighboring properties. Most activity centers have been monitored yearly since the early 1990s (Campbell Timberland Management, 2004).

The northern spotted owl (NSO) was listed as a threatened species under the Endangered Species Act (ESA) in 1990 as concern mounted over the continuing loss of habitat that the owls require for survival and reproductive success. In accordance with the ESA listing, landowners within the range of the NSO are required to survey for their presence if any kind of habitat altering activity such as timber harvest is proposed. The United States Fish and Wildlife Service (USFWS) is in charge of administration and consultations with regard to species protected under the ESA. The USFWS developed an NSO surveying protocol in 1991 (revised in 1992), which is followed today.

Figure 12: Northern Spotted Owl (Mike Stephens photo)

The California Forest Practice Rules define minimum foraging and nesting/roosting habitat conditions and require minimum habitat retention levels at the 500 foot, 1,000 foot, 0.7 mile, and 1.3 mile radii of the activity center. This information is included in every timber harvest plan and harvest activities cannot proceed without a determination by the USFWS after review of the THP that the proposed harvest will not harm the species. Despite efforts to make the process objective, locating NSO activity centers precisely and classifying habitat distribution accurately in the field is a challenging and subjective exercise.

The Fund is fortunate to have Mike Stephens, one of the region's NSO experts, responsible for NSO surveys, habitat classification review, and USFWS and CAL FIRE permit coordination. In addition to what is required by the ESA, the Fund has undertaken exhaustive survey efforts, true functional classification of habitat (e.g. not typing a stand as foraging habitat unless it is truly used as foraging habitat), and protection of inactive or abandoned nest sites that have the potential for re-use (because of the high degree of site fidelity and the rare nature of the nest structures).

On average, the Forests' owls have sufficient habitat, and the Fund's commitment to predominantly uneven-aged selection silviculture is designed to maintain and increase habitat values. The biggest threat to the future of the Forests' owls is not habitat loss (although that continues to be significant threat outside of our properties) but rather the invasive barred owl which displaces the NSO (Kelly et al 2003), suppresses its calling behavior (Crozier et al 2006), and is steadily increasing in Mendocino County.

A detailed report on the life history and habitat requirements of the northern spotted owl, with particular attention to the Forests’ owls, is included as Appendix G.

3.5 Role of Forests and the Atmosphere

A rapidly growing forest can absorb a remarkable amount of carbon dioxide; the annual growth on the Forests sequesters approximately 13,251 metric tons of carbon dioxide (the main climate change culprit). How forests are managed has a significant effect on our atmosphere.

The latest Intergovernmental Panel on Climate Change report estimated that 18 percent (and increasing) of global greenhouse gas emissions are the result of deforestation; the report recognizes financial incentives to reduce deforestation and to maintain and manage forests as one of only a handful of policy measures proven to be effective at reducing emissions (Intergovernmental Panel, 2007). The Redwood Region has a unique role in this equation, because the forests of the North Coast have an almost unparalleled ability to grow and store carbon dioxide. Thus, careful management of redwood forests can play a significant role in reducing net greenhouse gas emissions while the loss of redwood forests results in significant emissions.

In addition to carbon storage in standing forests, the use of wood building materials has a lower carbon footprint compared to concrete or steel (because of the much greater amount of energy utilized in manufacturing and distributing metal and masonry). Thus increasing the use of California’s native species as lumber and long-lived wood products can also result in decreased greenhouse gas emissions. As a conserved working forest, the Forests can have a positive climactic impact on several fronts.

3.5.1 Participation in the California Climate Action Registry

Because the Fund recognizes that action to address climate change is needed, the Big River and Salmon Creek Forests have been registered and verified as a Conservation-based Forest Management Project through the California Climate Action Registry (CCAR). Verification requires that landowners model the long-term carbon storage of their forests and report emission reductions that result from storing more carbon than required by law and common practice. This requirement necessitates a verifiable field inventory system that generates statistically reliable estimates of carbon within the forest (including living trees, snags and downed logs, shrubs, and below-ground carbon). The Fund’s reports on carbon inventory and projected storage, as well as descriptions of the project qualifications and modeling methodology, are publicly available at www.climateregistry.org.

3.5.2 Preparing for Likely Climate Change

Planning for the future of the Forests must include a realistic assessment of the likely implications of climate change on management objectives and strategies. A recent study on the implications of expected climate change on California’s native plants found that, with the exception of some particularly sensitive oak species, the Redwood Region is not likely to experience significant losses in plant diversity (Loarie et al, 2008).

While details of the future climate cannot be known with certainty, the general indication is that summers will get hotter (hence more arid), that winter storms will likely increase in severity, and that there will be significant changes in species' ranges (some expanding, some contracting, for both plants and animals). Some practical conclusions can be drawn relative to management of the Forests in anticipation of climate change:

1. Managing for ecological resiliency will become even more important— especially maintaining the full range of natural diversity and ecological succession processes. Practically speaking, Douglas-fir may become a more significant component of the Forest and efforts to exclude or discourage it from redwood stands (as was common in recent history) would be unwise. Establishing redwoods in large openings, especially south-facing slopes, will likely become more difficult. Even on sites with moderate moisture, retaining summer soil moisture will be important, in turn increasing the importance of maintaining shade, downed logs, and soil nutrients. Silvicultural practices on the Forests, therefore, should continue to be focused on maintaining mixed species stands that are well-stocked and maintained through selection silviculture that retains wildlife habitat features.
2. Invasive species will become more likely, especially those that originate from warmer climates. Monitoring and treatment of invasive plants and animals is already part of this Plan, but climate change will increase the importance and challenge of this responsibility. It also means greater emphasis should be placed on prevention of non-native species introductions and effective early control efforts, since those approaches are considerably more cost-efficient than later eradication efforts. Control of jubata (pampas) grass, broom, and other weeds will continue to be our highest priorities.
3. An expected increase in the severity of winter storms only increases the importance of storm-proofing the road system, an effort that is already well underway.
4. Fires, both natural and human-caused, will likely increase in frequency and severity. The Fund will need to maintain the capacity and expertise gained during the 2008 fire season.

3.6 Archaeology and Cultural History

The Big River and Salmon Creek watersheds lie within the Pomo ethnographic province, which indicates that the prehistoric resources most likely to be encountered on the Forests are lithic scatters with groundstone tool fragments 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 seasonal and perennial watercourses, including springs (Van Buren, 2005).

Archaeological and cultural resource surveys have been conducted by previous landowners during the preparation of timber harvest plans; many cultural sites have been located on the Properties. 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. 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 Forests are those related to early timber harvests. These types of sites 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 watersheds.

Figure 13: Abandoned 1950's era logging equipment (Matthew Gerhart photo)

Big River Cultural Resources

Cultural resources within the Big River Forest include remnants of historic occupation by indigenous people and non-indigenous settlers. The indigenous village of Búldam was located not far from the Big River Forest, just east of the town of Mendocino. The Pomo were the earliest known inhabitants of the Big River watershed. They hunted, gathered, and fished, often using fire as a vegetation management tool to favor the maintenance of habitat that supported plants and game animals. Colonization by Mexicans, Europeans, and later, North Americans, began to substantially alter the watershed, especially when commercial timber harvest began. Following the discovery of gold in California in 1849, the demand for lumber spiked (Van Buren, 2005).

Evidence of early settlers can still be seen in what remains of the Piccolotti homestead, remnants of logging camps on some of Big River's bends, and a partially collapsed cabin near Two Log Crossing. In 1852, mill owners constructed the first sawmill at the mouth of the Big River. In 1860, mill owners constructed the first splash dams to facilitate log transport. Use of splash dams along Big River and its tributaries continued through the early 1900s when a railroad was built in the watershed. As detailed previously, the watershed continues to experience legacy effects from over a century of timber harvest and log transport practices. The Big River channel was scoured from the force of the logs released from dams and it is thought that the levees along the river's banks quickly built up due to increased sedimentation.

Salmon Creek Cultural Resources

Cultural resources within the Salmon Creek Forest include remnants of historic occupation by indigenous people and non-indigenous settlers. The indigenous village of Kaba'toda was located on top of the high narrow ridge separating the Albion River from Salmon Creek one to two miles from the ocean (Barrett, 1908). The Northern Pomo preferred to live inland, out of the fog and dense redwood canopy, and closer to more plentiful acorns. Tools for acorn processing are likely to be found in this area, as well as chert or obsidian flakes or tools, sandstone mortars and pestles and shell middens.

Commercial harvesting of timber began along Salmon Creek when the White's Mill was built at the mouth of Salmon Creek around 1876; it was fed by the railroads that extended through Salmon Creek at that time. Many of these railroad grades were later converted to the trucking haul roads that are still used today. By the late 1870s families had settled in Salmon Creek with homesites occurring near Ketty, Hardell and Pullen gulches. A few remnants of these historic ranches remain including collapsed structures, vehicles, fencing, and orchards. The Pullen family built a mill in 1876 at the confluence of the north and main forks of Hazel Gulch. The Salmon Creek timberlands changed hands many times over the next 150 years and harvesting continued, with much of the large timber removed from 1880-1930.

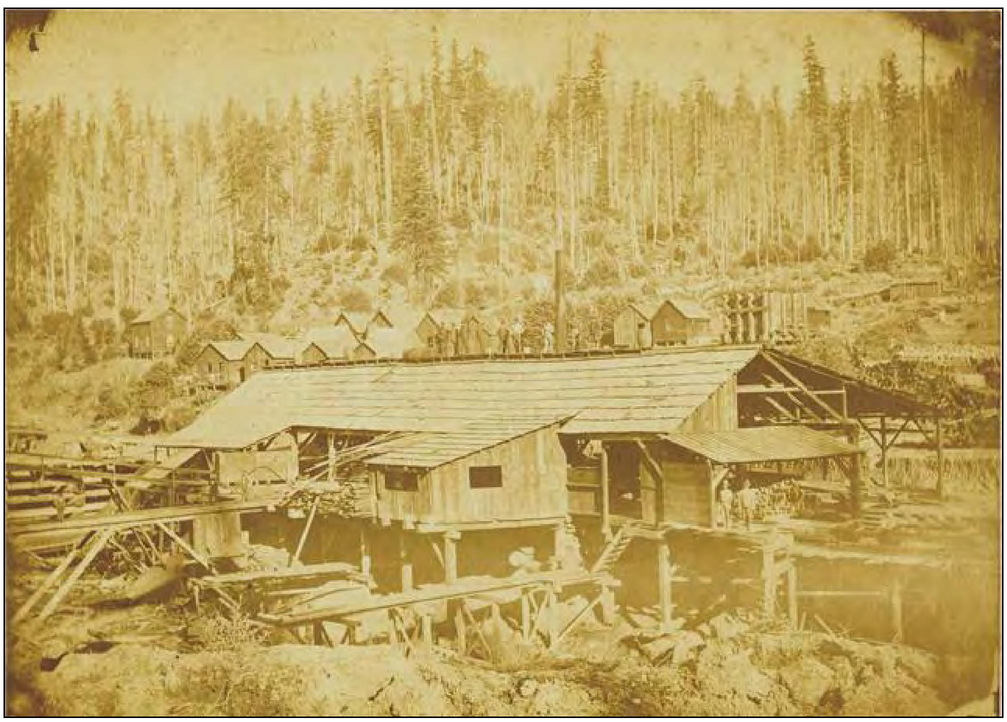


Figure 14: Pullen Mill on Salmon Creek in Albion (photo courtesy of the Mendocino County Historical Society, date unknown)

4. Management Goals and Measures

As previously noted, the “purposes for the acquisition and subsequent management of the [Forests] are (a) to ensure the permanent protection of the [Forests] from subdivision, residential and commercial development, mining, …, water diversion, and conversion to non-forest uses, and (b) protect, restore and enhance water quality and salmonid habitat, improve forest structure and increase natural diversity, provide a sustainable harvest of forest products, and, where appropriate, provide public access…” Section 4 presents specific management goals selected to achieve these purposes and the measures we will take to evaluate progress toward their attainment.

4.1 Overview of Watershed Management

As noted above, fundamental goals of the purchase and subsequent management of the Forests are to “protect, restore and enhance water quality and salmonid habitat, improve forest structure and increase natural diversity [and] provide a sustainable harvest of forest products…” Described in detail in the pages that follow, the primary means of restoring water quality and salmond habitat will be to: a) reduce direct and potential sediment inputs b) increase riparian canopy; c) minimize Class I diversions; and d) increase stream habitat complexity.

Also described in detail in the pages that follow, the primary means of improving forest structure, increasing natural diversity, and providing a sustainable harvest of forest products will be to implement unevenage silviculture where possible, and to develop and maintain large trees and increased stand inventories across the landscape, which will take time.

4.1.1 Road Management

A road management plan for the Big River and Salmon Creek Forests is attached as Appendix H. Specific actions listed in the road management plan to guide road maintenance, construction and decommissioning are presented below.

Initial Road Assessments and Baseline Data

A preliminary road assessment of the Forests was conducted shortly after they were acquired to identify any controllable road-related sediment sources and immediate maintenance needs. The findings were that the accessible roads surveyed were well drained and maintained and no major problems existed that needed immediate repair. Based on this initial survey, hand maintenance was conducted throughout 2007 and the first of many road improvement efforts to open inboard ditches, clean out culverts, and install rolling dips was conducted during 2008 on the Forests.

The Fund has also initiated comprehensive road assessments on the Forests to gather baseline data and prioritize road improvements as well as to identify roads which may be decommissioned. The Fund, in partnership with Pacific Watershed Associates Inc. (and with cost-share funds from DFG's Fisheries Restoration Grant Program) is conducting a road assessment on the Salmon Creek Forest; also with cost-share funding from DFG's Fisheries Restoration Grant Program, a detailed road assessment on the East Branch of the Little North Fork Big River has been completed in cooperation with the Mendocino County Resource Conservation District and Pacific Watershed Associates. Fieldwork for the Salmon Creek assessment will be completed in 2009 with one of the Fund's contractors being trained in the process to conduct the DFG-approved assessment methodology; this will facilitate the completion of road inventories and treatment prioritization on the Big River Forest by the end of 2012.

The road assessments utilize the DFG-approved "Upslope Assessment and Restoration Practices" methodologies described in the California Salmonid Stream Habitat Restoration Manual (Flosi et al, 2004). The methodologies provide a uniform, standardized and accepted protocol for identifying existing and potential erosion problems, and prescribing cost-effective treatments.

The goals of the road assessment are to develop an erosion control and erosion prevention plan that, when implemented, will: 1) substantially reduce the potential for future sediment delivery to nearby streams by improving road surface drainage; 2) upgrade or decommission road drainage structures to accommodate a 24-hour, 100-year storm discharge; 3) where roads are recommended for upgrading, provide for year-round, safe use of the inventoried road routes; and 4) reduce long-term road maintenance requirements and landowner costs.

Figure 15: Review of Roadwork with Pacific Watershed Associates and Stakeholders Following THP Operations, May 22, 2008 (Jenny Griffin photo)

4.1.2 Road Management Implementation Plan Timeframe

Road improvement (upgrading and decommissioning) and repairs will be conducted annually as part of the Fund’s ongoing maintenance and as part of larger initiatives identified in the erosion control and erosion prevention plan described above. The Fund also will continue to upgrade roads consistent with THP and the Regional Water Board’s General Waste Discharge Requirement (GWDR) order. Due to the size of the Forests and the costs of implementation, these measures may take up to 15 years to complete on Big River and up to ten years to complete on Salmon Creek; securing cost-share funding from DFG and other sources will accelerate these time-frames.

Previously Identified Controllable Erosion Sites

Upon the purchase of the Forests, the Fund assumed numerous THPs with prescribed road maintenance practices and timelines in the form of General Waste Discharge Requirement (GWDR) enrollments. THPs are enrolled into the GWDR program after THPs have been approved by CAL FIRE. An Erosion Control Plan (ECP), which represents an inventory of controllable sediment discharge sites with proposals for controlling the sites, is a requirement of the GWDR. The GWDR may be waived by the NCWQCB if the plan submitter meets certain baseline requirements in a THP, which the water board considers to minimize impacts.

The following table lists GWDRs and/or Categorical Waivers on the Forests (either assumed from the previous landowner or enrolled in since the acquisition), which require annual inspection and maintenance until sites are deemed stable and enrollment is terminated by the NCWQCB. The Fund is currently assessing remaining active THPs enrolled under the GWDR for completion and termination of coverage.

Table 4-1: List of GWDRs and Categorical Waivers on the Big River and Salmon Creek Properties

THP # & Name	**Watershed**	**WDID#**	**Enroll Date**	**Target End Date** (+/- 2 winters from completion)
1-06-017 Elf River	Big River	1B106017 MEN	5/01/06 *(CTM)*	Terminated
1-06-083 Hatch Gulch	Big River	1B106083 MEN	8/03/06 *(CTM)*	Terminated
1-05-096 Pond East	Big River	1B105096 MEN	8/10/2005 *(CTM)*	Terminated
1-05-100 Tunzi's East 40	Big River	1B105100 MEN	8/10/2005 *(CTM)*	Terminated
1-07-083 Jarvis Camp	Big River	1B107083 MEN	9/12/2007	Terminated
1-07-060 Riverbends	Big River	Cat. Waiver	NA	NA
1-06-099 Lower Salmon	Salmon Creek	1B106099 MEN	6/7/2007	TBD

1-07-191 Pullen Gulch	Salmon Creek	Cat. Waiver	NA	NA
1-04-061 Upper Salmon	Salmon Creek	1B104061 MEN	3/18/2005 (*CTM)*	Terminated
1-08-037 North of 20	Big River	Cat. Waiver	NA	NA
Wheel Gulch	Big River	Cat. Waiver	NA	NA
Laguna Pass	Big River	TBD	NA	NA

Sediment Reduction Plan

To reduce sediment delivery from the road system, emphasis will be placed on increasing the number of drainage points along roads and reducing the potential for diversion at culverted watercourse crossings. Reducing diversion will be accomplished by the following management practices:

- New culverts and culverts proposed for replacement will be sized to meet the 100-year storm event.
- New or replaced culverts will be installed at stream grade with a critical dip.
- A trash rack or stake shall be installed upstream of the culvert to catch or turn debris prior to reaching the pipe. The stake shall be centered upstream of the culvert a distance equal to the culvert diameter; e.g. the stake shall be two feet upstream of a 24-inch diameter culvert.
- Rock armored fill or temporary crossings will be used on secondary roads, which see only periodic activity, to reduce maintenance requirements. Minor crossings on permanent roads may be converted to rock armored fill crossings over time.
- New roads will be designed with gentle grades, and long rolling dips will be constructed into the road and outsloped to relieve surface runoff. Where possible, watercourse crossings will be designed such that road grades dip into the crossing and then climb out of the crossing eliminating the need for abrupt critical dips.

Permanent Roads: Roads used year-round shall be designed, constructed, reconstructed or upgraded to permanent road status with the application of an adequate layer of competent rock for surface material and the installation of permanent watercourse crossings and road prism drainage structures. These roads shall receive regular and storm period inspection and maintenance as required throughout the winter period.

Seasonal Roads: Roads used primarily during the dry season but to a limited extent during wet weather shall be designed, constructed, reconstructed, and upgraded to provide permanent watercourse crossings - either culverts or rock armored fill crossings and road surface drainage structures. Roads shall be upgraded as necessary with the application of spot-rocking where needed to provide a stable running surface during the specified period of use. These roads shall receive inspection at least once during the wet weather period and shall receive at least annual maintenance.

Temporary Roads: Roads designated as temporary shall be designed to prevent erosion such that regular and storm period maintenance is not needed to prevent sediment discharges to a watercourse. All watercourse crossings, except rock armored fill crossings, shall be removed prior to October 15 of each year of installation. Inspections of these roads will occur for three years after use. Ordinary maintenance will be performed when the road is opened for use.

"The Handbook of Forest and Ranch Roads" prepared by Weaver and Hagans (1994, with updates) will be used as a guideline for all proposed road construction and improvement projects.

Road Decommissioning: Two types of "at risk" roads have been identified as a priority for decommissioning: temporary or seasonal near-stream roads and roads on unstable slopes (typically those that traverse headwall swales). As road assessments are conducted, "at risk" roads will be identified and evaluated for decommissioning. Where alternative haul roads exist or can be constructed that replace the need for maintaining "at risk" roads, the "at risk" road will be scheduled for decommissioning. Alternatively, if no alternate access can be identified, then the "at risk" road may be upgraded or temporarily decommissioned.

4.1.3 Road Improvement Monitoring

Effectiveness monitoring to evaluate road upgrades and sediment inputs associated with THPs are conducted annually in keeping with the NCWQCB's GWDR enrollment program. Annual monitoring reports are sent to the NCRWQCB every June (for plans that have not been closed) describing the condition of each site identified during the THP process, any new sites created or discovered and whether or not the mitigation action proposed is working as designed. To the extent possible all permanent and seasonal roads will be checked for erosion problems after large storm events and all opened roads will be checked at least once a year for erosion problems. Corrective action will be taken as necessary to maintain crossings in a condition that will not deliver sediments.

Long term monitoring will consist of mapping and tracking watercourse crossings using the Geographic Information System (GIS) in which each crossing will be mapped with Global Positioning System tools and the condition of the crossing shall be noted. Any changes made and the year they were made shall also be noted in the GIS database. Over time a complete inventory of all the road watercourse crossings will exist in the GIS database. The data can then be used to detail annual or cumulative sediment reduction activities on the Forests.

4.2 Riparian Habitat Protection and Restoration Measures

The California Forest Practice Rules and other requirements of the NCRWQCB and DFG provide extensive and complex protections for watercourses. By most estimations, combined they are the world's most comprehensive and restrictive regulations governing forestry operations near watercourses. These rules are designed to protect against changes in sediment delivery, shade, large wood recruitment, late seral wildlife habitat, bank stability, and many other issues. The rules were developed in response to major declines in salmonid habitat conditions over the last three decades.

In general, aquatic conditions seem to be slowly recovering from the past practices and current regulatory protective measures should prevent further degradation. But it is unclear whether aquatic conditions are recovering quickly enough to recover and sustain salmonids, particularly in light of human impacts on other life stages. The acceleration of both aquatic and terrestrial restoration measures proposed in this Plan is intended to improve the prospects for the recovery and maintenance of salmonids in the Big River and Salmon Creek Forests.

As stated above, improvement of spawning and migration habitat for salmonid species is a key management goal for the Fund and one of the principal motivations for the acquisition of the Forests. Prohibiting development and agricultural uses on the properties will preclude the largest possible impacts on water quality, followed by comprehensive property-wide road assessments to identify and prioritize sites with sediment delivery potential (the treatment of which will occur over the next ten to fifteen years at an estimated expense of over $5 million). In addition, the following silvicultural practices (discussed in more detail in Section 4.4, below) also will be implemented to improve water quality:

1. Upslope silviculture. Practicing principally uneven-age single-tree selection silviculture to maintain a mature forest across the Forests with minimal openings will reduce the potential hydrologic impacts of even-aged management, which studies at Caspar Creek (http://www.fs.fed.us/psw/topics/water/caspar/) have linked to temporary increases in peak flows, sediment yields, and ambient temperature. Uneven-aged management does, however, require more frequent entries and increased road infrastructure, which is why the next strategy is so important.

2. Increased riparian protection. In addition to standard Watercourse and Lake Protection Zone measures, forest management will include increased canopy retention across all classes of streams.

Watercourse and Lake Protection Zone Measures

Class I streams: A 150-foot WLPZ will be established. There will be no harvesting allowed within the first 50 feet adjacent to the watercourse transition line (as defined by the FPR and identified in the field). Within the next 25 feet at least 85 percent canopy cover must be maintained. Within the remaining 75 feet at least 65 percent canopy cover must be maintained. (Canopy cover**,** a measure of the percentage of potential open space occupied by the collective tree crowns in a stand, here includes overstory and midstory conifer and hardwoods.) The conifer component of the overstory canopy shall not be reduced below 50 percent of the total overstory retained. The California Forest Practices Rules (FPR) provide for harvest within the first 75 feet as long as 85 percent canopy cover is maintained. The remainder of the zone must contain at least 65 percent canopy cover and at least 25 percent of the original overstory conifer must be maintained within the zone.

Class II streams: Using the variable width (slope-dependent) WLPZs defined by the FPR, the Fund will retain at least 75 percent overstory canopy. The conifer component of the overstory canopy shall not be reduced below 50 percent of the total overstory retained. The FPR require 50 percent canopy to be maintained and at least 25 percent of the original overstory conifer must be maintained.

Class III streams: Using the variable width Equipment Limitation Zone (ELZ) defined by the FPR, where there are no overstory retention requirements under the FPR, the Fund will retain at least 50 percent canopy, and a minimum of 25 percent overstory conifer.

[Note: conformance with all canopy requirements will be measured as an average across not less than a 200-foot lineal WLPZ segment—the same as the FPR.]

The Fund believes these three simple measures of increased retention (one per stream class) a) complement the project goals and the process and review requirements of the existing regulations; b) are efficient for foresters to implement in the field; and c) offer higher confidence that aquatic habitat conditions will improve.

In the MOU, the Fund committed to management practices that, among other things, "establish riparian buffers that are wider than required under the Forest Practice Rules." The Fund's forest management policies meet that requirement by providing greater canopy retention within the WLPZ and increased basal area and canopy retention upslope from the WLPZs. A specific example of the wider buffer is the no-cut buffer along Class I streams which has been expanded from only bank and channel trees to 50 feet from the stream—a significant expansion. Additionally, the predominant silviculture beyond the formal WLPZ buffers will be single-tree selection which substantially extends the effective riparian buffer width.

4.2.2 Aquatic Habitat Restoration

Aquatic habitat degradation has resulted from increased bedload and excess stream siltation caused by erosion, and increased water temperature caused by pool filling and a reduction in riparian vegetation. Aquatic habitat restoration includes reducing sediment inputs and increasing shade canopy as described in the previous sections. Baseline data that will be used to measure anticipated improvements in aquatic habitat include stream habitat surveys that have been conducted in the past by DFG, and spawning surveys currently underway by DFG.

Big River has been identified in the Recovery Strategy for California Coho Salmon (DFG 2004), in which seven recommendations were made regarding compliance with DFG 1600 stream crossing and diversion permitting. The Fund currently maintains several active Class I water diversion permits for road watering on the mainstem Big River and Salmon Creek which it inherited from the prior owner. The stream diversion rates are stipulated in the 1600 permit. Over time these will be replaced by permanent Class II water diversions into tanks with return overflow, which are better for aquatic habitat and water quality because the diversion rates are very low and off the main channels. Despite the increased upfront cost, these tanks offer the significant benefit of not needing to access or divert water from Class I streams.

Due to the complexity of the stream environment and difficulty of working directly in stream channels, aquatic habitat restoration is expected to progress naturally as stored sediment loads are transported downstream and potential sediment inputs are removed or mitigated. The riparian management strategy described herein will result in increased stream shading over time and reduced water temperature. Removing water drafting from Class I channels as described above will help maintain stream flow by reducing the diversion rates. Direct instream habitat enhancement may occur if and when logical opportunities present themselves and stream survey data indicates that direct action is warranted.

The primary instream restoration activity will be the introduction of LWD in small order Class I channels where the likelihood of success is high. The prior land manager implemented numerous LWD installations along Two Log, Salmon and Hazel creeks (the highest priority locations); subsequent projects are being considered for lower Salmon Creek and smaller tributaries on Big River. Gravel extraction can be beneficial in some systems with high levels of gravel aggradation because it can promote gravel movement and pool development in some cases. However, because of the potential technical and regulatory challenges, instream gravel removal is likely to be a low priority.

4.2.3 Aquatic Habitat Restoration Monitoring

Habitat improvements in the stream environment shall be monitored using stream habitat data derived from the habitat sampling methodology found in the *California Salmonid Steam Habitat Restoration Manual* (Flosi et al 1998, 3rd edition) currently in use by DFG.

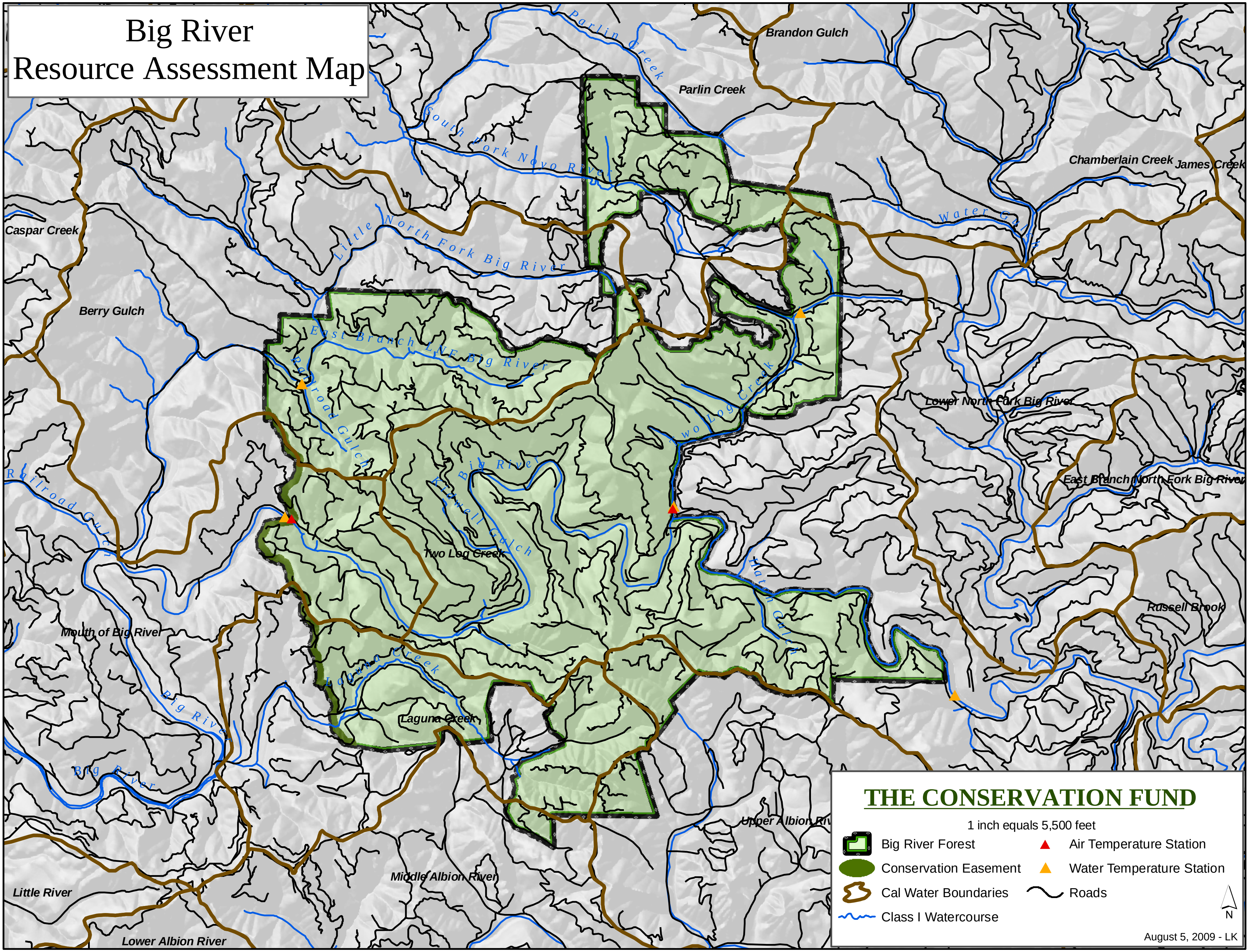
Some baseline data exists for many coastal streams from DFG stream surveys conducted in the past ten years. All of Salmon Creek and Class I tributaries within the Salmon Creek Forest were surveyed in 2007 utilizing the *California Salmonid Steam Habitat Restoration Manual* protocol.

Another available stream habitat sampling method adopted by the U.S. EPA is the EMAP methodology. Both methods are acceptable; however since baseline data exists in the *California Salmonid Steam Habitat Restoration Manual* protocol, the Fund has elected to continue with that sampling methodology. As a complement to either system, it will be important to maintain the network to monitor instream temperature with remote water and air temperature sensing probes (HOBO temps). Additionally, since a principal objective of this Plan is to increase salmonid populations and productivity, the Fund will seek to expand on the DFG spawner survey reaches as the program develops.

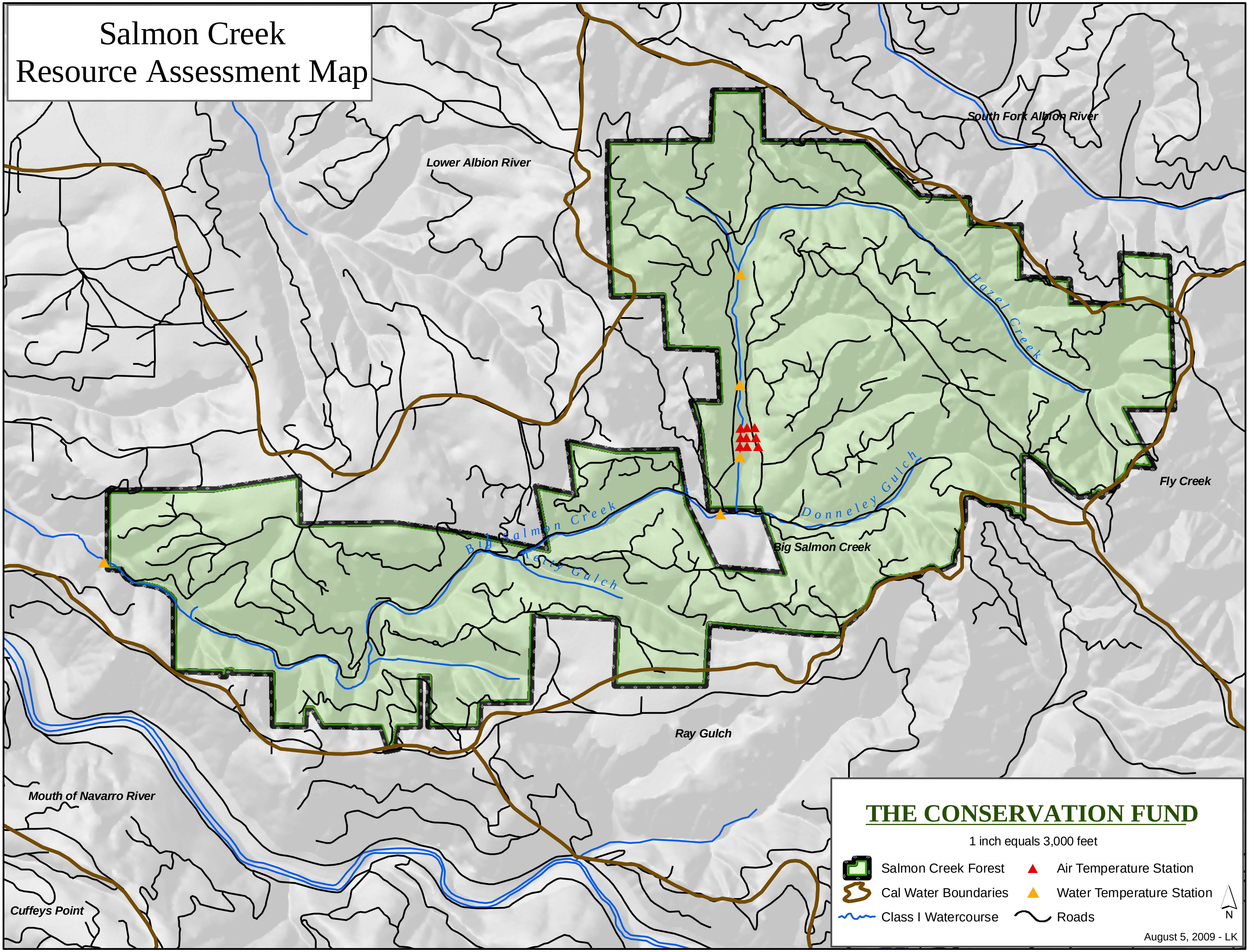
The Fund expects positive changes from the road and stream practices mentioned in the previous sections. However, instream habitat is slow to respond to even the best intended management practices. Therefore, measuring stream habitat more than once every ten years is generally not recommended. The DFG stream habitat assessment protocol does suggest that streams be inventoried after large storm events. The need to re-inventory will be assessed if such an event does occur; timing of the previous inventory and other previously planned management activities will be factors when deciding to re-inventory streams ahead of the recommended ten year interval.

The eleven habitat inventory components of the *California Salmonid Stream Habitat Restoration Manual* include: flow, channel type, temperature, habitat type, embeddedness, shelter rating, substrate composition, canopy, bank composition and vegetation, large woody debris count, and average bankfull width. The Salmon Creek Stream Assessment conducted by DFG in 2007 is available at the DFG Coastal Watershed Program website (http://coastalwatersheds.ca.gov/Watersheds/NorthCoast/MendocinoCoastalStreams/MendocinoCoastalStreamsCentralSubbasin/SalmonCreekDocuments/tabid/671/Default.aspx). Resource Assessment Maps (Figures 5 and 6) show the location of HOBO temps, Class I watercourses and California watershed planning boundaries.[14]

[14] CalWater is a spatial dataset of watersheds in California, developed by the Interagency Watershed Mapping Committee. Geodata may be downloaded from CAL-ATLAS Geospatial Clearinghouse: http://www.atlas.ca.gov/download.html



Big River
Resource Assessment Map
Brandon Gulch
Parlin Creek
Parlin Creek
South Fork Novo River
Chamberlain Creek
James Creek
Caspar Creek
Little North Fork Big River
Water Gulch
Berry Gulch
East Branch LNF Big River
Railroad Gulch
Two Log Creek
Lower North Fork Big River
Big River
Kidwell Gulch
Railroad Gulch
East Branch North Fork Big River
Two Log Creek
Halfway Gulch
Russell Brook
Mouth of Big River
Laguna Creek
Big River
Laguna Creek
Big River
Upper Albion River
Middle Albion River
Little River
Lower Albion River
THE CONSERVATION FUND
1 inch equals 5,500 feet
Big River Forest
Conservation Easement
Cal Water Boundaries
Class I Watercourse
Air Temperature Station
Water Temperature Station
Roads
N
August 5, 2009 - LK


Salmon Creek
Resource Assessment Map
Lower Albion River
South Fork Albion River
Hazel Creek
Donneley Gulch
Big Salmon Creek
Big Salmon Creek
Fly Creek
Ray Gulch
Mouth of Navarro River
Cuffeys Point
THE CONSERVATION FUND
1 inch equals 3,000 feet
Salmon Creek Forest
Cal Water Boundaries
Class I Watercourse
Air Temperature Station
Water Temperature Station
Roads
N
August 5, 2009 - LK

4.3 Invasive Weed Management

In their field surveys of the Forests, consulting botanists Geri Hulse-Stephens and Kerry Heise have identified two invasive plants that are the highest priority for treatment: jubata or pampas grass (*Cortaderia jubata*) and French broom (*Cytisus* spp.), both of which can have a severe ecological impact and are commonly found on both Forests in natural and manmade openings. Both have airborne seeds but are commonly spread through road grading and other vehicle use. Invasive species management will initially focus on the control of these two species.

The Fund will employ chemical and mechanical control techniques to reverse the spread of invasive species, with a preference for mechanical (including manual) control measures where they will be effective. Only licensed and insured contractors with a good track record for safety and compliance may apply herbicides. All herbicide application must be in conformance with label guidelines and applicable laws. The Fund has used Roundup to control invasive species on the Big River Forest and manual control techniques on Salmon Creek; additionally, Mendocino Land Trust volunteers have manually removed invasives on the west end of the Big River Forest. Due to the small size of the Salmon Creek Forest, our preference for mechanical treatments, and the availability of volunteers, the Fund does not expect to use herbicides on Salmon Creek.

The highest priority for treatment will be areas planned for upcoming timber harvest or road improvement projects so as to discourage the further spread of invasives. If done prior to flowering, the physical removal of plants during road grading can reduce the spread of invasive species. However, this generally does not permanently remove the plant from a site once established and subsequent treatments to reduce the population will be required. General road maintenance such as grading and roadside brushing will be the second line of defense to prevent invasives from re-invading a site once the initial treatment has occurred.

Addressing the high priority invasives promptly is a high priority because climate change is expected to make these species more competitive at occupying openings and roadsides. Ultimately, forest management which promotes dense forest cover to shade out invasive plants like jubata grass and broom, will have the greatest and most long-lasting impact on controlling invasive species.

4.3.1 Invasive Weed Monitoring

Ongoing monitoring will focus on the distribution of invasive plants and the effectiveness of treatment efforts. Project botanists and field foresters will continue to identify and record locations of invasives. Additional evaluation projects will monitor the effectiveness of treatment efforts by long-term survivorship of individual populations, similar to the monitoring occurring along Olsen Gulch Road on the GRF (Heise and Hulse-Stephens, 2008).

4.4 Forest Management

The following forest management policies and strategies have been developed to guide the long-term management of the forest resources of the Big River and Salmon Creek Forests to ensure sustainability and fulfill the purposes of the MOU. These policies and strategies are derived from the Integrated Resource Management Plan for the Garcia River Forest completed in 2006 and from interim management policies set forth in the MOU as refined by the Fund in 2006 and 2007. In many cases these are policies and there should not be exceptions: in some cases they are guidelines and slight variations are to be expected. Forestry is an inherently site-specific endeavor and policies must retain the flexibility to adapt to individual stand conditions, market characteristics, or logger capabilities.

4.4.1 Forest Management Strategies

- Silviculture practiced on the Forests will be primarily uneven-aged single-tree or small group selection in order 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. Even-aged variable retention harvests (that retain large trees and habitat features) may be used to rehabilitate conifer sites now dominated by hardwood, in future salvage situations, or to address a specific habitat need (e.g. increase openings for woodrat production); group selection or variable retention will likely be used on Douglas-fir sites; and all regeneration harvests will encourage natural regeneration.
- The Forests must generate sufficient revenue for loan payments, and to the extent consistent with the purposes set forth in the MOU, investment in restoration and enhancement measures (e.g. restoration projects, road upgrades).
- Harvest levels will be significantly less than growth rates over the next few decades so as to increase timber inventory and carbon storage.
- Increased riparian buffers will be provided so as to improve riparian habitat conditions and increase water quality protection.
- Special attention will be given to developing and retaining critical wildlife habitat features, such as snags, downed wood, and trees of significant size.
- While the Forests presently contain smaller trees and more hardwoods than would have occurred naturally, over time the selected silvicultural method are intended to ensure the Forests more closely approximate natural conditions.
- There are no old growth stands on the properties; there are individual trees that are residual old growth—these and other very large trees and true oaks will be maintained [see retention requirements in 4.4.5].

- Include ample internal and external review of proposed and completed THPs through the Field Consultation, Annual Operations Review, and public tours [described further in 4.4.8].
- The Fund has obtained, and will continue to maintain, certification under the Forest Stewardship Council and Sustainable Forestry Initiative standards.
- The Fund will continue to report carbon sequestration through the California Climate Action Registry.

4.4.2 High Conservation Value Feature Protection

Most of the forest management policies are intended to guide the management of those areas of the Forests that will support commercial timber harvesting operations. However, one of the most important steps in determining how to manage a forest is recognizing which areas have unique ecological values that outweigh their potential contribution from a commercial harvest perspective. The protection of these features is critical to achieving the program objectives of restoring habitat for species of concern and increasing the natural diversity and ecological health of these forests.

Specific policies to address these features include the following:

- All pygmy forest, true oak (*Quercus* spp.) woodlands and native grasslands will be preserved. Where these vegetation communities grade into adjoining conifer forest, the surrounding forest is to be managed to buffer and protect the unique ecological attributes of pygmy forests, oak woodlands, and native grasslands.
- There are no large wetlands on the Properties, but springs, seeps, and small wetlands shall receive protection measures at least equivalent to Class III streams except when originating at a road cutbank. (Class III protections include retaining at least 50 percent canopy and a minimum of 25 percent overstory conifer).
- Riparian forests, particularly along Class I streams, will be managed to provide for closed canopy mature forest with a high component of downed logs and other late-seral features. [Some removal of timber can be consistent with this objective - see WLPZ Protection Measures in Section 4.2, above.]
- Nest sites for northern spotted owl are to be managed in accordance with the requirements of the USFWS and the Fund’s biological consultant, Mike Stephens (see Section 3.4.3 and Appendix G for details). Inactive nest sites will be protected (because of the likelihood of repeat nesting).
- Other features that are fairly rare on the landscape and may have unique habitat value include cliff faces, alder thickets, and recently burned areas. These will be mapped and receive site-specific protection measures when they are within or adjoining a potential timber harvest area. As necessary, additional expertise will be gathered to determine appropriate protection measures.

Additional information on the identification and protection of these features can also be found in the High Conservation Value Features Program Memo, which is available from the Fund's North Coast office.

4.4.3 Harvest Levels

Careful determination of appropriate harvest levels is critical to ensuring sustainability and achieving the conservation and economic objectives for the Forests. The target annual harvest level for the first two decades is 4.65 million board feet (the MOU restriction is for not greater than 5.1 million board feet and the previously referenced appraisal estimated that the FPR would allow harvest of 8.5 million board feet). Actual harvest volumes in 2007 and 2008 were 3.3 and 3.5 net million board feet, respectively. An average annual harvest level of 4.65 million board feet on the Forests will allow overall inventory increases of 34 percent over the next two decades, consistent with the objective of increasing the average size and overall stocking of the forest. More recent modeling done for the purposes of carbon sequestration projections indicates that an annual allowable cut of 4.65 million board feet represents about 1.3 percent of the inventory, or 23 percent of the annual growth, which should allow for a significant increase in the size and stocking of the forest in the next two decades. Ultimately, however, the goal is not to achieve a specific number (forest inventory is an inexact science) but to achieve a more natural species balance (i.e., less tanoak), with greater stocking and greater average tree size.

4.4.4 Silvicultural Objectives

The principal silvicultural objectives are to grow large high-quality trees, increase structural complexity and natural diversity and establish a high level of sustainable timber production through selective harvests. These measures should maximize value growth and develop and maintain important late-seral habitat characteristics for wildlife and non-timber forest vegetation. "Crop tree" target diameters are 30 to 36 inches for redwood and 22 to 28 inches for Douglas-fir. Forest management will seek to ensure that late-seral ecological functions and processes are present within a managed forest. Ultimately, these measures are intended to develop stands that have high canopy closure, some large mature trees, and a high degree of structural diversity. In time, certain stands may be excluded from harvest so as to fully return to old growth conditions, once they are on an appropriate trajectory.

For additional information on silviculture decisions, THP development, harvest operations, and contractor selection please see the Fund's Forest Management Supplemental Information in Appendix I.

Figure 16: H & M Logging, Cable Yarder on Salmon Creek, 2007 (Sheila Semans photo)

4.4.5 Harvest Retention Requirements and Guidelines

Within a harvest area, the Fund will permanently retain or recruit downed wood, snags, and trees with high wildlife value given their recognized ecological role and ability to enrich the surrounding stand. The following policies for downed wood, snags, and wildlife trees are meant to implement this strategy by providing clear rules and numerical targets for certain types of features. [The FPR do not categorically address general wildlife habitat retention trees (although there are some requirements for protection of active raptor nests), but additional guidance is available from DFG.] Retention trees will be painted ("W") or tagged by the field foresters as they are marking the timber harvest to communicate the value of these features not just to the loggers but also the public and future foresters. Because a harvest can include over a thousand retention trees, they are not mapped or recorded unless they are suspected NSO nest trees. And while maintaining trees with high wildlife value is important, it is also critical to recognize the wildlife value of the surrounding stand and the conserved landscape, and not expect the harvest stand to mimic or contain all features which may be better represented in other areas of the property.

Downed Wood

Target: two pieces per acre (at least one conifer, 18 inch minimum diameter and ten feet minimum length).

Actions:

- Retain existing downed wood except in situations of recent windfall or fire outside of WLPZ. (In most stands this should be sufficient to meet the target.)
- Retain snags and mark trees for recruitment snags to eventually become downed wood.
- Redistribute cull logs from the landing (unless used for firewood or instream restoration).

Snags and Wildlife Trees

Target: four per acre on average across stand.

Criteria for mandatory retention:

- Snags (minimum 18-inch DBH and 20 foot height);
- Conifers greater than 48-inch DBH;
- Old-growth trees (use MRC definition if in question – see Appendix K);
- Raptor nest trees;
- Hardwoods over 20 inches;
- Murrelet habitat trees (use MRC definition if in question – see Appendix K);
- Den trees (cavity greater than three inch diameter and greater than ten feet above ground);
- Trees with basal hollows or other significant features (cavities, acorn granaries, significant burn scars, significant or unusual lichen accumulation, signs of deformity, decadence, unusual bark patterns, or other unique structure or features).

Actions:

- Retain all mandatory trees and snags except where necessary to fall for operator safety, and protect with screen trees if appropriate.
- If below the target number, mark and retain additional recruitment trees. [Additional wildlife trees will likely be marked in the future from the surrounding stand as it develops.]

General Harvest Retention Guidelines

- Marked wildlife trees should be considered “escapement” trees—they are not intended for future harvest and are allowed to grow beyond the crop tree target size.
- In the absence of mandatory retention trees, on average at least one conifer per acre should be retained from the largest ten percent of the diameter distribution of the stand.
- Marking of the wildlife trees (with paint or tags) is intended to communicate the recognition of the importance of that stem to future foresters, agency reviewers, and the public.
- For the next 20 years some preference for snag and downed log creation and wildlife tree recruitment will be given to cull trees and whitewoods (because of their low financial value) even though they may have a shorter lifespan.
- All retention is subject to operational considerations; the felling of any tree is permitted when necessary for operator safety, road right of way, or yarding corridors. Field foresters will attempt to avoid locating yarder corridors where they would conflict with mandatory retention wildlife trees.
- Targets shall be assessed across the entire harvest stand, not on an individual acre basis.
- Preference is for spatial grouping (clumps of downed wood, snags, and/or wildlife trees).
- The above criteria shall apply to selection harvests. When marking variable retention harvests extra screen trees may be appropriate.

All of the foregoing requirements and guidelines are subject to further review and amendment as the science and practice of forest management evolves and new research is developed and applied. Because of past practices, some portions of the Forests do not have sufficient wildlife features and the initial targets set forth above are intended to guide the long-term retention and recruitment of these features.

Two or three of anything per acre is an admittedly arbitrary number chosen to put the Forests on the right trajectory for the development and maintenance of late-seral habitat characteristics within a managed forest; achieving some of these targets will likely take more than one entry. These distribution and size targets are not expected to be the ultimate value but merely what is appropriate to select and recruit in the next twenty years; the development of late-seral habitat elements is a long-term process and will be shaped over several harvest entries. In addition, it is unclear how the establishment of Sudden Oak Death (documented on GRF) will affect the Forests.

4.4.6 Timber Marking Guidelines

Timber marking (designating individual trees for harvest) is the art of shaping future forest stand conditions by extracting merchantable forest volume while protecting and enhancing wildlife habitat such that the end result is a forest that is well-stocked, rapidly-growing, and healthy with abundant and diverse wildlife habitat features. Approaches to timber marking vary by stand condition and silvicultural objective and it is difficult to identify a universal prescription.

Because of the thousands of individual judgment calls that are made while marking a stand, even individual foresters with the same objective would inevitably make slightly different decisions. The general goal of timber marking by the Fund is relatively simple: current (pre-harvest) conditions should be improved by the time of re-entry (typically ten to twenty years) while also increasing net growth. “Improved” is a subjective term but for the purposes of this Plan it means increased values for conifer basal area, merchantable volume, snags and downed logs per acre. These are also some of the values that will be used to monitor forest trends across the Forests.

Appendix I includes criteria drafted by two experienced local foresters, which strive to capture some of the art of achieving the desired balance between habitat recruitment and retention while removing sufficient conifer volume to satisfy the economic needs of the project. Timber marking will be conducted with these criteria in mind. One of the purposes of the Field Consultations (both pre- and post- harvest) is for the forestry team to discuss the timber marking, particularly in riparian stands, understocked areas, and near NSO activity centers.

4.4.7 Hardwood Management

Hardwood species, including tanoak, madrone, chinquapin, and alder, are an important ecological component of North Coast forests. Past management practices have resulted in an unnaturally high abundance of tanoak in many areas that historically were dominated by conifers. Mixed hardwoods account for 18 and 23 percent of the basal area on the Salmon Creek Forest and Big River Forest, respectively; in some stand types it is as high as 46 percent. For comparison, old growth conifer stands in the area often have ten percent or less of the basal area in hardwood species. Stands with greater than 25 percent of the basal area in hardwood species account for 23 percent of the forested acres.

In addition to the ecological imbalance, the high concentration of tanoak significantly reduces conifer growth and stocking and therefore the future financial value of the Forests, since tanoaks have effectively no commercial value (it costs more to log and deliver than they are worth as firewood). The long-term goal is to maintain an appropriate level of tanoak and other hardwoods (probably around ten percent on average). It is important to not try to eliminate hardwoods—merely to increase conifer site occupancy over time. To achieve these objectives, the following management measures will be implemented:

- All true oak (*Quercus* spp.) woodlands are to be preserved [none are known to occur on the Forests].
- All hardwood wildlife trees are to be retained (which includes all hardwoods 20 inches or greater), except where removal is required for safety concerns or necessary for yarding or road corridors.
- Where the post-harvest hardwood basal area would exceed 30 square feet of basal area per acre (averaged across the stand), hardwoods shall be controlled through manual falling or girdling or herbicide treatment through direct basal injection ("hack-and-squirt") or stump treatment to provide a post-harvest hardwood basal area of 15 to 30 square feet per acre. This may take more than one entry to achieve.
- Most hardwood reduction will be achieved within a selection or thinning harvest by selective falling of tanoaks to release existing conifers. While the tanoak stumps will likely re-sprout, the conifers should have established dominance and will eventually shade-out most of the sprouts. In this type of incremental treatment (selective falling), clumps of hardwoods and individual hardwoods which do not compete with desirable conifers will be left alone. [This treatment occurred to varying degrees in the Riverbends and North of 20 THPs on the Big River Forest.]
- There are many stands where selective hardwood felling would not be sufficient to meet the desired level of conifer site occupancy. In these situations, a more aggressive treatment will be utilized through a herbicide treatment that kills a majority of the tanoak to release either existing conifers or seedlings planted shortly before or after the hardwood treatment. Even within these prescriptions, smaller areas of intact hardwoods would be intentionally retained (for biodiversity reasons). Preference for hardwood retention will be given to large trees (greater than 20 inches), true oaks, chinquapins and madrones, and groups of hardwoods. Rehabilitation treatments (including the use of herbicides) are intended to be one-time interventions and should not need to be repeated because of the decreased openings and ground disturbance associated with subsequent harvests. [An example of this treatment occurred within the Variable Retention units of the Jarvis Camp THP on Big River.]
- The only herbicide to be used in hardwood control treatments currently is imazapyr (tradename Arsenal). Only licensed and insured contractors with a good track record for safety and compliance may apply herbicides. All herbicide application must be in conformance with label guidelines and applicable laws. Additional herbicides may be considered in the future as they are developed and tested and reviewed with respect to Forest Stewardship Council and Sustainable Forestry Initiative standards.
- Any planned use of herbicide will be clearly identified in the THP and THP summary.

- Reduction in the use of herbicides is an important objective; alternatives to herbicide treatment have been and will continue to be evaluated on a periodic basis. A comparison of herbicide treatment and logging of tanoaks for commercial firewood was evaluated as part of the Jarvis Camp THP. Monumented plots will allow for long-term evaluation of effectiveness but the initial impressions are that the logging method resulted in increased cost and site disturbance (exposed soil and damage to the residual stand). That said, a commercial market for tanoak would be pursued if it develops. Areas with well-established and good quality hardwoods will likely be managed for mature hardwoods instead of attempting to re-establish conifer.
- There will be no hardwood control with herbicides in WLPZs; manual falling or girdling of small hardwoods may be used, but only as part of a riparian shade enhancement project (likely with conifer underplanting).
- Priority for rehabilitation treatments will be given to high site, tractor-operable ground, with existing desirable redwood growing stock. Herbicide treatments will be less than 100 acres annually (on a rolling average basis).
- Hardwood control measures will be reviewed periodically and revised as appropriate based on knowledge and experience gained in the field over the next several years. Herbicides will likely also be used to control certain exotic invasive plants, primarily jubata grass and broom. No other uses of herbicides or pesticides are anticipated.

4.4.8 Fire Management

Fire is both a natural and human-caused presence on the North Coast landscape and requires careful consideration and preparation, as was amply demonstrated during the 2008 Mendocino Lightning Fire Complex. The Conservation Fund has developed a Fire Management Plan (included as Appendix J) to specify the fire prevention and response measures to be used on the Forests. This plan was submitted to CAL FIRE and is provided to all equipment operators working on-site and to the local volunteer fire departments. Decisions about fire control strategy and remediation will be made on a case-by-case basis by the North Coast Senior Forester.

Figure 17: Salmon Creek Fire June 27, 2008 (Jenny Griffin photo)

4.4.9 Monitoring and Forest Certification

Ongoing monitoring of both activity implementation and program effectiveness is a critical part of adaptive management and successful initiatives. Several monitoring strategies will be utilized in combination to ensure thorough review across multiple sectors and different temporal and geographic scales. There is detailed discussion of the aquatic monitoring strategies in Section 4.2.3, which are critical to and complementary of the forest monitoring strategies described in this section. Three broad categories of forest monitoring will be utilized: short-term harvest monitoring, long-term forest monitoring, and forest management certification. These are described in detail below.

4.4.9.1 Short-term Harvest Monitoring

Because of the sensitivity and significance of the timber harvest program, it will receive more detailed monitoring than other program activities. Numerous efforts are undertaken before, during, and following a timber harvest to ensure that it is completed in accordance with the Fund’s management policies, including safety, regeneration, residual stand quality, and aesthetic issues. This monitoring process begins before the harvest operation, with each THP's Field Consultation, which brings together all of the Fund's resource management team to identify any sensitive issues that deserve additional attention. For example, the Jarvis Camp THP had additional inventory plots established to monitor the effectiveness of the different tanoak control treatments. In addition there is a public THP tour, prior to operation and again following completion, to solicit suggestions and answer questions from interested stakeholders.

During the harvest the supervising forester is on-site at least weekly to review the performance of the Licensed Timber Operator and address any issues that may arise. Following the harvest, the Fund's resource management team is re-convened for the Annual Operations Review, which inspects completed operations to evaluate conformance with the Fund's policies and discuss any special issues. In connection with Field Consultations, weekly harvest inspections, the Annual Operations Review, and/or the required agency reviews, certain sites or issues will be identified for continued specialized monitoring (e.g. Erosion Control Plan sites are typically monitored for at least two winters). Results of THP inspections or monitoring are available from Fund staff by request.

4.4.9.2 Long-term Forest Monitoring

As part of the objective of restoring the forest inventory and late-seral wildlife habitat characteristics, there are several long-term monitoring targets that will be evaluated within the forest inventory system. Because of the continuous nature of the inventory updates and the long-term environmental response time, reporting on these metrics will occur approximately every ten years, although interim data will be factored into THPs and specific restoration projects. As the primary forest management goals are to increase inventory, forest productivity and late-seral characteristics, the monitoring targets are oriented around associated indicators.

Table 4-2: Long-term Forest Monitoring Targets

Objective	Metric	Current value	50 year target value	Criteria
Conifer volume	mbf/acre	23	30+	Net Scribner log scale, across all forested acres
Tree size	Percent of forest in size class 4 or greater	10	55+	Per stratification rules
Conifer growth	Board feet/acre/year	1,338	1,000+	Across all acres, pre-harvest
Snags	#/acre	0.5	>2	All species, >18"DBH
Downed logs	#/acre	6.3	>5	All species, >18" diameter
Hardwood competition	Percent basal area	22	<15	Average across all acres, all diameters.
Harvest volume	Percent of inventory	1.3	<2.0	Across all acres, averaged for ten year rolling window

4.4.9.3 Forest Certification

The Fund's North Coast Forest Conservation Program has been certified as in conformance with the Forest Stewardship Council and Sustainable Forestry Initiative standards for sustainable forest management by the accreditation firms Scientific Certification Systems and NSF International Strategic Registrations. These broad-ranging standards are intended to ensure that all forest management activities are planned and conducted to meet the established sustainability criteria which include hundreds of individual indicators covering everything from water quality protection and biodiversity conservation, to worker training and community involvement. Re-certifications are scheduled to occur every five years with surveillance audits every summer. The standards are publicly available at: www.fscus.org and www.sfiprogram.org; the reports of the Fund's auditors are available at www.scscertified.com or from the Fund's North Coast office.

The Big River and Salmon Creek Forests are also an approved and verified Conservation-based Forest Management project through the California Climate Action Registry. This program, endorsed by the California Air Resources Board, allows The Conservation Fund to quantify and publicly report on our greenhouse gas emission reductions through improved forest management. As part of the annual field audits for this program, independent auditors review the forest inventory system and greenhouse gas reporting system (including the Fund's fuel and energy usage). The Forest Project Protocol and the annual project reports are available at www.climateregistry.org.

This rigorous system of third-party audits is intended to help land managers evaluate and improve their practices and communicate their success. The Conservation Fund views participation in these programs as an important measure of program effectiveness and its commitment to advancing sustainable forestry.

5. Community Use and Involvement

The Fund will provide a range of opportunities for community use and involvement 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 demonstration to participation in restoration projects and unsupervised pedestrian and equestrian access.

To foster community involvement and support, the Fund provides guided tours of areas intended for timber harvests, road improvement and restoration projects, and native plants, as well as tours tailored for youth education. These programs familiarize the public with sustainable management methods and goals and build community partnerships. In addition, the Fund is developing an access program to allow unsupervised pedestrian and equestrian public access along a designated trail system, while emphasizing the public's role as stewards of the Big River and Salmon Creek Forests.

5.1 History of Community Use and Involvement

Beginning in the 1850s and continuing until their purchase by the Fund, the Big River and Salmon Creek Forests were managed as private industrial timberlands. These landowners officially had "no trespassing" policies, including warnings on property boundaries and security patrols, but trespass was difficult to prevent and a range of unauthorized recreational activities occurred on Big River and Salmon Creek, including hunting, fishing, pedestrian, equestrian, bicycle and off-highway vehicle use.

On the Big River Forest, the previous landowner provided access to members of Wilderness Unlimited, which held a lease to use the Property for hunting purposes. Case-by-case access was also provided to groups, such as an annual equestrian event that crossed onto Big River Forest from Jackson Demonstration State Forest.

Unauthorized activity on the Big River and Salmon Creek Forests is an on-going problem. Marijuana growers cause pollution, break gates and locks to gain access, and can be a safety concern for field personnel and other users. Motorcycle usage can tear up the roads, causing erosion and potentially damaging streams. The dumping of trash is unsightly, a pollution hazard, and costly to remove.

Presumably because of the ease of accessibility from both Albion Ridge and Middle Ridge neighbors, Salmon Creek has a more active history of use, including pedestrian, equestrian, motorcycles and trash dumping. Members of the Albion community have been very supportive of the Fund and have shown strong interest in continued access to the Forest for pedestrian and equestrian use. A group of volunteers have organized tree planting and invasive plant removal workdays to support the Fund's management goals.

Figure 18: Albion Community Volunteers Planting Redwood Seedlings in Salmon Creek Forest, 2008 (Rixanne Wehren photo)

5.2 Goals and Objectives for Community Use and Involvement

The Fund intends to provide a range of opportunities for community use and involvement that can be reasonably managed by the Fund in a manner that is 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 participation in restoration and unsupervised pedestrian and equestrian access. The following are the Fund's guidelines for community use and involvement.

- Be a good neighbor by holding to the highest professional standards, cooperating with other landowners, cleaning up trash, patrolling for illegal activities and providing assistance with community-based projects.
- Provide reasonable dispute management. Should a dispute arise with a local citizen, neighbor, partner organization, current or potential contractor, or other interested entity, the Fund will first seek to resolve the dispute through open communication, prior to more formal dispute resolution through mediation or litigation.
- Provide THP tours either before or shortly after submission of harvest plans to CAL FIRE, and again following completion of the operation. Fund staff will actively seek community review of its operations and programs and will be responsive to questions or concerns raised by the local community. THP Summaries will be provided to facilitate community understanding.

- Provide opportunities for on-site demonstrations of watershed restoration projects, sustainable forest management and other best management practices, public participation in research opportunities, educational tours, and restoration workdays.
- Build partnerships with local organizations that are mutually beneficial.
- Create a Stewardship Permit Access Program that will allow unsupervised pedestrian access and potentially other access opportunities along a designated trail system while emphasizing the public's role as stewards of the Properties.
- Establish volunteer groups to coordinate trail maintenance workdays and guided interpretive walks.
- Prepare an annual report that describes major activities on the Forests, changes to policies, and monitoring results.

5.3 Recreational Access Activities and Policies

5.3.1 Pedestrian Access

Big River and Salmon Creek pedestrian access is modeled on LandPaths' (Land Partners Through Stewardship) Stewardship Permit Access Program. LandPaths 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.

The Fund's Stewardship Permit Access Program (SPAP) will allow unsupervised pedestrian public access on designated roads while emphasizing the public's role as stewards of the Big River and Salmon Creek Forests. The Fund will begin implementation of the pedestrian program in the summer of 2009. The public will be allowed access only after having completed an orientation program and agreeing to conditions of use. Local SPAP publicity will be gradual, consistent with the necessity of manageable and responsible access; the program will be initiated small-scale and local and will grow, along with associated publicity, over time. Information about the Pedestrian Stewardship Permit Access Program will be available on the Fund's website beginning in 2009 (www.conservationfund.org/north_coast_forests). The goal of the SPAP is to allow unsupervised low-impact, environmentally responsible access along a portion of existing roads. The program will be continued only if access is manageable, affordable, and does not degrade natural resources or interfere with forest management.

Stewardship Permit Access Program Pedestrian Guidelines (subject to change)

- Pedestrians are allowed access only after having completed an orientation program, agreeing to conditions of use, and being issued a permit.

- The hours of operation for pedestrian permits are sunrise to sunset only.
- Pedestrians will utilize only the existing and designated roads.
- No hunting, fishing, camping, campfires, or trash dumping.
- Pedestrians will not harvest any natural resources, including wildflowers, wildlife, firewood and mushrooms from the Forests.
- Erosion will be minimized by limiting use to existing roads, respecting stream and riparian areas, and other restrictions as designated by the Fund.
- Timber harvesting area boundaries, which may close portions of the trail systems, will be respected and not entered upon by pedestrians during the active operating season.
- Closures may be applicable for certain seasonal restrictions, weather or road conditions, logging operations, and other management needs in connection with cultural and natural resource protection and management. .
- Pedestrians will be respectful of and courteous to other pedestrians, equestrians and vehicle operators on the Property and will yield to equestrians and vehicles when encountered.
- Pedestrians are responsible for reporting to the Fund any unauthorized uses or dangerous situations observed.
- Pedestrians do not have permission to access or cross neighboring properties.
- The Fund reserves the right to revoke any permit holder that fails to comply with any of these or other applicable conditions.

5.3.2 Other Recreational Uses

Permission for additional recreational activities may be expanded on a case-by-case basis. Potential expanded uses may include equestrian, mountain biking, swimming and wading, hunting, fishing and group events. Evaluations of requests will be based on safety, potential resource damage, community benefit and administrative impact.

A pilot equestrian SPAP will initially be offered on Salmon Creek Forest only. This program will serve as a test case for possible future permanent inclusion into the SPAP and potential expansion to Big River and or to bicyclists. This program has the potential to provide expanded stewardship activities and monitoring data on remote and less accessible areas. The equestrian pilot program will be evaluated for its success based on its ability to be managed by the Fund and evidence that it does not cause environmental impacts.

A mandatory orientation program for users will serve as introduction to the Fund and its management goals, the designated guidelines, and the approved access points and trails for equestrian use. Guidelines for the equestrian SPAP will be similar to the pedestrian guidelines but equestrians will be restricted to specific roads, subject to seasonal closures, and required to prevent the introduction of weeds.

5.3.3. Unauthorized Activities

The Fund conducts frequent security patrols of the Big River and Salmon Creek Forests to deter unauthorized access and illegal uses. These illegal activities include marijuana cultivation, trash dumping, poaching and off-highway vehicle use. Violators will be prosecuted.

5.4 Outreach Activities

Upon purchase of the Forests the Fund initiated guided tours of timber harvest areas, road improvements, restoration projects, native plants, and youth educational trips, with activity increasing annually. These events familiarize the public with sustainable management methods and goals and build community partnerships. Tours of timber harvest plans serve to demonstrate to the public the planning and process behind managing the forests sustainably and to solicit feedback on management activities.

Public tours of road and other infrastructure improvements offer opportunities to demonstrate and share information regarding the methods and steps the Fund is taking to improve the ecological conditions on the Forests. The Fund welcomes and appreciates community participation in restoration projects on the Forests. Volunteers on Salmon Creek have initiated redwood seedling-planting workdays, with 200 trees planted in January 2009. Many of these same community volunteers have taken on a non-native species removal project and have spent many hours removing jubata grass on Salmon Creek. Contributions such as this are very valuable and the Fund appreciates the individual effort and community support.

The Fund has also benefited from generous time donations by local naturalists that have resulted in tours focused on such topics as native plants, giving participants a solid connection with the natural world. The Fund makes it a priority to work with local school programs, such as Mendocino High School's School of Natural Resources (SONAR). Students toured Big River in 2008 to learn on the ground about sustainable forestry and will be creating semester projects in conjunction with the Fund in the coming years

5.5 Monitoring Strategies for Community Involvement

The goal of monitoring is to provide the Fund with the necessary background and feedback to appropriately manage the natural and cultural resources on Big River and Salmon Creek. Monitoring will be conducted continually, analyzed annually and incorporated into policies and annual program reviews.

Staff and area foresters will be responsible for monitoring and evaluating the impacts of pedestrian and equestrian access. Evaluations will be based on safety, resource damage, community benefit and administrative impact. Users will be required to notify the Fund of illegal or dangerous activity and may be asked to provide information on trail conditions and wildlife occurrences. The program will be continued only if access is manageable, affordable, does not degrade natural resources or interfere in forest management.

Figure 19: Volunteer Invasive Plant Removal on Salmon Creek (Rixane Wehren Photo)

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 (a 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-sized 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

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 DFG 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, or an 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

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, or 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 goals such as structure, composition, interactions, and abiotic and biotic processes; these must be maintained to ensure the long-term viability of conservation goals

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 seasonal 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 exceed the available stream flow.

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 six feet (two 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 that 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 even-aged 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: see attached Appendix K for detailed definitions

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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Appendices

- A. Memorandum of Understanding
- B. Assessor Parcel Numbers
- C. Geology and Soils
- D. Aquatics Management Plan for Big River
- E. Aquatics Management Plan for Salmon Creek
- F. Botanical Assessment
- G. Northern Spotted Owl Report
- H. Road Management Plan
- I. Forest Management Supplemental Information
- J. Fire Management Plan
- K. Old-growth Definitions

APPENDIX A: MEMORANDUM OF UNDERSTANDING

This Memorandum of Understanding ("MOU") is entered into by and among the State Water Resources Control Board ("State Water Board"), the California State Coastal Conservancy ("SCC"), the Wildlife Conservation Board ("WCB") and The Conservation Fund ("TCF") (collectively, the "Parties"; sometimes individually, a "Party") this ___ day of October, 2006.

Background

1. TCF has entered into an agreement dated January 11, 2006 (as later amended) to purchase approximately 16,100 acres of forestland in Mendocino County ("Properties") from Hawthorne Timber Company for $48,500,000 on or before October 15, 2006 ("Agreement"). The purpose of the acquisition is to prevent fragmentation of forest-lands; protect, restore and enhance water quality and salmonid habitat; improve forest structure and increase natural diversity; and provide public access where appropriate.

2. On June 29, 2006, SCC approved a grant of $7,250,000 to TCF (the "SCC Grant") to assist with the acquisition of the Properties, subject to the conditions in Exhibit A-1 (the "SCC Approval").

3. On July 19, 2006, the State Water Board approved a State Revolving Fund (SRF) loan to TCF of $25,000,000 (the "SWB Loan") to assist with the acquisition of the Properties, subject to the conditions in Exhibit A-2 (the "State Water Board Approval").

4. On August 17, 2006, WCB approved a grant of $7,250,000 to TCF (the "WCB Grant") to assist with the acquisition of the Properties, subject to the conditions in Exhibit A-3 (the "WCB Approval").

5. The State Water Board Approval requires as a condition of funding the State Water Board Loan that the Parties enter into a memorandum of understanding to, among other things, "ensure that the [Properties] will be used, managed, and restored to the conditions that are agreed upon by the applicant and the funding agencies… [and] will also include the essential terms of conservation easements and/or Covenants, Conditions, and Restrictions (CCR) that will ensure that the properties will not be sold at a later date for any purpose other than intended."

6. The SCC Approval, the State Water Board Approval and the WCB Approval (collectively, the "Approvals") each have established specific conditions and requirements which must be met prior to the disbursement of funds to complete the purchase of the Properties. In some cases, the conditions and requirements of a Party require the fulfillment of conditions by another Party or the Parties.

7. In light of the foregoing, the Parties desire to enter into this MOU to fulfill the requirements of the State Water Board Approval, to coordinate their respective requirements and conditions with respect to the purchase of the Properties and to establish an understanding as to the fulfillment of certain post-closing matters as provided below.

Understandings

1. Project Purposes. Without modifying or limiting in any way the requirements, conditions or terms of the Approvals, the Parties additionally desire to state in this memorandum their understanding and agreement that the general purposes of the acquisition and subsequent management of the Properties are (a) to ensure the permanent protection of the Properties from subdivision, residential and commercial development, mining (except for gravel mining for use on the property, in a manner otherwise consistent with and in furtherance of the purposes stated in this paragraph), water diversion, and conversion to non-forest uses, and (b) protect, restore and enhance water quality and salmonid habitat improve forest structure and increase natural diversity, provide a sustainable harvest of forest products, and, where appropriate, provide public access, through the implementation of the Plan, as defined in Section 3, and the interim management guidelines, as described in Section 6 (the "Project Purposes").

2. Securing the Project Purposes. In addition to the agreements between TCF and each of the Parties as contemplated in each of the Approvals, the Parties intend that the Project Purposes will be permanently secured by recording at closing an Offer to Dedicate and Declaration of Restrictive Covenants (the "OTD") in favor of the Coastal Conservancy and a Notice of Unrecorded Grant Agreement (with covenants affecting real property) in favor of WCB (the "Notice"). The purpose of the OTD and the Notice is to provide legal assurance that the Project Purposes are fulfilled irrespective of any breach or failure of TCF to meet its obligations or the subsequent transfer or transfers of the Properties. The Parties further agree that a conservation easement consistent with the Project Purposes and approved in writing by the Parties (the "Approved Conservation Easement") can be substituted for the OTD, in which case the OTD will be of no further effect. The Parties further agree that the Grant Agreement between WCB and TCF will provide, among other things, that upon a future sale or transfer of the Properties and the substitution of an Approved Conservation Easement, the Approved Conservation Easement shall include the terms and conditions of WCB's Grant Agreement in lieu of the Notice.

3. The Plan. Each of the Approvals requires that TCF prepare a document that describes how the Properties will be managed. The SCC Approval and the WCB Approvals each require that TCF work with certain public agencies, local stakeholders and other interested parties to "prepare a forest management and restoration plan, plan sustainable timber harvests which eventually will fund the repayment of loans taken to purchase and /or manage the [P]roperties, the implementation of the forest management and restoration plan, and provide public access" by December 31, 2008. The State Water Board Approval requires "that no later than two years after the acquisition of the [Properties] the [T]CF develop a water quality management and restoration plan (WQMRP). This plan will explain the measures the [T]CF will implement to correct and prevent deterioration of the watersheds due to past, current, and proposed forest management practices , and how performance and benefits of the Project will be measured". The Parties will agree on the form of the plans required under the Approvals and may consider the preparation of a single plan which conforms to the respective conditions and requirements of each of the Approvals (individually, or collectively, the "Plan"). The Plan will include all of the elements

specified therefore in the Approvals and such other elements as the Parties may agree to include during the development of the Plan.

4. Plan Development. TCF will lead the work necessary to develop and gain approval of the Plan in accordance with the Approvals. TCF will invite and encourage the participation of public agencies, the local community and other stakeholders. The public agencies involved will include at least the Parties, the California Departments of Fish and Game, Forestry and Fire Protection and Parks and Recreation and the North Coast Regional Water Quality Control Board (the "Regional Water Board"). A final draft of the Plan will be submitted to SCC, State Water Board , WCB and the Regional Water Board not later than two years following the acquisition of the Properties.

5. Management of the Properties upon Completion of the Plan. Upon completion and approval of the Plan as required by the Approvals, the Properties will be managed in a manner consistent with the Plan once it has been completed and approved in accordance with the Approvals.

6. Interim Management Guidelines. Until the Plan is approved, the Properties will be managed in a manner consistent with the following general guidelines:

A. Forest Management. TCF intends to promptly seek and maintain certification of its management of the Properties by the Forest Stewardship Council ("FSC"). Such certification, so long as it is maintained, will be sufficient evidence of TCF's fulfillment of the Parties' forest management requirements as set forth in the Approvals. The Parties understand that attaining FSC certification may take a year or more following the purchase of the Properties. In the interim, TCF's management of the Properties will generally be guided by the following management guidelines:

(i) Reduce harvest levels by between 40 to 50% below the levels allowed under the Forest Practice Rules in effect at the time of the purchase of the Properties ("Forest Practice Rules"), as established in the appraisal of the Properties prepared by Appraisal Associates dated April 13, 2006 and revised July 6, 2006. The Parties agree that harvest level reductions will vary from year to year and in any given year may not be attained (or may be exceeded) and that the attainment of these levels will be determined by averaging harvest levels over a period of 5 years.

(ii) Use single tree or small group selection as the primary silvicultural prescription, with the recognition that other harvest methods such as commercial thinning and variable retention prescriptions may be necessary to achieve the Project Purposes.

(iii) Establish riparian buffers that are wider than required under the Forest Practice Rules.

B. Water Quality Measures. Implementation of the forest management measures described above and the permanent protection of the Properties from subdivision, residential and commercial development, mining, water diversion, and conversion to non-forest uses such as vineyard development, as required by the Approvals, will prevent further degradation and will enhance water quality on the Properties. In addition to these measures, TCF will:

(i) Implement management measures consistent with the Nonpoint Source Program Strategy and Implementation Plan, 1998 – 2013 ("NPS Implementation Plan") and the Big River Total Maximum Daily Load for Sediment developed by the US EPA, Region IX in December, 2001 ("Big River TMDL"), as adopted by the Regional Water Board in Resolution No. R1-2004-0087.

(ii) Review the Garcia River Forest Site Specific Management Plan as approved by the Executive Officer of the Regional Water Board, dated May 8, 2006 (the "Garcia SSMP") and adopt the appropriate provisions thereof as interim water quality management measures for the Properties. TCF will seek guidance from staff of the Regional Water Board in selecting the appropriate provisions for use on the Properties.

7. Amendment. This MOU may be amended at any time by the mutual written consent of the Parties.

8. Scope. As stated above, the purpose of this MOU is to fulfill the requirements of the State Water Board Approval, to coordinate the Parties' respective requirements and conditions with respect to the purchase of the Properties and to establish an understanding as to the fulfillment of certain post-closing matters as provided herein.

9. Conflicts. In the event of conflicts between this MOU and any one or more of the Approvals, deference will be given to the pertinent provisions of the Approval or Approvals deemed to conflict with this MOU.

10. Notices. Notices and other communications between the Parties should be delivered to the following Party representatives at the locations provided:

State Water Resources Control Board
c/o Barbara Evoy
1001 I Street, 16th Floor
Sacramento, CA 95812
Phone: (916) 341-5632
Fax: (916) 341-5707

State Coastal Conservancy
c/o Executive Officer
1330 Broadway, Suite 1300
Oakland, CA 94612-2530
Phone: (510) 286-4185
Fax: (510) 286-0470

Wildlife Conservation Board
c/o Executive Director

1807 13th Street, Suite 103
Sacramento, CA 95814
Phone: (916) 445-8448
Fax: (916) 323-0280

The Conservation Fund
c/o Chris Kelly
P.O. Box 5326
Larkspur, CA 94977
Phone: (415) 927-2123
Fax: (415) 924-7354

11. Counterparts. This MOU may be signed in counterparts.

12. Concurrent Funding. The Parties agree that each Party's deposit of funds into escrow is contingent upon the concurrent assurance from each of the other Parties that their funds are similarly obligated and ready for deposit. The Parties will provide for this assurance through their respective escrow instructions.

APPENDIX B: ASSESSOR PARCEL NUMBERS

Big River				
APN	**Acreage**	**Township**	**Range**	**Section**
021-060-05	120.00	18N	16W	34
021-060-09	80.00	18N	16W	34
021-070-19	240.00	17N	16W	8
021-070-20	240.00	17N	16W	9
021-080-16	640.00	17N	16W	16
021-080-21	80.00	17N	16W	21
021-080-22	560.00	17N	16W	21
021-080-23	520.00	17N	16W	17
021-080-26	721.00	17N	16W	20
021-080-27	136.00	17N	16W	19-20
021-090-20	280.89	17N	16W	33
021-090-41	320.00	17N	16W	28
021-090-42	183.00	17N	16W	28
021-090-43	203.00	17N	16W	29
021-090-44	147.00	17N	16W	28
021-090-45	447.00	17N	16W	29, 32
021-100-72	58.00	17N	16W	11
021-100-79	29.00	17N	16W	2, 11
021-100-81	1,358.00	17N	16W	1, 2
021-110-28	2,395.00	17N	16W	14, 15, 22, 23
021-110-29	365.00	17N	16W	13
021-120-62	129.00	17N	16W	34
021-120-91	1,474.00	17N	16W	26, 27
021-120-92	789.00	17N	16W	27, 34, 35
021-370-65	223.00	17N	15W	30
125-040-21	40.00	16N	17W	3
Total Acreage	**11,777.89**			
Salmon Creek				
APN	**Acreage**	**Township**	**Range**	**Section**
123-430-12	240.00	16N	17W	36
123-430-17	150.77	16N	17W	35
125-230-15	200.00	16N	17W	20
125-230-17	60.00	16N	17W	21
125-340-04	520.00	16N	16W	29
125-340-17	155.00	16N	16W	32
125-340-21	671.10	16N	16W	31
125-350-01	620.00	16N	16W	28

Salmon Creek				
APN	**Acreage**	**Township**	**Range**	**Section**
125-350-04	300.00	16N	16W	27
125-350-19	403.43	16N	16W	33
125-350-20	119.40	16N	16W	34
126-220-02	160.00	15N	17W	2
126-220-05	12.25	15N	17W	2
126-220-06	40.00	15N	17W	2
126-220-08	34.00	15N	17W	2
126-230-25	37.77	15N	17W	2
126-230-26	0.70	15N	17W	2
126-260-03	320.00	15N	17W	1
126-270-01	40.00	15N	17W	1
126-270-06	60.00	15N	17W	1
126-270-07	39.68	15N	17W	1
128-010-02	33.97	15N	16W	6
128-020-01	40.00	15N	16W	6
Total Acreage	**4,258.07**			

APPENDIX C: GEOLOGY AND SOIL
ELIAS STEINBUCK

BIG RIVER AND SALMON CREEK PROPERTIES

1. GEOLOGY

The regional geologic landscape of the Big River and Salmon Creek properties were shaped by the tectonic collision of the Farallon and North American plates during the Mesozoic and early to middle Tertiary. As the Farallon plate was subducted beneath the North American plate a deep subduction trench formed and a majority of the rock that comprises the Coast Range Mountains was deposited in this offshore basin as deep sea fan deposits. Tectonic forces mixed these sediments with other less common rock types as subduction continued, subsequent metamorphism and accretion of this new terrane to the western margin of North America resulted in what we collectively refer to as the Franciscan Complex (Blake and Jones, 1981).

The Franciscan Complex is composed of three distinct belts: the eastern belt, the central belt, and the coastal belt. Generally they decrease in age and metamorphic grade from east to west (Blake and Jones, 1981). Geologic mapping conducted in the region indicates that the Big River and Salmon Creek properties are solely underlain by the coastal belt Franciscan complex (Kilbourne, 1983a. and 1983b.; Manson, 1984; Braun and others, 2005). Generally, the coastal belt Franciscan consists of arkosic sandstone and andesitic greywacke sandstone that underwent low grade metamorphism as a result of subduction. Shear strength of the exposed bedrock is highly variable and dependent upon the local structure, bedding, and lithology.

The orientation of the structural grain of the Franciscan complex is controlled by the northwest-southeast trending San Andreas Fault Zone, a right-lateral strike slip fault whose main trace is located offshore approximately 5 miles west of the Salmon Creek property and 15 miles west of the Big River property. Geologic research indicates the Pacific Plate has been moving north relative to the North American Plate along the San Andreas Fault Zone for the past 30 million years (Atwater, 1970). The related Maacama Fault Zone trends northwest-southeast down the Ukiah and Willits valleys approximately 15 miles east of the Big River property.

Unique to the Salmon Creek property, uplift of the Coast Range Mountains coupled with global sea level fluctuations created topographic steps along the present day coastline where quartz sand was deposited on broad wave cut terraces. Through the combined effect of tectonic uplift and lower sea level the coastal river canyons became deeply incised, cutting down through the marine terrace deposits. Subsequent retreat of continental glaciers resulted in rising sea levels that flooded the mouths of coastal rivers and formed present day estuaries (Fuller and others, 2004). Remnants of the marine terrace deposits can be found along the broad low-gradient ridge tops on the Salmon Creek property.

Landslides are widespread across the Coast Range Mountains. Large deep-seated rockslides (e.g. translational-rotational landslides) occur on both the Big River and Salmon Creek properties and are generally characterized by a very slow moving slide mass and deep slide plane extending well into bedrock. A majority of the shallow landslides (e.g. debris slides and flows) occur on slopes over 65% and are concentrated on steep streamside slopes along the outside of meander bends along the mainstems of Big River and Salmon Creek and their larger tributaries (Kilbourne, 1983a. and 1983b.; Manson, 1984; Braun and others, 2005).

Recent unconsolidated channel deposits composed primarily of sand, silt and gravel are exposed along the active channels on both the Big River and Salmon Creek properties.

2. SOILS

The Natural Resource Conservation Service soil survey depicts 13 distinct soil complexes in the Big River and Salmon Creek properties (Rittiman and Thorson, 2001). Formed from the weathering of sedimentary rock, colluvial soils blanket a majority of the hillslopes across the Coast Range Mountains. Rittiman and Thorson (2001) mapped the following soils on the Big River and Salmon Creek properties:

- Irmulco-Tramway complex
- Dehaven-Hotel complex
- Vandamme-loam
- Vandamme-Irmulco complex
- Ornbaun-Zeni complex
- Glenblair gravelly loam
- Threechop-Ornbaun complex
- Boontling loam
- Big River loamy sand
- Carlain loam
- Quinliven-Ferncreek complex
- Ferncreek sandy loam
- Shinglemill-Gibney complex

Thickness of the overlying colluvial soil can be highly variable. Generally, colluvium is thin along ridges and upper sideslopes (typically 1-2 feet), and thick (as much as 5-10 feet) within deep swales and local depressions. Soil types are identified and described in detailed below in, “Soil Types and Descriptions.”

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For more information on Soil Types and Descriptions, see 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/

APPENDIX D: AQUATIC MANAGEMENT PLAN FOR BIG RIVER
CAMPBELL TIMBERLAND MANAGEMENT, LLC

Mendocino Lumber Company Crew Circa 1870s

Big River Aquatic Management Plan

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1 Overview of Properties

The Big River and Salmon Creek watersheds have unique ecological factors that affect each stream network differently from the standpoint of fishery production. The two watersheds have differing thermal regimes, landscape management histories, and discharge characteristics, which suggest separate treatment strategies to guide aquatic restoration including increasing salmonid production. The purpose of the following watershed overview is to address factors affecting the Fund's Big River ownership from a fishery standpoint.

1.1 Overview

The Big River component of The Conservation Fund (TCF) ownership primarily comprises the Middle Subbasin of the Big River Watershed as described by North Coast Watershed Assessment Program (2006) (Figure 1-2). The Property also contains several larger tributaries to Big River and (to a lesser extent) the Noyo that have significant value to fisheries. There are pronounced differences between stream conditions within the tributaries and the mainstem, and consequently these will be addressed separately. The aquatic management plan for Big River relies on synthesis of information derived from the 2006 North Coast Watershed Assessment Program (NCWAP) assessment (Downie et al 2006), data from Campbell Timberland Management (CTM, unpublished), Georgia Pacific (GP), and Klamath Resource Information System (KRIS) Big River (2003).

Because salmonids are often considered an indicator of watershed and ecosystem health, this section is predominantly focused on information and management recommendations relevant to salmonid habitat and populations.

Big River

Big River drains an approximately 180-square mile watershed in the northern California Coastal Range in western Mendocino County (Figure 1-1). The river enters the Pacific Ocean approximately ten miles south of Fort Bragg and extends 24 miles to the east. The Big River Basin drains east to west and borders on the Noyo and Caspar basins to the north and the Albion and Navarro basins to the south. Much of the watershed is presently managed for timber production; nearly ten percent of the watershed is owned and managed by The Conservation Fund (TCF), hereafter referred to as the Property.

For analysis and organization, the Big River NCWAP divided the basin into three subbasins (Coast, Middle, Inland) (Figure 1-2). The Property encompasses most of the Middle and a smaller fraction of the Coast subbasins. For brevity, the overview discussion will focus primarily on Middle Subbasin attributes. For more detail on the entire Big River watershed, refer to NCWAP *Big River Basin Assessment* (2006).

Vegetation in the Coast and Middle Subbasins is primarily conifer forest comprised of coast redwood (*Sequoia sempervirens*) and Douglas fir (*Pseudotsuga menziesii*). The primary constituents of the riparian canopy are coast redwood, Douglas-fir, red alder (*Alnus rubra*) and willow (*Salix* Spp.), all of which is nearly continuous throughout the stream network. Streambed gradient is generally low (≤ 2%) throughout the mainstem reaches. The regional climate is characterized as Mediterranean with wet, mild winters and dry summers. Rainfall averages 55-65 inches annually.

The entire watershed including the Middle and Coast Subbasins support runs of coho salmon and steelhead trout (see Section 1.2.2 for species description). Chinook have been reported occasionally, but presently there are no significant runs (Downie et al 2006). Historical anecdotes indicate that Big River supported significant populations of coho and steelhead with an associated recreational and local commercial fishery. By the 1950s agency reports indicated that the populations were depleted and in serious decline. Since that initial disclosure, stream enhancement and restoration efforts have been ongoing throughout the watershed. However, no research on overall watershed salmonid abundance has been conducted, and Downie et al (2006) assumes that the salmonid populations are static and have not changed notably since the 1950s

The Property contains approximately eleven miles of mainstem Big River and 13 miles of tributaries with habitat attributes conducive to salmonid production. For this analysis of stream and habitat conditions in the Property subbasins, the perennial fish bearing streams are considered separately from the mainstem reach due to differential instream thermal regimes. The summer water temperatures in the mainstem are generally unsuitable for rearing salmonids, whereas most of the perennial tributaries are within suitable thresholds. However, it should be noted that the mainstem is suitable spawning habitat, but juveniles must migrate to thermally appropriate habitat for summer rearing.

1.1.1 Location and Watercourse Description

The Middle and Coast subbasins of Big River are located in Mendocino County California, drain approximately 32,000 acres (Figure 1-2), and are tributary to the Pacific Ocean. Elevations range from sea level at the mouth of the creek to approximately 210 feet at the confluence of the North Fork Big River (Middle Subbasin Boundary). The mouth of Big River is located at 39° 18.114' N Latitude and 123° 47.542' W Longitude. Instream conditions such as discharge, thermal properties, and gradient typify many of the characteristics commonly associated with coastal Northern California watersheds. Discharge rates, which are not influenced by snow pack, vary significantly between summer and winter flows. Instream daily average temperatures in the perennial tributaries range from 17° C (63° F) in summer to 7° C (45° F) in winter, and daily average mainstem summer water temperatures are often over 20° (68° F) (GP unpublished, CTM unpublished) (KRIS Big River 2003). Although summer stream temperatures are moderated by the watershed's close proximity to the coastal marine climatic conditions, the summer thermal regime on the mainstem within the Property is mainly driven by the influx of streamflow from the hot interior reaches. Within the Property boundaries, Big River mainstem is predominantly a low gradient, moderately entrenched F-4 Rosgen channel type[1] characterized by high pool development and low velocity discharge. Two Log Creek, the primary fish-bearing tributary on the Property is predominantly a B-4 channel type, which is characterized by a riffle-dominated channel and infrequently spaced pools. The larger perennial tributaries within the Property confines have suitable habitat conditions for salmonid production. Conversely, the mainstem has limited value for salmonids due to excessive stream temperatures during the summer rearing period, although the mainstem does offer spawning habitat in winter, juveniles must primarily rear in the tributaries during summer.

[1] Rosgen channel types include 42 distinct channel classes, primarily based on gradient and dominant substrate characteristics. Various quantitative metrics help to classify channels, although it is not uncommon for specific metrics to vary among several classes.

1.1.1.1 Maps

Figure 1-1. Fishery Overview of TCF Big River Ownership with Coho and Steelhead ESUs.

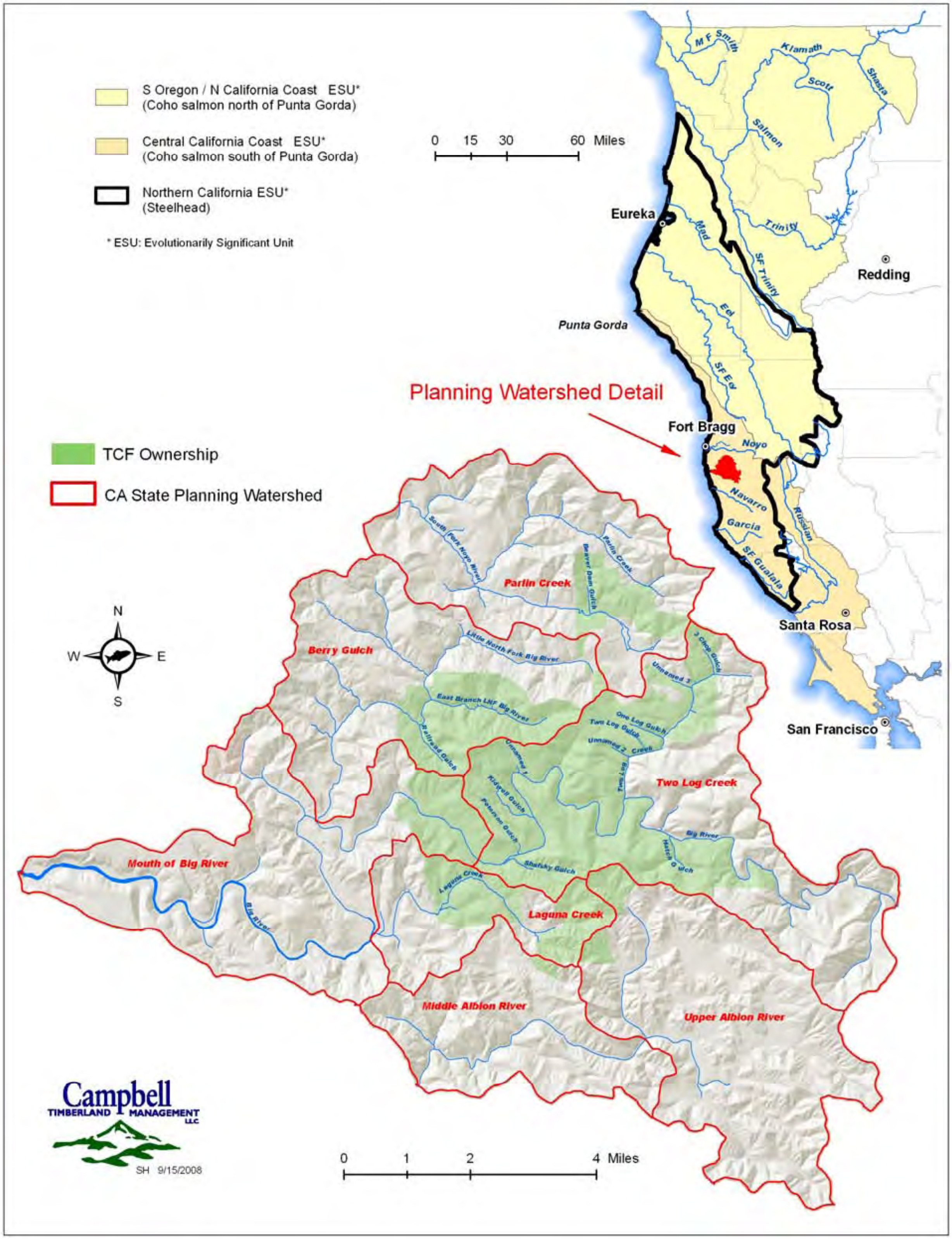
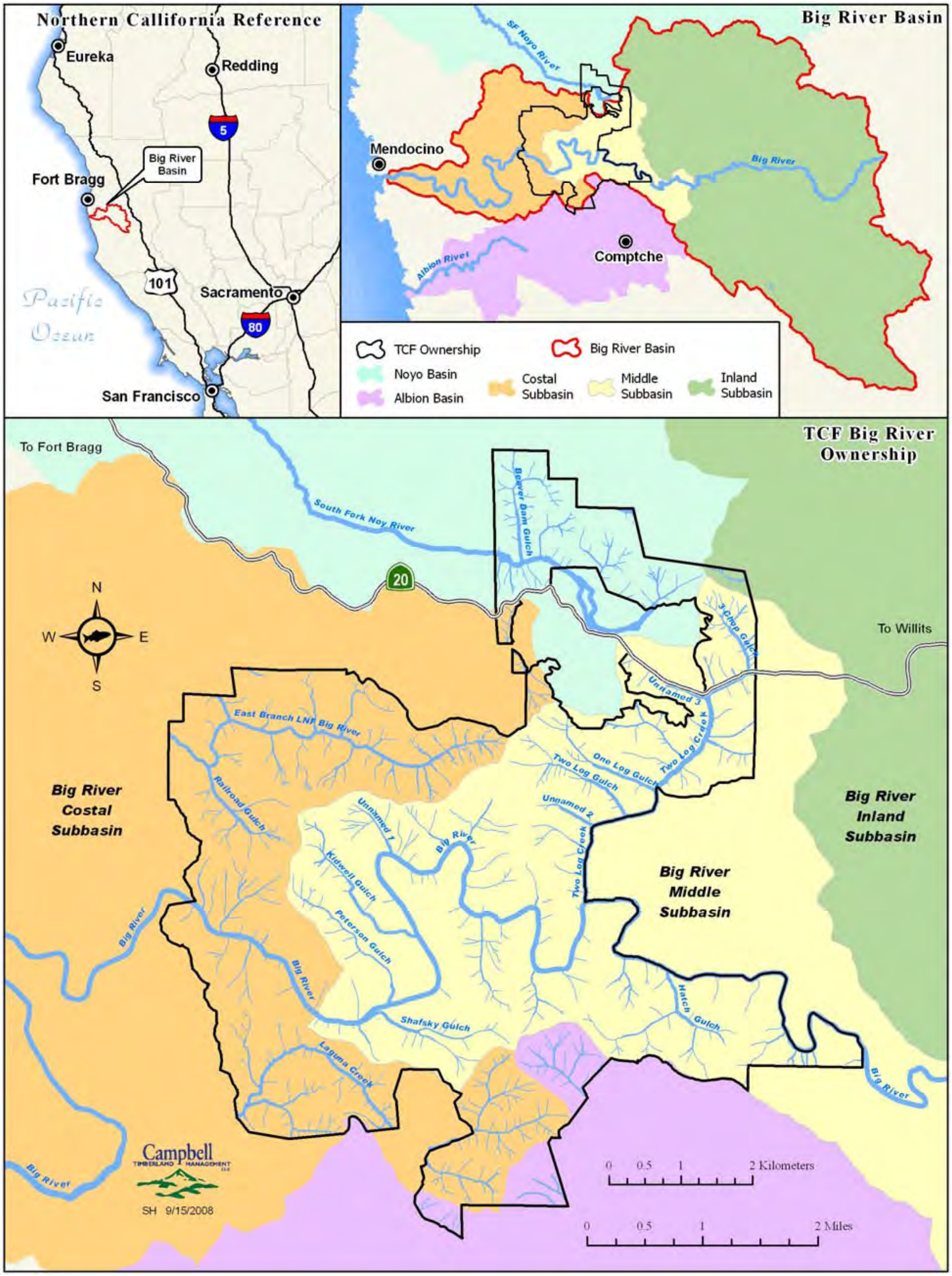


Figure 1-2. Location of NCWAP (2006) Subbasin Study Regions in Relation to Property.



1.1.2 Context

Aquatic conditions in Big River, like many watersheds in the region, are presently more influenced by recovery processes from past management practices than by present practices. Therefore, in order to prescribe management practices that improve aquatic conditions and promote fish production, Section 1.1.2.1 provides a brief description of the past land use history of the Big River watershed from a fishery perspective.

1.1.2.1 History

Before the European settlement of the Mendocino area and subsequent logging operations in the basin, Big River likely hosted three species of anadromous Pacific salmonids: coho, steelhead, and possibly to a lesser extent Chinook salmon. Other species of salmonids likely “strayed” into the watershed on an infrequent basis but did not constitute recurring spawning populations. Presently the watershed still supports coho and steelhead in reduced numbers compared to presumed prehistoric populations, and based on studies conducted in the nearby Noyo basin (Gallagher and Wright 2007), a small population of Chinook salmon may persist in Big River. However, their presence is undocumented.

The watershed history of Big River has been generally well documented (Downie et al 2006; Warick and Wilcox 1981). From the perspective of aquatic ecology and fisheries on the Property, it is unnecessary to review the modern history of anthropogenic disturbance across the basin, but only to outline a few key points. The Big River Basin has been listed as a temperature and sediment impaired waterbody, and as such considerable literature has been generated regarding stream conditions (GMA 2001, Downie et al 2006) and their historical context.

Logging began in the watershed in the 1850s, and management for timber harvesting presently continues. The infrastructure of the early logging era, which ran from approximately 1850 to 1945, consisted of a large mill and an associated mill town (Mendocino) located at the river mouth. A rail line was constructed throughout the estuary and lower basin to facilitate log transport to the mill. The rail network essentially terminated in Laguna Gulch and the East Branch of the Little North Fork. Beyond the lower areas serviced by the rail line, logs were moved to the mill by the use of hydrologic force in the practice known as splash dam logging. For this transport method, logs were stored in the active stream channel throughout the summer (or longer) until the onset of winter rains or “freshets.” In order to store enough hydrologic potential to move the logs, a series of dams were constructed throughout the aquatic network (Figure 1-7). When the stored capacity and stream flow was sufficient, the dams were sequentially tripped to allow a whitewater torrent to mobilize the logs down-channel, eventually arriving at the mill. Because log jams and snags would delay log transport (sometimes for years), they were removed from the channel by crews throughout the summer months. This method of transport was employed throughout the upper basin and all major tributaries. The history of this practice in Big River is well documented by W. F. Jackson in *Big River was Dammed* (1991). During this era, timber was generally dragged downslope with cables powered by “steam donkeys” or oxen, either directly to the mainstem channel or by gulch running tramways that brought logs to the channel.

The end of World War II (1945) initiated the era of tractor logging in this and most other watersheds in the region. Tractor technology, which had been perfected during the war, was used to pull logs downslope to landings and road systems commonly based within the active fluvial network. By the 1980s replacement of the fluvial-based road networks by upslope road systems began and resultantly timber was cable-yarded to upslope landings. Presently, about half of most industrial logging operations in the watershed are cable-yarded, with tractor logging comprising the remainder (Downie et al 2006).

As tractor-logging operations increased across the northern California landscape, it became apparent that the practice of removing logging waste by pushing it with heavy equipment into the river was creating barriers to spawning salmon migration (Figures 1-3 and 1-4). Resource agencies responded by mandating the removal of logging debris from the river at the end of operations, which was usually accomplished with heavy equipment. Declines in anadromous Pacific salmonid populations were thought to result primarily from their lack of access to spawning habitat posed by logging debris. This perception, now generally believed only one of many factors affecting fish stocks, initiated the era of log removal from stream systems throughout the North Coast. From the late 1950s to the early 1990s, crews employed by State and County agencies routinely removed large woody debris (LWD) from stream networks throughout northern California – a practice that, as described below, resulted in additional problems. A map of the wood removal areas and additional information can be viewed on the KRIS Big River website (http://www.krisweb.com/krisbigriver/krisdb/html/krisweb/index.htm).

The practice of splash dam logging likely contributed to the decline of anadromous Pacific salmonids in the watershed due to channel homogenization. Log quantities by the tens of thousands, stored throughout the fluvial network over-summer (Figure 1-5), were annually sluiced through the larger channels, essentially scouring the channel of most complexity and roughness elements (Figure 1-6). Whatever obstructions to log passage that remained were systematically blasted from the channel by crews during summer low flows. The net result is a U-shaped channel with little heterogeneity. Aquatic habitat complexity is a well-known stream condition affecting anadromous salmonids during their freshwater phase, as well as many other aquatic organisms.

In addition to channel simplification, it's likely that splash dam log drives also widened and decreased the depth of the overall channel, consequently increasing the probability of additional solar radiation to the stream channel and thereby increasing stream temperatures. Excessive water temperature is another well-known factor affecting anadromous salmonids.

The initial tractor logging era (1945-1980) and the associated fluvial-based road network delivered deleterious quantities of sediments to the Big River planning watersheds (GMA 2001). Multiple facets of these operations caused sediment delivery to the fluvial network and have been well documented (Burns 1970). Tractors operated on steep slopes, throughout upslope watercourses, and yarded timber downslope to landings, increasing soil erosion. Road networks, streamside landings, and watercourse crossings often failed further inundating the network with sediment. Excessive sediment loads are deleterious to salmonids through many pathways (Burns 1970; Kondolf 2000): sediment can limit survival-to-emergence (STE) of juveniles from the redds (Trappel and Bjornn 1983); decrease aquatic insect production; decrease sub-surface water flows (thereby increasing stream temperature); decrease habitat complexity by burying structural components; and limit foraging opportunities for fish during winter due to the associated turbidity during high flows (Sigler et al 1984). The known effects of excessive sediment bedload in the channel clearly contributed to the decline of salmonids and trout throughout the watershed, and modern timber harvest practices have adapted in response.

Although the in many cases stream clearance was necessary to allow fish passage, the mandate to remove LWD from streams either by timber operators at the end of operations with heavy equipment, or by stream clearance crews, also contributed to anadromous salmonid declines in the watershed. Instream structure especially in the form of LWD has many beneficial attributes for aquatic species (Bjornn and Reiser 1991). The loss of lotic habitat complexity from stream clearance activities, splash damming, and burial from excessive bedload clearly impacted salmonid populations, and the legacy effects continue today.

1.1.2.2 Historic Photographs

Figure 1-3. Typical Northern California Stream Condition After Historic Logging Operations Circa 1955 (GP Unpublished).

Figure 1-4. Typical Barrier To Fish Passage From Historic Logging Operations Circa 1955 (GP Unpublished).

Figure 1-5. Logs Stored In Stream Channels Awaiting Winter Flows Circa 1880 (The Robert J. Lee Photographic Collection Of The Mendocino County Historical Society).

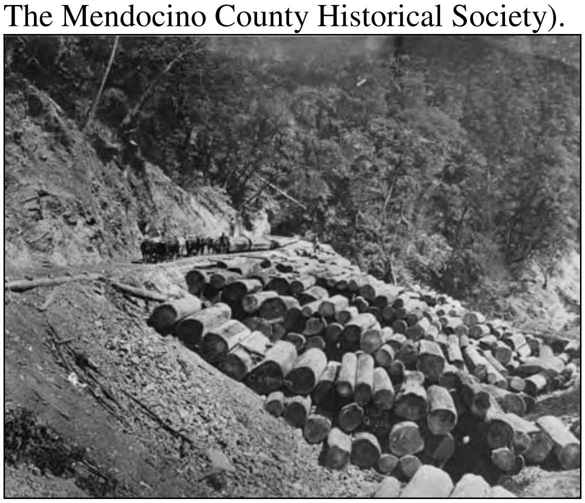
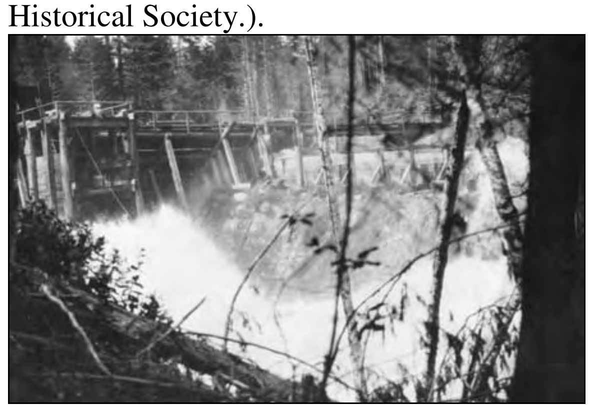


Figure 1-6. Log Drive In Big River, Circa 1924 (The Robert J. Lee Photographic Collection Of The Mendocino County Historical Society).

Figure 1-7. Big River Splash Dam Circa 1925 (The Robert J. Lee Photographic Collection Of The Mendocino County Historical Society.).



1.2 Ecological Conditions

This section describes habitat types, riparian communities, and aquatic species of special concern found on the Property.

1.2.1 Species Occurrences and Habitat Types

1.2.1.1 Riparian Communities

The riparian corridor on mainstem Big River and its Class I perennial tributaries, show substantial dense, riparian habitat. Migratory Neotropical birds are expected to be more abundant in these areas. The smaller tributary streams are often intermittent and do not show substantial riparian tree development.

Table 1-1, below, is a summary of the total miles of class I, II, and III streams found in each State Planning Watershed contained within the Big River ownership (Figure 1-8). Calculations are based on data collected by CTM (2001, unpublished).

Table 1-1. Summary Of Total Stream Miles By Classification Within State Planning Watersheds Located On TCf Ownership, Big River.

Planning Watershed	Predominant Stream	Total Acres	Acres of Ownership in Watershed	Percent of Ownership in Watershed	**Class I** (total mi) on TCF Big River	**Class II** (total mi) on TCF Big River	**Class III** (total mi) on TCF Big River
1113.300402	Berry Gulch	7,999	1,996	17.0	4.3	4.7	13.6
1113.300302	Chamberlain Creek	7,868	37	0.3	0.2	0.2	0.3
1113.300401	Laguna Creek	3,246	1,421	12.1	2.7	4.2	12.2
1113.400001	Middle Albion River	4,878	65	0.6	0	0.1	0.8
1113.300403	Mouth of Big River	9,548	951	8.1	1.6	1.5	4.9
1113.200302	Parlin Creek	7,578	871	7.4	1.4	3.0	7.1
1113.300406	Two Log Creek	11,432	5,982	51.1	18.6	12.3	32.9
1113.400006	Upper Albion River	8,739	383	3.3	0	2.2	2.2
Total	**-**	**-**	**11,707**	**100**	**28.8**	**28.2**	**74.0**

1.2.1.2 Rivers

Big River Mainstem

The Property encompasses approximately nine percent of the Big River watershed (Figures 1-1, 1-2) and 11.9 miles of the mainstem river. Temperature monitoring conducted by GP in 1994-1999, CTM in 2000-2005, and TCF in 2006-2007 (all unpublished) (Figures 2-3, 2-4) indicate that stream temperatures during summer months are not within suitable ranges for coho and steelhead, according to the *NCWAP Big River Middle Subbasin Profile and Synthesis* (Downie et al 2006). However, snorkel surveys conducted by Big Rivers Stewards in 2006 and 2007 indicate that juvenile salmonids of both species persist in the mainstem in small numbers (Matt Coleman, Big River Stewards Coordinator, Mendocino Land Trust, pers. comm. 2008). Stream habitat surveys conducted by GP in 1996 and CDFG in 2002 suggest that the mainstem contained fair to poor habitat conditions for salmonids. Shade canopy values were below target values, with only 33 % closed canopy (in 2002); however, on fourth order watercourses such as Mainstem Big River target values do not apply (Downie et al 2006)[2]. Spawning habitat quality was rated as suitable (Downie et al 2006). Pool habitat by depth was rated as good in 2002, with 93% of the pools having optimal depth for the stream order. CDF&G protocol states that ideally 40% of instream habitat (by length) should be in pool habitat. In Big River, CDFG surveyors (2002) found 45% of the stream in pool habitat, indicating suitable pool frequency. Pool shelter was during that survey was found to be low with a rating of 45. Eighty is considered an optimal rating for shelter in pool habitat (Flossi 1998). Low shelter values may result from Large Organic Debris (LOD) and Large Woody Debris (LWD) scarceness as discussed in Section 1.1.2.1

Upper South Fork Noyo River (SFNR)

This fork of the Noyo River located in the Parlin Creek Planning Watershed is a well-known producer of coho and steelhead (Gallagher and Wright 2007). Instream habitat is generally well shaded, pools are frequent and deep, and the summer water temperatures are suitable for rearing salmonids. However, TCF has little influence on fishery conditions in the stream due to limited ownership adjacent to the watercourse (Figure 1-2) (Table 1-2).

1.2.1.3 Perennial Streams

Portions of approximately 14 streams and small creeks within the Big River ownership are considered class I stream habitat, displayed on a map in Figure 1-8. A class I stream classification denotes potential habitat for salmonid species exists, and that the presence of salmon is not required for this classification.

Table 1-2, below is a summary of the total miles of class I, II, and III streams found in the selected class I sub watersheds, contained within the Big River ownership. Calculations are based on data collected by CTM (2001, unpublished).

Table 1-2. Summary Of Total Stream Miles By Classification Within The Class I Habitat Sub Watersheds Located On TCF Ownership, Big River.

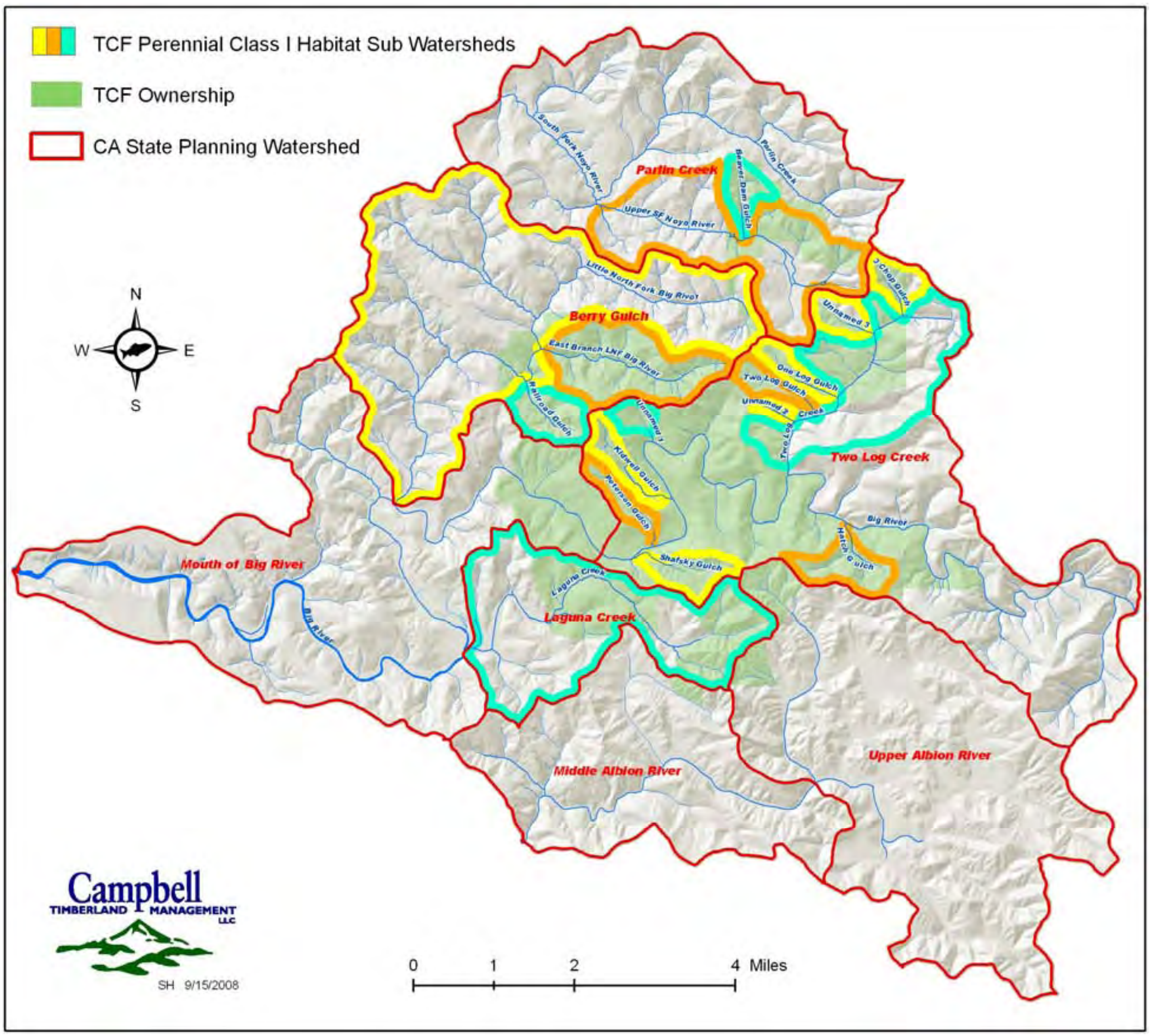
Sub Watershed Name	Total Acres	Acres of Ownership in Sub Watershed	Percent of Ownership in Sub Watershed	**Class I** (total mi) on TCF Big River	**Class II** (total mi) on TCF Big River	**Class III** (total mi) on TCF Big River
Hatch Gulch	442	441	3.8	0.6	1.1	2.7
Kidwell Gulch	281	281	2.4	0.9	0.9	1.0
Laguna Creek	3,242	1,421	12.1	2.7	4.3	12.2
Little North Fork Big River*	6,429	1,996	17.1	4.3	4.1	13.6
Peterson Gulch	255	255	2.2	0.2	1.0	1.4
Shafsky Gulch	361	358	3.1	0.6	0.7	2.2
South Fork Noyo River**	2,591	805	6.9	1.2	3.0	6.9
Two Log Gulch***	3,057	1,659	14.2	5.9	4.5	11.5
Unnamed 1	163	163	1.4	0.1	0.3	1.6

[2] Typically, larger, high order channels are too wide to expect adequate shading from tree canopy due to maximum tree heights.

Sub Watershed Name	Total Acres	Acres of Ownership in Sub Watershed	Percent of Ownership in Sub Watershed	Class I (total mi) on TCF Big River	Class II (total mi) on TCF Big River	Class III (total mi) on TCF Big River
Subtotal	**-**	**7,379**	**63**	**16.5**	**19.9**	**53.1**
Remainder of Big River mainstem		3,777	95	11.9	5.8	17.5
All other minor drainages		551	5	0.4	2.5	3.4
Total	**-**	**11,707**	**100**	**28.8**	**28.2**	**74.0**

* Includes class I perennial tributaries: East Branch Little North Fork Big River, and Railroad Gulch
** Includes class I perennial tributary: Beaver Dam Gulch
*** Includes class I perennial tributaries: 3 Chop Gulch, One Log Gulch, Unnamed 2, and Unnamed 3

Figure 1-8. Map Of Perennial Class I Habitat Sub Watersheds On TCF Ownership, Big River.



The following short narratives are provided for all Class I tributaries. They are listed in watershed position, beginning with the most downstream tributary within the ownership.

3 Chop Gulch (Ayn Creek)

Also known as Ayn Creek, this fish-bearing watercourse presently contains a barrier to anadromous fish migration. A "shotgun culvert" under the State Highway 20 crossing extends out from the bank and is elevated above the receiving plunge pool surface, preventing adult migration. Resident trout have been observed in the subbasin (Downie et al 2006).

Beaver Dam Gulch

This small watercourse is tributary to the South Fork of the Noyo (SFN). It contains less than a mile of Class I habitat (Table 1-2). A 2005 stream survey associated with a Timber Harvest Plan (THP- 1 – 98- MEN) found optimal habitat conditions for salmonids. Coho and steelhead have been observed throughout the SFN, but spawning adults have not been observed in this Gulch (Gallagher and Wright 2007).

East Branch of Little North Fork Big River (EBLNF Big River).

A 2002 habitat inventory survey by CDFG of this subbasin indicates that while the amount pool habitat is sufficient, depth characteristics may be deficient (pools are too shallow). However, this is a small first order tributary and depth thresholds may not apply. The survey also indicates that canopy and shelter values are suitable, but spawning conditions (based on embeddedness values) are unsuitable (Downie et al 2006). In 2002 a failed stream crossing was removed in the upper end of the gulch to allow fish migration (see Section 2.1.1.3). Instream temperatures are fully suitable, and coho and steelhead consistently inhabit this gulch (Downie et al 2006).

Hatch Gulch

Juvenile coho and steelhead have been frequently observed in this small first order stream. Limited temperature monitoring indicates fully suitable temperatures for salmonids (Downie et al 2006). Habitat inventory surveys from 1996 (GP) indicate that canopy cover was fully suitable, shelter values are suitable, pool depth and frequency are unsuitable, and spawning conditions based on summer cobble observations are fully unsuitable. As a small first order stream, pool frequency and depth targets are not applicable, and embeddedness observations during summer may not correlate to spawning quality in winter (see Section 2.1.1.1).

Kidwell Gulch

Kidwell is another small first order gulch with restricted fisheries values due to limited flow potential. The results of surveys conducted in 2002 by CDFG suggest that spawning and pool habitat is deficient, but that canopy values are suitable. The target thresholds are likely not valid for this small subbasin.

Laguna Creek

The lower reaches of this creek, managed by California Department of Parks and Recreation, are predominately wetland marsh. The control point for the impounded marsh pond is composed of large redwood logs that may form a barrier to fish passage from the mainstem in some form. Limited temperature monitoring by GP indicates fully suitable temperatures for both coho and steelhead, but only juvenile steelhead have been observed. Considering the multiple barriers to fish passage presented by the marsh, there is a high probably that Laguna is populated solely by resident rainbow trout (GP 1996). Similar to other small, first order streams tributary to Big

River, stream target conditions are likely not relevant. The lower reaches have more ecological value as a wetland than the upper reaches do as salmonid habitat.

Little North Fork Big River (LNFBR)

The LNFBR is a productive fish-bearing stream where coho and steelhead have been reliably reported since the 1950s. Shelter values, canopy values, pool frequency and depth, are optimal for salmonids (Downie et al 2006). CDFG (Downie et al 2006) reports poor spawning conditions from cobble embeddedness observed during summer surveys (see section 2.1.1.1). From a management standpoint, TCF owns only a minor reach of this stream, totaling less than two miles (Figure 1-2), suggesting there is limited impact from TCF management activities on aquatic conditions in the stream.

One Log Gulch

This very small gulch is not likely to contribute to fish production in the watershed. Because of its size, habitat inventories have not been conducted. Foresters employed by CTM classified a small segment as fish bearing based on the possibility of suitable habitat, not on actual fish observations.

Peterson Gulch

Similar to the other small, un-surveyed gulches on the Property, this gulch offers an exceedingly small amount of habitat for fish (Table 1-2). It probably provides more fisheries value as a cooling influence and feed producer for fish in the mainstem.

Railroad Gulch

This gulch, located in the Berry Gulch Planning Watershed (Figure 1-2), is not the same as another surveyed gulch with the same name, located in the Mouth of Big River planning Watershed. This watercourse is also limited for fish production due to size. A small amount of the stream was classified by CTM as fish bearing based on the possibility of fish habitation.

Shafsky Gulch

This gulch has minimal drainage area and has not been surveyed, likely due to its small influence on overall fish production. Foresters for CTM determined that about a half mile of the lower drainage should be considered fish bearing based on habitat conditions.

Two Log Creek

Although this sub watershed is a perennial stream, tributary to the mainstem, there are other Class I streams tributary to the Creek. It contains 2.8 miles of fish-bearing habitat and is the most significant tributary to Big River on the Property, with consistent historical documentation of coho and steelhead. Stream temperatures within the subbasin are generally suitable for salmonids (Figure 2-5) except for a short period in 2006 when the entire region experienced a heat spell. A survey in 2002 found spawning conditions suitable, but shelter conditions and pool depth deficient (Downie et al 2006). In 2004 a stream enhancement project was implemented by CTM throughout the subbasin (see Section 2.1.1.2): 30 LWD structures were placed at sites to enhance fish production. As a consequence, shelter values and pool frequency/depth may have increased since the 2002 survey.

Two Log Gulch

This small un-surveyed gulch, tributary to Two Log Creek, has limited value for direct fish production. Foresters employed by CTM classified a small segment (Table 1- 2) of the stream as fish bearing based on potential habitat, not fish presence.

Unnamed 1, 2, and 3 Gulches

These three gulches most likely directly support few if any fish. They have not been surveyed; habitat was classified as fish bearing by foresters working for CTM based on the possibility that they might support a small number of steelhead.

1.2.2 Special Status Animal Species

1.2.2.1 Coho Salmon

Coho have been definitively observed throughout Big River and most of its tributaries (Downie et al 2006) (GP 1996). 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 state and federally listed as endangered in 2005. This ESU includes all naturally spawned populations of coho salmon in coastal streams south of the Mattole River in Humboldt County 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 that 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 10 to 17.5° C (55-63.5° F). Redds are laid in gravel that range in size from 1.3 to 10.2 cm. in diameter and intergravel mortality begins to occur when fine sediments exceed 13 percent of the substrate composition within the redd egg pocket (note that redd construction involves a winnowing process that clears the egg pocket of most fine material). 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 habitats 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. The majority of coho juveniles migrate to the ocean at age one and return to fresh water to spawn after two to three years.

1.2.2.2 Steelhead Trout

Steelhead have also been observed throughout the Big River watershed (Downie et al 2006). 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 in Mendocino and Sonoma counties. 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 illustrates flexibility in adapting to variable stream conditions, it exposes juvenile steelhead to adverse over-summer and over-winter stream conditions including 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 10 to 17.5° C (60-63.5°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.

1.2.3 Other Aquatic Species

Big River supports many aquatic and semi-aquatic vertebrate species besides fish (Table 1-3). Many of these species are completely terrestrial for varying fractions of their life histories, but may use the watercourse for feeding, breeding, and/or rearing.

In addition to coho and steelhead, four other fish species are commonly found in the fresh water environment of Big River (Table 1-3). The two sculpin species are commonly observed in most Class I watercourses in the region. Biologists employed by GP and CTM have directly observed Pacific Lamprey. Whether other lamprey species are endemic in the watershed is unknown, but all three species may occur. Big River is within the range of River and Western Brook Lamprey but these species have not been directly observed.

Table 1-3. Aquatic Species Observed or Potentially Occurring in Big River Property

Common Name	Species	Listing Status	Comments
Reptiles			
Northern Pacific Pond Turtle	*Actinemys marmorata*	None	Common
Western Aquatic Garter Snake	*Thamnophis couchi*	None	Common
Amphibians			
Coastal (Pacific) Giant Salamander	*Dicamptodon tenebrosus*	None	May hybridize with *ensatus*
Southern Torrent Salamander	*Rhyacotriton variegatus*	California Species of Special Concern (CDFG)	
Northwestern Salamander	*Ambystoma gracile*	None	
Rough-skinned Newt	*Taricha granulosa*	None	
Red-bellied Newt	*Taricha rivularis*	None	
Coast Range Newt	*Taricha torosa*	California Species of Special Concern (CDFG)	
Ensatina	*Ensatina eschscholtzi*	None	
Black Salamander	*Aneides flavipunctatus*	None	
Tailed Frog	*Ascaphus truei*	Threatened (CESA) California Species of Special Concern (CDFG)	
Western Toad	*Bufo boreas*	None	
Pacific Treefrog	*Hyla regilla*	None	

Common Name	Species	Listing Status	Comments
Bullfrog	*Rana catesbeiana*	None	Invasive species
Northern Red-legged Frog	*Rana aurora aurora*	California Species of Special Concern (CDFG)	
Foothill Yellow-legged Frog	*Rana boylei*	California Species of Special Concern	
Fish			
Pacific Lamprey	*Lampetra tridentata*	None	
River Lamprey*	*Lampetra ayresi*	None	
Western Brook Lamprey*	*Lampetra richardsoni*	None	
Threespine Stickleback	*Gasterosteus aculeatus*	None	Common
Prickly Sculpin	*Cottus asper*	None	Common
Coastrange Sculpin	*Cottus aleuticus*	None	Common
Sacramento Sucker*	*Catostomus occidentalis*	None	

* listed as within the range of these fish species by Moyle (2002), but not observed by CTM staff.

2 Background for Restoration and Enhancement

In northern California watersheds, salmonids are considered the keystone aquatic species by state and federal regulatory agencies. The State Water Resources Control Board and the US EPA consider salmonids a key indicator of water quality. Coho in this region have been listed as state and federally endangered and steelhead have been listed as federally threatened.

Consequently, the aquatic management goals are tailored to promote healthy salmonid populations with the assumption that other aquatic taxa will also thrive. Therefore, healthy instream habitat conditions that are known or assumed to promote salmonids are the overarching goal of the Aquatic Management Plan.

Management goals relative to salmonids within the Salmon Creek Watershed should be tailored towards the preservation or enhancement of aquatic habitat elements necessary for salmonid survival. These elements include maintenance/enhancement of shade canopy, recruitment of large wood (either naturally or artificially), maintenance of summer flows, and prevention of discharges of fine sediments. The incorporation of these elements into property wide management plans should be considered relative to any management activity, not just those near aquatic habitats.

2.1 Restoration and Enhancement

The following recommendations and prioritization of aquatic restoration and management actions was based on a synthesis of existing reports and recommendations pertaining to aquatic restoration. This process involved the review and analysis of pertinent documents and field surveys conducted in the watershed and formulating restoration objectives relevant to the Property. The following suggested approach relies on an analysis of limiting instream factors identified within the watershed.

Because this watershed has been 303d listed for temperature and sediment by the US EPA, numerous information sources are available on the watershed. This analysis and subsequent recommendations rely primarily on the assessment of the watershed conducted by NCWAP (Downie et al 2006), habitat inventory surveys conducted by GP, habitat inventory surveys by CDFG, and from instream temperature, aquatic vertebrate, and sediment monitoring conducted by GP and CTM from 1993-2004.

Nearly all the major watersheds in northern California have been impacted by historic logging operations, and, as discussed in Section 1.1.2.1, Big River shares a similar history. The restoration and enhancement measures prescribed in this plan rely on a conceptual limiting factors analysis to determine aquatic bottlenecks to salmonid production as per Meehan et al (1991).

2.1.1 Aquatic Limiting Factors Analysis

The life requirements for anadromous Pacific salmonids in the freshwater environment are generally well understood (Bjorn and Reiser 1991). Survival in their freshwater phases depends on the availability of cool, clean water, unlimited migratory access throughout the stream network, clean spawning gravel, suitable and adequate food supplies, and complex instream shelter components to avoid predation. These necessary life-history components are provided by a diverse and complex aquatic habitat. When any of these life history components are missing or degraded, fish stock production can be adversely impacted. The basis of a limiting factors analysis is to identify and evaluate these requirements throughout the watershed on a spatial and temporal scale. When these requirements are evaluated on both watershed and reach scales, factors that promote or limit salmonid stocks can be identified.

Natural disturbance factors such as landslides and wildfires that limit salmonid stocks in watersheds, while generally covering larger areas than sites of human disturbance, are usually not distributed throughout the watershed. The stochastic nature of these disturbances, which tend to rotate though watersheds on a broad temporal and spatial scale, allow individual sub-basins sufficient time for recovery. On a watershed scale this creates diverse and dynamic habitat conditions for salmonids. In contrast, human disturbances tend to be comparatively smaller on an individual basis, but usually more widely distributed throughout the watershed (Reeves 1995). Naturally occurring landslides and other disturbances occur within the Big River watershed; however, their impacts to salmon stocks are minimal compared to anthropogenic disturbances such as road building that are more widely distributed throughout the basin.

The concept of a limiting factors analysis was first introduced in the 1980s (Everest and Sedell 1984) (Meehan 1991) and has been utilized extensively in assessment studies of proximate regional watersheds (Klamt [NCWAP Gualala] 2002; Downie et al [NCWAP Albion] 2004; Downie et al [NCWAP Big River] 2006) by the California Department of Fish and Game and by others throughout the Pacific Northwest to identify problems within watersheds and direct stream restoration activities. For the purposes of this aquatic management plan it is not necessary to discuss the entirety of all studies and processes involved. Rather the purpose is to establish that certain stream conditions are commonly recognized to influence salmonid production in most watersheds throughout this region, and they are generally well recognized in peer reviewed articles and publications (Reeves and Everest 1989) (Bisson, In press).

In Big River and other watersheds in this region, stream condition is thought to consist of these factors: adequate stream flow, suitable water quality, and complex habitat.

Adequate stream flows are critical for salmonid production at all points through their freshwater life cycle. A suitable winter flow regime is required for upstream migrating spawners and egg development within redds, and rearing juveniles need adequate summer flows for feeding, predator evasion, and thermal refugia. A natural hydrologic regime that decreases the magnitude of winter peak flow events and increases flows during the summer drought period favors salmonid production. The natural hydrograph of coastal watersheds in northern California is often one of limited flows during summer, limiting carrying capacity and connectivity throughout the aquatic habitat. Consequently, freshwater salmonid survival is particularly tied to diminished flows during summer. In Big Salmon Creek within TCF ownership, stream diversions do not occur and drafting occurs minimally, so stream flows are thought to mimic the natural hydrologic regime and are not considered limiting beyond normal variance.

Water quality considerations for salmonid production consist of three factors: 1) water temperatures, 2) turbidity, and 3) sediment load. Steam temperature in summer is often thought to be critically important for growth and rearing in salmonids (Hines and Ambrose, 2000). Literature suggests that suitable temperatures for salmonids at this life history stage range between 10.0° – 17.5° C depending on the species. Steelhead are generally slightly more tolerant of higher stream temperatures than coho.

Turbidity, or the relative clarity of water, can affect primary productivity of aquatic vegetation. This consequently affects aquatic insect production, which in turn may alter salmonid productivity. Increased suspended sediment loads can interfere with juvenile salmonids ability to locate prey and decrease overall growth rates.

The final aspect of water quality is stream sediment bedload, which can be subdivided into two separate analyses: compositional and quantitative. Although salmonids use a winnowing process to flush out fine materials during redd construction, if the proportion of fine sediment within the substrate is excessive, survival-to-emergence (STE) of fry from the redd is reduced (Kondolf 2000). Fine sediment reduces interstitial flow through the spawning gravel, subsequently reducing the dissolved oxygen flow to embryos and the flushing of metabolites. Excessive overall quantities of sediment affect juvenile salmonids generally in two ways: debris torrents in winter, when large amounts of sediment are suspended in the water column, can cap redds as sediment comes out of suspension; and deleterious quantities of bedload within channels in summer can force stream discharge to flow subsurface, effectively reducing rearing habitat in small streams during a critical life stage.

Habitat complexity for salmonids has also been thoroughly researched and discussed in fishery literature (Flosi et al 1998). An optimally complex condition for salmonids is thought to consist of a combination of riffle, flatwater and pool habitat types. Riffles provide spawning substrate and a rearing area for fry; flatwater provides connectivity through the stream network and some rearing habitat for juveniles; pools provide refugia from predation and high stream velocities in winter, foraging habitat throughout the year, and rearing habitat in summer.

Stream conditions for salmonids are also dictated by the quality of the adjacent riparian habitat. Shade canopy from dense bank dwelling vegetation limits the amount of sunlight that reaches the stream, buffering excessive stream temperatures in summer and insulating overly cool temperatures in winter. Green leaf matter falling from streamside trees provides a nutrient source for aquatic insects that in turn become feed sources for fish. The course woody habitat elements recruited from the fall of riparian trees eventually forms roughness and shelter components within the active channel in the form of LWD. A well functioning riparian zone also provides stream bank stability with dense vegetative root masses, limiting sediment delivery from bank failures and streamside landslides.

The limiting factors assessment analyzes aquatic factors thought to limit salmonids in the instream residency component of their life history. The following narrative outlines the goals, background, discussion, and recommendations for each limiting factor identified. Habitat assessment surveys identify the majority of limiting factors in the watershed and are consequently addressed first. Table 2-1 summarizes limiting factors within the watershed and management recommendations.

Table 2-1. Summary of Limiting Factors and Management Recommendations.

Limiting Factor	Regulatory Reference	Measured Parameters		Desired Condition	Management Recommendations
Habitat	*Desired Salmonid Freshwater habitat Conditions for Sediment-Related Indices* (NCRWQCB 2006).	**Pool habitat**		Where applicable, increasing trend in frequency and length.	Monitoring should occur according to the protocols found in the *California Stream Restoration Manual* (Flosi et al 2004).
		Pool depth		Where applicable, increasing trend in pool depth.	
		Primary pool distribution		Maintain 40 % of stream habitat by length in 2nd- 4th order streams.	
LWD	*Desired Salmonid Freshwater habitat Conditions for Sediment-Related Indices* (NCRWQCB 2006).	**Bankfull Channel Width (m)**	**Index (per 100m of Channel length)**	An increasing trend in the frequency of LWD within active stream channels.	Monitoring should occur according to the protocols found in the *California Stream Restoration Manual* (Flosi et al 2004).
		1 to 6	> 38 pieces		
		> 6 to 30	> 63 pieces		
Fish Passage	*California Stream Restoration Manual (Flosi et al 2004).*	Bridge and culvert parameters as prescribed in manual.		Fish passage at all crossings at all life-history stages in Class I watercourses.	Monitoring should occur according to the protocols found in the *California Stream Restoration Manual* (Flosi et al 2004).
Stream Temperature	NCWAP Overview and Methods (2006)	**MWAT Range**	**Description**	Maintain summer stream temperatures within 10º C – 16.5º C (50º F – 62º F).	Monitoring should occur at some or all historic monitoring stations.
		10º - 15.5º C	Fully Suitable		
		16º - 16.5ºC	Moderately Suitable		
Sediment	*Desired Salmonid Freshwater habitat Conditions for Sediment-Related Indices* (NCRWQCB 2006).	**Turbidity (ntu)**		Turbidity should not increase more than 20 percent above naturally occurring background levels.	Stream channel confluences should be monitored for turbidity during storm events.
		Suspended Sediment Load (tons/day)		The suspended sediment load and suspended sediment discharge rate of surface waters should not adversely affect beneficial uses	Stream channel confluences should be monitored for suspended sediment loads
		Embeddedness		An increasing trend in the number of locations where gravels and cobbles are < 25% embedded.	Monitoring should occur according to the protocols found in the *California Stream Restoration Manual* (Flosi et al 2004).

2.1.1.1 Habitat Assessment

Goals

The primary goal of habitat assessment surveys is to determine the quality of the aquatic habitat within watersheds. The information generated in the assessment is used to identify areas in need of remediation and guide restoration efforts. The secondary goal is to generally identify how fish use the watershed, which areas are optimal for different components of their life history: spawning, rearing, and over-wintering.

Background

Big River and its tributaries were originally surveyed to determine habitat quality for anadromous salmonids in the 1950s and 1960s. The intent of these original surveys, however, was to gather qualitative information, and while they illustrate general stream conditions at that time they are difficult to compare to latter surveys for trend analyses. In the early 1990s CDF&G developed its present day methodology to survey, analyze, and report on aquatic habitat conditions (Flosi 1998), which relies on a more quantifiable data analysis. The streams within the Big River Property confines were surveyed using the present methodology in the late 1990s and early 2000s. Unfortunately, the methods used presently cannot be readily compared with past surveys. The two reporting systems also differed slightly in their conceptual view about aquatic habitat quality with regard to LWD. The older 1950s –1960s reports tend to regard LOD, LWD as potential barriers to fish passage that should removed, with little recognition to the aquatic benefits of logjams in streams. Consequently it is difficult to determine whether jams actually posed barriers to fish passage over a longer time scale. It is interesting to note that a 1959 survey of Two Log Creek found “17 logjams; many barriers” (Downie et al 2006). Then in 1966, two years after the 1964 flood, no barriers were observed, which illustrates the ephemeral nature of wood in stream systems.

The 2006 NCWAP analysis of the Middle and Coastal subbasin study units brings together a multitude of research efforts that encompass the Property. The results of this synthesis suggest the following three stream condition parameters are limiting salmonid production:

1. Water temperatures in Mainstem Big River during summer are not suitable for rearing salmonids.
2. Splash dam logging and wood removal projects have diminished channel complexity throughout most of the stream network.
3. Excessive sediment delivery to the watercourse from legacy and present practices may be limiting the survival-to-emergence of fry from redds, and reducing the feeding success of rearing parr.

Discussion

To effectively manage the stream network within the confines of the Big River Property, it is necessary to recognize that the tributaries require a different strategy than the mainstem. In general the NCWAP analysis suggests that the tributaries may suffer from excessive bedload and sediment, while the mainstem suffers from excessive water temperature.

All inventory surveys conducted throughout the Property clearly indicate that lack of instream structure and channel homogenization are primary factors limiting fish production in the Middle and Coastal subbasins in both the tributaries and the mainstem. These findings would then suggest a universal strategy throughout the Property to increase shelter values and pool habitat recruitment. The benefits to ecosystem resilience from instream structure have been well documented (Maser and Sedell 1994). Instream shelter components, particularly from organic sources as wood, have been attributed to many beneficial aspects of aquatic ecology, as listed:

- Aquatic macro-invertebrate production
- Structural shelter habitat for aquatic organisms including salmonids
- Structural habitat for aquatic organisms in the form of pool habitat development
- Increased over-summer water storage due to increased pool development.
- Increased bank stability due to decreased bank downcutting and increased riparian flooding during peak flows
- Shelter habitat for rearing salmonid juveniles in summer
- Shelter habitat for salmonids (adult and juvenile) from high stream velocity events in winter
- Spawning gravel retention and sorting and storage of sediment.

The NCWAP assessment indicates that of the tributaries to Big River within the Property, Two Log Creek is the most significant fish-bearing stream. The meta-population approach to determine priority locations for restoration and remediation give areas that consistently support fish populations more weight than locations with varying distributions. The basis for this approach is that thriving stocks will re-seed sink areas where habitat conditions are sub-optimal but improving. Therefore, higher priority is given to “shore up” existing high quality reaches such as Two Log Creek.

The habitat surveys indicate unsuitable embeddedness values in many of the perennial streams on the Property. These observations are then extrapolated into spawning suitability statements. A caveat to embeddedness observations, however, should be noted: embeddedness is a measure of the degree to which a surface lying cobble is buried. Observers note the degree of “buried-ness” at pool tail-outs during summertime surveys. Pool tail-outs are thought to be the most likely spawning locations for anadromous salmonids; however, empirical data from spawning surveys indicates that salmonids use a variety of channel locations (Gallagher and Wright 2007). Therefore, cobble observations taken at tail-outs may not correlate spatially to spawning areas. Additionally, embeddedness observations are taken in summer while anadromous salmonids spawn in winter, allowing a considerable temporal interval between the two assumed related events. The CDFG provides no cited references that have researched the relationship between embeddedness observations in summer and spawning suitability in winter. Stillwater Sciences (2008) found only a weak statistical relation between fine sediment and embeddedness observations, and, additionally, found no statistically significant correlation between fines measured in summer and fines measured in redds in winter. Kondolf (2000) notes that spawning salmonids actively “winnow” fine sediment from the redds as a cleansing process, and recommends a correction factor when assessing fine sediment in the substrate.

Recommendations

All recent assessment surveys and associated reports generated in the Big River Middle and Coastal subbasins consistently suggest that channel homogenization due to lack of LWD is a primary factor limiting salmonids in Big River. The other clear limitation to anadromous salmonid production is excessive summer water temperatures in the mainstem. However, there are limited management actions (see Section 2.1.1.4) available to correct this long-term problem.

The aquatic management strategy for this watershed should therefore focus on increasing wood loading in the active channel. Current forest practices will ensure that riparian corridors are managed for natural recruitment of large trees into the channel, as has been occurring within the recent management regime.

However, the rate of wood recruitment from natural processes like mortality, bank failures, streamside landslides and windfall is likely insufficient for the near term needs. The natural mortality of redwoods in particular (considering the life span of these trees and their resistance to disease) and fall probability (the probability that dying trees will actually fall in the channel) would result in a very slow rate of recruitment. The immediacy of the problem, therefore, suggests that artificial wood recruitment is necessary. Section 2.1.1.2 addresses artificial LWD recruitment in the watershed.

Future habitat assessments are proposed in the following phases:

Phase One (2009-2010)

- Conduct LWD surveys in select reaches of the watershed to determine deficiencies in wood loading.

Phase Two (Begin 2010)

- Conduct Habitat Inventory Surveys on a ten-year frequency to continue monitoring aquatic habitat conditions.

2.1.1.2 LWD

Goals

Reflecting the scarcity of LWD within the watercourse and the associated unfavorable aquatic habitat conditions as found in the habitat assessment surveys, the primary goal is simply to increase channel complexity through the artificial recruitment of LWD into the stream network where necessary. The secondary goal is to implement wood based enhancement projects efficiently with minimal negative ecological impacts and maximized enhancement properties.

Background

In 2004 a stream enhancement (mitigation) project was initiated by CTM throughout Two Log Creek. Channel structural values were enhanced through the use of large log structures. The design techniques incorporated elements of "hard-anchored" structures combined with loose scour logs to allow for log mobility. In all, 30 structures were completed throughout the stream, enhancing habitat values in the project reach.

Discussion

Stream enhancement projects utilizing wood structures can generally be accomplished with either wood collected from timber harvest operations, or harvested/salvaged specifically for the project. Although the 2004 Two Creek wood project successfully enhanced stream conditions, it was generally costly. A self-loading log truck transported large logs (16'- 40') harvested from outside the project area to staging areas adjacent to the 30 structure sites. The logs were then "flown" in to the site and placed with a cable yarder and an associated logging crew. To complete the installations, crews from the California Conservation Corps were hired to secure the logs to streamside anchor points.

There are a number of disadvantages to using cull logs from timber operations and logs felled away from the site. The primary disadvantage to this method is that log stock collected away from the site must be transported. A functional road network to the restoration site is then required, and heavy equipment must be used extensively within the channel and along the banks. The site's overall restoration value is consequently diminished by increased sediment delivery. In the Two Log Project, cable yarders were used to transport logs from staging areas to the sites, which minimized sediment delivery. However, cable yarding is not a cost effective method to use consistently on multiple projects. Additionally, salvaged logs are often inferior both in length and structural considerations. Logs deficient in length characteristics often must be permanently anchored to existing stationary landmarks to avoid being flushed from the basin during high flows. These associated requirements are costly and, more importantly, result in structures that are sub-optimal from the perspective of fish habitat. Permanently anchored structures don't allow log movement. As a consequence, important hydrologic processes such as scour and sediment sorting are limited because the immobile log cannot descend into the subsequent scour hole.

Large unanchored logs approximately two times the channel width should be used for in-channel structure. Length allows some hydrologic mobility while also limiting large-scale movement, retaining the valuable wood within the watershed. Due to the mature riparian conditions found in most perennial stream reaches on the Big River Property and the cooling influence of the marine dominated climate, it can be reasonably assumed that selected riparian trees in the perennial streams could be placed into the channel without undo negative impact to the stream's thermal regime. Using select riparian trees for instream structure is cost effective, it minimizes damage to the channel banks, and it minimizes damage to riparian vegetation because heavy equipment use is minimized. This method also allows for increased flexibility in site selection, as a functioning road network is not required.

A review of the information available for the Big River Basin clearly indicates the mainstem reach in the Middle and Coastal subbasins is deficient in LWD as well being thermally impaired. The wide channels found in forth order streams such as the mainstem Big River increase stream exposure to solar radiation and contribute to excessive water temperatures. Management actions along the mainstem should promote channel width reductions along with increases in channel depth. Channel structure, in the form of large logs with attached root-masses, creates scour points that increase channel depth and decrease width. Stream banks that were formerly exposed to the full scouring forces of winter peak streamflows are then protected, creating suitable recruitment zones for colonizing streamside vegetation and enhancing further bank stabilization processes. Although there is little shade canopy along the mainstem (due to the magnitude of the channel width), it seems unlikely that riparian tree growth will correct the temperature problem in the near future, with channel conditions as they presently occur. To return the channel structure to a heterogeneous state, as it likely existed before the era of logging and stream clearance activities, management should consider plans to add selected large streamside conifers with attached root-masses to the active channel as LWD. The associated increase in red alder and willow recruitment will contribute to stream cooling influences and increase feeding opportunities for rearing anadromous salmonids.

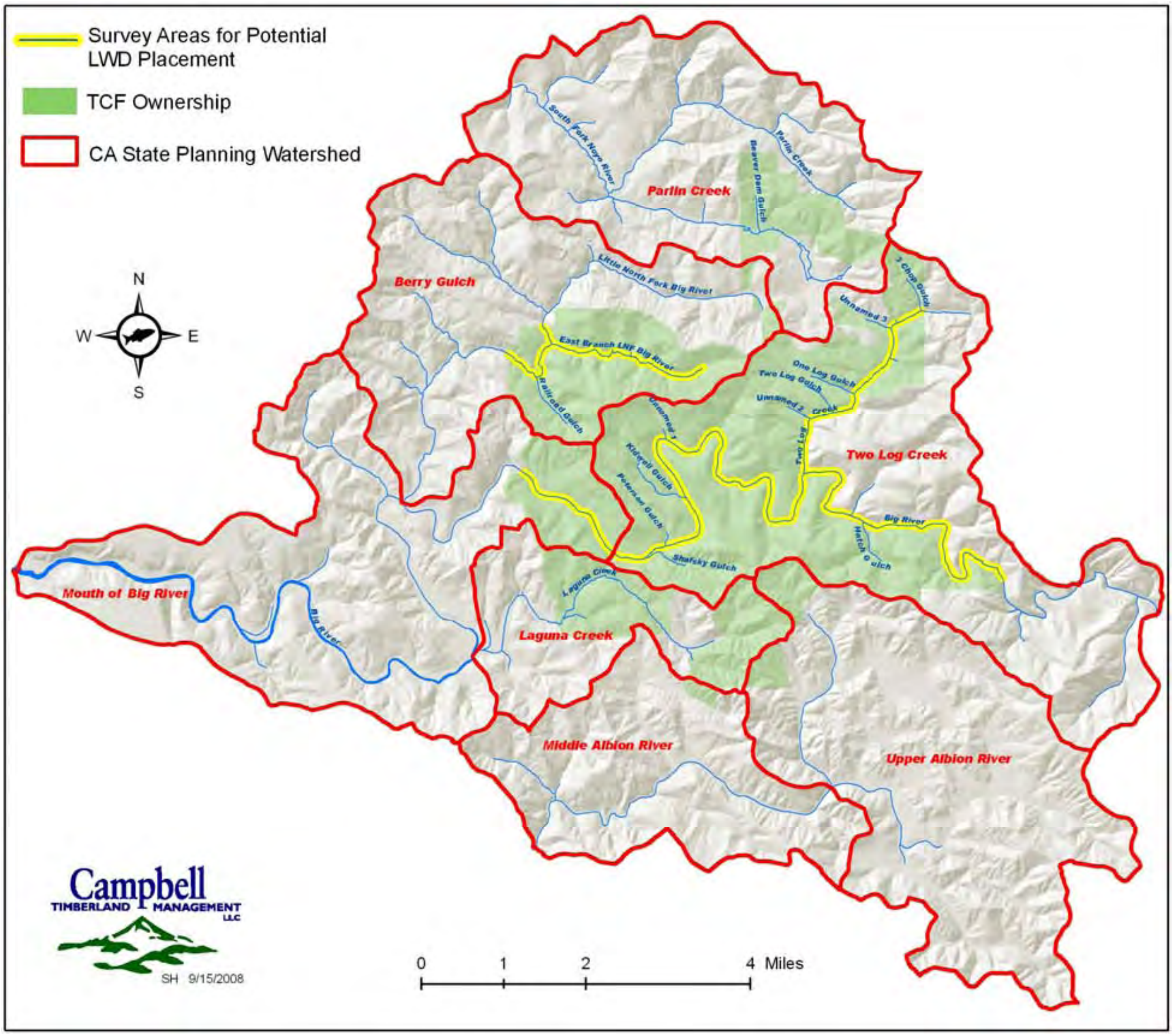
Recommendations

- Survey mainstem and tributary reaches in the list below to quantify LWD.
- Treat select reaches found deficient in LWD in mainstem Big River and its tributaries using the procedure described above. Note that treatment costs for the smaller channel tributaries will be less than mainstem costs. This is due to the differential in channel sizes: treatment on the mainstem requires that large trees are pulled over with heavy equipment to keep the root masses intact, while treatment on the smaller streams requires only cut logs. A rough treatment cost estimate for five to six miles of smaller stream reaches (based on a average cost of $9,000/mile) is $54,000 if all tributary reaches are treated. On the mainstem, where tractors are needed for implementation, costs can be broken down to a per tree basis. Cost estimates range from $400 to $900 per tree depending on location and difficulty. Depending on funding constraints, these reaches can be prioritized for fisheries values and implemented as resources become available.
- Assess the following prioritized areas for LWD deficiencies and, when applicable, target these areas for potential restoration sites:

  1. **Two Log Creek**
     a. Although a stream enhancement project was previously implemented in this stream, considering the fisheries values found here, additional instream structures are recommended. The entire 2.8-mile stream reach should be re-surveyed to identify supplementary placement sites.
  2. **Mainstem Big River**.
     a. The entire 11.8-mile reach between Property boundaries should be evaluated for large structure placements.
  3. **LNF Big River**
     a. The reach defined by the Property boundaries (1.2 miles) should be evaluated for LWD placement.
  4. **EBLNF Big River**
     a. The 2.1-mile reach defined by the confluence to Class I habitat termination should be evaluated for artificial LWD enhancement.

The potential for fish production in Laguna Creek and the smaller perennial streams does not warrant expenditures for stream enhancement other than best management practices of the riparian zones.

Figure 2-1. Recommended LWD Survey Reaches for Potential Stream Enhancement.



2.1.1.3 Fish Passage

Goals

Adult salmonids require access to spawning habitat, and juvenile rearing fish need access to feed sources and refugia habitat in order to thrive. Refugia habitat is often categorized as: 1) thermal refugia (cooler areas during hot periods); 2) over-wintering refugia (low velocity areas protected from peak flow events); and 3) predator refugia (areas protected from predation). Any area in the watershed utilized by fish at any point in their life history is defined as Class I habitat. This portion of the Aquatic Monitoring Plan identifies barriers to fish migration and recommends actions to eliminate them.

Background

Since 1994 past landowners have been removing problematic culverts and other anthropogenic barriers to fish migration as part of the timber harvest process and, additionally, as watershed improvements outside the process. Over time most known artificial barriers to fish passage have been removed within the watershed.

In 2002 CTM removed a 75 foot-wide barrier to fish passage from the upper EBLNF Big River in connection with the East Side Rumbler (THP 1-01-290 MEN), opening nearly a mile of potential Class I stream habitat. The legacy crossing constructed in 1976 was mainly constructed of earthen fill material and contributed deleterious quantities of aggregate sediment during peak flow events through bank failures and head cutting. More than 1,000 cubic yards were removed from the stream network in this action. However, there are few if any area left on the Property where significant amounts of potential fish-bearing habitat are disconnected from anadromous salmonid migration.

Discussion

On small watercourses, the amount of Class I habitat that is available to fish upstream of a culvert-formed partial barrier is limited, and the potential risk of downstream degradation to quality habitat from sediment released by culvert removal is high. In the few instances in the watershed where these conditions exist, the potential overall benefit to the fishery must be weighed against the potential risks and costs. Managers often have a limited restoration resource budget. The costs versus the potential overall benefit to the resource must be weighed to prioritize remediation actions. An expensive culvert removal that opens a small amount of marginal habitat may not have the same resource value as remediation in an impacted mainstem reach with potential for much greater fish production.

The current culvert crossings on both One Log Gulch and Two Log Gulch (not Creek) are an example of this management problem. Both creeks are very small (226 and 238-acre drainage area, respectively) and offer little Class I habitat due to limited flow potential. However, past land managers were required to classify the lower reaches of the stream as fish bearing based on habitat conditions - not fish presence, even below the culvert. The present culvert placement likely does not allow fish passage for salmonids (or other aquatic organisms) at all life stages. To remove the culverts would require considerable fill removal and the installation of two bridges, an expensive action. Considering the substantial amount of resources needed for remediation and monitoring on the known fish producing and impacted reaches across the Property, the removal of these culverts should be low priority. As the relatively new culverts wear out over time they should be replaced, but they are not immediate action items.

Recommendations

Monitoring and assessment of barriers to fish passage should continue throughout the watershed in the form of reconnaissance surveys, and fish passage in suspect crossing and culverts can be evaluated using protocols described in the *Salmonid Stream Habitat Restoration Manual* (Flosi et al 2002). When potential artificial barriers are identified, the risks of removal should be evaluated against potential gain to the fishery. When the assumed gain to the resource is greater than the potential negative effects, the barrier should be removed.

2.1.1.4 Water Temperature

Goals

Literature concerning stream temperatures for coho and steelhead indicates that suitable temperatures for these salmonids occur within the range of 10º to 17.5° C (50-63.5° F), when gauged from a seven-day rolling average of the daily average temperatures (Welsh 2001; Sullivan 2000; Downie et al 2006). For this Aquatic Management Plan, the thresholds developed by NCWAP (Downie et al *Big River Assessment Overview and Methods* 2006) (Walker 2007) are used (10º C to 16.5º C) (50º F – 62º F) (Table 2-1). These thresholds were developed by a panel of fisheries scientists upon a literature review of northern California stream temperatures and juvenile salmonids. The maximum of the weekly averages is referred to as MWAT and is often used as a single point metric to evaluate stream temperature. The goal for the aquatic management plan is maintain instream MWATs on the cooler end of the stated suitable range.

Background

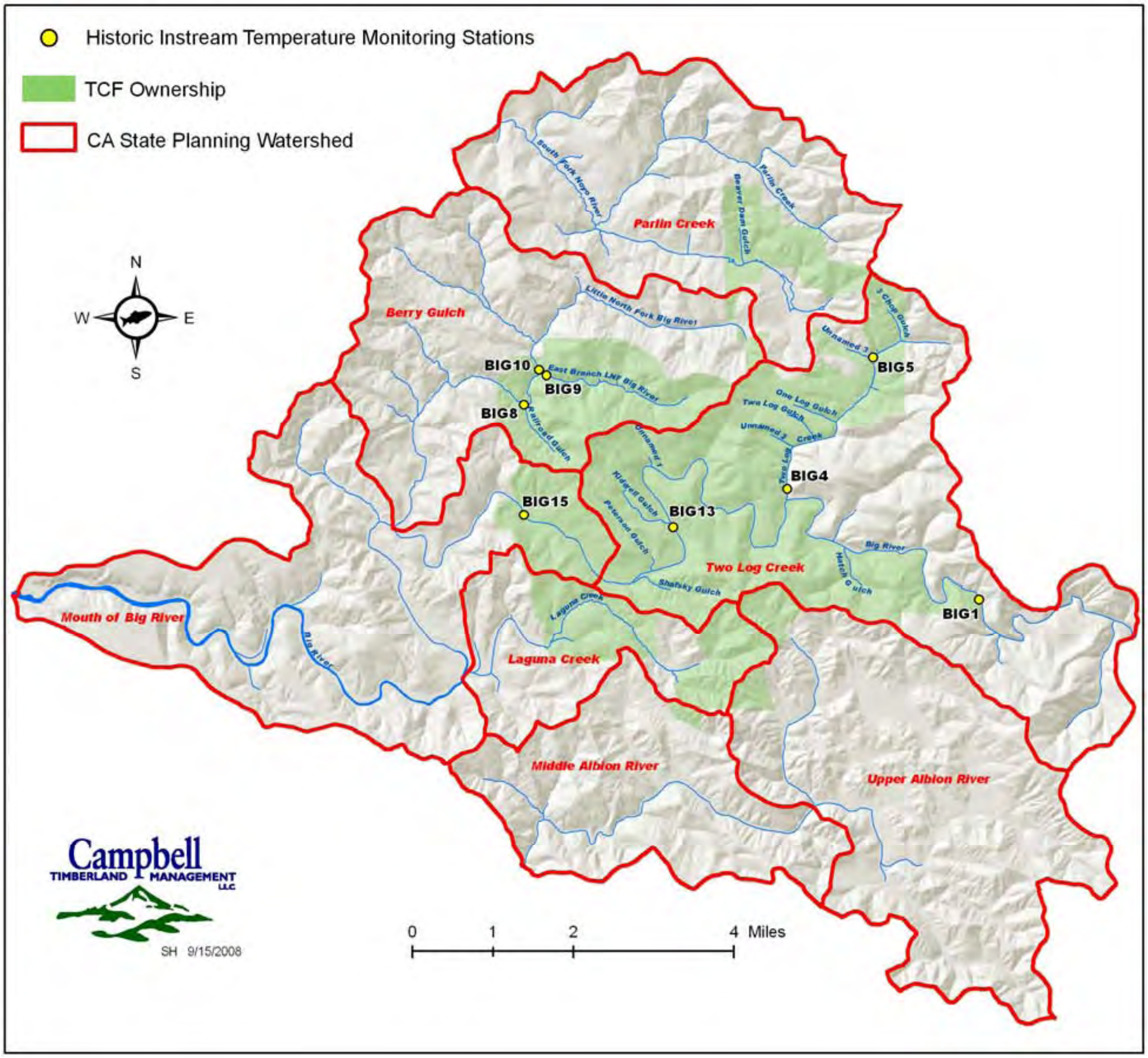
Over ten years of stream temperature data (Table 2-2) collected at eight permanent stations (Figure 2-2) by GP, CTM and TCF confirm that summer stream temperatures, shown as the Maximum of the Weekly Average Temperatures (MWAT), are unsuitable for salmonid production at the upstream Property line (Figures 2-3 and 2-4). Data also show that the temperature regime changes little as streamflow passes through the nearly twelve-mile mainstem channel on the Property. This suggests that the mainstem thermal regime is almost completely driven by upstream conditions and that TCF managers have little direct control over mainstem stream temperatures. Until upstream conditions change, the stream temperature regime in the mainstem reach within the Property will probably remain static**.**

Temperature monitoring data confirms that, contrary to conditions found on the mainstem reach, the perennial fish-bearing streams within the Property are more suitable for rearing salmonids (Downie et al 2006) (Figure 2-5). In 2006 a heat spell is noted in late July in both the Mainstem and Two Log thermographs.

Table 2-2: Temperature Monitoring Stations Within the Property by Year

Station	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
BIG1	x	x	x		x	x	x	x	x	x		x	x
BIG4	x	x			x	x	x	x	x	x		x	x
BIG5									x	x		x	x
BIG8	x	x	x		x	x	x	x	x	x			x
BIG9	x	x			x	x	x	x		x		x	
BIG10	x	x	x		x	x	x	x		x	x		
BIG13					x	x	x	x	x	x			
BIG15									x	x		x	

Figure 2-2. Instream Temperature Monitoring Stations on the Big River Property (1994-2006)



Discussion

Efforts to increase canopy along the mainstem and subsequently increase stream-cooling may help somewhat reduce temperature over the long-term. However, stream attributes tend to vary by stream size and order. Larger channels, as found on the mainstem, generally have deeper pools and more open canopy than smaller channels. Although canopy values on the mainstem did not reach CDFG target values, the mainstem of Big River is a fourth order stream and the target values do not apply (Downie et al 2006). The stream cooling properties of the riparian corridor may be enhanced in the mainstem following a management regime of LWD enhancement sites as discussed in Section 2.1.1.2. However, as previously stated, TCF managers have no control over the stream temperature in reaches upstream of the Property boundaries.

Until riparian corridors mature in the upstream reaches, stream temperatures during summer will remain high.

The results of instream temperature monitoring by previous resource managers indicate that water temperature over-summer is generally suitable for salmon in the perennial streams. This is likely due to the sub-watersheds' proximity to the coast and the optimal canopy values found in the riparian corridors.

Figure 2-3. Summer Seven-Day Rolling averages of the Daily Average Temperature (1994-2007) at the Upstream Property Boundary. The Highest Seven-Day Peak of The Rolling Average is the Annual MWAT.

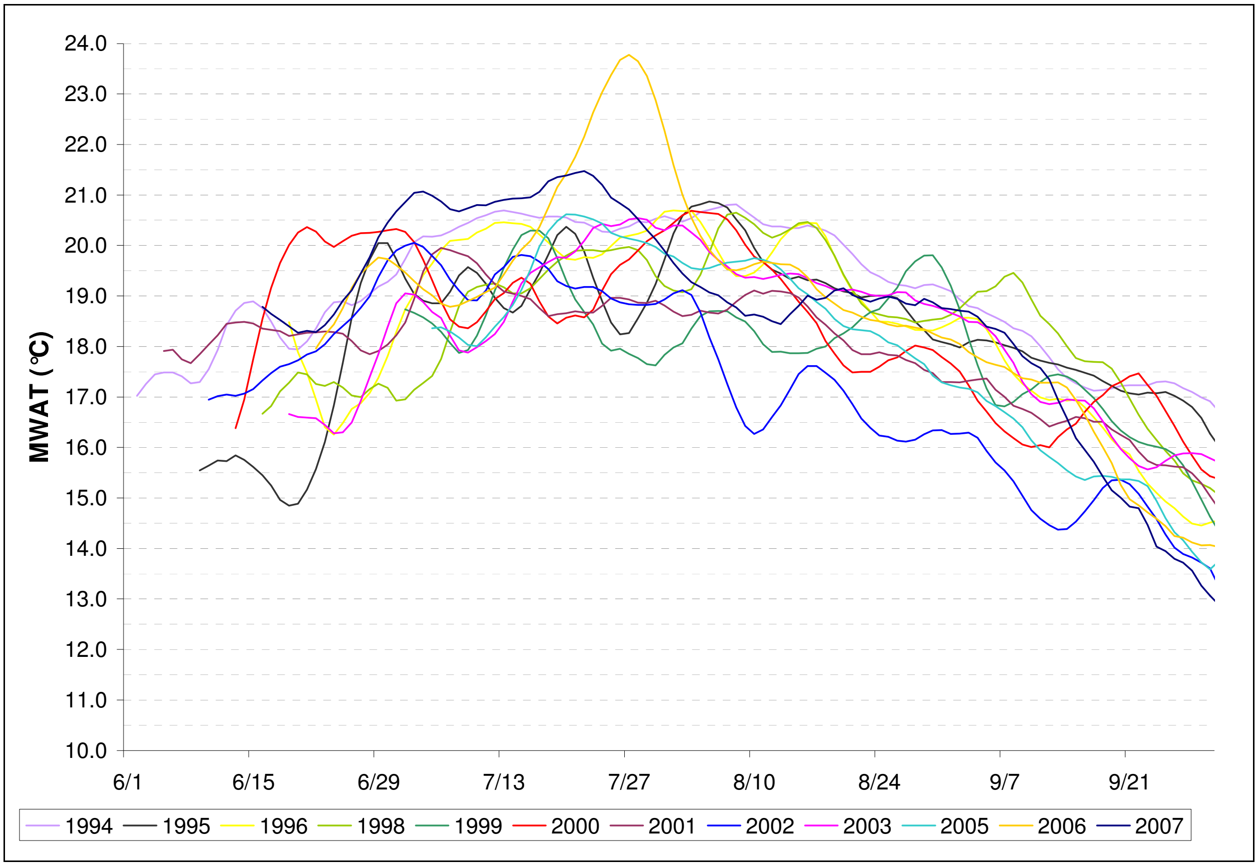


Figure 2-4. Summer 7- Day Rolling Averages Of The Daily Average Temperature (2002, 2003, 2005, 2007) Near The Downstream Property Boundary (Wheel Gulch). The Highest 7-Day Peak Of The Rolling Average Is The Annual MWAT.

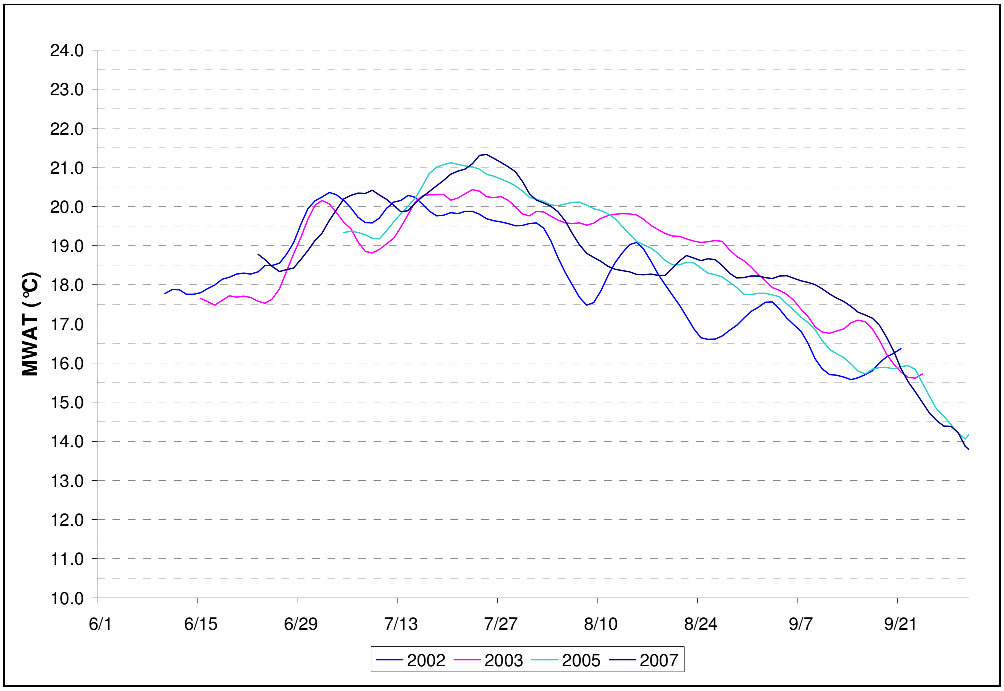
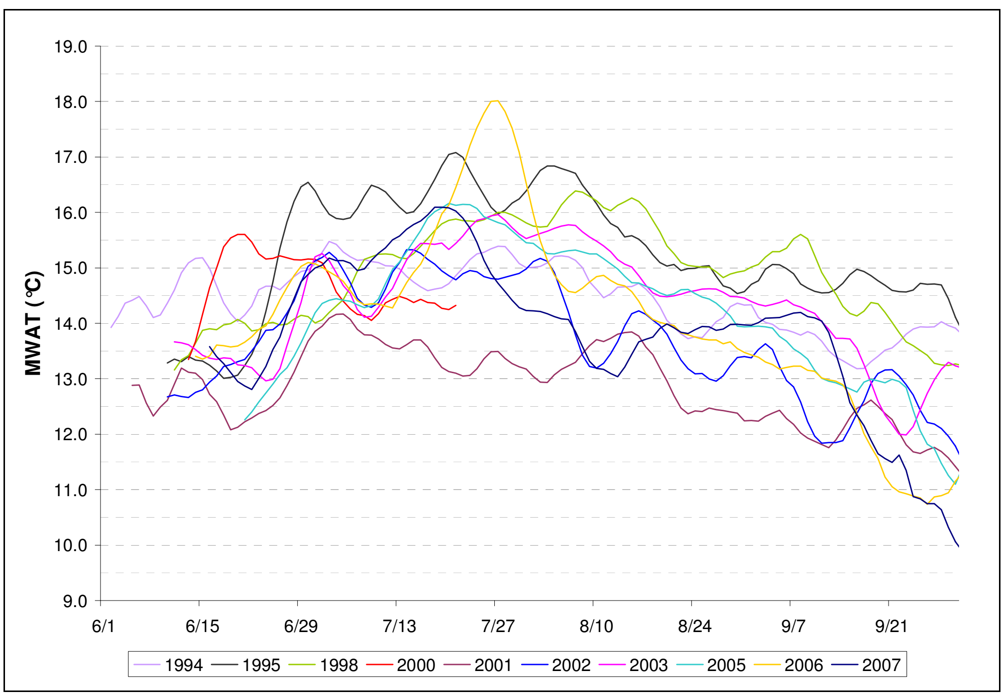


Figure 2-5. Summer 7-Day Rolling Averages Of The Daily Average Temperature (1994-2007) At Lower Two Log Creek. The Highest 7-Day Peak Of The Rolling Average Is The Annual MWAT.



Recommendations

Stream temperature monitoring should continue in the watershed. At a minimum, pairs of thermal data loggers should be maintained near the downstream and upstream Property boundaries on the mainstem. As resources allow, data loggers should be installed within the lower reaches of Two Log Creek and EBLNF Big River. Other fish-bearing watercourses on the Big River Property are either too limited for fish production, or are little affected by TCF Property management actions.

The technology available for continuous stream temperature monitoring has been remarkably refined since the 1990s both in terms of memory and cost. The costs associated for monitoring two sites with redundant data-loggers (over-summer) is approximately $1,000 annually. This cost includes staff resources. The estimated cost to operate a suite of up to four monitoring sites with redundancy (over-summer) amounts to approximately $1,500 annually, including staff resources.

It should be noted that analysis of monitoring data suggests that over-summer stream temperatures in the perennial streams are generally in the range considered suitable for salmonids, although somewhat on the high end of that range. Riparian management policies in these smaller streams should promote increasing canopy trends that subsequently promote stream cooling. Temperature monitoring should continue to ensure that the instream temperature regime remains on a cooling trend. On the mainstem Big River, little can be done to alleviate high stream temperatures other than address problems associated with channel homogeny.

2.1.1.5 Sediment

Goals

Abundant literature exists documenting the negative effects of excessive sediment and turbidity on salmonids. Excessive levels of fine sediment in redds reduce the survival-to-emergence rates of fry, and excessive turbidity in the water column reduces the feeding success of parr, particularly during critical winter months.

Although many of the tributary channels to Big River are presently storing excessive sediment loads, the mainstem channel is scouring down to bedrock in some reaches due to the lack of channel structure (Downie et al 2006).

This portion of the Aquatic Management Plan identifies actions to reduce sediment delivery into the watercourse by disconnecting the existing and historic road networks from the stream network, stabilizing upslope areas, and allowing excessive bedload that have collected in the tributary channels to be redistributed downstream to the lower mainstem channel by natural hydrologic processes. Sorting and storing of gravels within the mainstem can be accomplished through the use of added LWD materials.

Background

The logging road network in this portion of TCF ownership has been developed over decades. The oldest roads were converted from railroad grades created in the first half of the 20th century. With the arrival of trucks in the 1930s, the network was extended. Overstory removal harvesting in the 1950s through 1970s was accompanied by road building throughout this portion of the watershed, generally to facilitate downhill tractor yarding. The enactment of the Forest Practice

Rules and trend toward harvesting uphill via cable yarding led to disuse of much of the old road network.

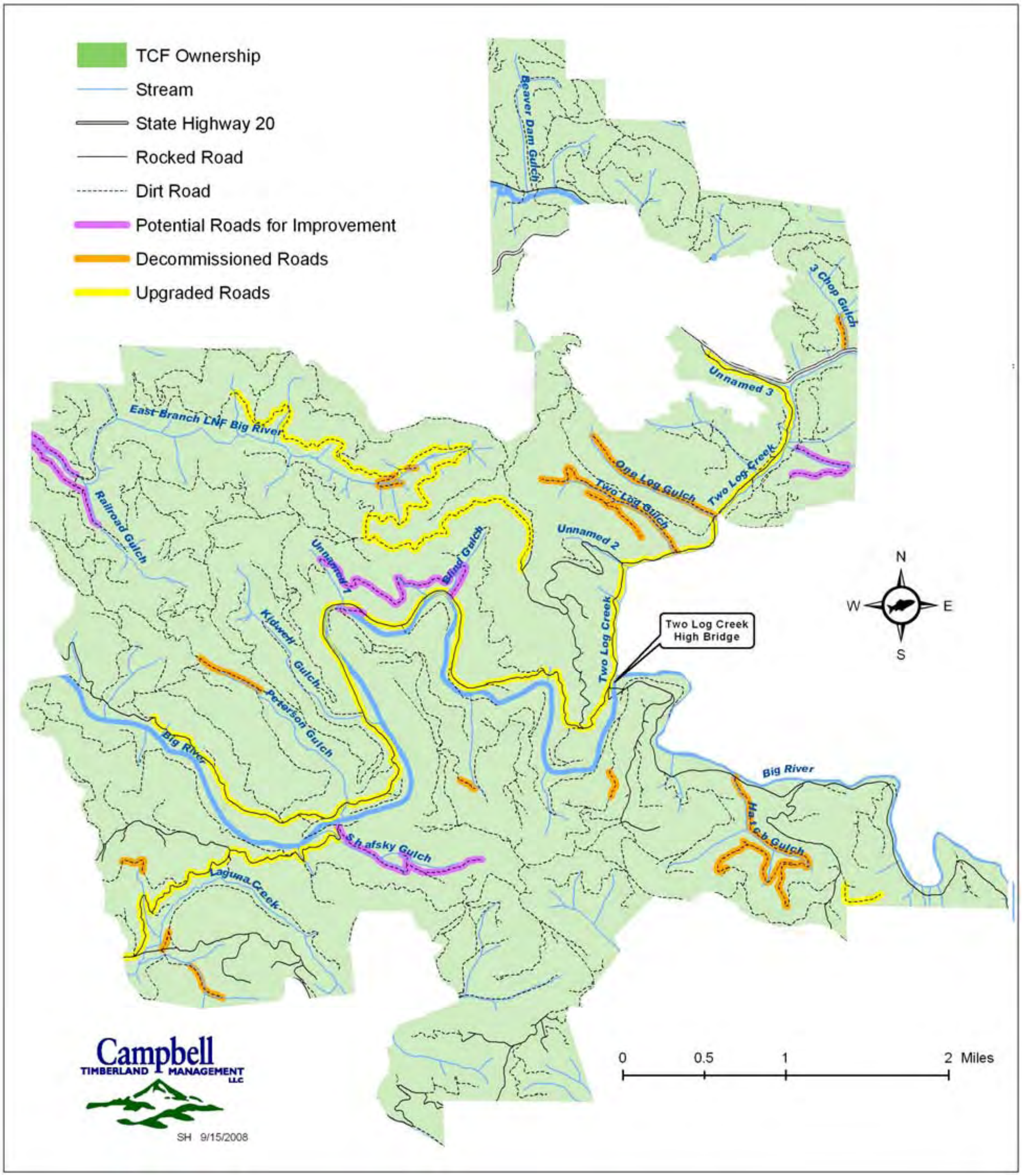
The road decommission at the head of Peterson Gulch may have been the first in this area of the Property. In the late 1990s small sections of road were decommissioned in connection with timber harvest plans north and east of Shafsky Gulch. In 1999 an agreement between Georgia-Pacific and the NCRWQCB resulted in the incorporation of a road management plan into THP 01-99-430MEN. The plan required a detailed inspection and report of the main haul road from the Two Log gate to Wheel Gulch, across Big River, and through Laguna creek. Once approved by NCRWQCB, the road drainage was upgraded, culverts replaced, and the road largely re-rocked.

Subsequent to the change in landowners from Georgia-Pacific to Hawthorne, the rate of improvement increased and a number of additional roads have been properly decommissioned. Improvements included a concerted effort to fix the road and crossings around the East Branch of the Little North Fork, which was in poor shape. This included the pulling of a large 1960s-era Humboldt crossing which was continuing to both dam the East Branch and input sediment. The road between the "Old Growth Road" to "Scotts Pond" was chosen for upgrades via outsloping and rolling dips. Of significance, the old road systems in the gulches shown as "One Log" and "Two Log" as well as Hatch Gulch have been decommissioned, removing long reaches of potential inputs.

Overall, the road system in this portion of Big River has been substantially improved in the last ten years, but there are still many legacy problems to address.

The Big River watershed was listed as an impaired water body under Section 303(d) of the Clean Water Act for sediment in 1993. The U.S. EPA approved a sediment TMDL for the Big River watershed in 2001. The TMDL specifies that anthropogenic sources of sediment associated with roads and to a lesser extent harvest areas will need to be reduced. The North Coast Regional Water Quality Control Board (NCRWQCB) has not yet developed a watershed specific TMDL implementation plan for Big River. In 2004 the NCRWQCB adopted a Total Maximum Daily Load Implementation Policy for Sediment Impaired Receiving Waters in the North Coast Region (Resolution No. R1- 2004-0087). This resolution directs the NCRWQCB Executive Officer to: " Use all available authorities, including existing regulatory standards and permitting and enforcement tools, to more effectively and efficaciously pursue compliance with sediment-related standards by all discharger of sediment waste." The resolution also directed the Executive Officer to develop a work plan that would set priorities for addressing excess sediment at a watershed-specific level and also describe how and when available authorities and permitting and enforcement tools will be used.

Figure 2-6. Decommissioned and Upgraded Roads (1994-2005), and Recommended for Improvement.



Discussion

In the last ten years a substantial number of projects have aimed at benefiting aquatic resources on the Property (Figure 2-6). In order to address upslope sediment sources, selected roads were either upgraded or decommissioned. Road upgrade work included the replacement and addition of drainage features designed to accommodate 100-year storm flows as well as road surfacing improvements. Roads prioritized for decommissioning were mainly located in streamside management zones, and efforts were made to restore natural drainage and encourage re-vegetation of the road prism. Additionally, the aforementioned LWD project in Two Log Creek successfully increased channel complexity and improved habitat conditions for salmonids.

In June 2008 the NCRWQCB adopted Resolution R1-2008-0057 regarding the Regional Board Staff Work Plan To Control Excess Sediment In Sediment-Impaired Watersheds. The Staff Work Plan describes both regional and watershed specific tasks. The Work Plan includes priority rankings for each regional task and for each sediment-impaired watershed. For Big River, NCRWQCB staff are projected to commence work in fiscal year 2013/2014. Big River watershed specific task No. 5 specifically directs staff to work TCF and other with larger landowners "educating them on their responsibilities to control excess sediment, coming agreements on time schedules and excess sediment control strategies, provide technical guidance, regularly checking on progress, and other cooperative efforts."

Recommendations

The following recommendations are based on past experience of CTM resource managers and foresters and do not take into consideration subsequent assessments and remediation by TCF. Locations referenced below are depicted in Figure 2-6.

1. Shafsky Gulch

The legacy road in Shafsky Gulch during CTM ownership had steep cuts and fills on its lowest reaches, and a low gradient crossing with little fill on the Class I section needed minor improvement. Beyond this there is the Class II crossing at the switchback and then a legacy crossing to an old streamside landing. During CTM ownership, the legacy crossing had steep banks that delivered sediment to the watercourse. The legacy road above this point parallels the watercourse and should be ripped and replanted to restore the WLPZ adjacent to the marshy reaches of Shafsky creek.

2. Short Spur between “unnamed 1” gulch and Blind Gulch.

There is a short spur on the south side of the river, which once led to a road crossing. This spur was never fully decommissioned and during CTM ownership there were some associated drainage and erosion problems.

3. Blind Gulch

The road system in Blind Gulch was meant to facilitate tractor logging. During CTM ownership, the portion of the road near Blind Gulch had poor drainage. As the road exits Blind Gulch to the west, drainage problems combined with slide activity. Beyond this point the road continued to the west and needed drainage and crossing improvements. Whether this road should be decommissioned or upgraded depends on the desired harvesting techniques for the western end of the road system. It is possible that a switch back road from the "Scotts Pond" region could be designed, allowing the "Blind Gulch" section to be completely decommissioned.

4. Little North Fork Railroad Grades.

The two roads shown as ‘Potential for improvement’ were originally railroad grades. The northernmost grade is adjacent to the Little North Fork of Big River. East of the current logging road crossing, the grade is not shown as "Potential for Improvement" as there is no equipment access. There may be opportunity for equipment access downstream of the current crossing, and there is the potential for some of the old fills to be removed. These grade fills were a point source for sediment to the Little North Fork during CTM ownership. Vegetation that has grown since the grade fell into disuse would require consideration.

The second road shown as 'Potential for improvement' was a railroad incline that connected to Railroad Gulch. The section shown west of the current logging road had one or two failing Class III crossings which are accessible by heavy equipment. The portion of grade east of the current logging road had several Class III crossings that could be removed, as well as drainage improvements.

5. Two Log Tributary
On the east side of Two Log Creek during CTM ownership there was a midsized tributary with a road on its north slope in reasonable condition. However, where the road crosses to the south side the crossing could have been improved. The southern portion of the road was not well drained and should be improved or decommissioned.

2.2 Adaptive Management and Information

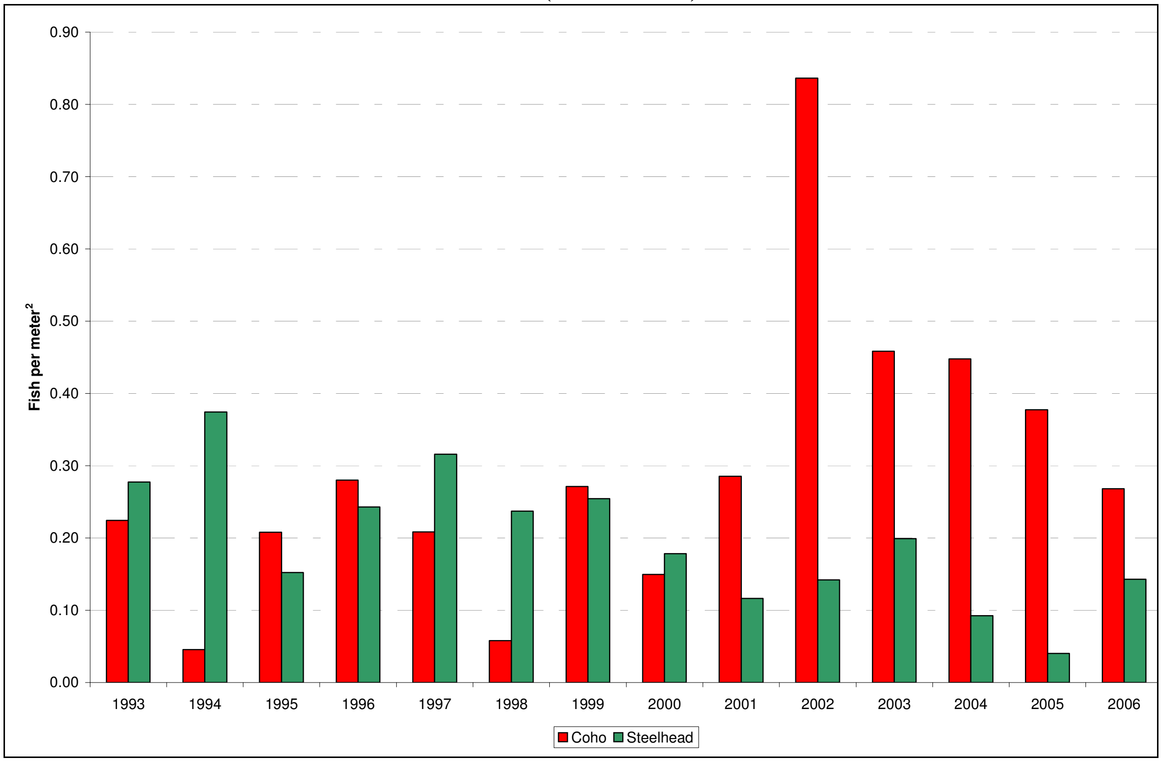
Monitoring is an essential component of the aquatic restoration planning, and monitoring of key aquatic parameters provides an index to measure the successfulness of management strategy. Monitoring restoration activities and watershed responses to landscape management activities completes the adaptive management cycle by assessing the impacts of management actions and evaluating their impact to aquatic species. Monitoring allows managers to identify and correct watershed problems as they occur and determine proper remediation.

2.2.1 Monitoring Goals and Discussion

In 1993, GP resource managers developed a monitoring plan for the Big River Property based on an index reach approach, where specific locations were monitored annually for aquatic habitat parameters; it was continued through 2005 by CTM. The monitoring regime consisted of the follwing: two monitoring stations to monitor aquatic vertebrate abundance; ten stations to monitor instream temperature; and two stations to monitor sediment (using McNeil methods) (McNeil and Ahnell 1964). In 1996 GP survey crews carried out extensive habitat typing of mainstem Big River and most of its tributaries. CDFG survey crews repeated the process in some of the tributaries and parts of the mainstem from 1999 to 2002. In 2004 the NCRWQCB adopted General Waste Discharge Requirements (GWDR) for timber operations that required erosion control plans (ECPs). As a consequence, monitoring for sediment delivery from road construction and maintenance has also been conducted on the Property.

After more than ten years of monitoring and observations, the trends in stream conditions are generally apparent: sediment and temperature related problems still occur in Big River, particularly on the mainstem. However, the trends in juvenile coho abundance from aquatic vertebrate monitoring suggest aquatic conditions are generally becoming more suitable for salmonids (Figure 2-7).

Figure 2-7. Aggregate Coho and Steelhead Densities from Two Monitoring Stations in Big River (1993-2006)



What can't be determined from the past monitoring strategy is the overall adult spawning population (escapement) and the relationship between specific riverine factors limiting salmonids and broad scale marine conditions. It is often overlooked that instream conditions only affect salmonids for half their life cycle, and there may be other regional or ESU level population trends that are beyond the control of resource managers. Electrofishing monitoring stations only capture a snapshot of juvenile abundance at a specific location within the stream and are not confident indicators of the basin-wide population. At this point in the adaptive management monitoring process, it's logical to continue some past activities such as temperature monitoring, but to also expand the scope to include more robust salmonid population monitoring.

Regional fisheries biologists for CDFG Northern Region Coastal Watershed Planning and Assessment Program have developed a sampling and modeling protocol that produces estimates of escapement (spawners) from spawning ground surveys (SGS) (Gallagher and Wright 2007). The methodology, which has been developed and implemented in this region, has been employed by neighboring landowners, and will soon be incorporated into the California Coastal Salmonid Monitoring Plan. The survey methods have been peer reviewed (Gallagher et al. 2007) and fall in to a larger, regional framework. From a management standpoint it is advantageous to incorporate a proven and accepted monitoring strategy that not only produces watershed escapement estimates, but also links them to regional populations trends.

Another advantage to SGS is that they are relatively inexpensive to conduct. Survey crews of two crewmembers conduct surveys on randomly selected spawning habitat reaches on two-week intervals. Approximately 30 percent of the identified spawning habitat in the watershed is surveyed and adult spawner population estimates are generated at the end of the spawning season. The former Property manager, CTM, has employed these methods in Pudding Creek, a similar and nearby watershed, from 2004 until the present, and has have received grant funding for staffing needs for all years. Spawning surveys can also be conducted with volunteer staffing, as the survey protocol is not unduly complicated.

In order to understand how broad scale salmonid population trends influence watershed populations, managers should also determine the overall production of juveniles leaving the stream network**.** Once the spawning and outmigrant (smolt) populations are quantified, important relationships can be established between instream survival and ocean survival, illustrating potential bottlenecks in overall production. Coho are an ideal species for this type of monitoring due to their somewhat rigid life history. Coho smolts typically leave the stream at about 12 –18 months and return as adult spawners in two years, producing a reliable three-year cycle. The proportional relationship between smolts and spawners, the percentage of outmigrants that return, is a reliable indicator of ocean survival. Likewise, the proportion of spawners to their outmigrating progeny is a good indicator of overall stream production.

The Property, however, only encompasses nine percent of the entire Big River Basin; so trapping of smolts in the mainstem will not produce an estimate of juvenile production solely for the Property. Unless a cooperative study effort among the larger landowners can be implemented, there would be little utility in pursuing outmigrant population estimation methods on the Property. If a cooperative study could be successfully implemented, the location below LNF Big River confluence on the mainstem adjacent to the Woodlands tract would be ideal to station a rotary screw trap. Smolt population estimates generated from trap captures below the confluence would represent the annual production for the entire basin. Considering the costly and extensive salmonid habitat restoration and remediation efforts conducted across the basin by major landowners and the public in the form of grant funds, it would be prudent for diverse resource manages to cooperate on a plan to quantify basin smolt production. Monitoring of this type, and for these species, is being conducted on similar watersheds (Hayes et al 2008) in northern California. Once outmigration is quantified, comparison of production among watersheds may reveal similar or differing trends, which then informs how the Big River population relates to the regional or ESU level population. Even without adult spawning (escapement) numbers, smolt production estimates are valuable monitoring information.

Due to the listing status of both endemic salmonids and their perceived importance by regulatory agencies as a keystone or indictor species of water quality, quantified population estimates are valuable. From the public relations perspective, population estimates of retuning adults are more meaningful to the general populace than over-summer juvenile relative abundance or other measures of instream salmon productivity. From a fishery perspective, escapement is the final measure of success for the population. Section 2.2.2 discusses a two-tier approach to aquatic monitoring in the watershed that maintains some elements of former monitoring activities and incorporates fish population monitoring.

Not all past monitoring activities should be continued. Some previous monitoring actions should be replaced with activities that more directly gauge current best management practices. For example, McNeil sampling is time and resource intensive and does not identify sources of fine sediment delivery into the watercourse. Monitoring of direct and indirect sediment sources from roads, hillsides, and channel banks will direct adaptive management decisions by prioritizing enhancement resources, and it will help identify ineffective past management practices.

2.2.2 Two Tiered Approach to Monitoring

The proposed monitoring plan that follows prioritizes monitoring in the near term, and provides a framework for long term monitoring goals. Monitoring activities listed in Tier One are actions that should be implemented in the near future to provide: 1) baseline data on fish population status; 2) feedback to managers on erosion associated with roads, hillsides and stream banks in the mainstem and sub-watersheds; and 3) continued temperature monitoring. Tier One monitoring is used to evaluate the effectiveness of current best management practices, and is considered a cost and resource-effective approach. These approaches are effective in providing relatively quick feedback to resource managers.

Tier Two provides long-term goals to apply as funding resources allow. These are more in depth watershed trend monitoring approaches over a broader temporal scale. While they are generally more costly to implement than Tier One objectives, they will provide insight on the status of long-term restoration objectives for adaptive managers.

Table 2-3. Two-Tiered Monitoring Approach

	Sediment	Temperature	Fish	Aquatic Habitat
Tier One	1) Road Assessments and Erosion Control Plan development. 2) Forensic turbidity surveys throughout winter months.	Monitoring at lower and upper Property boundary.	Determine approximate salmonid spawning populations through spawning ground surveys.	Conduct stream habitat inventory and LWD surveys at ten year intervals or as dictated by management activities
Tier Two	Continuous automated turbidity monitoring at all major tributaries.	Monitoring above and below tributary confluences to identify thermally limiting reaches.	Determine approximate smolt populations through rigorous downstream trapping program.	Conduct periodic management adaptations as a result of ongoing limiting factors analysis.

2.2.2.1 Sediment Monitoring

Tier One

Sources of delivery into Big River watercourses from roads, hillsides, and stream banks should be addressed. Qualified personnel should make assessments of existing roads, and road related erosion should be reduced where possible. Following road assessment, an ECP should be implemented. After the ECP is initiated and road erosion reduction activities have occurred, treated sites should be monitored to ensure management practices are functioning properly. Erosion from hillsides and stream banks should be identified and addressed if erosion is associated with management activities.

Forensic monitoring of turbidity is another tool used to identify sediment inputs. Monitoring can be performed either optically or by taking “grab samples” from the stream channel. Once an area of high turbidity is identified, survey crews follow the turbidity trace upstream in order to identify the sediment source. If the source is controllable, a treatment plan is subsequently drafted.

Tier Two

Continuous automated turbidity and suspended sediment monitoring is another monitoring tool used to identify tends and point sources of sediment delivery. Installation of a monitoring station can easily cost in excess of $10,000 (not including staff resources). Ideally, monitoring sites are installed on all major tributary confluences and at the lower property boundary. Although expensive, continuous automated sampling greatly reduces staff time and allows sampling to take place during peak flow events when safety is a concern.

2.2.2.2 Stream Temperature Monitoring

Tier One

Instream temperature monitoring at the stations previously developed by GP and CTM, which has been continued by TCF, should continue. A set of redundant data-loggers should be installed at the upstream and downstream Property boundaries, with summer stream temperature data collected continuously at 60 or 90-minute intervals. This simple approach would incur an annual cost of $1,000.

Tier Two

Other adaptive management prescriptions may indicate over time that additional aquatic temperature monitoring is needed to identify problematic reaches or tributaries. If managers decide to adopt this future strategy, a suite of ten monitoring sites with redundant data-loggers would incur an annual cost of $2,000- $3,000.

2.2.2.3 Salmonid Population Monitoring

Tier One

Section 2.1.1 describes a peer-reviewed methodology to estimate spawning salmonid populations on a watershed scale using spawning ground surveys. To implement this methodology at the suggested thirty percent sampling rate, it would require a staff of two on a part-time basis from November until the end of April. If the monitoring scheme were integrated with a similar plan for the Big Salmon Creek stream reaches contained within the TCF ownership, staff would be employed full-time for the survey period. The staff resources necessary to complete the population-monitoring proposal for both the Big River and Big Salmon Creek watersheds would require approximately $40,000 – $50,000 annually based on a rate of $20 per hour for two staff for six months, excluding vehicle expenses. Volunteer labor may also be utilized as previously discussed.

Tier Two

Section 2.1.1 also illustrates a plan to monitor the annual smolt, or downstream migrant, population at a watershed scale. The proposed methodology, however, is dependant on support from other landowners in the watershed. Smolt trapping on the mainstem within TCF's ownership will not generate juvenile abundance information specific to the Property. For a watershed scale estimate of smolt production, a trap located directly below the LNF Big River confluence on the mainstem is recommended. The LNF Big River is the lowest major fish-bearing tributary to the Big River basin, and it has road access which is vitally important to a trapping operation. This proposed trapping station is located on State Park's lower Big River ownership and therefore, at a minimum, would require its cooperation for access.

To implement the plan, a rotary screw trap is necessary. The use of passive integrated transponder (PIT) tags would increase the study resolution; however PIT tags are not required. A staff of one or two can safely operate the trap for the annual four month trapping period, which extends from early February to late May. Due to the seasonal overlap of the smolt trapping period and the spawning ground surveys, the same personnel can conduct both studies, maximizing funding for staff resources. Downstream monitoring expenses are shown in Table 2-2. The estimate for the initial start-up expense is approximately $30-40,000, with an annual operating budget in subsequent years of $15-16,000 excluding vehicle expenses.

Table 2-4. Expenses Related to Annual Smolt Trapping Monitoring

Expense Item	Amount	Note
8' Rotary screw trap	$20,000.00	One-time cost
PIT Tags	$6,000.00	Annual expense, but not required
PIT tag reader	$1,500.00	One-time cost
Staff	$6,400.00	1 staff, part -time @ $20.00hr for 4 months
Misc supplies	$3,000.00	Waders, etc

2.2.2.4 Stream Habitat Inventory Monitoring

Tier One

Habitat inventory surveys at 10-year intervals are recommended in order to detect watershed trends over time as suggested by CDFG (Flosi 1998). The habitat in Big River was last surveyed in 2002 and should soon be conducted to establish baseline data for the new ownership. LWD assessment surveys should also be initiated to determine watershed enhancement priorities.

Tier Two

To assess reach scale aquatic restoration needs, assessment surveys on Class I watercourses adjacent to and in conjunction with timber harvest plans are recommended. The utility of this monitoring strategy is that enhancement activities can then be conducted as a component of the THP. Enhancement actions often utilize heavy equipment and good road networks found in timber harvest operations. From the standpoint of increasing the value of enhancement activities by minimizing their ecological impact (e.g. opening new roads and tractor activity), and by increasing their economy, working within the THP process has many advantages.

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APPENDIX E: AQUATIC MANAGEMENT PLAN FOR SALMON CREEK
CAMPBELL TIMBERLAND MANAGEMENT, LLC

Hazel Creek, 1998

Aquatic Management Plan for Big Salmon Creek

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1 Overview of Properties

The Big Salmon Creek watershed has unique ecological factors that affect the stream network differently than those in found in Big River. The two watersheds have differing thermal regimes, landscape management histories, and discharge characteristics, which suggest separate treatment strategies to guide aquatic restoration, which includes increasing salmonid production. The purpose of the following watershed overview is to address factors affecting the Big Salmon Creek watershed from a fishery standpoint.

1.1 Overview

Because salmonids are often considered an indicator of watershed and ecosystem health, this section is predominantly focused on information and management recommendations relevant to salmonid habitat and populations.

Big Salmon Creek

Big Salmon Creek is a relatively small coastal watershed in Northern California, with the entire drainage area lying within eight miles of the coast (Figure 1-1). Much of the watershed is presently managed for timber production, and nearly 48 percent of the watershed is owned and managed by The Conservation Fund (TCF), hereafter referred to as the Property. Vegetation in the area is primarily conifer forest comprised of coast redwood (*Sequoia sempervirens*) and Douglas-fir (*Pseudotsuga menziesii*). The primary constituents of the riparian canopy are coast redwood, Douglas-fir, and red alder (*Alnus rubra*), which is nearly continuous throughout the stream network. Streambed gradient is generally low (<2 percent) throughout the mainstem reaches. The regional climate is characterized as Mediterranean with wet, mild winters and dry summers.

This watershed has a number of geographic and ecologic features that promote coho and steelhead production, and since the early 1990s studies based on electrofishing surveys and other methods have shown that Big Salmon Creek has supported stable populations of both species (Georgia Pacific [GP] 1995-1999 unpublished data; Campbell Timberland Management [CTM] 2000-2004 unpublished data). Big Salmon Creek is located within eight miles of the coast and the associated cool marine climate, which moderates stream temperature during the relatively hot northern California summer. Excessive stream temperature is a well-known factor limiting salmonids during the summer rearing phase of their life histories. The low stream gradients with meandering, sinuous channels found at the watershed scale in Big Salmon Creek favor coho salmon in particular. The canopy formed by the coniferous forest type also promotes cooler stream temperatures during the summer and, additionally, adds a roughness element to stream channels in the form of large wood debris (LWD), which further slows stream velocity and increases pool habitat, another factor promoting salmonid production.

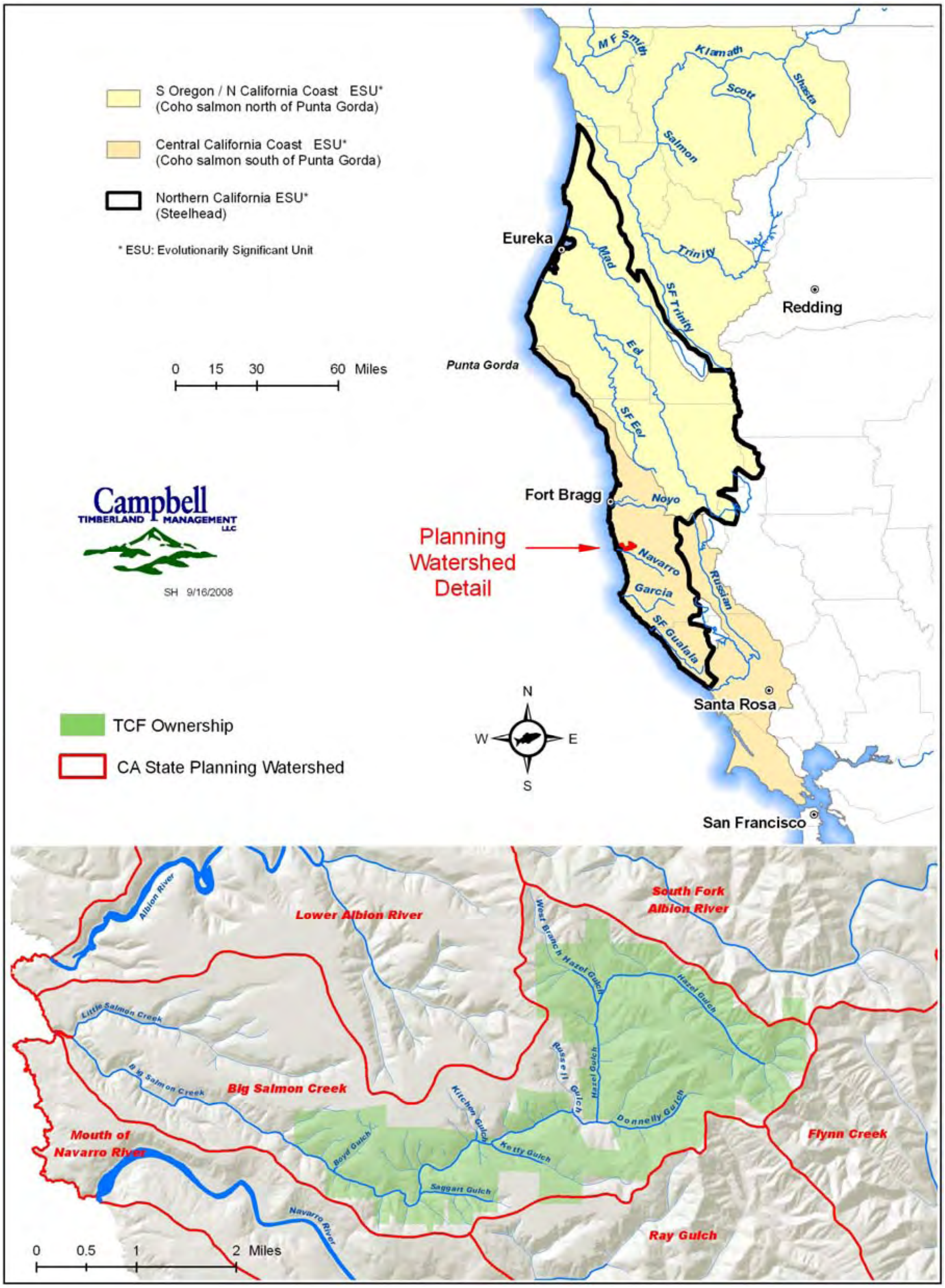
1.1.1 Location and Stream Description

Big Salmon Creek is located in Mendocino County California, drains approximately 8,600 acres (Figure 1-1) and is tributary to the Pacific Ocean. Elevations range from sea level at the mouth of the creek to approximately 1,200 feet in the headwater areas. To locate the mouth of Big Salmon Creek, refer to Section 35; T16N R17W of the Elk 7.5 minute U.S. Geological Survey quadrangle map. Instream conditions such as discharge, thermal properties, and gradient typify many of the characteristics commonly associated with small, coastal northern California watersheds. Discharge rates, which are not influenced by snow pack, vary significantly between summer and winter flows. Instream daily average temperatures range from 16.5° C (62° F) in summer to approximately 7° C (45° F) in winter, and the summertime water temperatures are moderated by the watershed's close proximity to the coastal marine climatic conditions. Within the Property boundaries, Big Salmon Creek is predominantly a low gradient, moderately entrenched F-3 Rosgen channel type[1] characterized by high pool development and low velocity discharge. Big Salmon Creek has optimal coho habitat conditions and, considering the small drainage area, has had relatively high rates of coho production.

[1] Rosgen channel types include 42 distinct channel classes, primarily based on gradient and dominant substrate characteristics. Various quantitative metrics help to classify channels, although it is not uncommon for specific metrics to vary among several classes.

1.1.1.1 Location Map with Coho and Steelhead ESUs

Figure 1-1. Fishery Overview of TCF Salmon Creek Ownership with Coho and Steelhead ESUs.



1.1.2 Context

Aquatic conditions in Big Salmon Creek, like many watersheds in the region, are presently more influenced by recovery processes from past management practices than by present practices. Therefore, in order to prescribe management practices that improve aquatic conditions and promote fish production, Section 1.1.2.1 provides a brief description of the past land use history of the Big Salmon Creek watershed from a fishery perspective.

1.1.2.1 History

Logging and ranching operations were initiated in the Big Salmon Creek watershed as early as the 1860s. By 1880 a logging railroad had been constructed within the floodplain, and linked the coastal mill at the ocean confluence (Whitesboro) with reaches as far upstream as Hazel Gulch. In that period logs were generally skidded down slope to floodplain based railcars and logging camps, mobilizing soil downslope to the active stream channel. In the upper areas of Hazel Gulch, logs were likely skidded by oxen down the active channel, which had been cribbed or converted to a log skid road to facilitate log transport. Remnants of the cribbing within the active channel still exist in parts of upper Hazel Gulch (small channels were often converted to oxen skid roads by planking logs crosswise to the channel to allow oxen to pull logs downstream).

Figure 1-2. Remnant Dam Structure on Hazel Gulch

Although dams were constructed for log and ranch ponds at various locations within the channel, splash dam logging, or stream based log drives, did not significantly occur in the Big Salmon Creek watershed. Logs were moved to the coast mill by railway. A remnant dam structure can still be observed just above the confluence of Hazel Gulch and West Branch Hazel (Figure 1-2).

The present day effects from the railroad era logging practices on fish production are a presumed increased sediment load in the active channel and floodplain. Historically, it is assumed that mobilized upslope soils inundated the watercourse beyond background levels. However, the legacy impacts on stored instream bedload, and, consequently, on present day fish production is unknown. The remnants of the railroad grade, which in many areas ran within or adjacent to the floodplain, is presently sloughing off into the watercourse in some areas during peak flow events, increasing sediment delivery into the watercourse on a stochastic (randomly determined) basis. Excessive instream sediment has been attributed to poor salmonid production at many points in their life history (Burns 1970; Kondolf 2000; Trappel and Bjornn 1983).

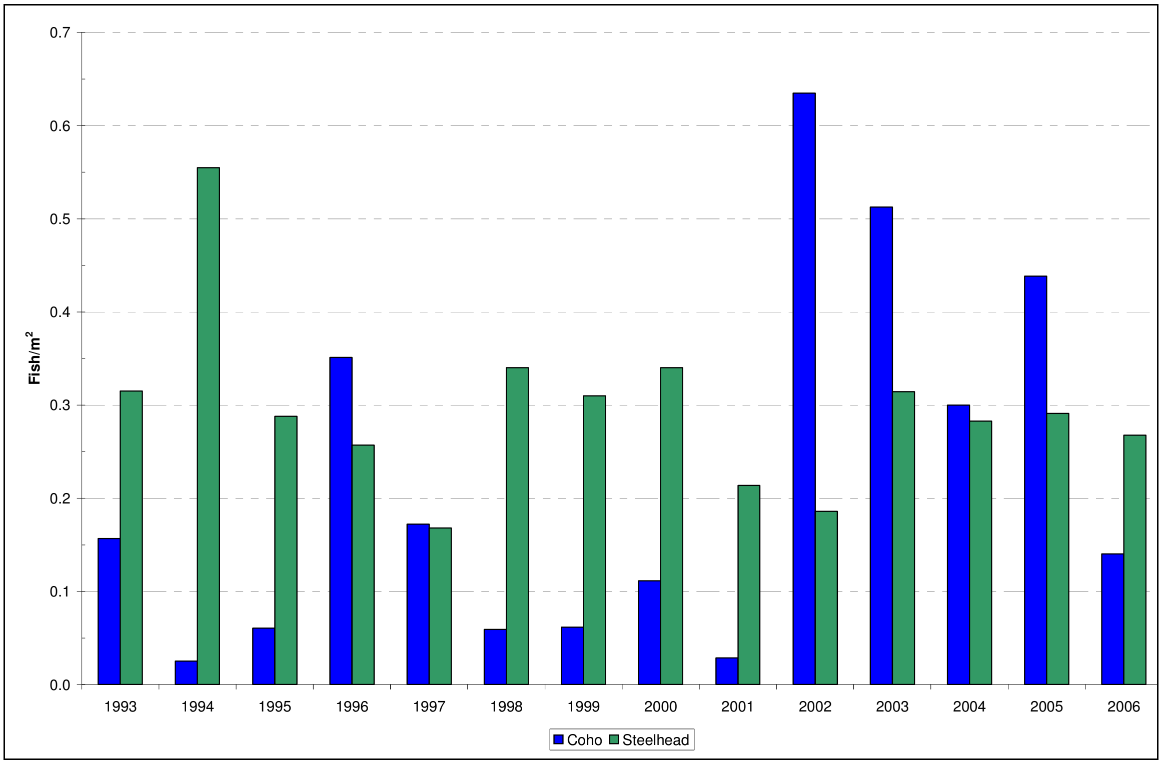
By the 1950s logging was accomplished largely by tractor operations. As a consequence, a network of streamside roads and landings were constructed throughout the Property. Tributary streams were often completely blocked during operations, and the impounded areas were inundated with green logging slash and exposed to direct sunlight, resulting in severe dissolved oxygen deficiencies, high stream temperatures, and corresponding juvenile fish mortality (Figures 1-4 to 1-7). Upon completion of tractor operations, logging debris was routinely disposed into the watercourse. During this era it was also common to operate tractors within the active channel to facilitate operations.

The impact on fisheries from the 1950s and 1960s operations was likely severe. The combined effects of: 1) massive sediment delivery into the stream network from tractor yarding and road and landing construction: 2) barriers to adult fish passage (spawners); and 3) direct mortality of rearing juvenile fish most likely had a devastating impact on Big Salmon Creek fish populations. By 1966 CDFG considered instream habitat conditions poor for salmonids (Primbs and Edward 1966).

By the early 1960s CDFG recognized the negative impacts to upstream migration from the practice of disposing of large tree boles and logging waste into the stream network, which had three primary aquatic impacts: 1) it prohibited migrating fish to access upstream spawning habitat in winter; 2) it introduced deleterious quantities of sediment to the stream; and 3) it reduced instream dissolved oxygen content in summer from rotting green waste. In addition to the impacts on fish, these practices impacted most endemic aquatic animal species within the watershed, from aquatic macro-invertebrates to amphibians.

Concerns regarding this practice resulted in the institution and initiation of the era of large woody debris (LWD) removal from northern California stream networks. Work crews were routinely hired by various state and county agencies to clear streams of large wood. Additionally, CDFG instituted policies that mandated stream clearance with tractors by the end of logging operations. The net result of these policies, while well intentioned, was the removal of most instream structure and the straightening of sinuous channels and a secondary negative impact on salmonids after the first setback from the initial logging practices. Many stream sections in Big Salmon Creek are presently deficient in LWD and have straight (bowling alley) stream reaches that are approximately a tractor blade width wide. This development can be observed in the mainstem reach around Saggart Gulch where the channel has been straightened and lacks LWD. The channel is downcutting in this area as a result.

Figure 1-3. Aggregate Relative Abundance of Juvenile Coho and Steelhead at All Monitoring Locations in Big Salmon Creek (1993-2005).



Since the 1970s, the Big Salmon Creek fishery conditions have been improving. As the knowledge base of timber harvest practices and resulting impacts on stream conditions increased, streamside-logging practices have dramatically improved. The Z'berg-Nejedley Forest Practice Act of 1973 mandated timber harvest prescriptions that consider the effects on wildlife and fisheries, and the era of LWD removal ended in the 1990s. Electro-fish sampling by former land managers suggest that coho and steelhead populations within Big Salmon Creek are presently stable (Georgia Pacific unpublished data 1993-1999; CTM unpublished data 2000-2005)(Figure 1-3). The salmonid community within Big Salmon Creek may now be more influenced by broad scale oceanographic and climatic conditions than by current specific instream factors. For example, MacFarlane and Hayes (2008) from the NMFS Southwest Science Center attributed a 70% decline in 2007 run of coho spawners throughout California and southern Oregon to extremely poor ocean conditions. However, although there is evidence to suggest that presently instream conditions may not be the primary limiting factor to fish production, there is still need for restoration and enhancement within the watershed. Beneficial stream conditions can help buffer the effects on the population of poor ocean conditions.

1.1.2.2 Historic Photographs

Figure 1-4. Typical 1960s Era Stream Crossing, Possibly Located in Donnelly Gulch (SFPWM 1965-66).

Figure 1-5. Stream Crossing with Impounded Flow, Green Logging Waste, and Direct Exposure to Sunlight, Possibly in Donnelly Gulch (SFPWM 1965-66).

Figure 1-6. Typical 1960s Stream Crossing Through Mainstem Big Salmon Creek, Possibly Located Near Elliot Road (SFPWM 1965-66).

Figure 1-7. Tour of Big Salmon Creek for Committee Report Prepared by the Subcommittee on Forest Practices and Watershed Management (SFPWM 1965-66).

1.2 Ecological Conditions

This section describes habitat types, riparian communities, and aquatic species of special concern found on the ownership.

1.2.1 Species Occurrences and Habitat Types

1.2.1.1 Riparian Communities

The smaller tributary streams to Big Salmon Creek are often intermittent and do not show substantial riparian tree development. The riparian corridor on mainstem Big Salmon Creek and its Class I perennial tributaries, however, is often dense. Migratory neotropical birds are expected to be more abundant in these areas.

Table 1-1, below, is a summary of the total miles class I, II, and III streams found in each Planning Watershed contained within the Salmon Creek ownership. Calculations are based on data collected by CTM (2001).

Table 1-1. Summary of Total Stream Miles, By Classification, Within State Planning Watersheds Located on TCF Ownership, Salmon Creek.

Planning Watershed	Predominant Stream	Total Watershed Acres	Acres of Ownership in Watershed	Percent of Ownership in Watershed	Class I (total mi) on TCF Salmon Creek	Class II (total mi) on TCF Salmon Creek	Class III (total mi) on TCF Salmon Creek
1113.400005	Big Salmon Creek	8,602	4,126	98.12	9.9	15.5	23.6
1113.400002	South Fork Albion River	5,837	40	0.95	0	0	0
1113.500706	Ray Gulch	3,910	26	0.62	0	0	0
1113.400003	Lower Albion River	8,076	8	0.19	0	0	0
1113.500705	Flynn Creek	4,865	4	0.10	0	0	0
1113.500707	Mouth of Navarro River	7,782	1	0.02	0	0	0
Total	-	-	**4,205**	**100**	**9.9**	**15.5**	**23.6**

1.2.1.2 Rivers

Big Salmon Creek Mainstem

The Property encompasses approximately 48 percent of the Big Salmon Creek watershed (Table 1-1). Temperature monitoring conducted by GP (1994-1999) and CTM (2000-2004) (Figure 2-3) indicate that stream temperature during summer months are within suitable ranges for coho and optimal ranges for steelhead. Stream habitat surveys conducted by CDFG in 2007 suggest that the surveyed reaches within the ownership contained generally good habitat conditions for salmonids. Shade canopy values were good at over 90 percent. Spawning habitat conditions were also considered good, with 85 percent of the habitat units surveyed described as being good or acceptable. Pool habitat by depth was also rated as good, with 62 percent of the pools having optimal depth for the stream order. CDFG (Flosi and Renyolds 1998) protocol states that ideally

40 percent of instream habitat (by length) should be in pool habitat. In Big Salmon Creek, surveyors found 38 percent of the stream in pool habitat. Pool shelter was also found to be slightly but not significantly low at 86(CDFG 2007). CDFG (Flosi and Renyolds 1998) states that a measure of 100 is desirable in pools. Low pool frequency and shelter values may result from the lack of large woody debris (LWD) as discussed in Section 1.1.2.1.

Juvenile coho and steelhead presence has been regularly observed throughout the Big Salmon Creek mainstem through electro-fish abundance surveys (GP unpublished 1995-1999, CTM unpublished 2000-2004), and stream habitat typing (CDFG 2007). Eight 50-meter electro-fish monitoring stations were established throughout the ownership on Big Salmon Creek and its tributaries and monitored annually. CDFG conducted routine stream habitat inventory surveys throughout the watershed in 2007.

1.2.1.3 Perennial Streams

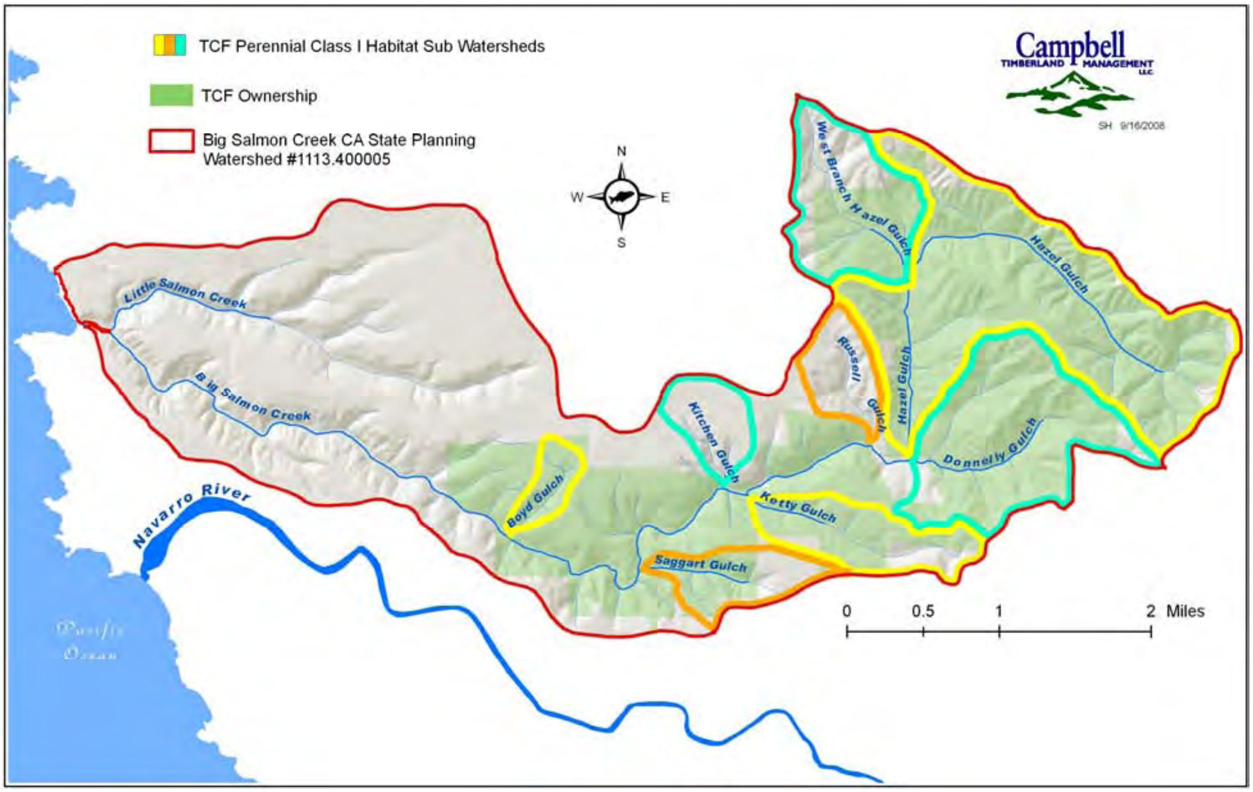
There are approximately nine small creeks and tributaries to Big Salmon Creek that are considered, in part, class I stream habitat, displayed on a map in Figure 1-8 (GP Unpublished 1996; CTM Unpublished 2005; CDFG 2007). A class I stream classification denotes potential habitat for salmonid species exists, and that the presence of salmon is not required for this classification.

Table 1-2. Summary of Total Stream Miles By Classification Within Perennial Class I Habitat Sub Watersheds Located on TCF Ownership, Salmon Creek.

Sub Watershed Name	**Total Acres**	**Acres of Ownership in Sub Watershed**	**Percent of Ownership in Sub Watershed**	**Class I** (total mi) on TCF Salmon Creek	**Class II** (total mi) on TCF Salmon Creek	**Class III** (total mi) on TCF Salmon Creek
Boyd Gulch	124.7	122.1	2.90	0.07	1.17	0.72
Donnelley Gulch	818.6	748.7	17.80	0.93	1.60	6.10
Hazel Gulch*	2124.0	1731.0	41.16	3.87	6.01	11.07
Ketty Gulch	369.5	276.7	6.58	0.56	0.89	0.51
Kitchen Gulch	207.4	3.5	0.08	0.07	0	0
Russell	221.2	16.7	0.40	0	0	0
Saggart Gulch	260.4	160.6	3.82	0.75	0.80	0.78
Subtotal	-	**3,059**	**72.75**	**6.25**	**10.47**	**19.18**
Remainder of Big Salmon Creek mainstem	-	1,068	25.39	3.65	5.03	4.42
All other minor drainages	-	78	1.85	0	0	0
Total	**-**	**4,205**	**100**	**9.9**	**15.5**	**23.6**

* Includes class I perennial tributary: West Branch Hazel Gulch

Figure 1-8. Map of Perennial Class I Habitat , Within the Sub Watersheds, on TCF Ownership, Salmon Creek.



The following short narratives are provided for all Class I tributaries. They are listed in watershed position, beginning with the most downstream tributary within the ownership.

Boyd Gulch

This watercourse contains 1.24 miles of combined Class I and II stream habitat. However, only a small proportion of the gulch (Table 1-2) is considered Class I habitat. No recorded surveys have been conducted there but it can be assumed that no other fishery management prescriptions are necessary other than best forest management practices.

Saggart Gulch

Saggart Gulch has similar conditions to those found in Ketty Gulch. It is a small, low gradient watercourse with limited flow potential. Observations within the watercourse indicate anthropogenic negative factors for fisheries from 1960s era logging practices. In the 2007 CDFG survey, this gulch was not considered an anadromous stream. However, foresters for CTM classified 0.75 mi of the stream as fish habitat due to the potential for restorability.

Kitchen Gulch

Most instream habitat in this watercourse is not suitable for juvenile salmonid rearing due to gradient and insufficient flow potential. The 2007 CDFG survey found that only a small proportion of the lower stream channel was acceptable for salmonids (Table 1-2). The survey determined that canopy was optimal, but pool habitat and shelter conditions were slightly deficient. It must be noted that Kitchen Gulch is a small watercourse and would not normally support pool habitat formations similar to that found in the mainstem.

Ketty Gulch

A stream survey conducted by CTM (2005) found the instream habitat characteristics observed in Ketty Gulch to resemble other low order gulches of moderate gradient in the Big Salmon Creek watershed. The survey reach appeared to be moderately impacted and, in some places, heavily impaired by historic logging practices and associated road construction. Evidence of near-channel tractor activity, from most likely the 1960s era timber harvesting and associated road construction, remains today. The banks and channel are unstable in some locations, but it appears that the moderate to heavy pool filling is the result of legacy effects. Despite the filled-in pools, embeddedness values are relatively low with 71 percent of the observed spawning riffles considered suitable for spawning.

Riparian canopy structure within the surveyed reach was acceptable at 90 percent. Large woody debris levels in the surveyed reach appear to be favorable with 22 pieces per 1000 ft; however, much of the LWD was centralized in large logjams affording structural complexity to only that particular location.

Russell Gulch

Class I habitat in Russell Gulch extends a small distance upstream from its confluence with the mainstem up to a bedrock sheet barrier (Table 1-2). The small amount of Class I habitat likely serves as over-wintering refugia for juveniles during high flow events.

Hazel Gulch

This watercourse is the largest tributary to Big Salmon Creek. It contains approximately 2.7 miles of Class I habitat (Table 1-2) and a large proportion of the spawning, rearing and over-wintering habitat within the entire Big Salmon Creek watershed. The 2007 CDFG survey found good shade canopy for salmonids. However, survey results suggest that Hazel Gulch is deficient in LWD, which is evidenced not only in low wood counts, but also as deficiencies in other channel attributes associated with instream LWD. Survey results suggest that shelter values are deficient, pool habitat lacking, and gravel storage and sorting processes need improvement. The paucity of LWD in the channel is consistent with the legacy effects from the historic impoundment in Hazel near its confluence with West Branch Hazel Gulch. Much of the stream channel in this area was inundated as a log/farm pond, then later subject to stream clearance activities during timber harvest operations in the 1960s. Coho and steelhead have been observed throughout this gulch (CDFG 2007).

West Branch Hazel

This gulch is tributary to Hazel Gulch and offers a small amount of marginal salmonid habitat (Table 1-2), and is generally better suited for steelhead and rainbow trout. The channel entrance is an 18 ft bedrock sheet with a 45° slope, which probably partially limits adult migration (Primbs 1966). Within the gulch there is little available spawning habitat due to natural geomorphic conditions. Rainbow trout have been observed in the gulch (CDFG 2007).

Donnelly Gulch

This tributary resembles Hazel Gulch and Ketty Gulch. It is a low order watercourse with moderate to low gradient and limited streamflow potential. The lower end of Donnelly Gulch sustained some channel damage from logging operations in the 1960s era. As a result, sediment delivery mostly occurs as bank failures in the gulch. Additionally, LWD and the other stream processes associated with wood in channels are deficient. Coho and steelhead have been consistently observed in Donnelly (GP unpublished 1993- 1999; CTM unpublished 2000-2005; CDFG 2007), and Class I habitat extends for nearly 0.93 miles (Table 1-2). Pullen Gulch is a small sub-watershed tributary to Donnelly and provides a small amount of Class I habitat at the confluence.

1.2.2 Special Status Animal Species

1.2.2.1 Coho Salmon

Coho have been definitively observed throughout Big Salmon Creek and most of its tributaries. 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 10 to 17.5° C (50-63.5° F) (a greater range than proposed for management thresholds). Redds are constructed in gravel that range in size from 1.3 to 10.2 cm. in diameter and intergravel mortality begins to occur when fine sediments exceed 13 percent of the substrate composition within the redd egg pocket. Note that redd construction involves a winnowing process that clears the egg pocket of most fine material. 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. The majority of coho juveniles migrate to the ocean at age one and return to fresh water to spawn after two to three years.

1.2.2.2 Steelhead Trout

Steelhead have also been observed throughout the Big Salmon Creek watershed. Steelhead (*Oncorhynchus mykiss*) were 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, some steelhead do not die after spawning, and 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 10° C to 17.5° C (50-63.5°F) (a greater range than proposed for management thresholds). 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 within the egg pocket of the redd, intergravel mortality begins occur. Steelhead spawning behavior generally winnows out fine sediment material.

1.2.3 Other Vertebrate Aquatic Species

Big Salmon Creek supports many aquatic and semi-aquatic vertebrate species besides fish (Table 1-3). Many of these species are completely terrestrial for varying fractions of their life histories, but may use the watercourse for feeding, breeding, or rearing.

Table 1-3. Aquatic Species Directly Observed Or That May Occur In Big Salmon Creek Within The Property.

Common Name	Species	Listing Status	Comments
Reptiles			
Northern Pacific Pond Turtle	*Actinemys marmorata*	None	
Western Aquatic Garter Snake	*Thamnophis couchi*	None	
Amphibians			
Coastal (Pacific) Giant Salamander	*Dicamptodon tenebrosus*	None	May hybridize with *ensatus*
Southern Torrent Salamander	*Rhyacotriton variegatus*	California Species of Special Concern (CDFG)	
Northwestern Salamander	*Ambystoma gracile*	None	
Rough-skinned Newt	*Taricha granulosa*	None	
Red-bellied Newt	*Taricha rivularis*	None	
Coast Range Newt	*Taricha torosa*	California Species of Special Concern (CDFG)	
Ensatina	*Ensatina eschscholtzi*	None	
Black Salamander	*Aneides flavipunctatus*	None	
Tailed Frog	*Ascaphus truei*	Threatened (CESA) California Species of Special Concern (CDFG)	
Western Toad	*Bufo boreas*	None	
Pacific Treefrog	*Hyla regilla*	None	
Bullfrog	*Rana catesbeiana*	None	Invasive species
Northern Red-legged Frog	*Rana aurora aurora*	California Species of Special Concern (CDFG)	
Foothill Yellow-legged Frog	*Rana boylei*	California Species of Special Concern	
Fish			
Pacific Lamprey	*Lampetra tridentata*	None	
River Lamprey	*Lampetra ayresi*	None	
Western Brook Lamprey	*Lampetra richardsoni*	None	
Threespine Stickleback	*Gasterosteus aculeatus*	None	Common
Prickly Sculpin	*Cottus asper*	None	Common
Coastrange Sculpin	*Cottus aleuticus*	None	Common

In addition to coho and steelhead, generally three other fish species are commonly found in Big Salmon Creek (Table 1-3). The two sculpin species are commonly observed in most Class I watercourses in the region. Biologists employed by GP and CTM have also directly observed Pacific Lamprey. Whether other lamprey species are endemic in the watershed is unknown, but all three species may occur.

2 Management Goals

In northern California watersheds, salmonids are considered the keystone aquatic species by state and federal regulatory agencies. The State Water Resources Control Board and the US EPA consider salmonids a key indicator of water quality. Coho in this region have been listed as state and federally endangered and steelhead have been listed as federally threatened.

Consequently, the aquatic management goals are tailored to promote healthy salmonid populations with the assumption that other aquatic taxa will also thrive. Therefore, healthy instream habitat conditions that are known or assumed to promote salmonids are the overarching goal of the Aquatic Management Plan. These elements include maintenance/enhancement of shade canopy, recruitment of large wood (either naturally or artificially), maintenance of summer flows, and prevention of discharges of fine sediments. The incorporation of these elements into property wide management plans should be considered relative to any management activity, not just those near aquatic habitats.

2.1 Restoration and Enhancement

This aquatic restoration and enhancement plan was prepared by: 1) synthesizing existing reports and recommendations pertaining to aquatic restoration; and 2) identifying and prioritizing aquatic restoration and management actions. This process involved the review and analysis of pertinent documents and field surveys conducted in the watershed and formulating restoration objectives relevant to the Property. The suggested approach relies on an analysis of limiting instream factors identified within the watershed. However, this watershed has not been listed as water quality limited under section 303(d) of the Federal Clean Water Act (impaired). Consequently, there is generally less baseline information available than neighboring watersheds germane to restoration and enhancement. This analysis and subsequent recommendations rely on aquatic habitat inventory surveys conducted GP in 1996, CDFG in 2007, and from instream temperature, aquatic vertebrate, and sediment monitoring conducted by GP and CTM from 1993-2004.

Nearly all the major watersheds in northern California have been impacted by historic logging operations, and, as discussed in Section 1.1.2.1, Big Salmon Creek shares a similar history. The restoration and enhancement measures prescribed by this aquatic management plan relies on a conceptual limiting factors analysis to determine aquatic bottlenecks to salmonid production as per Meehan et al (1991).

2.1.1 Aquatic Limiting Factors Analysis

The life requirements for anadromous Pacific salmonids in the freshwater environment are generally well understood (Bjorn and Reiser 1991). Survival in their freshwater phases depends on the availability of cool, clean water, unlimited migratory access throughout the stream network, clean spawning gravel, suitable and adequate food supplies, and complex instream shelter components to avoid predation. These necessary life-history components are provided by a diverse and complex aquatic habitat. When any of these life history components are missing or degraded, fish stock production can be adversely impacted. The basis of a limiting factors analysis is to identify and evaluate these requirements throughout the watershed on a spatial and temporal scale. When these requirements are evaluated on both watershed and reach scales, factors that promote or limit salmonid stocks can be identified.

Natural disturbance factors such as landslides and wildfires that limit salmonid stocks in watersheds, while generally covering larger areas than sites of human disturbance, are usually not distributed throughout the watershed. The stochastic nature of these disturbances, which tend to rotate though watersheds on a broad temporal and spatial scale, allow individual sub-basins sufficient time for recovery. On a watershed scale this creates diverse and dynamic habitat conditions for salmonids. In contrast, human disturbances tend to be comparatively smaller on an individual basis, but usually more widely distributed throughout the watershed (Reeves et al 1995). Naturally occurring landslides and other disturbances occur within the Big Salmon Creek watershed; however, their impacts to salmon stocks are minimal compared to anthropogenic disturbances such as historic road building that are more widely distributed throughout the basin.

The concept of a limiting factors analysis was first introduced in the 1980s (Everest and Sedell 1984) (Meehan 1991) and has been utilized extensively in assessment studies of proximate regional watersheds (Klamt et al [NCWAP Gualala] 2002; Downie et al [NCWAP Albion] 2004; Downie et al [NCWAP Big River] 2006) by the North Coast Watershed Assessment Program (NCWAP California Resources Agency) and by others throughout the Pacific Northwest to identify problems within watersheds and direct stream restoration activities. For the purposes of this aquatic management plan it is not necessary to discuss the entirety of all studies and processes involved. Rather the purpose is to establish that certain stream conditions are commonly recognized as influencing salmonid production in most watersheds throughout this region, and they are generally well recognized in peer reviewed articles and publications (Reeves and Everest 1989) (Bisson In press).

In Big Salmon Creek and other watersheds in this region, stream condition is thought to be primarily controlled by these factors: adequate stream flow, suitable water quality, and complex habitat.

Adequate stream flows are critical for salmonid production at all points through their freshwater life cycle. A suitable winter flow regime is required for upstream migrating spawners and egg development within redds, and rearing juveniles need adequate summer flows for feeding, predator evasion, and thermal refugia. A natural hydrologic regime that decreases the magnitude of winter peak flow events and increases flows during the summer drought period favors salmonid production. The natural hydrograph of coastal watersheds in northern California is often one of limited flows during summer, limiting carrying capacity and connectivity throughout the aquatic habitat. Consequently, freshwater salmonid survival is particularly tied to diminished flows during summer. In Big Salmon Creek within the Property, stream diversions do not occur and drafting occurs minimally, so stream flows are thought to mimic the natural hydrologic regime and are not considered limiting beyond normal variance.

Water quality considerations for salmonid production consist of three factors: 1) water temperatures, 2) turbidity, and 3) sediment load. Steam temperature in summer is often thought be the critically important for growth and rearing in salmonids (Hines and Ambrose, 2000). Literature suggests that suitable temperatures for salmonids at this life history stage range between 10.0° – 17.5° C depending on the species. Steelhead are slightly more tolerant of higher stream temperatures than coho.

Turbidity, or the relative clarity of water, can affect primary productivity of aquatic vegetation. This consequently affects aquatic insect production, which in turn may alter salmonid productivity. Increased suspended sediment loads can interfere with juvenile salmonids' ability to locate prey and feed thereby decreasing overall growth rates.

The final aspect of water quality is stream substrate composition, which can be subdivided into two separate analyses: compositional and quantitative. Although salmonids use a winnowing process to flush out fine materials during redd construction, if the proportion of fine sediment within the substrate is excessive, survival to emergence (STE) of fry from the redd is reduced (Kondolf 2000). Fine sediment reduces interstitial flow through the spawning gravel, subsequently reducing the dissolved oxygen flow to embryos and the flushing of metabolites. Excessive overall quantities of sediment affect juvenile salmonids generally in two ways: debris torrents in winter (when large amounts of sediment are suspended in the water column) can cap redds as sediment comes out of suspension; and in summer, deleterious quantities of bedload within channels can force stream discharge to flow subsurface, effectively reducing rearing habitat in small streams during a critical life stage.

Habitat complexity for salmonids has also been researched and discussed in fishery literature (Flosi and Renyolds 1998). An optimally complex condition for salmonids is thought to consist of a combination of riffle, flatwater and pool habitat types. Riffles provide spawning substrate and a rearing area for fry; flatwater provides connectivity through the stream network and some rearing habitat for juveniles; pools provide refugia from predation and high stream velocities in winter, foraging habitat throughout the year, and rearing habitat in summer.

Stream conditions for salmonids are also dictated by the quality of the adjacent riparian habitat. Shade canopy from dense bank dwelling vegetation limits the amount of solar radiation that reaches the stream, buffering excessive stream temperatures in summer and insulating overly cool temperatures in winter. Green leaf matter falling from streamside trees provides a nutrient source for aquatic insects that in turn become feed sources for fish. The coarse woody habitat elements recruited from the fall of riparian trees in the form of LWD eventually forms roughness and shelter components within the active channel. A well functioning riparian zone also provides stream bank stability with dense vegetative root masses, limiting sediment delivery from bank failures and streamside landslides.

The limiting factors assessment analyzes aquatic factors thought to limit salmonids in the instream residency component of their life history. The following narrative outlines the goals, background, discussion, and recommendations for each limiting factor identified. Habitat assessment surveys identify the majority of limiting factors in the watershed and are consequently addressed first. Table 2-1 summarizes limiting factors within the watershed and management recommendations.

Table 2-1. Summary of Limiting Factors and Management Recommendations.

Limiting Factor	Regulatory Reference	Measured Parameters		Desired Condition	Management Recommendations
Habitat	*Desired Salmonid Freshwater habitat Conditions for Sediment-Related Indices* (NCRWQCB 2006).	**Pool habitat**		Where applicable, increasing trend in frequency and length.	Monitoring should occur according to the protocols found in the *California Stream Restoration Manual* (Flosi et al 2004).
		Pool depth		Where applicable, increasing trend in pool depth.	
		Primary pool distribution		Maintain 40 % of stream habitat by length in 2 [nd]- 4 [th] order streams.	
LWD	*Desired Salmonid Freshwater habitat Conditions for Sediment-Related Indices* (NCRWQCB 2006).	**Bankfull Channel Width (m)**	**Index (per 100m of Channel length)**	An increasing trend in the frequency of LWD within active stream channels.	Monitoring should occur according to the protocols found in the *California Stream Restoration Manual* (Flosi et al 2004).
		1 to 6	> 38 pieces		
		> 6 to 30	> 63 pieces		
Fish Passage	*California Stream Restoration Manual (Flosi et al 2004).*	Bridge and culvert parameters as prescribed in manual.		Fish passage at all crossings at all life-history stages in Class I watercourses.	Monitoring should occur according to the protocols found in the *California Stream Restoration Manual* (Flosi et al 2004).
Stream Temperature	NCWAP Overview and Methods (2006)	**MWAT Range**	**Description**	Maintain summer stream temperatures within 10º C – 16.5º C (50º F – 62º F).	Monitoring should occur at some or all historic monitoring stations.
		10º - 15.5º C	Fully Suitable		
		16º - 16.5ºC	Moderately Suitable		
Sediment	*Desired Salmonid Freshwater habitat Conditions for Sediment-Related Indices* (NCRWQCB 2006).	**Turbidity (ntu)**		Turbidity should not increase more than 20 percent above naturally occurring background levels.	Stream channel confluences should be monitored for turbidity during storm events.
		Suspended Sediment Load (tons/day)		The suspended sediment load and suspended sediment discharge rate of surface waters should not adversely affect beneficial uses	Stream channel confluences should be monitored for suspended sediment loads
		Embeddedness		An increasing trend in the number of locations where gravels and cobbles are ? 25% embedded.	Monitoring should occur according to the protocols found in the *California Stream Restoration Manual* (Flosi et al 2004).

2.1.1.1 Habitat Assessment

Goals

The primary goal of habitat assessment surveys is to determine the quality of the aquatic habitat within watersheds. The information generated in the assessment is used to identify areas in need of remediation and guide restoration efforts. The secondary goal is to generally identify how fish use the watershed and which areas are optimal for different components of their life history: spawning, rearing, and over-wintering.

Background

In 1996 a comprehensive habitat inventory survey was conducted by GP throughout the Big Salmon Creek watershed to assess aquatic habitat conditions and subsequently recommend potential habitat enhancement options.

When CTM assumed management of the watershed in 2000, a plan was instituted to evaluate all Class I watercourses adjacent to and within Timber Harvest Plans for factors limiting salmonid production. In the case of road related sediment delivery issues, road network upgrades were implemented as part of timber operations (see Section 2.1.1.5).

As a result of the assessment information generated and as mitigation for a quarry accident on Big River, in 2004, CTM implemented a stream enhancement LWD project on the mainstem of Big Salmon Creek and selected tributaries. The project area is upper mainstem Big Salmon Creek and Lower Hazel Gulch, and consists of 16 log structures that use anchored and unanchored design elements. In 2007 CDFG revisited the watershed and conducted habitat inventory assessments with associated recommendations.

Discussion

The results from the GP habitat inventory surveys, THP related surveys, and the CDFG survey in 2007 all suggest that lack of channel complexity, or channel homogenization, is the most apparent problem for the aquatic ecosystem. Presumably these are legacy effects from the 1960s era logging practices and stream clearance activities. The benefits to ecosystem resilience from instream structure have been well documented (Maser and Sedell 1994). Instream shelter components, particularly from organic sources such as wood, have been attributed to many beneficial aspects of aquatic ecology, as listed below:

- Aquatic macro-invertebrate production
- Structural shelter habitat for aquatic organisms including salmonids
- Structural habitat for aquatic organisms in the form of pool habitat development
- Increased over summer water storage due to increased pool development
- Increased bank stability due to decreased bank downcutting and increased riparian flooding during peak flows
- Shelter habitat for rearing salmonid juveniles in summer
- Shelter habitat for salmonids (adult and juvenile) from high stream velocity events in winter
- Spawning gravel retention and sorting and storage of sediment.

Although sediment delivery issues remain a problem in some areas, all the assessment surveys on the mainstem suggest, contrary to what might be expected, that the watershed may lack suitable quantities of spawning substrate due to stream channel homogenization. Many stream reaches, both in the mainstem and within the tributaries, have actively downcut through the floodplain to bedrock. Heterogeneous channels with sufficient roughness from geologic and biologic sources (boulders and large wood) store and sort sediment. These areas of sediment deposition are often primary spawning habitat for salmonids. The paucity of spawning habitat and downcutting in Big Salmon Creek was noted in the 2007 CDFG surveys as well as in earlier reports by CTM and GP.

This phenomenon has also occurred within the neighboring Albion River watershed, presumably for the same reasons. Cynthia LeDoux-Bloom, Associate Marine Fisheries Biologist for CDFG, recommends the addition of suitable spawning gravels in certain areas of the watershed (Pers. Comm. 2008).

Lack of suitable spawning substrate may not necessarily limit populations of coho or steelhead in small stream systems. Density dependant juvenile population dynamics and stream carrying capacity create an ecological feedback loop such that when many spawners succeed, the resultant overabundance of progeny may be significantly depleted by limits to stream carrying capacity and density dependant interactions. Conversely, when few spawners are successful the mortality in progeny from density dependent interactions is decreased. Therefore, few successful spawners may seed a small stream network as adequately as numerous spawners, although the genetic range in the progeny will be less.

In Big Salmon Creek, however, suitable spawning substrate is presently distributed more heavily in the tributary gulches than the mainstem. In years where high flows predominate, this distribution would benefit fish spawning higher in the network, whereas in drought years spawning habitat would be limiting. An additional consideration during drought conditions with fish spawning lower is that progeny, due to low flow, would have limited opportunities to migrate upstream to avoid density dependant interactions and competition with other fish - essentially limiting available rearing habitat. Although stream networks rarely attain ideal attributes for salmonids at all spatial and temporal scales - because habitat conditions naturally vary - the optimal distribution of spawning substrate in Big Salmon Creek should be more equivalent between tributary and mainstem reaches. This would allow a greater range of useful spawning habitat during all streamflow conditions and ensure a higher probability of spawning success in all types of streamflow conditions.

Suitable rearing habitat occurs throughout the Class I stream network on the Property. During wet years with favorable rainfall, all Class I tributaries and the mainstem serve as beneficial rearing habitat. During drought conditions, however, the lack of flow potential and pool habitat in the tributaries limits habitats for fish, and often forces fish to migrate downstream in search of better conditions. This further increases competition in the mainstem and ultimately mortality rates as well. The flow potential of tributary reaches cannot be increased. However, the anthropogenic lack of channel structure exacerbates the problem with the subsequent lack of pool formation and water storage. The overabundance of bedload in these small channels then deteriorates the situation even further due to the tendency of streams to flow hyporheic, or sub-surface, during low flow periods. Over time, overabundant sediment in the tributaries will redistribute in the mainstem if there is sufficient channel structure available for storage.

The entire basin encompassed by the Property offers suitable over-wintering habitat for juvenile salmonids during dips in the hydrograph between storms. During high-flow or peak events, however, water velocity can severely impact juveniles and cause significant mortality – particularly in the mainstem. As discussed, significant channel structure slows stream velocity and therefore offers refugia for over-wintering salmonids. The observed paucity of channel structure in the mainstem suggests that, presently, it does not offer adequate over-wintering habitat during extended periods of high flow. And that fish are subsequently forced to use the smaller tributary confluences as over-wintering refugia. Fish probably use the confluences of Pullen, Hardel, Russell, Boyd, and Kitchen Gulches as refugia during peak flows.

Recommendations

All assessment surveys and associated reports generated in Big Salmon Creek since 1996 consistently suggest that channel homogenization due to lack of LWD is the major factor limiting salmonids in Big Salmon Creek - within the ownership. The other factors generally thought to limit fish production in northern California streams, such as canopy and associated stream temperatures are not nearly as critical in this watershed (see Section 2.1.1.4).

The aquatic management strategy for this watershed should therefore focus on increasing wood loading in the active channel. Riparian corridors should be managed for natural recruitment of large trees into the channel, as has been historically occurring within the recent management regime.

However, the rate of wood recruitment from natural processes like mortality, bank failures, streamside landslides and windfall is likely insufficient for the near term needs. The natural mortality of redwoods in particular (considering the life span of these trees and their resistance to disease) and fall probability (the probability that dying trees will actually fall in the channel) would result in a very slow rate of recruitment. The immediacy of the problem, therefore, suggests that artificial wood recruitment is necessary. Section 2.1.1.2 addresses artificial LWD recruitment in the watershed.

Future habitat assessments are proposed in the following phases:

Phase One (2009-2010)

- Conduct LWD surveys in select reaches of the watershed to determine deficiencies in wood loading.

Phase Two (2012-2017)

- Conduct Habitat Inventory Surveys on a five-year frequency basis to continue monitoring aquatic habitat conditions or following ten year flood events.

2.1.1.2 LWD

Goals

Reflecting the paucity of LWD within the watercourse and the associated detrimental aquatic habitat conditions as found in the habitat assessment surveys, the primary goal is simply to increase channel complexity through the artificial recruitment of LWD into the stream network where necessary. The secondary goal is to implement wood based enhancement projects efficiently with minimal negative ecological impacts and maximized enhancement properties.

Background

As previously discussed, in 2004 an LWD project was implemented in Big Salmon Creek and Hazel Gulch. Although design components were primarily anchored structures, some unanchored logs were added to the channel.

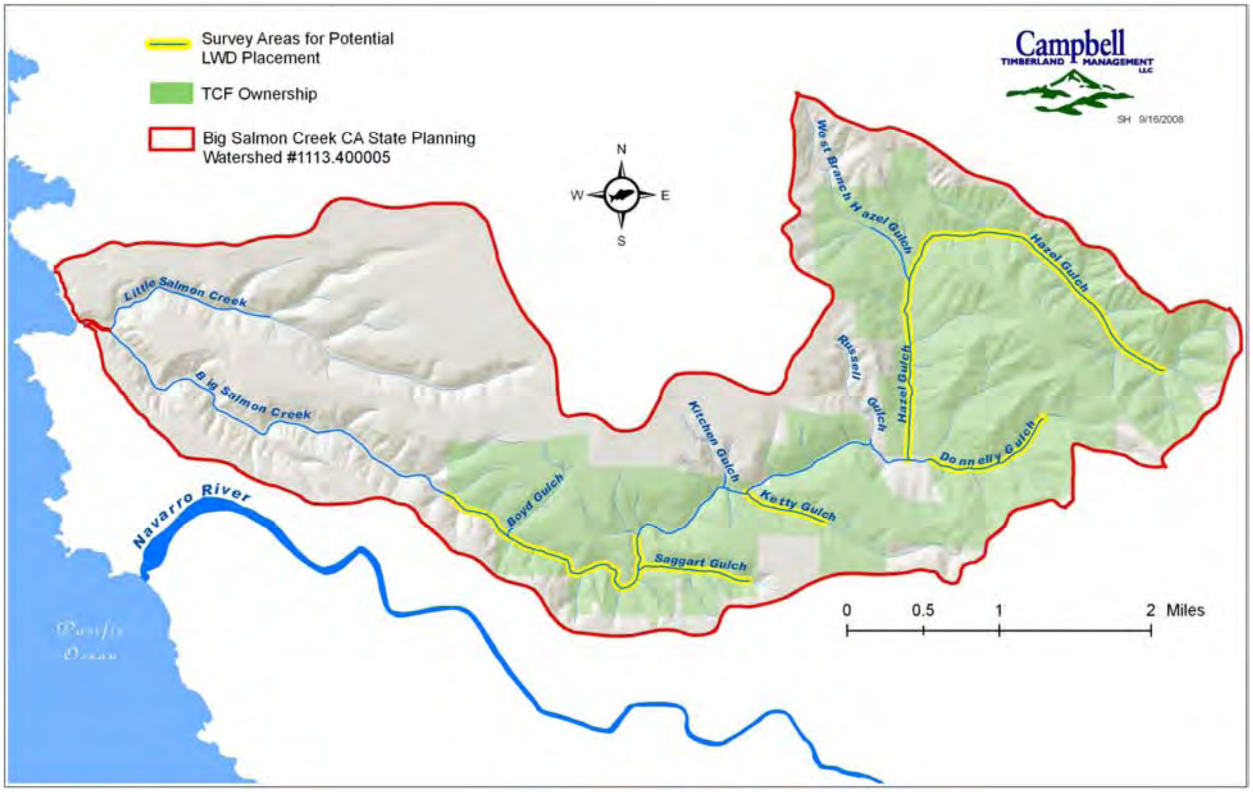
Discussion

Stream enhancement projects utilizing wood structures can generally be accomplished with either wood collected from timber harvest operations, or harvested/salvaged specifically for the project. In the 2004 Big Salmon Creek wood project, managers found a number of disadvantages to using cull logs from timber operations and logs felled away from the site. The primary disadvantage to this method is that log stock collected away from the site must be transported. A functional road network to the restoration site is then required, and heavy equipment must be used extensively within the channel and along the banks. The site's overall restoration value to aquatic organisms is consequently diminished by the potential for increased sediment delivery. Additionally, salvaged logs are often of inferior quality both in length and structural considerations. Logs deficient in length characteristics often must be permanently anchored to existing stationary landmarks to avoid being flushed from the basin during high flows. These associated requirements are costly and, more importantly, result in structures that are sub-optimal from the perspective of fish habitat. Permanently anchored structures also don't allow log movement. As a consequence, important hydrologic processes such as scour and sediment sorting are limited because the immobile log cannot descend into the scour hole.

Ideally, large unanchored logs approximately two times the channel width should be used for in-channel structure. Length allows some hydrologic mobility while also limiting large-scale movement, retaining the valuable wood within the watershed. Due to the excellent canopy values found in this watershed and the cooling influence of the marine dominated climate, it can be reasonably assumed that selected riparian trees could be placed into the channel without undo negative impact to the stream's thermal regime. Using select riparian trees for instream structure is cost effective, it minimizes damage to the channel banks, and it minimizes damage to riparian vegetation because heavy equipment use is minimized. This method also allows for increased flexibility in site selection, as a functioning road network is not required.

Recommendations

Figure 2-1. LWD Survey Reaches for Potential Stream Enhancement.



Due to the problems associated with anchored instream structures, many institutions involved with LWD enhancement projects have started implementing an "accelerated recruitment" approach in which streamside trees of sufficient length are placed directly into the channel. Other resource managers in the region have implemented this method on nearby watersheds at cost of approximately $9,000 per mile. Accordingly, recommendations include:

- Survey Class I mainstem and tributary reaches to quantify LWD;
- Treat select reaches found deficient in LWD in mainstem Big Salmon Creek and its tributaries using this "accelerated recruitment" procedure. A rough treatment estimate of three to four miles of mainstem reaches and ten miles of tributary reaches produces an overall estimate of $117,000. Depending on funding constraints, these reaches can be prioritized for fisheries values and implemented as resources become available.
- Assess the following areas for LWD deficiencies and, when applicable, identify and implement potential restoration sites (see also Figure 2-1):

  1. **Hazel Gulch**
     a. Lower Hazel from confluence with Donnelley Gulch to West Branch Hazel
     b. Upper Hazel from North Fork Hazel to end of Class I habitat
  2. **Lower mainstem Big Salmon Creek.**
     a. From "first crossing" to lower Property boundary

3. **Donnelly Gulch**
    a. From Pullen Gulch to Class I habitat termination
4. **Ketty Gulch**
    a. Confluence to Class I habitat termination
5. **Saggart Gulch**
    a. Confluence to Class 1 termination

The mainstem reach between Russell Gulch and Saggart Gulch has the lowest priority for LWD assessment and implementation because this area was the location for the 2004 LWD project reach. Stream enhancement in this area may still be necessary, but untreated areas in the basin now have higher priority.

2.1.1.3 Fish Passage

Goals

Adult salmonids require access to spawning habitat, and juvenile rearing fish need access to feed sources and refugia habitat in order to thrive. Refugia habitat is often categorized as 1) thermal refugia, or cooler areas during hot periods; 2) over-wintering refugia, or low velocity areas protected from peak flow events; and 3) predator refugia, or areas protected from predation. Any area in the watershed utilized by fish at any point in their life history is defined as Class I habitat. The goal of the aquatic management plan is to allow fish access to these areas by identifying and removing all barriers to fish migration.

Background

Since 1994 past landowners have been removing problematic culverts and other anthropogenic barriers to fish migration as part of the timber harvest process and, additionally, as watershed improvements outside the timber harvest process. Over time most known artificial barriers to fish passage have been removed within the watershed.

Discussion

On small watercourses, such as Kitchen Gulch, the amount of Class I habitat available to fish upstream of a culvert formed partial barrier is limited, and the potential risk of downstream degradation to quality habitat from sediment released by culvert removal is high. In the few instances in the watershed where these conditions exist, the potential overall benefit to the fishery must be weighed against the potential risks.

Recommendations

Monitoring and assessment of barriers to fish passage should continue throughout the watershed in the form of reconnaissance surveys. When potential artificial barriers are identified, the risks of removal should be weighed against potential gain to the fishery. When the assumed gain to the resource is greater than the potential negative effects, the barrier should be removed. Fish passage in suspect crossing and culverts can be evaluated using protocols described in the *Salmonid Stream Habitat Restoration Manual* (Flosi et al 2002).

2.1.1.4 Water Temperature

Goals

Literature concerning stream temperatures for coho and steelhead indicates that suitable summertime temperatures for these salmonids occur within the range of 10° C to 17.5° C (50°-64° F), when gauged from a seven day rolling average of the daily average temperatures (Welsh et al 2001; Sullivan et al 2001; Downie et al 2006). For this Aquatic Management Plan, the thresholds developed by NCWAP (Downie et al *Big River Assessment Overview and Methods* 2006) (Walker 2007) are used (10º C to 16.5º C) (50º F – 62º F) (Table 2-1). These thresholds were developed by a panel of fisheries scientists upon a literature review of northern California stream temperatures and juvenile salmonids. The maximum of the weekly averages is referred to as MWAT and is often used as a single point metric to evaluate stream temperature. The goal for the aquatic management plan is maintain instream MWATs within, or preferably below, the stated suitable range.

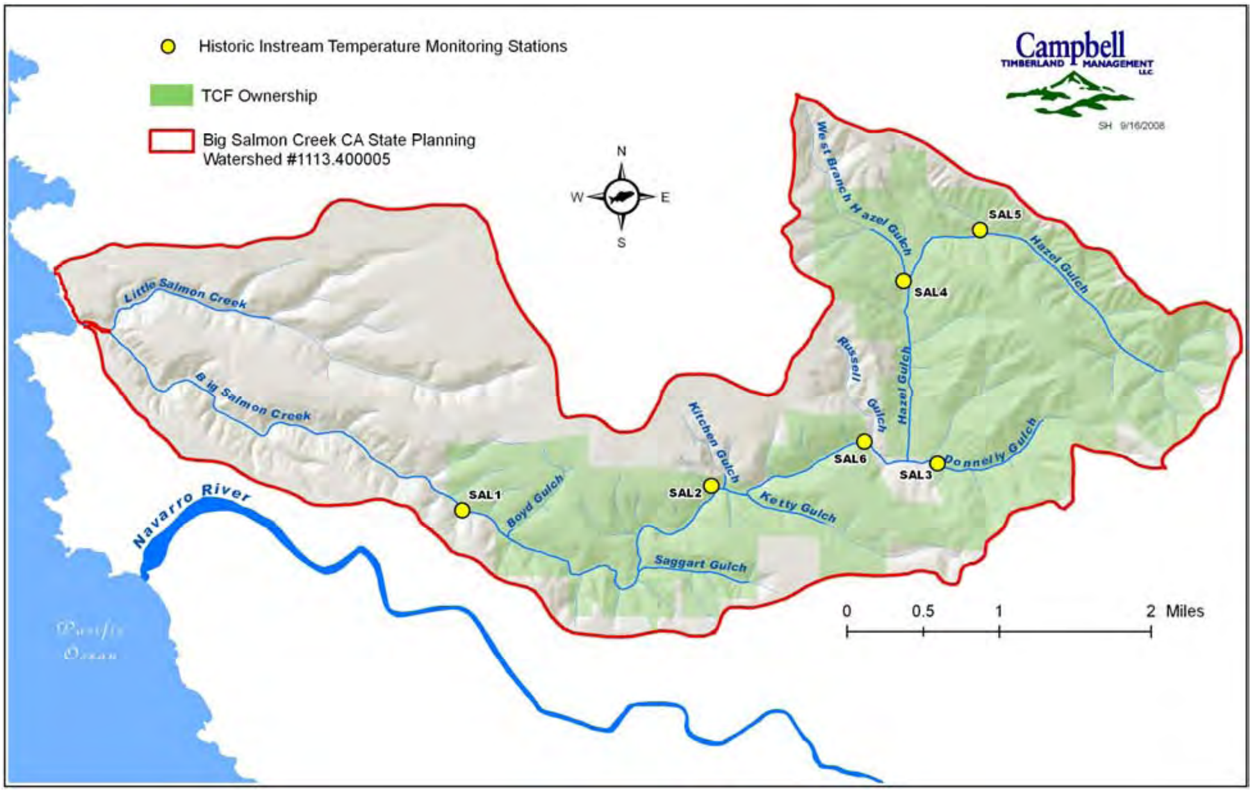
Background

Table 2-2. Temperature Monitoring Sites Within the Property and Years Deployed.

Station	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
SAL1		X	X	X	X	X	X	X	X	X	X			X
SAL2	X	X	X	X	X	X	X	X						
SAL3	X	X	X	X	X	X	X	X						
SAL4	X	X	X	X		X	X	X						X
SAL5	X	X												
SAL6		X	X			X	X	X	X	X				X

Since 1994 resource management staff on the Big Salmon Creek ownership has maintained six temperature data loggers throughout the stream network (Table 2-1, Figure 2-2). In 2005 a separate, additional long-term aquatic temperature study was initiated in lower Hazel Gulch, which is presently ongoing.

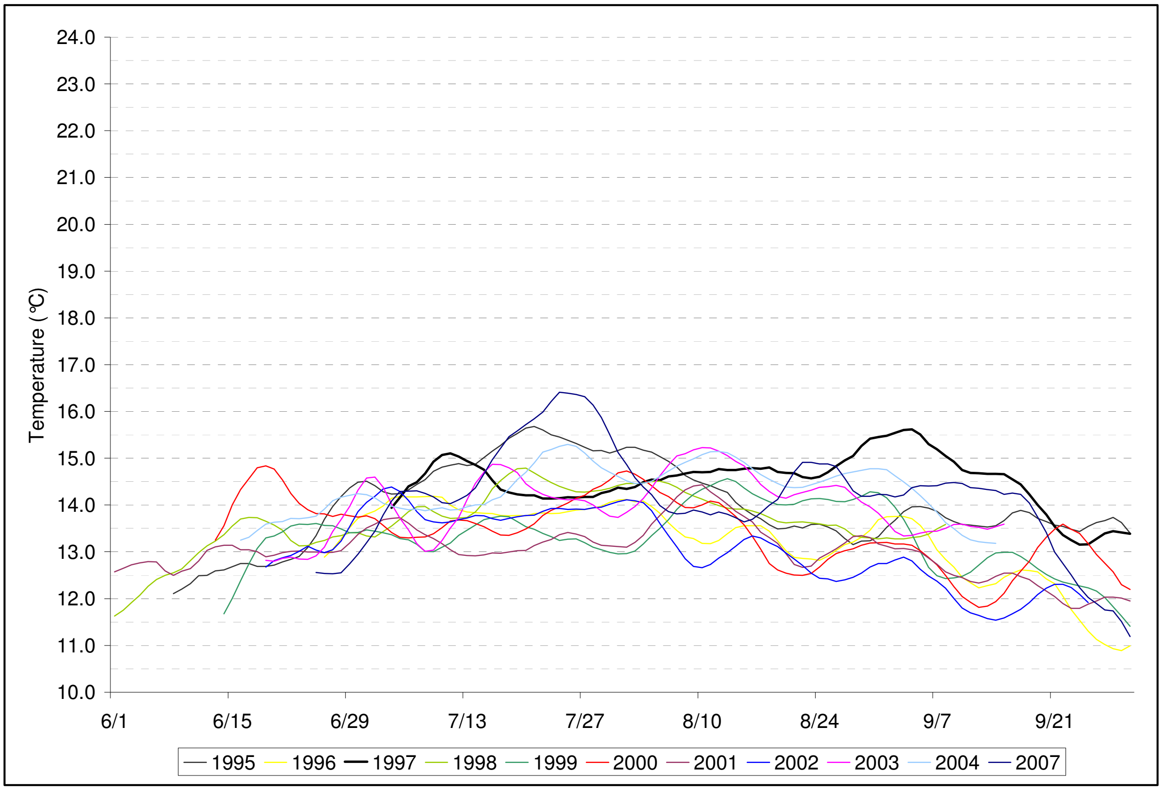
Figure 2-2. Instream Temperature Monitoring Stations On The Big Salmon Creek Property (1994-2007)



Discussion

The results of long-term instream temperature monitoring by previous resource managers indicate that water temperature over summer is suitable for salmon and steelhead (Figure 2-3). As previously discussed, this is likely due to the watershed's proximity to the coast and the optimal canopy values found in the riparian corridors.

Figure 2-3. Summer Rolling Averages Of The Daily Average Temperature (1995-2007). The Highest 7-Day Peak Of The Rolling Average Is The Annual MWAT. (SAL 1)



Recommendations

Stream temperature monitoring should continue in the watershed. At a minimum, two thermal data loggers should be maintained near the downstream Property boundary. As resources allow, data loggers can be installed above and below stream confluences to help identify thermally impaired reaches, if they occur.

The technology available for continuous stream temperature monitoring has been remarkably refined since the 1990s both in terms of memory and cost. The costs associated for monitoring a single site with redundant data-loggers (over summer) is approximately $1,000 annually. This cost includes staff resources. The estimated cost to operate a suite of ten monitoring sites with redundancy (over summer) amounts to approximately $2,000 – 3,000 annually, including staff resources.

It should be noted that analysis of monitoring data suggests that over-summer stream temperatures are in a suitable range for salmonids. Temperature monitoring should continue to ensure that this regime is suitable, but expenditures of resources to reduce stream temperature other than normal best management practices in the basin are presently unnecessary. Available stream enhancement resources should be applied to other identified watershed deficiencies in this basin, or other watersheds on the Property.

2.1.1.5 Sediment

Goals

There is abundant literature documenting the negative effects of excessive sediment and turbidity on salmonids. Excessive levels of fine sediment in redds reduce the survival to emergence rates of fry, and excessive turbidity in the water column reduces the feeding success of parr, particularly during critical winter months.

Although many of the tributary channels to Big Salmon Creek are presently storing excessive sediment loads from earlier logging practices, the mainstem is actually deficient in some reaches (see Section 2.1.1.1), which results in a reduction of available spawning habitat.

The sediment goals of the aquatic management plan are to reduce fine sediment delivery into the watercourse by disconnecting the existing and historic road networks from the stream network, stabilizing upslope areas, and to allow excessive sediment load in tributary channels to be redistributed within the mainstem channel by natural hydrologic processes. Sorting and storing of gravels within the mainstem can be accomplished through the use of added LWD materials.

Background

Since 1992 the THP process has resulted in the remediation of numerous sources of sedimentation across the ownership within the Big Salmon Creek watershed. In addition to these beneficial measures, the previous landowner had proactively addressed sediment sources outside of the THP process. These activities included culvert/crossing upgrades on Lower Pullen Gulch, Russell Gulch, N.F. Hazel Gulch, Upper Donnelly Gulch, Middle Donnelly Gulch, Center Fork Hazel Gulch, and Kitchen Gulch. Significant road reconstruction occurred on both the Elliott and Iron Gate roads, previously considered the largest perceived sediment sources remaining on the then Hawthorne Timber Company ownership in Big Salmon Creek.

These two roads were subject to the following treatments: berm removal, out-sloping, and installation of rolling dips on approximately 8,300 feet of seasonal road; and rocking of 6,000 feet of the Elliott Road.

The following list is a summary of road related improvements on property in the Big Salmon Creek watershed:

- Road Abandonment: 5.25 miles (27588 feet) of road length, including associated landings (compared to less than 1.5 miles new construction)
- Road Geometry Modification: 8,300+ feet of existing seasonal road altered to maintenance-free design.
- Road Rocking: 4.1 miles (21677 feet) of road length.
- Watercourse crossing removals: 35+ crossings.
- Class I Upgrades: two crossings upgraded to bridges.
- Other Upgrades: replacement of 5+ undersized culverts on Class II and III crossings and installation of a culvert at one chronic wet spot location.

Discussion

The watershed has undergone a long history of impactive logging and ranching operations. Although Big Salmon Creek is on a recovery trend from excessive sediment within stream channels, undoubtedly, many sediment delivery sources still exist that should be identified and treated.

Recommendations

Outside the THP process, road monitoring during the winter period should be conducted throughout the road network to identify and treat sources of road related sediment delivery. Within the THP process, road related sediment sources should also be identified and treated. To identify and possibly implement treatment for landslides and bank failures within the watershed, reconnaissance surveys of the major channels in the watershed should be conducted for signs of obvious sediment intrusions during winter months following ten year flood events.

2.2 Adaptive Management and Information

Monitoring is an essential component of the aquatic restoration plan, and monitoring of key aquatic parameters provides an index to measure the success of management strategies. Monitoring of restoration activities and watershed responses to landscape management activities completes the adaptive management cycle, by assessing the impacts of management actions and general ecological conditions and evaluating the impact to aquatic species. Monitoring allows managers to identify and correct watershed problems as they occur and determine proper remediation.

2.2.1 Monitoring Goals and Objectives

Although Big Salmon Creek has not been listed as impaired under the Clean Water Act, a monitoring regime had been previously implemented. In 1993, GP resource managers developed a monitoring plan based on an index reach approach, and it was continued through 2005 by CTM. Eight monitoring stations were established to monitor aquatic vertebrate abundance, instream temperature, and sediment (using McNeil methods) (McNeil and Ahnell 1964). In 1996 GP survey crews carried out extensive habitat typing of mainstem Big Salmon Creek and most of its tributaries. CDFG survey crews repeated the process in 2007. In 2004 the NCRWQCB adopted General Waste Discharge Requirements (GWDR) for timber operation that required erosion control plans (ECPs). As a consequence, monitoring for sediment delivery from road construction and maintenance has also been conducted on the Property.

After more than ten years of monitoring and observations, the trends in stream conditions are generally apparent. Although sediment related problems still occur in Big Salmon Creek, the trends shown from monitoring habitat, instream fish abundance and temperature parameters indicate that aquatic conditions are generally beneficial for salmonids. What is not known, and cannot be determined from the past monitoring strategy, is the overall adult spawning population (escapement) and the relationship between specific riverine factors limiting salmonids and broad scale marine conditions (i.e., the number of salmonids that exit from and return to the watershed). It is often overlooked that instream conditions only affect salmonids for possibly half their life cycle, and there may be other regional or ESU level population trends that are beyond the control of resource managers. At this point in the adaptive management monitoring process, it is logical to continue some past monitoring activities such as temperature, but to also expand the scope to include salmonid population monitoring.

Regional fisheries biologists for CDFG Northern Region Coastal Watershed Planning and Assessment Program have developed a sampling and modeling protocol that produces estimates of escapement (spawners) from spawning ground surveys (SGS) (Gallagher and Wright 2007). The methodology, which has been developed and implemented in this region, has been employed by neighboring landowners, and will soon be incorporated into the California Coastal Salmonid Monitoring Plan. The survey methods have been peer reviewed (Gallagher et al. 2007) and fall into a larger, regional framework. From a management standpoint it is advantageous to incorporate a proven and accepted monitoring strategy that not only produces watershed escapement estimates, but also links them to regional populations trends.

Another advantage to SGS is that they are relatively inexpensive to conduct. Two member survey crews conduct surveys on randomly selected spawning habitat reaches on two-week intervals. Approximately 30 percent of the identified spawning habitat in the watershed is surveyed and adult spawner population estimates are generated at the end of the spawning season. The former Property manager, CTM, has employed these methods in Pudding Creek, a similar and nearby watershed, from 2004 until the present, and they have received grant funding for staffing needs for all years. Spawning surveys can also be conducted with volunteer staffing, as the survey protocol is not unduly complicated.

In order to understand how broad scale salmonid population trends influence watershed populations, managers must also determine the overall production of juveniles leaving the stream network. Once the spawning and outmigrant (smolt) populations are quantified, important relationships can be established between instream survival and ocean survival, illustrating potential bottlenecks in overall production. Coho are an ideal species for this type of monitoring due to their somewhat rigid life history. Coho smolts typically leave the stream at about 12 –18 months and return as adult spawners in 2 years, producing a reliable 3-year cycle. The proportional relationship between smolts and spawners, the percentage of outmigrants that return, is a reliable indicator of ocean survival. Likewise, the proportion of spawners to their outmigrating progeny is a good indicator of overall stream production. Based on CDFG surveys (Primbs and Edward 1966, CDFG 2007) and the professional judgment of biologists previously employed in the watershed, the Property encompasses much of the prime spawning and rearing habitat in the Big Salmon Creek basin, and is consequently well suited for this type of monitoring.

Due to the listing status of both endemic salmonids and their perceived importance by regulatory agencies as a keystone or indictor species of water quality, quantified population estimates are valuable. From the public relations perspective, population estimates of returning adults are more meaningful to the general populace than over-summer juvenile relative abundance or other measures of instream salmon productivity, and from a fishery perspective, escapement is the final measure of success for the population. Section 2.2.2 discusses a two-tier approach to aquatic monitoring in the watershed that maintains some elements of former monitoring activities and incorporates fish population monitoring.

Not all past monitoring activities should be continued. Some previous monitoring actions should be replaced with activities that more directly gauge current best management practices. For example, McNeil sampling is time and resource intensive and does not identify sources of fine sediment delivery into the watercourse. Monitoring of direct and indirect sediment sources from roads, hillsides, and channel banks will direct adaptive management decisions by prioritizing enhancement resources, and it will help identify ineffective past management practices.

2.2.2 A Two Tiered Approach to Monitoring

The proposed monitoring plan provides information for priority monitoring in the near term, and a framework for long term monitoring goals. Monitoring activities listed in Tier One are actions that should be implemented in the near future to provide 1) baseline data on fish population status, 2) feedback to managers on erosion associated with roads, hillsides and stream banks in the mainstem and sub-watersheds, and 3) continued temperature monitoring. Tier One monitoring is used to evaluate the effectiveness of current best management practices, and are generally thought to be cost and resource effective approaches (Table 2-3). Though these approaches may be more basic, they are effective in providing relatively quick feedback to resource managers.

Tier Two provides long-term goals to apply as funding resources allow. These are more in depth watershed trend monitoring approaches over a broader temporal scale. While they are generally more costly to implement than Tier1 objectives, they will provide insight on the status of long-term restoration objectives for adaptive managers.

Table 2-3. Two Tiered Monitoring Approach Table.

	Sediment	Temperature	Fish	Aquatic Habitat
Tier One	1) Road Assessments and Erosion Control Plan development. 2) Forensic turbidity surveys throughout winter months.	Monitoring at lower Property boundary	Determine approximate salmonid spawning populations through spawning ground surveys.	Conduct stream habitat inventory surveys at 5 year intervals or as dictated by management activities
Tier Two	Continuous Automated Turbidity Monitoring at all major tributaries	Monitoring above and below tributary confluences to identify thermally limiting reaches	Determine approximate smolt populations through rigorous downstream trapping program.	Conduct periodic management adaptations to results of ongoing limiting factors analysis

2.2.2.1 Sediment Monitoring

Tier One

Although Big Salmon Creek is not listed as an impaired waterbody for sediment, sources of delivery from roads, hillsides, and stream banks should be addressed. Qualified personnel should make assessments of existing roads, and sites of road related erosion should be treated. Following a road assessment, an ECP should be implemented. After the ECP is initiated and erosion reduction activities have occurred, treated sites should be monitored to ensure management practices are functioning properly. Erosion from hillsides and stream banks should be identified and addressed to the extent feasible, particularly if erosion is associated with management activities.

Forensic monitoring of turbidity is another tool used to identify sediment inputs. Monitoring can be performed either through direct ocular observation or by taking “grab samples” from the stream channel. Once an area of high turbidity is identified, survey crews follow the turbidity trace upstream in order to identify the sediment source, and a treatment plan is subsequently drafted.

TCF’s “Salmon Creek Sediment Source Assessment Project,” proposed in 2007 and selected by CDFG’s Fisheries Restoration Grants Program for funding in 2008, will develop an erosion prevention action plan, including recommended treatment prescriptions and implementation cost estimates, in order to correct sediment related problems that currently have negative impacts on salmonids and water quality.

Specific project tasks include: 1) Assess upslope sediment sources along 70 miles of roads within the upper half of the Big Salmon Creek watershed. 2) Identify sites of sediment delivery, prioritize erosion risk, and develop detailed, site specific prescriptions and costs for upslope erosion control and erosion prevention treatments. 3) Provide workshops to general public, regulators and interested citizens. All inventory methods, calculations, prioritization and recommended treatments will follow guidelines and standards described in the "Handbook for Forest and Ranch Roads, a Guide for Constructing, Re-constructing and Maintaining Wildland Roads" commissioned by CDF&FP, the NRCS and the MCRCD (1994), and the “California Salmonid Stream Habitat Restoration Manual, Chapters 9 and 10” (Flosi et al 1998 and 2002).

Tier Two

Continuous automated turbidity and suspended sediment monitoring is another monitoring tool used to identify tends and point sources of sediment delivery. Installation of a monitoring station can easily cost in excess of $10,000 (not including staff resources). Ideally, monitoring sites are installed on all major tributary confluences and at the lower Property boundary. Although expensive, continuous automated sampling greatly reduces staff time and allows sampling to take place during peak flow events when safety is a concern.

2.2.2.2 Stream Temperature Monitoring

Tier One

As discussed and recommended in the limiting factors analysis (Section 2.1.1), stream temperature in Big Salmon Creek does not appear to presently limit salmonid production. A pair of thermal data-loggers installed at the pre-existing lower Property boundary monitoring station would adequately measure temperature trends in the watershed. This simple approach would incur an annual cost of $1,000.00.

Tier Two

Other adaptive management prescriptions may indicate over time that additional aquatic temperature monitoring is needed to identify problematic reaches or tributaries. If managers decide to adopt this future strategy, a suite of ten monitoring sites with redundant data-loggers would incur an annual cost of 2- $3,000.

2.2.2.3 Salmonid Population Monitoring

Tier One

Section 2.2.1 describes a peer-reviewed methodology to estimate spawning salmonid populations on a watershed scale using spawning ground surveys. To implement this methodology at the suggested thirty percent sampling rate, it would require a staff of two on a part-time basis from November until the end of April. If the monitoring scheme were integrated with a similar plan for the Big River stream reaches contained within the TCF ownership, staff would be employed full-time for the survey period. The staff resources necessary to complete the population monitoring proposal for both The Big Salmon and Big River watersheds would require approximately $40,000 – $50,000 annually based on a rate of $20 per hour for two staff for six months. The proposed expense budget does not include vehicle expenses. Volunteer labor may also be utilized as previously discussed.

Tier Two

Section 2.2.1 also illustrates a plan to monitor the annual smolt, or downstream migrant, population at a watershed scale. To implement the plan, a rotary screw trap is necessary. The use of PIT (passive integrated transponder) tags would increase the study resolution; however PIT tags are not required. A staff of one or two can safely operate the trap for the annual four month trapping period, which extends from early February to late May. Due to the seasonal overlap of the smolt trapping period and the spawning ground surveys, the same personnel can conduct both studies, maximizing funding for staff resources. Downstream monitoring expenses are shown in Table 2-3. The estimate for the initial start-up expense is approximately $30-40,000, with an annual operating budget in subsequent years of $15-16,000. This budget does not include vehicle operating expenses.

Table 2-4. Expenses Related To Annual Smolt Trapping Monitoring.

Expense Item	Amount	Note
Rotary screw trap	$17,000.00	One-time cost
PIT Tags	$6,000.00	Annual expense, but not required
PIT tag reader	$1,500.00	One-time cost
Staff	$6,400.00	1 staff, part -time @ $20.00hr for 4 months
Misc supplies	$3,000.00	Waders, etc

2.2.2.4 Stream Habitat Inventory Monitoring

Tier One

This plan suggests surveys of habitat inventory in five-year intervals or after ten year flood events in order to detect watershed trends over time. CDFG (Flosi and Renyolds 1998) protocol indicates a ten-year interval. The habitat in Big Salmon Creek was last surveyed in 2007 and consequently is a low priority monitoring action until 2012.

Tier Two

To assess reach scale aquatic restoration needs, the Plan calls for assessment surveys on Class I watercourses adjacent to and in conjunction with timber harvest plans. The utility of this monitoring strategy is that enhancement activities can then be conducted as a component of the THP. Enhancement actions often utilize heavy equipment and good road networks as found in timber harvest operations. From the standpoint of increasing the value of enhancement activities by minimizing their ecological impact (by opening new roads and tractor activity), and by increasing their economy, working within the THP process has many advantages.

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APPENDIX F: BOTANICAL RESOURCE ASSESSMENT

BOTANICAL RESOURCE ASSESSMENT FOR THE CONSERVATION FUND'S BIG RIVER AND SALMON CREEK PROPERTIES, MENDOCINO COUNTY, CA

May 14, 2008

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Introduction and Overview

The purpose of this botanical resource assessment was to evaluate the botanical resources of the Big River and Salmon Creek properties (the Properties) administered by The Conservation Fund.

This assessment: summarizes identified special status plants and communities, vegetation habitat types, gaps in surveys, and invasive plants and pathogens; inventories vascular flora; and provides management recommendations.

Based on existing information, botanical resources were assessed with respect to both diversity of habitats and species diversity within those habitats. The over-all quality of the resource was further assessed by identifying known species on these sites, rare, endangered and sensitive species, sensitive plant communities, and threats to these (species and?) communities.

The Big River and Salmon Creek properties host rich botanical resources. The preliminary inventory of vascular flora of the Big River property is represented by at least 317 species in 203 genera and 68 families. The preliminary inventory of vascular flora of the Salmon Creek property is represented by at least 234 species in 159 genera and 62 families. Twelve special status plants and two special status communities were identified on the Properties. Eighty-eight invasive plants on Big River and 49 on Salmon Creek were identified throughout six distinct vegetation types, and 35 bryophytes and 12 lichens have been identified to date.

A baseline survey of both properties will provide additional information for informed management decisions.

Methods

Rare Plant Review

A query was made from the On-line 7th Edition of the CNPS Inventory of Rare and Endangered Plants and the California Natural Diversity Database (CNDDB) specifying all rare plants from CNPS Lists 1A, 1B, 2, and 3 for an area approximately 696 sq. miles (eight 7.5 min. quad sheets) surrounding the Elk USGS quadrangle where the Salmon Creek property is located. Using the same resources a search was conducted for all rare plants for an area approximately 1237 sq. miles (twelve 7.5 min. quad sheets) surrounding the Noyo Hill, Northspur, Comptche and Matheson Peak USGS quadrangles where the Big River property is located. Plants restricted to coastal bluff habitat, coastal marsh and sand dunes were not included due to the absence of suitable habitat on the Properties. CNPS List 4 species are only shown on a search by county so a separate search was made for Mendocino County. All List 4 species found in habitats known to occur on the Properties were considered for inclusions. A further refinement of the search was made by consulting The Jepson Manual of Higher Plants of California including only those known to occur within the North Coast (Nco), North Coast Range Outer (NcoRO) and the Northwest (NW).

Timber Harvest Plan Review

In order to identify survey gaps of the known botanical resources of the Big River and Salmon Creek properties a review of Timber Harvest Plans (THPs) was made. Nancy Winters of the Resource Management Department of the California Department of Forestry (CDF) at Howard Forest in Willits was contacted and she worked with me to find THPs filed at that office for the Properties. I reviewed plans as far back as 1996 and several in 1997, 1998, 1999. In a conversation with Charles Martin, a CDF forester, I learned that full botanical surveys were not required until the California Native Plant Society (CNPS) listings of rare, endangered and threatened species were adopted around 2001 by the California Department of Fish and Game (CDF&G).

The following is a list of Timber Harvest Plans that were reviewed:

Salmon Creek					
THP#	**THP Name**	**Map**	**Finds**	**Surveyor(s)**	**Acres**
1-01-116	Saghart Gulch	Yes	CABO, CUGO, MICA	Shayne Green	
1-01-290	East Rumbler	Yes	No finds	Shayne Greene	
1-02-014	Pulllman	Yes	No finds	Shayne Greene/ Jim McIntosh	124
1-02-133	Mezner	Yes	CABO, MICA, CUGO, CACA	Shayne Greene	166
1-04-161	Upper Salmon Creek	Yes	CACA, MICA, CABO,VEFI	Shayne Greene/ Jim McIntosh	
1-07-191	Pullman	Yes	No finds	Shayne Greene	407
Big River					
1-01-290	Berry Gulch	Yes	No finds	Shayne Greene	334
1-04-049	Two Log	Yes	SIMA, CABO, PICA	Shayne Greene	
	River Bends	Yes	No finds	Matt Richmond/ Kyle Wear/ Jim McIntosh	

Abbreviations for rare plants and their meaning:

CACA = *Campanula californica*, swamp harebell, CNPS List 1B.2
CABO = *Calamagrostis bolanderi*, Bolander's reed grass, CNPS List 4.2

CUGP = *Cupressus goveniana* ssp. *pigmaea,* pygmy cypress, CNPS List 1B.2
MICA = *Mitella caulenscens*, leafy stemmed mitrewort, CNPS List 4.2
SIMA = *Sidalcea malachroides*, maple-leafed checkerbloom, CNPS List 4.2
VEFI = *Veratrum fimbriatum*, fringed false hellebore, CNPS List 4.3

During this review photocopies of maps of the survey areas were made where plant species had been recorded and these were sent by hard copy to The Fund's GIS contractor to be developed into a map of areas where botanical surveys have been conducted. A plant list for each property (Appendix C, D & E) was compiled based on this information. The current species list from botanical surveys by Kerry Heise and Geri Hulse-Stephens, currently in progress on three THPs on Big River, was also included. A list of Bryophytes and Lichens observed to date on these THPs is included (Appendix E).

Sensitive Plant Communities Review

A search of the CNDDB for the sensitive communities within the USGS quads in which the Properties lie produced a list of five sensitive communities known to occur within the Elk quadrangle and four sensitive communities known to occur within the Comptche, Northspur, Matheson Peak and Noyo Hill quad. These communities are: Mendocino Pygmy Cypress Forest, Coastal Valley and Freshwater Marsh, Northern Coastal Marsh, Sphagnum bog, Grand Fir Forest and Coastal Brackish Marsh. During the THP review two records were found for sensitive communities: Coastal Freshwater Marsh on the Big River and Pygmy Cypress Forest on Salmon Creek.

Invasive Plants Review

A list of exotic plants was compiled from the preliminary Properties' species lists. This list was then modified by removing all exotic species not listed in the California Invasive Plant Inventory (February 2006). Then a table was compiled of all invasive exotics, their vegetation type, their degree of invasiveness and the Property on which they have been observed (Appendix G).

Invasive exotic infestation treatments were reviewed at the Cal-IPC website (cal-ipc.org), The Nature Conservancy website (tncweed.ucdavis.edu), and in Invasive Plants of California's Wildlands (Bossard et al 2000). CNPS's invasive exotic plant policy was reviewed at its website at cnps.org.

No Sudden Oak Death occurrences have been documented at this time on the Properties but a review of regulated host and associated plants was made at the United States Department of Agriculture website and the list was modified to reflect the hosts and associated plants known to occur on the Properties. This list is in the body of the report.

Vegetation Habitat Types Review

A review of the vegetation habitat types was made by referencing a summary of vegetation types (see Table 1, below). A review of field notes from field visits by Geri Hulse-Stephens to the Properties was made and descriptions of communities some of the communities are included herein. A complete survey of vegetation types has not been made of the Properties.

RECOMMENDATIONS

Plant Inventory and Special Status Plant Recommendations

In a preliminary overview it appears that there are many areas of both Properties that have not been surveyed. By far the survey gaps on the Big River property appear to be the greatest because of the limited review of past Big River THPs. Additionally, the survey lists reviewed in the THP archives did not represent the diversity of species with potential to occur in these habitats. Gaps in compiled plant lists for Big River and Salmon Creek are apparent in some under-represented families which include *Asteraceae*, The Sunflower Family, *Brassicaceae*, the Mustard Family, *Facaceae*, the Pea Family and *Poaceae*, the Grass Family. These families' diversity is generally well represented in the outer North Coast Range. Many lists reviewed did not include many genera and species common to the area. Some lists treated some plant identifications by genus only followed by "sp." indicating that the species encountered was not identified to the level of specific epithet. Some of these are included in the compiled species lists for the Properties.

Rare byrophytes and lichens have only been recently included in CNPS or CNDDB lists of rare species with potential to occur. This understudied group of non-vascular plants has little representation in the current compilation of species observed on the Properties and there is potential for rare bryophytes and lichens to occur that are not known to occur within the CNDDB, CNPS search area.

Sensitive plant communities are considered valuable for the diversity and often rarity of the species they support and as a resource need to be inventoried and documented on the Properties. It is recommended that property-wide floristic survey of vascular plants, bryophytes, and macrolichens on the Big River and Salmon Creek Properties be conducted to document existing plant species, occurrences of rare, threatened or endangered species, other special status plants, vegetation communities, and invasive plants that could potentially threaten native plant populations property wide. Special status plants are not limited to those that have been listed by state and federal agencies but include any plants that, based on all available data, can be shown to be rare, threatened, or endangered (CNPS 2001). In addition, listed terrestrial communities (areas that are of highly limited distribution, and may or may not contain special status plants) are areas with high conservation value and are recommended for inventory and documentation. It is recommended that sampling be done by representative vegetation types with attention to slope, aspect, hydrology, and soils. An exotic plant assessment should be included, and spatial data should be collected for rare plant occurrences and invasive plant infestations; photo-documentation should be a component of each of these assessments.

In addition to the baseline and floristic surveys it is recommended that a rare plant and listed terrestrial communities protection policy be developed (see Appendix F for a list of rare plants occurring on the Properties). An estimate of costs for a baseline botanical survey and rare plant and sensitive natural area survey are included in Appendix H.

Rare plants are by definition of limited distribution or population size. Whether broadly distributed, though occurring infrequently and in small populations, or narrowly distributed and locally abundant, each rare plant has optimal conditions that allow for its continued survival. Some plants are sensitive to disturbance and some plants are disturbance dependent. It is important to have such information when making management decisions. Knowledge of these conditions will be foundational to an informed management strategy for each species found on the Properties. A monitoring plan is recommended for each elemental occurrence,* with management strategies developed for each species, adapted over time based on the results of monitoring.

*NDDB defines a rare plant occurrence (an "Element Occurrence" or "EO") as a population (or group of populations) of plants separated by at least ¼ mile from another population(s). NDDB will map separate populations in detail, but will consider them all one EO if they occur within ¼ mile of each other.

Invasive Plants and Pathogens Recommendations

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 populations are regulated by slowly-evolved natural controls. When introduced to a novel environment without these controls, however, some exotic species become invasive.

Exotic flora of the Properties is noted in the preliminary species lists (Appendix C and D). On Big River, 88 exotic species have been observed; on the Salmon Creek property, 49 species have been observed. Exotic species are largely represented by the Poaceae, Asteraceae and Fabaceae families. Many of the more conspicuous exotics are associated with roads that traverse the Properties and represent disturbed habitat. A list of the invasive species on the Salmon Creek and Big River properties, vegetation types in which they occur, and Cal IPC rating are provided in Appendix G. Two species, Jubata grass (*Cortaderia Jubata*) and French Broom (*Genista monspessulana [Cytisus m.]*) 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.

No current or historical mapping of invasive plants was found in the initial scoping of the Big River and Salmon Creek properties. Review of aerial photographs available for the Properties does not render adequate enough resolution and magnification to decipher invasive plant infestations. Direct knowledge and familiarity of the landscape by astute observers will render the highest level of assessment at this time. It is recommended that for the Salmon Creek property Albion resident Linda Perkins and consulting forester Darcie Mahoney be asked to map sites known to them. For the Big River property the botanists currently conducting botanical surveys for THPs, Geri Hulse-Stephens and Kerry Heise, can be charged with the same task for the areas in which they are surveying and any travel between sites. These mappings can be passed to others familiar with the Properties in the spring and summer of 2008. When possible, spatially explicit data will be collected and a baseline invasive plant distribution map will be developed and amended over time.

Once identified, critical infestations can be monitored. Any significant disturbance that bares the soil and opens the canopy providing habitat for the spread of invasive exotic plants may be added to monitoring sites. After the initial data collection and mapping of invasive exotic populations, monitoring, prevention, and treatment plans may be developed.

Community involvement may significantly assist in preventing the spread of invasive exotics. Jubata grass is of particular concern to community members and resource professionals alike. On May 2, 2008 a meeting was held on the Salmon Creek property with a small stakeholders group. In attendance were consulting forester Darcie Mahoney, Albion residents Linda Perkins, Bill Heil, and Bernard McDonald, and the author, consulting botanist Geri Hulse-Stephens. During the meeting, the life history of jubata grass was discussed along with strategies for its removal and prevention. Jubata grass plants have only female flowers and set viable seed without pollination. Flowering occurs from late July to September. Seeds are spread up to 20 miles from the mother plant by the wind. Individual inflorescences can produce 100,000 seeds. The development of seed occurs before flowering (UC WeedRIC). Seeds do not appear to survive long in the soil. Seedlings can establish quickly on bare sandy roadcuts and unvegetated areas such as landings, roadsides and landslides. Seedlings have a low rate of survival when in competition with grasses, mulch or in shaded areas (Bassard 2000). Stakeholders expressed a desire to be active in the removal and prevention of jubata grass on the Salmon Creek property and collectively rejected the use of chemical treatments. Recommendations which resulted from the meeting included hiring a vegetation management specialist to help formulate a plan, and involving the community in post treatment monitoring and removal of small plants. The stakeholders will continue to develop their proposal. Strategies discussed at the meeting follow:

Prevention of spread

-Removal of flowering stalks before seed maturity.

-Mulching bare ground with debris from the mowing of mature plants.

-Over-seeding of disturbed sites with desirable vegetation to prevent seedling establishment.

Removal of established plants:

-Exposing base of mature plants with a weed-eater or chainsaw and tarping or wrapping the crowns with black plastic (on roadsides and landings only where easily monitoring and accessed).

-Using a bucket excavator to remove plants in large infested areas. Stacking and exposing roots to sunlight to prevent regeneration by root/plant fragments.

This set of strategies will contribute to the overall prevention plan for this species.

Invasive Pathogens

Outbreaks of Sudden Oak Death caused by the pathogen Phytopthora ramorum have killed tens of thousands of native oak and tanoak trees in 14 coastal counties in California. 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 Properties have not detected sudden oak death. A list of regulated hosts and plants associated with Phytopthora ramorum is regularly updated and available on line at www.aphis.usda.gov/ppq/ispm/pramorum.

Hosts currently known to be on the Properties are:

Acer macrophyllum, big leaf maple

Adiantum aleuticum, western maidernhair fern

Adiantum jordani, California maidenhair fern

Arbutus menziesii, madrone

Arctostaphylos manzanita, manzanita

Frangula californica (Rhamnus californica), California coffeeberry

Frangula purshiana (Rhamnus purshiana), cascara

Lithocarpus densiflorus, tan oak

Lonicera hispidula, California honeysuckle

Maianthemum racemosum (Smilacina racemosa), false Solomon's seal

Pseudotsuga menziesii var. menziesii and all nursery grown *P. menziesii*, Douglas-fir

Rhododendron macrophyllum, California rose bay

Rhododendron occidentale, western azalea

Rosa gymnocarpa, wood rose

Sequoia sempervirens, cast redwood

Trientalis latifolia, western starflower

Umbellularia californica, California bay laurel

Vaccinium ovatum, evergreen huckleberry

Vegetation Types

A table of vegetation types on the Properties is included below along with some specific habitat observations. These descriptions are incomplete and it is recommended that a vegetation type field survey in conjunction with the baseline floristic survey and rare plant survey will provide an understanding of the unique attributes of these habitats on the Properties.

The Properties are dominated by redwood/Douglas-fir habitat, which accounts for approximately 80 percent of the land base. Primary conifer species are coast redwood and Douglas-fir. The table below details habitat types and approximate associated acreage of the Big River and Salmon Creek tracts according to the California Vegetation ("CalVeg") system.

Table 1: Wildlife Habitat Relationship Types

Vegetation Type	Approximate Acreage on Big River Tract	Approximate Acreage on Salmon Creek Tract
Annual Grass/Forb	**523.16**	**23.65**
Blueblossom Ceanothus	**532.93**	**605.18**
Canyon Live Oak	**6.23**	**0**
Pacific Douglas-Fir	**26.83**	**0**
Pygmy Cypress	**0.00**	**121.54**
Red Alder	**24.24**	**11.94**
Redwood	**38.86**	**0.00**
Redwood- Douglas Fir	**9,526.67**	**3,706.22**
Tanoak (Madrone)	**1,157.82**	**207.70**
Acreage subtotals:	**11,836.74**	**4,676.23**

Prior to a property-wide survey, habitat notes and general observations of habitat types contribute to the following descriptions. A fuller understanding of the composition of these habitats will develop from a baseline floristic inventory including detailed descriptions of vegetation types.

Douglas-Fir/Redwood Forest

A coniferous forest comprised largely of Douglas-fir and redwood covers much of the Big River and Salmon Creek properties. Common hardwoods associated with this forest include Pacific madrone, tanoak and chinquapin (*Chrysolepis chrysophylla*). Common conifers associated with this forest are western hemlock (*Tsuga heterophylla)*, grand fir *(Abies grandis)* and California nutmeg *(Torreya californica)*.

Past forest management practices and various site characteristics have produced a variety of stands in many different stages of re-growth, 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.

Common Species Associated with the Douglas-fir / Redwood Forest

Tree Canopy

Abies grandis	grand fir
Arbutus menziesii	Pacific madrone
Chrysolepis chrysophylla	chinquapin
Lithocarpus densiflorus	tanoak
Pseudotsuga menziesii	Douglas-fir
Sequoia sempervirens	redwood
Tsuga heterophylla	western hemlock
Umbellularia californica	California bay

Shrub Canopy

Baccharis pilularis	coyote brush
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 raspberry
Rubus parviflorus	thimbleberry
Rubus ursinus	California blackberry
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
Hieracium albiflorum	hawkweed
Madia madioides	woodland tarweed
Osmorhiza chilensis	sweet cicely
Pentagramma triangularis	goldback fern
Polygala californica	California milkwort
Sanicula crassicaulis	gamble weed
Viola sempervirens	evergreen violet
Whipplea modesta	yerba de selva

Grasslands

Grassland species composition changes with disturbance history, aspect, topographic relief, and soil moisture status. Grasslands 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*), and the native grasses, blue wild rye (*Elymus glaucus*), California brome (*Bromus carinatus var. carinatus*), and California oatgrass (*Danthonia californica*).

Wetlands

The major wetlands occurring on the Big River and Salmon Creek properties are the riparian areas draining the Big River and Salmon Creek watersheds. Other wetland types include seeps or meadows characterized by low but prolonged water discharge rates.

Riparian

The main branch of Big River and Salmon Creek support dense red alder (*Alnus rubra*) and Sitka willow (*Salix sitchensis*) with mature redwood along the banks. The torrent sedge (*Carex nudata*) grows in large, conspicuous tussocks next to boulders in the main stream channels. In flatter areas along silty terraces and gravel bars several native and exotic species occur such as panicled bulrush (*Scirpus microcarpus), nut-grass (Cyperus eragrostis*), *Equisetum* spp., velvet grass (*Holcus lanatus)*, and annual beard grass *(Polypogon monspeliensis*). In shady recesses and alcoves along the water's edge the vegetation is lush with lady fern (*Athyrium filix-femina*), and five finger fern is common. In areas of low gradient streams where soils are sandy and alluvial basins have formed, a rich diversity of species are found such as western azalea and elk clover (*Aralia californica*) along with listed species fringed false hellebore and swamp hairbell on Salmon Creek. On Big River similar habitats in upper watersheds support deer fern (*Blechnum spicant*), Western sword fern, giant horsetail (*Equisetum telemateia*), and moist habitat mosses such as *Leucolepis acanthoneuron* and *Scleropodium obtusifolium*.

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 Properties and support largely cosmopolitan wetland taxa such as *Carex* spp., *Juncus* spp., *Typha* spp., *Equisetum* spp., and *Salix* spp. Low gradient areas within gulches host rich wetland habitats supporting *Carex obnupta,* coast hedge nettle *(Stachys chamissonis),* mitrewort *(Mitella ovalis),* wild ginger *(Asarum caudatum*), and stream violet (*Viola glabella*).

Mixed Hardwood Forest and Woodland

This habitat type accounts for 6.23 acres on the Big River property but no field investigation of this habitat has been made. These forests usually 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.

Ceanothus Shrubland

The Big River property hosts 532.93 acres of this vegetation type; Salmon Creek hosts 23.65 acres. Further field investigations will allow for more detailed descriptions of the composition of these communities.

The Flora

The preliminary inventory of vascular flora of the Big River property is represented by at least 317 species in 203 genera and 68 families. The preliminary inventory of vascular flora of the Salmon Creek property is represented by at least 234 species in 159 genera and 62 families. Nomenclature follows that of the Jepson Manual (Hickman 1993). See Appendix C and D.

Conclusion

The Big River and Salmon Creek properties host rich botanical resources. A baseline survey of both properties will provide additional information for informed management decisions. It is recommended that the survey include the following:

1. Property-wide survey for vascular plants, bryophytes and macro lichens (see Plant Inventory and Special Status Plant Recommendations above).
2. Rare plant survey conducted according the *Guidelines for Assessing the Effects of Proposed Developments on Rare, Threatened and Endangered Plants and Natural Communites* (DFG 2000).
3. Development of a baseline invasive plant map.
4. Refinement of vegetation type descriptions.

An estimate of costs for the survey is found in Appendix H.

These surveys will reduce significantly the data gaps and will provide essential information for development of critical policies and procedures for best management practices to be applied on the Properties. With the information collected in these surveys: 1) an invasive plant monitoring plan along with prevention procedures can be developed; 2) sufficient information will be available to develop a rare plant monitoring and management plan to preserve and further the sensitive species and plant communities on the Properties; and 3) management recommendations for vegetation types may be developed based on an assessment of vegetation communities and their vitality in relationship to historical land management practices.

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Attachment A: (of Botanical Resouce Assessment, Appendix F) **List of Rare, Threatened or Endangered Species with Potential to Occur On The Conservation Fund Big River Property**

List of rare species queried from the CNPS Electronic Inventory 7th Edition centered on the Noyo Hill, Northspur, Comptche, and Matheson Peak quadrangles and remaining 12 contiguous quads. Plants restricted to coastal bluff habitat, coastal marsh, pygmy forest and sand dunes are not included. Those in bold have been found within the property boundary..
**Ranking system notes (see below table)*

Scientific Name	**Common Name**	**CNPS List**	**State Rank**	**Global Rank**	**Federal Status**	**Natural Communities**	**Blooming Period**
Agrostis blasdalei	Blasdale's bent grass	List 1B.2	S2.2	G2		Coastal bluff scrub, Coastal dunes, Coastal prairie.	May-Jul
Arctostaphylos mendocinoensis	pygmy manzanita	List 1B.2	S1?	G1		Closed-cone coniferous forest(acidic sandy clay).	Jan
Astragalus agnicidus	Humboldt County milk-vetch	List 1B.1	S2.1	G2		Broadleafed upland forest, North Coast coniferous forest/openings, disturbed areas, sometimes roadsides.	Apr-Aug
Astragalus breweri	Brewer's milkvetch	List 4.2	S3.2	G3		Chaparral, cismontane woodland, meadows and seeps. Not seen during survey.	Apr-June
Astragalus rattannii var. rattanii	Rattan's milkvetch	List 4.3	S3.3	G4T3		Chaparral, cismontane woodland, lower montane coniferous forests, gravelly streambanks.	Apr-July
Blennosperma nanum var. robustum	Point Reyes blennosperma	List 1B.2	S1.2	G4T1		Coastal prairie, Coastal scrub.	Feb-Apr
Calamagrotsis bolanderi	**Bolander's reed grass**	**List 4.2**	**S3.2**	**G3**		**Bogs/fens, meadows/seeps, coastal scrub, north coast coniferous forests**	**May-Aug**

Calamagrostis crassiglumis	Thurber's reed grass	List 2.1	S1.2	G3Q		Coastal scrub(mesic), Marshes/swamps (freshwater).	May-July
Calamagrostis foliosa	leafy reed grass	List 4.2	S3.2	G3		North coast coniferous forest; rocky.	May-Sept
Calamagrostis ophitidis	serpentine reed grass	List 4.3	S3.3	G3		Lower montane coniferous forest, chaparral, valley and foothill grassland; meadows and seeps; serpentinite.	Apr-July
Calandrinia breweri	Brewer's calandrinia	List 4.2	S3.2.?	G4		Chaparral; sandy, loamy disturbed areas. Chaparral.	Mar-June
Calystegia purpurata ssp. saxicola	coastal bluff morning-glory	List 1B.2	S2.2	G4T2		Coastal dunes, Coastal scrub, North Coast coniferous forest.	May-Sep
Campanula californica	swamp harebell	List 1B.2	S3.2	G3		Bogs/fens, Closed-cone coniferous forest, Coastal prairie, Meadows/seeps, Marshes/swamps(freshwater), North Coast coniferous forest/mesic.	Jun-Oct
Carex californica	California sedge	List 2.3	S2?	G5		Bogs/fens, Closed-cone coniferous forest, Coastal prairie, Meadows/seeps, Marshes/swamps (margins).	May-Aug
Carex lenticularis var. limnophila	lagoon sedge	List 2.2	S1S2.2	G5T5		Bogs/fens, Marshes/swamps, North Coast coniferous forest/shores, beaches; often gravelly.	Jun-Aug
Carex livida	livid sedge	List 1A	SH	G5		Bogs and fens.	Jun
Carex lyngbyei	Lyngbye's sedge	List 2.2	S2.2	G5		Marshes/swamps (brackish or freshwater).	May-Aug
Carex saliniformis	deceiving sedge	List 1B.2	S2.2	G2		Coastal prairie, Coastal scrub, Meadows and seeps, Marshes and swamps (coastal salt) /mesic.	Jun(Jul)
Carex viridula var. viridula	green yellow sedge	List 2.3	S1.3	G5T5		Bogs/fens, Marshes/swamps(freshwater), North Coast coniferous forest (mesic).	Jun-Aug

Castilleja mendocinensis	Mendocino Coast paintbrush	List 1B.2	S2.2	G2		Coastal bluff scrub, Closed-cone coniferous forest, Coastal dunes, Coastal prairie, Coastal scrub.	Apr-Aug
Ceanothus gloriosus var. exaltatus	glory brush	List 4.3	S3.3	G3G4T3		Chaparral.	Mar-June
Chorizanthe howellii	Howell's spineflower	List 1B.2	S1.2	G1	Endangered	Coastal dunes, Coastal prairie, Coastal scrub/sandy, often disturbed areas.	May-Jul
Coptis laciniata	**Oregon goldthread**	**List 2.2**	**S3.2**	**G4G5**		**Meadows/seeps, North Coast coniferous forest streambanks (mesic).**	**Mar-Apr**
Cupressus goveniana ssp. pigmaea	**pygmy cypress**	**List 1B.2**	**S2.2**	**G2T2**		**Closed-cone coniferous forest (usually podzol-like soil).**	**Apr-Aug**
Cypripedium californicum	California lady's slipper	List 4.2	S3.2	G3		Bogs and fens. Lower montane coniferous forests.	Mar-Aug
Cypripedium fasciculatum	clustered lady's slipper	List 4.2	S3.2	G4		Lower montane coniferous forest s, North Coast coniferous forest seeps and streambanks. Usually serpentinite.	Mar-Aug
Cypripedium montanum	mountain lady's slipper	List 4.2	S4.2	G4		North Coast coniferous forests, Broad leafed upland forests.	Mar-Aug
Epilobium septentrionale	Humboldt County fuchsia	List 4.3	S3.3	G3		Broad-leafed upland forest, North Coast coniferous forests; sandy or rocky.	Jul-Sept
Erigeron biolettii	streamside daisy	List 3	S3?	G3?		Broadleafed upland forest, Cismontane woodland, North Coast coniferous forest/rocky, mesic.	Jun-Oct
Erigeron decumbens var. robustior	robust daisy	List 4.3	S3.3	G4T3			Jun-July
Erigeron supplex	supple daisy	List 1B.2	S1.1	G1		Coastal bluff scrub, coastal prairie	May-Jul
Eriogonum umbellatum var. bahiiforme	bay buckwheat	List 4.2	S3.2	G5T3		Lower montane coniferous forest; often serpentinite.	Jul-Sept

Erythronium revolutum	coast fawn lily	List 2.2	S2.2	G4		Bogs/ fens, Broadleafed upland forest, North Coast coniferous forest/mesic, streambanks.	Mar-Jul
Fritillaria agrestis	stinkbells	List 4.2	S3.2	G5T3		Chaparral, valley and foothill grassland; sometimes serpentine. .	Mar-Jun
Fritillaria purdyi	Purdy's fritillary	List 4.3	S3.2	G3		Lower montane coniferous forest, chaparral; sometimes serpentinite.	Mar-Jun
Fritillaria roderickii	Roderick's fritillary	List 1B.1	S1.1	G1Q		Coastal bluff scrub, Coastal prairie, Valley and foothill grassland.	Mar-May
Gilia capitata ssp. pacifica	Pacific gilia	List 1B.2	S2.2?	G5T3T4		Coastal bluff scrub, Chaparral(openings), Coastal prairie, Valley and foothill grassland.	Apr-Aug
Glyceria grandis	American manna grass	List 2.3	S1.3?	G5		Bogs/fens, Meadows/seeps, Marshes/swamps (streambanks and lake margins).	Jun-Aug
Hemizonia congesta ssp. leucocephala	pale yellow hayfield tarplant	List 3	S2S3	G5T2T3		Coastal scrub, Valley and foothill grassland/sometimes roadsides.	Apr-Oct
Hemizonia congesta ssp. tracyi	Tracy's tarplant	List 4.3	S3.3	G5T3		North Coast coniferous forest/ openings; sometimes serpentinite.	May-Oct
Horkelia marinensis	Point Reyes horkelia	List 1B.2	S2.2	G2		Coastal dunes, Coastal prairie, Coastal scrub/sandy.	May-Sep
Horkelia tenuiloba	thin-lobed horkelia	List 1B.2	S2.2	G2		Broadleafed upland forest, Chaparral, Valley and foothill grassland (mesic) openings, sandy.	May-Jul
Iris longipetala	coast iris	List 4.2	S3.2	G5T3		Lower montane conferous forest/ rocky; often serpentinite.	Jul-Sept
Juncus supiniformis	hair-leaved rush	List 2.2	S2.2?	G5		Bogs/fens, Marshes/swamps (freshwater) near coast.	Apr-May

Lasthenia californica ssp. bakeri	Baker's goldfields	List 1B.2	SH	G3		Closed-cone coniferous forest (openings), Coastal scrub, Meadows and seeps, Marshes and swamps.	Apr-Oct
Lasthenia conjugens	Contra Costa goldfields	List 1B.1	S1.1	G1	Endangered	Cismontane woodland, Playas (alkaline), Valley and foothill grassland, Vernal pools/mesic..	Mar-Jun
Lathyrus glandulosus	stick pea	List 4.3	S3.3	G3		Oak woodland, roadsides.	Apr-Jun
Lathyrus palustris	marsh pea	List 2.2	S2S3	G5		Bogs/fens, Coastal prairie, Coastal scrub, Lower montane coniferous forest, Marshes/swamps, North Coast coniferous forest (mesic).	Mar-Aug
Leptosiphon acicularis	bristly leptosiphon	List 4.2	S3.2	G3		Coastal praire, valley and foothill grassland.	Apr-July
Leptosiphon latisectus	broad-lobed leptosiphon	List 4.3	S3.3	G3		Broadleafed upland forest, cismontane woodland.	Apr-June
Lilium maritimum	coast lily	List 1B.1	S2.1	G2		Broadleafed upland forest, Closed-cone coniferous forest, Coastal prairie, Coastal scrub, Marshes/swamps (freshwater), North Coast coniferous forest/sometimes roadside.	May-Aug
Lilium rubescens	**redwood lily**	**List 4.2**	**S3.3**	**G3**		**Broad-leafed upland forest, North Coast coniferous forests. Chaparral.**	**Apr-Aug**
Lomatium tracyi	Tracy's lomatium	List 4.3	S3.3	G3		Lower montane coniferous forest; serpentinite.	
Lotus formosissimus	Harlequin lotus	List 4.2	S3.2	G4		Broad-leafed upland forest, North Coast coniferous forest, valley and foothill graslands, coastal praire, meadows and seeps, marshes and swamps.	Mar-Jul

Lycopodium clavatum	running-pine	List 2.3 (up for review)	S3S4.2	G5		Lower montane coniferous forest (mesic), Marshes/ swamps, North Coast coniferous forest (mesic) often edges, openings, and roadsides.	Jun-Aug
Microseris borealis	northern microseris	List 2.1	S1.1	G4?		Bogs and fens, Lower montane coniferous forest, Meadows and seeps/mesic.	Jun-Sep
Microseris paludosa	marsh microseris	List 1B.2	S2.2	G2		Closed-cone coniferous forest, Cismontane woodland, Coastal scrub, Valley and foothill grassland.	Apr-June
Mitella caulescens	leafy stemmed mitrewort	List 4.2	S4.2	G5		Broadleafed upland forest, northcoast coniferous forests, Meadows/seeps, sometimes roadsides.	Apr-Oct
Packera bolanderi var. bolanderi	seacoast ragwort	List 2.2	S1.2	G4T4		Coastal scrub, North Coast coniferous forest/sometimes roadsides.	Apr-Jul
Piperia candida	**white-flowered rein orchid**	**List 1B.2**	**S3.2**	**G3G4**		**Broad-leafed upland forest, Lower montane coniferous forest, North Coast coniferous forest/sometimes serpentinite.**	**May-Sep**
Pityopus californica	California pinefoot	List 4.2	S3.2	G4G5		North Coast coniferous forest, lower montane coniferous forest/ mesic. This plant does not produce a flowering stalk every year.	May-Aug
Pleuropogon hooverianus	North Coast semaphore grass	List 1B.1	S1.1	G1		Broadleafed upland forest, Meadows/seeps, North Coast coniferous forest, open areas (mesic).	Apr-Aug
Pluropogon refractus	nodding semaphore grass	List 4.2	S3.2?	G4		North coast coniferous forests, riparian forests,mesic; meadows and seeps.	Apr-Aug

Ranunculus lobbii	Lobb's aquatic buttercup	List 4.2	S3.2	G4		North Coast coniferous forest, valley and foothill grasslands, vernal pools.	Feb-May
Ribes roezlii var amictum	hoary gooseberry	List 4.3	S3.3	G3G4T3		Broad-leafed upland forest, lower montane coniferous forest.	Mar-Apr
Ribes victoris	Victor's gooseberry	List 4.3	S3.3	G3		Broad-leafed upland forest, chaparral.	Mar-Apr
Rhynchospora alba	white beaked-rush	List 2.2	S3.2	G5		Bogs and fens, Meadows and seeps, Marshes and swamps(freshwater).	Jul-Aug
Sanguisorba officinalis	great burnet	List 2.2	S2.2	G5?		Bogs and fens, Broadleafed upland forest, Meadows and seeps, Marshes and swamps, North Coast coniferous forest, Riparian forest, often serpentinite.	Jul-Oct
Sidalcea calycosa ssp. rhizomata	Point Reyes checkerbloom	List 1B.2	S2.2	G5		Marshes and swamps (freshwater, near coast).	Apr-Sep
Sidalcea malachroides	**maple-leaved checker bloom**	**List 4.2**	**S3S4.2**	**G3G4**		**Coastal prairie, coastal scrub, north coast coniferous forests, riparian; often disturbed.**	**Apr-Aug**
Sidalcea malviflora ssp. purpurea	purple-stemmed checker bloom	List 1B.2	S2.2	G5T2		Broadleafed upland forest, Coastal prairie.	May-Jun
Trifolium buckwestiorum	Santa Cruz clover	List 1B.1	S1.1	G1		Broadleafed upland forest, Cismontane woodland, Coastal prairie/gravelly, margins.	Apr-May
Triquetrella californica	coastal triquetrella	List 1B.2	S1.2	G1		Coastal bluff scrub, Coastal scrub/soil.	
Usnea longissima	**long-beard lichen**		**S4.2**	**G4**		**North Coast coniferous forests, epyphitic.**	
Viola palustris	marsh violet	List 2.2	S1S2	G5		Bogs/fens (coastal), Coastal scrub (mesic). .	Mar-Aug
Wyethia longicaulis	Humboldt County wyethia	List 4.3	S3.3	G3		Broad-leafed upland forest, coastal praire, lower montane coniferous forest.	May-Jul

Zigadenus micranthus var. fontanus	marsh zigadenus	List 4.2	S3.2	G4T3		Chaparral, Lowere montane coniferous forest, meadows and seeps, marshes and swamps/ mesic, often serpentinite.	Apr-Jul

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CNPS Ranking

List 1A: Plants presumed extinct in California

List 1B: Plants rare, threatened or endangered in California and elsewhere

List 2: Plants rare, threatened or endangered in California but more common elsewhere

List 3: Plants about which we need more information-a review list

List 4: Plants of limited distribution- a watch list

Threat Ranks

0.1 - Seriously threatened in California (high degree/immediacy of threat)

0.2 - Fairly threatened in California (moderate degree/immediacy of threat)

0.3 - Not very threatened in California (low degree/immediacy of threats or no current threats known)

Global Ranking

G1 = Less than 6 viable element occurrences (Eos) <1000 individuals OR <2000 acres.

G2 = 6-20 Eos OR 1000-3000 individuals OR 2000-10,000 acres

G3 = 21-80 Eos OR 3000-10,000 individuals OR 10,000-50,000 acres

G4 = Apparently secure; factors of some concern; is, there is some threat or somewhat narrow habitat

G5 = Population or stand demonstrably secure; commonly found in the world

State Ranking

S1 = <6 EOs OR < 1000 individuals OR < 2000 acres

S1.1 = very threatened

S1.2 = threatened

S1.3 = no current threats known

S2 = 6-20 EOs OR 1000-3000 individuals OR 2000-10,000 acres

S2.1 = very threatened

S2.2 = threatened

S2.3 = no current threats known

S3 = 21-80 Eos or 3000-10,000 individuals OR 10,000-50,000 acres

S3.1 = very threatened

S3.2 = threatened

S3.3 = no current threats known

S4 = Apparently secure within California but factors exist to cause some concern. No threat rank.

Attachment B: (of Botanical Resouce Assessment, Appendix F) **List of Rare, Threatened or Endangered Species with Potential to Occur on The Conservation Fund Salmon Creek Property**

List of rare species queried from the CNPS Electronic Inventory 7th Edition centered on the Elk quadrangle and remaining 8 contiguous quads. Plants restricted to coastal bluff habitat, coastal marsh, and sand dunes are not included.
Listed species in bold have been found within the property boundary.
**Ranking system notes (see below table)*

Scientific name	**Common Name**	**CNPS List**	**State Rank**	**Gloval Rank**	**Federal Status**	**Natural Communities**	**Blooming Period**
Agrostis blasdalei	Blasdale's bent grass	List 1B.2	S2.2	G2		Coastal bluff scrub, Coastal dunes, Coastal prairie	May-Jul
Arctostaphylos mendocinoensis	pygmy manzanita	List 1B.2	S1?	G1		Closed-cone coniferous forest; acidic sandy clay	Jan
Astragulus breweri	Brewer's milkvetch	List 4.2	S3.2	G3		Chaparral, cismontane woodland, meadows and seeps	Apri-June
Boschniakia hookeri	small groundcone	List 2.3	S1S2	G5		North Coast coniferous forest	Apr-Aug
Calamagrostis bolanderi	**Bolander's reed grass**	**List 4.2**	**S3.**	**G3**		**Bogs and fens meadows and seeps, coastal scrub, north coast coniferous forests.**	**May-Aug**
Calamagrostis foliosa	leafy reed grass	List 4.2	S3.2	G3		North Coast coniferous forest; rocky	May-Sept

Calamagrostis ophitidis	serpentine reed grass	List 4.3	S3.3	G3		Chaparral; open, north-facing slopes, Lower montane coniferous forest, Meadows and seeps, Valley and foothill grassland; rocky, serpentinite	Apr-Jul
Calandrinia breweri	Brewer's calandrinia	List 4.2	S3.2?	G4		Chaparral, coastal scrub;sandy or loamy, disturbed sites and burns	May-Jun
Calystegia purpurata ssp. saxicola	coastal bluff morning-glory	List 1B.2	S2.2	G4T2		Coastal dunes, Coastal scrub, North Coast coniferous forest	May-Sep
Campanula californica	**swamp harebell**	**List 1B.2**	**S3.2**	**G3**		**Bogs and fens, Closed-cone coniferous forest, Coastal prairie, Meadows and seeps, Marshes and swamps (freshwater), North Coast coniferous forest;mesic**	**Jun-Oct**
Carex californica	California sedge	List 2.3	S2?	G5		Bogs and fens, Closed-cone coniferous forest, Coastal prairie, Meadows and seeps, Marshes and swamps; margins	May-Aug
Carex livida	livid sedge	List 1A	SH	G5		Bogs and fens	Jun
Carex lyngbyei	Lyngbye's sedge	List 2.2	S2.2	G5		Marshesand swamps; brackish or freshwater	May-Aug
Carex saliniformis	deceiving sedge	List 1B.2	S2.2	G2		Coastal prairie, Coastal scrub, Meadows and seeps, Marshes and swamps; coastal salt, mesic	Jun (Jul)

Castilleja mendocinensis	Mendocino Coast paintbrush	List 1B.2	S2.2	G2		Coastal bluff scrub, Closed-cone coniferous forest, Coastal dunes, Coastal prairie, Coastal scrub	Apr-Aug
Ceanothus gloriosus var. exaltatus	glory brush	List 4.3	S3.3	G3G4T3		Chaparral	Mar-Jun
Ceanothus gloriosus var. gloriosus	Point Reyes ceanothus	List 4.3	S3.3	G3G4T3		Closed-cone forest, Coastal scrub,	Mar-May
Coptis laciniata	**Oregon goldthread**	**List 2.2**	**S3.2**	**G4G5**		Meadows and seeps, North Coast coniferous foreststreambanks/mesic	**Mar-Apr**
Cupressus goveniana ssp. pigmaea	**pygmy cypress**	**List 1B.2**	**S2.2**	**G2T2**		Closed-cone coniferous forest (usually podzol-like soil)	
Cypripedium californicum	California lady's slipper	List 4.2	S3.2	G3		Bogs and fens, Lower montane coniferous forest; seeps and streambanks, usually serpentinite	Apr-Aug
Cypripedium fasciculatum	clustered lady's slipper	List 4.2	S3.2	G4		Lower montane coniferous forest, North Coast coniferous forest; usually serpentinite seeps and streambanks	Mar-Aug
Cypripedium montanum	mountain lady's slipper	List 4.2	S4.2	G4		Broadleafed upland forest, Cismontane woodland, Lower montane coniferous forest, North Coast coniferous forest	Mar-Aug
Epilobium septentrionale	Humboldt County fuchsia	List 4.3	S3.3	G3		Broadleafed upland forest, North Coast coniferous forest	Jul-Sept
Erigeron robustior	robust daisy	List 4.3	S3.3	G3		Lower montane coniferous forest, Meadows and seeps; sometimes serpentinite	Jun-Jul
Erigeron supplex	supple daisy	List 1B.2	S1.1	G1		Coastal bluff scrub, Coastal prairie	May-Jul

Eriogonum umbellatum var bahiiforme	bay buckwheat	List 4.2	S3.2	G5G3		Cismontane woodland, Lower montane coniferous forest; rocky, often serpentinite	Jul-Sept
Erysimum menziesii ssp. menziesii	Menzies' wallflower	List 1B.1	S2.1	G3?T2	Endangered	Coastal dunes	Mar-Jun
Erythronium revolutum	coast fawn lily	List 2.2	S2.2	G4		Bogs and fens, Broadleafed upland forest, North Coast coniferous forest; mesic, streambanks	Mar-Aug
Fritillaria agrestis	stinkbells	List 4.2	S3.2	G3		Chaparral, cismontane woodland,Valley and foothill grassland;clay, sometimes serpentinite	Mar-Jun
Fritillaria purdyi	Purdy's fritillary	List 4.3	S3.2	/g3		Chaparral, cismontane woodland,Lower montane coniferous forest; usually serpentinite	Mar-Jun
Gilia capitata ssp. pacifica	Pacific gilia	List 1B.2	S2.2?	G5T3T4		Coastal bluff scrub, Chaparral; openings, Coastal prairie, Valley and foothill grassland	Apr-Aug
Hemizonia congesta ssp. tracyi	Tracy's tarplant	List 4.3	S3.3	G5T3		Lower montane coniferous forest, North Coast coniferous forest; sometimes serpentinite	May-Oct
Iris longipetala	coast iris	List 4.2	S3.2	G3		Coastal prairie, Lower montane coniferous forest, Meadows and seeps; mesic	Mar-May
Juncus supiniformis	hair-leaved rush	List 2.2	S2.2?	G5		Bogs and fens, Marshes and swamps (freshwater) near coast	Apr-June

Lasthenia californica ssp. bakeri	Baker's goldfields	List 1B.2	SH	G3TH		Closed-cone coniferous forest(openings), Coastal scrub, Meadows/seeps, Marshes/swamps	Apr-Oct
Lasthenia californica ssp. macrantha	perennial goldfields	List 1B.2	S2.2	G3T2		Coastal bluff scrub, Coastal dunes, Coastal scrub	Jan-Nov
Lathyrus glandulosus	stick pea	List 4.3	S3.3	G3		Cismontane woodland; roadsides	Apr-Jun
Leptosiphon acicularis	bristly leptosiphon	List 4.2	S3.2	G3		Chaparral, cismontane woodland, Coastal prairie, Valley and foothill grassland	Apr-Jul
Leptosiphon latisectus	broad-lobed leptosiphon	List 4.3	S3.3	G3		Broadleafed upland forest, cismontane woodland	Apr-June
Lilium maritimum	coast lily	List 1B.1	S2.1	G2		Broadleafed upland forest, Closed-cone coniferous forest, Coastal prairie, Coastal scrub, Marshes/swamps (freshwater), North Coast coniferous forest/sometimes roadside	May-Aug
Lilium rubescens	redwood lily	List 4.2	S3.2	G3		Broadleafed upland forest, Chaparral, Lower montane coniferous forest, North Coast coniferous forest, Upper montane coniferous forest;sometimes serpentinite, sometimes roadsides	Apr-Aug
Lomatium tracyi	Tracy's lomatium	List 4.3	S3.3	G3		Lower montane coniferous forest, Upper montane coniferous forest; serpentinite	May-Jun

Lotus formosissimus	Harlequin lotus	List 4.2	S3.2	G4		Broadleafed upland forest, Closed-cone coniferous forest, Coastal prairie, Coastal scrub, Marshes/swamps (freshwater), North Coast coniferous forest, Valley and foothill grassland; wetlands, roadsides	Mar-Jul
Microseris borealis	northern microseris	List 2.1	S1.1	G4?		Bogs and fens, Lower montane coniferous forest, Meadows and seeps; mesic	Jun-Sep
Mitella caulescens	**leafy-stemmed mitrewort**	**List 4.3**	**S4.2**	**G5**		Broadleafed upland forest, Lower montane coniferous forest, North Coast coniferous forest, meadows and seeps, sometimes roadsides	**Apr-Oct**
Packera bolanderi var. bolanderi	seacoast ragwort	List 2.2	S1.2	G4T4		Coastal scrub, North Coast coniferous forest; sometimes roadsides	(Feb-Apr) May-Jul
Pinus contorta ssp. bolanderi	Bolander's beach pine	List 1B.2	S3.2	G5T3		Closed-cone coniferous forest (podzol-like soil)	
Piperia candida	white-flowered rein orchid	List 1B.2	S3.2	G3G4		Broadleafed upland forest, Lower montane coniferous forest, North Coast coniferous forest; sometimes serpentinite	May-Sep
Pityopus californica	California pinefoot	List 4.2	S3.2	G4G5		Broadleafed upland forest, Lower montane coniferous forest, North Coast coniferous forest, meadows and seeps; sometimes roadsides	May-Aug

Pleuropogon hooverianus	North Coast semaphore grass	List 1B.1	S1.1	G1		Broadleafed upland forest, Meadows and seeps, North Coast coniferous forest, Upper montane coniferous forest; mesic	Apr-Aug
Ranunculus lobbii	Lobb's aquatic buttercup	List 4.2	S3.2	G4		Cismontane woodland, North Coast coniferous forest, Valley and foothill grassland; Vernal pools; mesic	Feb-May
Pleuropogon refractus	nodding semaphore grass	List 4.2				North coast coniferous forests, riparian forests, mesic; meadows and seeps	Apr-Aug
Ribes roezlii var amictum	hoary gooseberry	List 4.3	S3.3	G3G4T3		Broadleafed upland forest, Cismontane woodland, Lower montane coniferous forest, Upper montane coniferous forest	Mar-Apr
Ribes victoris	Victor's gooseberry	List 4.3	S3.3	G3		Broadleafed upland forest, Chaparral; mesic, shady	Mar-Apr
Rhynchospora alba	white beaked-rush	List 2.2	S3.2	G5		Bogs/fens, Meadows/seeps, Marshes/swamps(freshwater)	Jul-Aug
Sidalcea malachroides	maple-leaved checker bloom	List 4.2	S3S4.2	G5T2		Broadleafed upland forest Coastal prairie	Apr-Aug
Sanguisorba officinalis	great burnet	List 2.2	S2.2	G5?		Bogs andfens, Broadleafed upland forest, Meadows and seeps, Marshes and swamps, North Coast coniferous forest, Riparian forest; often serpentinite	Jul-Oct
Sidalcea calycosa ssp. rhizomata	Point Reyes checkerbloom	List 1B.2	S2.2	G5T2		Marshes and swamps(freshwater, near coast)	Apr-Sep

Sidalcea malviflora ssp. patula	Siskiyou checkerbloom	List 1B.2	S1.1	G5T1		Coastal bluff scrub, Coastal prairie, North Coast coniferous forest; often roadcuts	May-Aug
Veratrum fimbriatum	**fringed false hellebore**	**List 4.3**	**S3.3**	**G3**		**Bog and fens, Coastal scrub, Meadows and seeps, north coast coniferous forests (mesic**	**Jul-Sept**
Sidalcea malviflora ssp. purpurea	purple-stemmed checkerbloom	List 1B.2	S2.2	G5T2		Broadleafed upland forest, Coastal prairie	May-Jun
Usnea longissima	**long-beard lichen**		**S3.2**	**G3**		**North Coast coniferous forest, epiphytic**	
Wyethia longicaulis	Humboldt County wyethia	List 4.3	S3.2	G3		Broadleafed upland forest, Coastal prairie, Lower montane coniferous forest; someties roadsides	May-Jul
Zigadenus micranthus var. fontanus	marsh zigadenus	List 4.2	S3.2	G4T3		Chaparral, cismontane woodland,Lower montane coniferous forest, Meadows and seeps, Marshes and swamps; vernally mesic, often serpentinite	Apr-Jul

See following page for CNPS, Global, and State ranking codes

CNPS Ranking

List 1A: Plants presumed extinct in California

List 1B: Plants rare, threatened or endangered in California and elsewhere but more common elsewhere

List 2: Plants rare, threatened or endangered in California

List 3: Plants about which we need more information-a review list

List 4: Plants of limited distribution- a watch list

Threat Ranks

0.1 - Seriously threatened in California (high detree/immediacy of threat)

0.2 - Fairly threatened in California (moderate)

.3 - Not very threatened in California (low)

Global Ranking

G1 = Less than 6 viable element occurrences (Eos) <1000 individuals OR <2000 acres.

G2 = 6-20 Eos OR 1000-3000 individuals OR 2000-10,000 acres

G3 = 21-80 Eos OR 3000-10,000 individuals OR 10,000-50,000 acres

G4 = Apparently secure; factors of some concern; i.e., there is some threat or somewhat narrow habitat

G5 = Population or stand demonstrably secure; commonly found in the world

State Ranking

S1 = <6 EOs OR < 1000 individuals OR < 2000 acres

S1.1 = very threatened

S1.2 = threatened

S1.3 = no current threats known

S2 = 6-20 EOs OR 1000-3000 individuals OR 2000-10,000 acres

S2.1 = very threatened

S2.2 = threatened

S2.3 = no current threats known

S3 = 21-80 Eos or 3000-10,000 individuals OR 10,000-50,000 acres

S3.1 = very threatened

S3.2 = threatened

S3.3 = no current threats known

S4 = Apparently secure within California but factors exist to cause some concern. No threat rank.

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Attachment C: (of Botanical Resouce Assessment, Appendix F) **Vascular Plants of The Conservation Fund Property at Big River, Mendocino County, California**

Plant surveys conducted Matt Richmond, Kyle Wear and Jim McIntosh 4/6, 4/27, 6/7, 6/8, 7/20, 8/11, 2006 and Kerry Heise and Geri Hulse-Stephens, 7/1, 7/19, 8/15, 2007, 4/9, 4/30, 5/1, 2008
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 = 317 Exotic Taxa = 88

Family	*Scientific Name*	Common Name	Exotic
SPHENOPHYTA - Horsetails			
Equisetaceae- Horsetail Family (3 taxa)			
	Equisetum arvense	common horsetail	
	Equisetum hyemale ssp. affine	common scouring rush	
	Equisetum telmateia ssp. braunii	giant horsetail	
PTEROPHYTA - Ferns and other non-seed plants			
Pteridaceae - Brake Fern Family (2 taxa)			
	Adiantum aleuticum	five-finger fern	
	Pentagramma triangularis ssp. triangularis	Goldenback Fern	
Polypodiaceae - Polypody Family (2 taxa)			
	Polypodium glycyrrhiza	Licorice Fern	
	Polypodium scouleri	leather leaf fern	
Dennstaedtiaceae - Bracken Fern Family (1 taxon)			

	Pteridium aquilinum var. pubescens	Bracken Fern	
Dryopteridaceae -Wood Fern Family (3 taxa)			
	Athyrium filix-femina	Lady Fern	
	Cystopteris fragilis	fragile fern	
	Polystichum munitum	Western Sword Fern	
Blechnaceae -Deer Fern Family (2 taxa)			
	Blechnum spicant	deer fern	
	Woodwardia fimbriata	Giant Chain Fern	
CONIFEROPHYTA - Conifers			
Cupressaceae - Cypress Family (1 taxon)			
	Cupressus lawsoniana	Port Orford Cedar	
Pinaceae - Pine Family (3 taxa)			
	Abies grandis	grand fir	
	Pseudotsuga menziesii	Douglas Fir	
	Tsuga heterophylla	western hemlock	
Taxaceae - Yew Family (1 taxon)			
	Torreya californica		
Taxodiaceae -Bald Cypress Family (1 taxon)			
	Sequoia sempervirens	Coast Redwood	
ANTHOPHYTA - Dicotyledones (Dicots)			
Aceraceae - Maple Family (Sapindaceae) (1 taxon)			
	Acer macrophyllum	Big Leaf Maple	
Anacardiaceae - Sumac Family (1 taxon)			
	Toxicodendron diversilobum	Poison Oak	
Apiaceae - Carrot Family (9 taxa)			
	Daucus pusillus	Rattlesnake Weed	
	Lomatium macrocarpum		
	Osmorhiza chilensis	Sweet Cicley	
	Sanicula bipinnatifida	purple sanicle	
	Sanicula crassicaulis	Gamble Weed	
	Sanicula laciniata	coast sanicle	

	Torilis arvensis	Japanese Hedge Parsley	x
	Torilis nodosa	Knotted Hedge Parsley	x
	Yabea microcarpa	hedge parsley	
Araliaceae - Ginseng Family (1 taxon)			
	Aralia californica	Elk Clover	
Aristolochiaceae - Pipevine Family (1 taxon)			
	Asarum caudatum	Wild-Ginger	
Asteraceae - Aster Family (48 taxa)			
	Achillea millefolium	yarrow	
	Adenocaulon bicolor	Trail Plant, Silver Arrow	
	Agoseris heterophylla		
	Agoseris sp.		
	Anaphalis margaritacea	Pearly Everlasting	
	Artemisia douglasiana	Mugwort	
	Aster chilensis	common California aster	
	Aster radulinus	Broad-leafed Aster	
	Baccharis douglasii	Marsh Baccharis	
	Baccharis pilularis	Coyote Brush	
	Bellis perennis	English daisy	x
	Carduus pycnocephalus	Italian Thistle	x*
	Chrysanthemum segetum	Corn Chrysanthemum	x
	Cirsium arvense	Canada thistle	x
	Cirsium brevistylum	Indian thistle	
	Cirsium vulgare	Bull Thistle	x
	Conyza canadensis	horseweed	
	Crepis capillaris	hawksbeard	x
	Erechtites minima	Fireweed	x
	Erigeron foliosus var. mendocinus		
	Eriophyllum lanatum var. arachnoideum	Common Wooly Sunflower	
	Filago gallica		x
	Gnaphalium japonicum		x
	Gnaphalium luteo-album		x

	Gnaphalium purpureum		
	Gnaphalium ramosissimum	Everlasting	
	Gnaphalium stramineum		
	Helenium puberulum		
	Hieracium albiflorum	Hawkweed	
	Hypochaeris glabra	Smooth Cat's Ear	x
	Hypochaeris radicata	Hairy Cat's Ear	x
	Leucanthemum vulgare	ox-eyed daisy	x
	Madia exigua	Litter Tarweed	
	Madia gracilis	Slender Tarweed	
	Madia madioides	Woodland Tarweed	
	Petasites frigidus var palmatus	coltsfoot	
	Senicio jacobaea	tansy ragwort	
	Silybum marianum	milk vetch	x
	Soliva sessilis		x
	Sonchus asper	Prickly sow thistle	x
	Sonchus oleraceus	common sow thistle	x
	Taraxacum officionalis	California dandelion	x
Berberidaceae - Barberry Family (3 taxa)			
	Achlys californica	vanilla leaf	
	Berberis nervosa	Barberry	
	Vancouveria planipetala	Redwood Ivy	
Betulaceae - Birch Family (2 taxa)			
	Alnus rubra	red alder	
	Corylus cornuta var. californica	Hazelnut	
Boraginaceae - Borage Family (4 taxa)			
	Cynglossum grande	Hound's Tongue	
	Myosotis discolor	Blue Scorpion Grass	x
	Myosotis latifolia	forget-me-not	x
	Plagiobothrys sp.		
Brassicaceae- Mustard Family (5 taxa)			
	Brassica rapa	fiels mustars	x

	Brassica sp.		
	Cardamine californica var. sinuata	milk maids	
	Cardamine oligosperma		
	Raphanus raphanistrum	jointed charlock	x
Callitrichaceae - Water Starwort Family (1 taxon)			
	Callitriche heterophylla var. bolanderi	Bolander's Water-Starwort	
Campanulaceae - Bluebell Family (1 taxon)			
	Campanula prenanthoides	California Bedstraw	
Caprifoliaceae - Honeysuckle Family (4 taxa)			
	Lonicera hispidula var. vacillans	Honeysuckle	
	Sambucus mexicana	Blue Elderberry	
	Sambucus racemosa		
	Symphoricarpos mollis	Creeping Snowberry	
Caryophyllaceae - Pink Family (9 taxa)			
	Cerastrium arvense	field chickweek	
	Cerastium glomeratum	Mouse-ear Chickweed	x
	Sagina decumbens ssp. occidentalis	pearlwort	
	Silene californica	Indian Pink	
	Silene gallica	Windmill Pink	x
	Spurgularia rubra		x
	Stellaria crispa	crisp chickweed	
	Stellaria media	common chick-weed	x
	Stellaria nitens	shining chick-weed	
Chenopodiaceae - Goosefoot Family (1 taxon)			
	Chenopodium bothrys	Jerusalem oak	x
Convolvulaceae - Morning-Glory Family (1 taxon)			
	Calystegia purpurata ssp purpurata		
Cornaceae - Dogwood Family (1 taxon)			
	Cornus nuttallii	Mountain Dogwood	
Datiscaceae - Datisca Family (1 taxon)			
	Datisca glomerata	Durango Root	
Dipsacaceae - Teasel Family (1 taxon)			

	Dipsacus fullonum	wild teasel	x
Ericaceae - Heath Family (11 taxa)			
	Allotropa virgata	sugar stick	
	Arbutus menziesii	madrone	
	Arctostaphylos columbiana		
	Arctostaphylos manzanita ssp. manzanita	common manzanita	
	Chimaphila menziesii	little prince's pine	
	Gaultheria shallon	salal	
	Pyrola picta	white-veined wintergreen	
	Rhododendron macrophyllum		
	Rhododendron occidentale	western azalea	
	Vaccinium ovatum	California huckleberry	
	Vaccinium parvifolium	red huckleberry	
Fabaceae - Pea Family (30 taxa)			
	Genista monspessulana	French Broom	x*
	Lathyrus jepsonii var. californicus		
	Lathyrus polyphyllus		
	Lathyrus torreyi		
	Lathyrus vestitus var. vestitus	hillside pea	
	Lotus aboriginus		
	Lotus corniculatus	birdfoot trefoil	x
	Lotus humistratus	hill lotus	
	Lotus micranthus	miniature lotus	
	Lotus purshianus	Spanish lotus	
	Lupinus arboreus		
	Lupinus bicolor	miniature lupine	
	Lupinus rivularis		
	Medicago polymorpha	California burclover	x
	Melilotus alba	white sweetclover	x
	Trifolium bifidum var bifidum		
	Trifolium bifidum var decipiens		

	Trifolium campestre	hop clover	x
	Trifolium cernuum		x
	Trifolium dubium	little hop clover	x
	Trifolium microcephalum	maiden clover	
	Trifolium repens		x
	Trifolium subterraneum	subterranean Clover	x
	Trifolium varigatum	white-topped clover	
	Trifolium willdenovii	tomcat clover	
	Vicia gigantea		
	Vicia hirsuta		x
	Vicia sativa ssp nigra	common vetch	x
	Vicia sativa ssp sativa	spring vetch	x
	Vicia tetrasperma		x
Fagaceae - Beech Family (2 taxa)			x
	Chrysolepis chrysophylla	chinquapin	
	Lithocarpus densiflorus	tan oak	
Gentianaceae - Gentian Family (1 taxon)			
	Centaurium muehlenbergii		
Geraniaceae - Geranium Family (4 taxa)			
	Erodium botrys	Broadleaf Filaree	x
	Erodium cicutarium	Red-stemmed Filaree	x
	Geranium dissectum	Cut-leaf Geranium	x
	Geranium molle	Dove-foot Geranium	x
Grossulariaceae - Gooseberry Family (1 taxon)			
	Ribes sanguineum var. glutinosum	pink-flowering currant	
Hydrophyllaceae - Waterleaf Family (4 taxa)			
	Hydrophyllum tenuipes		
	Nemophila parviflora		
	Phacelia bolanderi		
	Phacelia sp.		
Hypericaceae - St. John's Wort Family (2 taxon)			
	Hypericum anagaloides	tinker's penny	

Lamiaceae - Mint Family (6 taxa)			
	Mentha pulegium	Penny Royal	x*
	Prunella vulgaris var. lanceolata	Self-Heal	
	Prunella vulgaris var.vulgaris	self-heal	x
	Satureja douglasii	Yerba Buena	
	Stachys ajugoides var. ajugoides	Hedge Nettle	
	Stachys chamissonis	coast hedge nettle	
Lauraceae - Laurel Family (1 taxon)			
	Umbellularia californica	California Bay	
Linaceae - Flax Family (1 taxon)			
	Linum bienne	Common flax	x
Malvaceae - Mallow Family (1 taxon)			
	Sidalcea malachroides List 4.2	***maple-leafed checkerbloom***	
Myricaceae- Wax Mytrle Family (1 taxon)			
	Myrica california	California Wax Myrtle	
Onagraceae - Evening Primrose Family (1 taxon)			
	Epilobium ciliatum ssp. ciliatum	Northern Willow Herb	
Oxalidaceae- Oxalis Family (3 taxa)			
	Oxalis oregana	Redwood Sorrel	
Philadelphaceae - Mock Orange Family (1 taxon)			
	Whipplea modesta	Yerba de Selva, Modesty	
Plantaginaceae - Plantain Family (2 taxa)			
	Plantago lanceolata	English Plantain	x
	Plantago major	common plantain	x
Polemoniaceae - Phlox Family (3 taxa)			
	Collomia heterophylla	Varied-Leaf Collomia	
	Leptosiphon bicolor	Bicolored Leptosiphon	
	Navarretia squarrosa	Skunkweed	
Polygalaceae - Milkwort Family (1 taxon)			
	Polygala californica	California Milkwort	
Polygonaceae - Buckwheat Family (4 taxa)			

	Rumex acetosella	sheep sorrel	x
	Rumex conglomeratus		x
	Rumex crispus	curly dock	x
	Rumex salicifloius	willow dock	
Portulacaceae - Purslane Family (3 taxa)			
	Claytonia perfoliata ssp mexicana	miner's lettuce	
	Claytonia perfoliata ssp perfoliata		
	Claytonia sibirica	candy flower	
Primulaceae - Primrose Family (2 taxa)			
	Anagallis arvensis	Scarlet Pimpernel	x
	Trientalis latifolia	Star Flower	
Ranunculaceae - Buttercup Family (6 taxa)			
	Anemone oregana	windflower	
	Aquilegia formosa	Columbine	
	Ranunculus californicus	California buttercup	
	Ranunculus occidentalis	western buttercup	
	Ranunculus repens	creeping buttercup	x
	Ranunculus unciatus		
Rhamnaceae - Buckthorn Family (3 taxa)			
	Ceanothus foliosus var foliosus		
	Ceanothus thyrsiflorus		
	Rhamnus californica	California Coffeeberry	
Rosaceae - Rose Family (9 taxa)			
	Aphanes occidentalis	western lady/s mantle	
	Fragaria vesca	Wood Strawberry	
	Horkelia californica ssp. dissita		
	Potentilla glandulosa ssp. glandulosa	Sticky Cinquefoil	
	Rosa gymnocarpa	Wood Rose	
	Rubus discolor	Himalayan Blackberry	x*
	Rubus leucodermis	Western Raspberry	
	Rubus parviflorus	Thimbleberry	
	Rubus ursinus	California Blackberry	

Rubiaceae - Madder Family (6 taxa)			
	Galium aparine	Goose Grass	x
	Galium californicum ssp. californicum	California Bedstraw	
	Galium muricatum	Humboldt Bedstraw	
	Galium parisiense	Wall Bedstraw	x
	Galium porrigens	Climbing Bedstraw	
	Sherardia arvensis	Field Madder	x
Salicaceae - Willow Family (4 taxa)			
	Salix lasiolepis	arroyo willow	
	Salix lucida ssp lasiandra	shining willow	
	Salix scouleriana	Scouler's willow	
	Salix sitchensis	Sitka willow	
Saxifragaceae - Saxifrage Family (5 taxa)			
	Boykinia occidentalis		
	Heuchera micrantha	Alum Root	
	Mitella ovalis		
	Tellima grandifora	fringe cups	
	Tiarella trifoliata var unifoliata	lace flower	
Scrophulariaceae - Figwort Family (10 taxa)			
	Digitalis purpurea	foxglove	x
	Mimulus guttatus		
	Mimulus moschatus	musk monkeyflower	
	Parentucelllia viscosa		x
	Scrophularia californica	California figwort	
	Synthyris reniformis	snow queen	
	Triphysaria pusilla		
	Triphysaria versicolor ssp. versicolor		
	Veronica americana	American brooklime	
	Veronica scutellata	marsh speedwell	
Urticaceae - Nettle Family (1 taxon)			
	Urtica dioica ssp gracilis	American stinging nettle	
Violaceae - Violet Family (2 taxa)			

	Viola glabella	stream violet	
	Viola sempervirens	evergreen violet	
MONOCOTYLEDONES - The Monocots			
Cyperaceae - Sedge Family (11 taxa)			
	Carex bolanderi		
	Carex deweyana ssp. leptopoda		
	Carex globosa		
	Carex gynodynama		
	Carex hardfordii		
	Carex obnupta		
	Carex nudata	Torrent Sedge	
	Carex sp		
	Carex subfusca		
	Cyperus eragrostis		
	Scirpus microcarpus		
Iridaceae - Iris Family (2 taxa)			
	Iris douglasii	Douglas Iris	
	Sisyrinchium bellum	Blue-eyed Grass	
Juncaceae - Rush Family (7 taxa)			
	Juncus bolanderi	Bolander's Rush	
	Juncus bufonius	Toad Rush	x
	Juncus effusus var. pacificus		
	Juncus occidentalis		
	Juncus patens	Common Rush	
	Luzula comosa	Wood Rush	
	Luzula pariflora	small-flowered wood rush	
Lemnaceae - Duckweed Family (1 taxon)			
	Lemna minor		
Liliaceae - Lily Family (13 taxa)			
	Brodiaea sp.		
	Chlorogalum pomeridianum	soaproot	
	Clintonia andrewsiana	clintonia	

	Dichelostemma ida-maia	firecracker flower	
	Disporum hookeri	Hooker's fairybell	
	Disporum smithii	Smith's fairybell	
	Lilium pardalinum ssp. pardalinum	Leopard Lily	
	Scoliopus bigelovii	fetid adders tongue	
	Smilacina racemosa	branched false solomon's seal	
	Smilacina stellata	star false solomon's seal	
	Trillium ovatum	western trillium	
	Xerophyllum tenax	bear-grass	
	Zigadenus fremontii	death camus	
Orchidaceae - Orchid family (5 taxa)			
	Calypso bubulso	calypso orchid	
	Corallorhiza maculata	spotted coralroot	
	Corallorhiza mertensiana.	Merten's coralroot	
	Goodyera oblongifolia	rattlesnake plantain	
	***Piperia candida* List 1B.2**	***white flowered piperia***	
Poaceae - Grass Family (38 taxa)			
	Agrostis exarata		
	Agrostis pallens		
	Aira caryophyllea	silver European hairgrass	x
	Anthoxanthum ordoratum	sweet vernal grass	x
	Avena barbata	slender wild oat	x
	Briza maxima	quaking grass	x
	Briza minor		x
	Bromus carinatus var. carinatus	California brome	
	Bromus diandrus	ripgut brome	x
	Bromus hordeaceus	soft chess	x
	Bromus laevipes	Woodland Brome	
	Bromus sterilis	poverty brome	x
	Bromus vulgaris		
	***Calamagrostis bolanderi* List 4.2**	***Bolander's reed grass***	

	Cortaderia jubata	Jubata Grass	x*
	Cynosurus echinatus	hedgehog dogtail	x
	Dactylis glomerata	orchard grass	x
	Danthonia californica	California oatgrass	
	Danthonia pilosa	oatgrass	x
	Deschampsia elongata	slender hairgrass	
	Elymus glaucus ssp. glaucus	blue wildrye	
	Festuca occidentalis	western fescue	
	Festuca rubra	Red Fescue	
	Festuca subulata		
	Festuca subuliflora		
	Gastridiium ventricosum	nit grass	x
	Hierochloe occidentalis	sweet grass	
	Holcus lanatus	common velvet grass	x
	Hordium jubatum	foxtail barley	x
	Lolium multiflorum	Italian ryegrass	x
	Lolium perenne	perennial ryegrass	x
	Melica hardfordii		
	Melica subulata	Alaska onion grass	
	Melica torreyana	Torrey's melic	
	Phalaris aquatica	harding grass	x
	Polypogon interruptus	ditch beard grass	x
	Polypogon monspeliensis	annual beard grass	x
	Trisetum canescens		
	Vulpia bromoides		x
	Vulpia myuros var. hirsuta		x
Typhaceae - Cattail Family (1 taxon)			
	Typha sp.		

Attachment D: (of Botanical Resouce Assessment, Appendix F) **Vascular Plants of the Conservation Fund Property at Salmon Creek,**
Mendocino County, California

Plant surveys conducted 2001-2007 by various botanists.
See table under the Timber Harvest Plans Review section of this report.
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 elsewhere;
List 3 = A review list, plants needing more information
List 4 = A watch list, plants of limited distribution.
No abundance information was available for this survey area.
Total Taxa = 235 Exotic Taxa = 49

Family	*Scientific Name*	Common Name	Exotic
SPHENOPHYTA - Horsetails (1 taxon)			
Equisetaceae - Horsetail Family (1 taxon)			
	Equisetum telmateia ssp. braunii	giant horsetail	
PTEROPHYTA - Ferns and other non-seed plants			
Pteridaceae - Brake Fern Family (2 taxa)			
	Adiantum aleuticum	five-finger fern	
	Pentagramma triangularis ssp. triangularis	goldenback fern	
Polypodiaceae - Polypody Family (1 taxon)			
	Polypodium glycyrrhiza	licorice fern	
Dennstaedtiaceae - Bracken Fern Family (1 taxon)			
	Pteridium aquilinum var. pubescens	bracken fern	
Dryopteridaceae -Wood Fern Family (3 taxa)			

	Athyrium filix-femina	lady fern	
	Dryopteris expansa	wood fern	
	Polystichum munitum	western sword fern	
Blechnaceae -Deer Fern Family (2 taxa)			
	Blechnum spicant	deer fern	
	Woodwardia fimbriata	giant chain fern	
CONIFEROPHYTA - Conifers			
Cupressaceae - Cypress Family (1 taxon)			
	Cupressus goveniana ssp. pigmaea List 1B.2	pygmy cypress	
Pinaceae - Pine Family (5 taxa)			
	Abies grandis	grand fir	
	Pinus contorta ssp bolanderi List 1B.2	**Bolander pine**	
	Pinus muricata	Bishop pine	
	Pseudotsuga menziesii	Douglas fir	
	Tsuga heterophylla	western hemlock	
Taxaceae - Yew Family (1 taxon)			
	Torreya californica		
Taxodiaceae -Bald Cypress Family (1 taxon)			
	Sequoia sempervirens	coast redwood	
ANTHOPHYTA - Dicotyledones (Dicots)			
Aceraceae - Maple Family (Sapindaceae) (1 taxon)			
	Acer macrophyllum	big leaf maple	
Anacardiaceae - Sumac Family (1 taxon)			
	Toxicodendron diversilobum	poison oak	
Apiaceae - Carrot Family (7 taxa)			
	Daucus pusillus	rattlesnake weed	
	Oenanthe sarmentosa	ditch carrot	
	Osmorhiza chilensis	sweet cicley	
	Sanicula crassicaulis	gamble weed	
	Torilis arvensis	Japanese hedge parsley	x
	Torilis nodosa	knotted hedge parsley	x

	Yabea microcarpa	hedge parsley	
Araliaceae - Ginseng Family (1 taxon)			
	Aralia californica	elk clover	
Aristolochiaceae - Pipevine Family (1 taxon)			
	Asarum caudatum	wild-ginger	
Asteraceae - Aster Family (24 taxa)			
	Adenocaulon bicolor	trail plant	
	Anaphalis margaritacea	pearly everlasting	
	Baccharis douglasii	marsh baccharis	
	Baccharis pilularis	coyote brush	
	Bellis perennis	English daisy	x
	Cirsium arvense	Canada thistle	
	Cirsium vulgare	bull thistle	x
	Conyza canadensis	horseweed	
	Erechtites glomerata	cut-leaved coast fireweed	x
	Erechtites minima	fireweed	x
	Eriophyllum lanatum var. arachnoideum	common wooly sunflower	
	Gnaphalium luteo-album		x
	Gnaphalium purpureum		
	Gnaphaliuim stramineum		
	Hieracium albiflorum	hawkweed	
	Hypochaeris radicata	hairy cat's ear	x
	Lasthenia minor	goldfields	
	Leucanthemum vulgare	ox eye daisy	x
	Madia madioides	woodland tarweed	
	Petasites frigidus var palmatus	coltsfoot	
	Senecio jacobaea	tansy ragwort	x
	Senecio sylvaticus		x
	Sonchus oleraceus	common sow thistle	x
	Taraxacum officionalis	California dandelion	x
Berberidaceae - Barberry Family (4 taxa)			
	Achlys californica	vanilla leaf	

	Berberis aquifolium		
	Berberis nervosa	barberry	
	Vancouveria planipetala	redwood ivy	
Betulaceae - Birch Family (2 taxa)			
	Alnus rubra	red alder	
	Corylus cornuta var. californica	hazelnut	
Boraginaceae - Borage Family (2 taxa)			
	Cynglossum grande	hound's tongue	
	Plagiobothrys sp.		
Brassicaceae- Mustard Family (3 taxa)			
	Cardamine californica	milk maids	
	Cardamine oligosperma		
	Rorippa nasturtium-aquaticum	water cress	
Campanulaceae - Bluebell Family (2 taxa)			
	***Campanula californica* List 1B.2**	**swamp harebell**	
	Campanula prenanthoides	California harebell	
Caprifoliaceae - Honeysuckle Family (4 taxa)			
	Lonicera hispidula var. vacillans	honeysuckle	
	Sambucus mexicana	blue elderberry	
	Sambucus racemosa	red elderberry	
	Symphoricarpos mollis	creeping snowberry	
Caryophyllaceae - Pink Family (2 taxa)			
	Cerastium glomeratum	mouse-ear chickweed	x
	Stellaria sp.		
Celastraceae - Staff Tree Family (1 taxon)			
	Euonymus occidentalis	western burning bush	
Convolvulaceae - Morning-Glory Family (1 taxon)			
	Calystegia purpurata ssp purpurata		
Cucurbitaceae - Gourd Family (1 taxon)			
	Marah oreganus	coast manroot	
Ericaceae - Heath Family (13 taxa)			
	Arbutus menziesii	madrone	

	Arctostaphylos canescens	hoary manzanita	
	Arctostaphylos columbiana		
	Arctostaphylos nummularia	shatterberry	
	Chimaphila menziesii	little prince's pine	
	Gaultheria shallon	salal	
	Ledum glandulosum	western Labrador tea	
	***Pityopus californicus* List 4.2**	**California pinefoot**	
	Pyrola picta	white-veined wintergreen	
	Rhododendron macrophyllum		
	Rhododendron occidentale	western azalea	
	Vaccinium ovatum	California huckleberry	
	Vaccinium parvifolium	red huckleberry	
Fabaceae - Pea Family (13 taxa)			
	Cytisus scoparius	Scotch broom	x*
	Genista monspessulana	French broom	x*
	Lathyrus latifolius	perennial sweet pea	x
	Lathyrus torreyi		
	Lotus corniculatus	birdfoot trefoil	x
	Lotus micranthus	miniature lotus	
	Lotus sp.		
	Lupinus sp.		
	Melilotus sp.		x
	Trifolium sp.		
	Trifolium willdenovii	tomcat clover	
	Vicia hirsuta		x
	Vicia sativa ssp sativa	narrow-leaved vetch	x
Fagaceae - Beech Family (2 taxa)			
	Chrysolepis chrysophylla	chinquapin	
	Lithocarpus densiflorus	tan oak	
Gentianaceae - Gentian Family (1 taxon)			
	Centaurium venustum	canchalagua	
Geraniaceae - Geranium Family (1 taxon)			

	Geranium sp.		x
Grossulariaceae - Gooseberry Family (1 taxon)			
	Ribes sanguineum var glutinosum		
Hydrophyllaceae - Waterleaf Family (2 taxa)			
	Nemophila parviflora		
	Phacelia bolanderi		
Lamiaceae - Mint Family (5 taxa)			
	Mentha pulegium	penny royal	x*
	Prunella vulgaris var. lanceolata	self-heal	
	Satureja douglasii	yerba buena	
	Stachys ajugioides var rigida	hedge nettle	
	Stachys chamissonis	coast hedge nettle	
Lauraceae - Laurel Family (1 taxon)			
	Umbellularia californica	California bay	
Linaceae - Flax Family (1 taxon)			
	Linum bienne	Common flax	x
Myricaceae- Wax Mytrle Family (1 taxon)			
	Myrica california	California wax myrtle	
Oxalidaceae- Oxalis Family (2 taxa)			
	Oxalis oregana	Redwood sorrel	
	Oxalis sp.		
Papaveraceae - Poppy Family (1 taxon)			
	Dicentra formosa	bleeding heart	
Philadelphaceae - Mock Orange Family (1 taxon)			
	Whipplea modesta	modesty	
Plantaginaceae - Plantain Family (2 taxa)			
	Plantago lanceolata	English plantain	x
	Plantago major	common plaintain	
Polemoniaceae - Phlox Family (1 taxon)			
	Navarretia squarrosa	skunkweed	
Polygalaceae - Milkwort Family (1 taxon)			
	Polygala californica	California milkwort	

Polygonaceae - Buckwheat Family (2 taxa)			
	Rumex acetosella	sheep sorrel	x
	Rumex sp.		
Portulacaceae - Purslane Family (2 taxa)			
	Claytonia perfoliata	miner's lettuce	
	Claytonia sibirica	candy flower	
Primulaceae - Primrose Family (2 taxa)			
	Anagallis arvensis	scarlet pimpernel	x
	Trientalis latifolia	star flower	
Ranunculaceae - Buttercup Family (4 taxa)			
	Aquilegia formosa	columbine	
	Coptis lacinata ***List 2.2***	**Oregon goldthread**	
	Ranunculus californicus	California buttercup	
	Ranunculus uncinatus		
Rhamnaceae - Buckthorn Family (3 taxa)			
	Ceanothus thyrsiflorus		
	Rhamnus californica	California coffeeberry	
	Rhamnus purshiana	cascara	
Rosaceae - Rose Family (9 taxa)			
	Cotoneaster pannosa		x
	Fragaria vesca	wood strawberry	
	Potentilla sp.		
	Rosa gymnocarpa	wood rose	
	Rubus discolor	Himalayan blackberry	x
	Rubus leucodermis	western raspberry	
	Rubus parviflorus	thimbleberry	
	Rubus spectabilis	salmon berry	
	Rubus ursinus	California blackberry	
Rubiaceae - Madder Family 3 taxa)			
	Galium aparine	goose grass	x
	Galium parisiense	wall bedstraw	x
	Galium sp.	climbing bedstraw	

Salicaceae - Willow Family (3 taxa)			
	Salix lucida ssp lasiandra	shining willow	
	Salix scouleriana	Scouler's willow	
	Salix sitchensis	Sitka willow	
Saxifragaceae - Saxifrage Family (7 taxa)			
	Boykinia occidentalis		
	Heuchera micrantha	alum root	
	Mitella caulescens List 4.3	**leafy stemmed mitrewort**	
	Mitella ovalis		
	Tellima grandifora	fringe cups	
	Tiarella trifoliata var unifoliata	lace flower	
	Tolmiea menziesii	youth-on-age	
Scrophulariaceae - Figwort Family (5 taxa)			
	Digitalis purpurea	foxglove	x
	Mimulus aurantiacus	sticky monkeyflower	
	Mimulus sp.	musk monkeyflower	
	Scrophularia californica	California figwort	
	Veronica americana	American brooklime	
Solanaceae - Nightshade Family (2 taxa)			
	Solanum americanum		
	Solanum xanti		
Urticaceae - Nettle Family (1 taxon)			
	Urtica dioica ssp gracilis	American stinging nettle	
Violaceae - Violet Family (2 taxa)			
	Viola glabella	stream violet	
	Viola sempervirens	evergreen violet	
MONOCOTYLEDONES - The Monocots			
Cyperaceae - Sedge Family (10 taxa)			
	Carex deweyana ssp. leptopoda		
	Carex gynodynama		
	Carex hendersonii		
	Carex obnupta		

	Carex pachystachya	thick-headed sedge	
	Carex rossii	Ross's sedge	
	Cyperus sp.		
	Cyperus strigosus	false nutsedge	
	Eleocharis macrostachya	spikerush	
	Scirpus microcarpus		
Iridaceae - Iris Family (2 taxa)			
	Iris douglasii	Douglas iris	
	Sisyrinchium bellum	blue-eyed grass	
Juncaceae - Rush Family (5 taxa)			
	Juncus bufonius	toad rush	
	Juncus effusus var. pacificus		
	Juncus ensifolius	dagger-leaf rush	
	Juncus patens	common rush	
	Luzula comosa	wood rush	
Liliaceae - Lily Family (7 taxa)			
	Clintonia andrewsiana	clintonia	
	Disporum hookeri	Hooker's fairybell	
	Scoliopus bigelovii	fetid adders tongue	
	Smilacina racemosa	branched false solomon's seal	
	Smilacina stellata	star false solomon's seal	
	Trillium ovatum		
	Veratrum fimbriatum List 4.3	**fringed false hellebore**	
	Zigadenus fremontii	death camus	
Orchidaceae - Orchid family (5 taxa)			
	Calypso bulbosa	calypso orchid	
	Corallorhiza maculata	spotted coralroot	
	Corallorhiza mertensiana		
	Goodyera oblongifolia	rattlesnake plantain	
	Piperia candida List 1B.2	**white flowered piperia**	
Poaceae - Grass Family (37 taxa)			

	Agrostis pallens		
	Agrostis sp.		
	Aira caryophyllea	silver European hairgrass	x
	Anthoxanthum ordoratum	sweet vernal grass	x
	Avena barbata	slender wild oat	x
	Briza maxima	quaking grass	x
	Briza minor		x
	Bromus carinatus var. carinatus	California brome	
	Bromus hordeaceus	soft chess	x
	Bromus orcuttianus	Orcutt's brome	
	Bromus sp.		
	Bromus sterilis	poverty brome	x
	Bromus vulgaris		
	Calamagrostis bolanderi ***List 4.2***	**Bolander's reed grass**	
	Cortaderia jubata	jubata grass	x*
	Cynosurus echinatus	hedgehog dogtail	x
	Dactylis glomerata	orchard grass	x
	Danthonia californica	California oatgrass	
	Danthonia pilosa	oatgrass	x
	Deschampsia elongata	slender hairgrass	
	Elymus glaucus ssp. glaucus	blue wildrye	
	Festuca arundinacea	tall fescue	x
	Festuca idahoensis	Idahoe fescue	
	Festuca occidentalis	western fescue	
	Glyceria elata	fowl mannagrass	
	Hierochloe occidentalis	sweet grass	
	Holcus lanatus	common velvet grass	x
	Lolium multiflorum	Italian ryegrass	x
	Lolium perenne	perennial ryegrass	x
	Melica subulata		
	Phalaris arundinacea	reed canary grass	
	Phalaris californica		

	Poa kelloggii		
	Poa sp.		
	Polypogon australis	Chilean beardgrass	x
	Polypogon monspeliensis	annual beard grass	x
	Trisetum canescens		

Attachment E: (of Botanical Resouce Assessment, Appendix F) **Bryophytes and Lichens of the Big River Forest, Mendocino County, California**

Survey conducted by Kerry Heise and Geri Hulse-Stephens 4/9, 4/11, 4/30, 5/1, 6/5, 6/6 2008

MOSSES	
AULACOMNIACEAE	
Aulacomnium androgynum	
BRACHYTHECIACEAE	On rotten logs and old stumps
Brachythecium frigidum	
Homalothecium nuttallii	
Isothecium cristatum	On moist banks next to creek
Isothecium stoloniferum	On hardwood bark and rock
Kindbergia oregana	On old fallen logs
Kindbergia praelonga	On shaded logs and boulders
Scleropodium obtusifolium	On shaded duff and tree bases and logs, old roadbeds
Scleropodium touretii	On moist to wet logs, rock along streams
	On boulder inundated with water
CRYPHAEACEAE	On moist to dry soil and over humus
Dendroalsia abietina	
DICRANACEAE	On red alder, oak bark
Dicranum fuscescens	
Dicranium howellii	
	On shaded rotten log
DITRICHACEAE	On shaded rotten log
Ceratodon purpureus	
Ditrichum ambiguum	
	On bare soil in sunny sites
FISSIDENTACEAE	On shaded soil of roadbanks
Fissidens crispus	
Fissidens grandifrons	
	On damp soil banks
FUNARIACEAE	Aquatic on rock in running water
Funaria hygrometrica	
GRIMMIACEAE	On sunny soil on road edge
Racomitrium varium	

LEPTODONTACEAE	On rock, moist or dry
Alsia californica	
LESKEACEAE	On shaded branch of Cal. nutmeg
Claopodium whippleanum	
LEUCODONTACEAE	On bare soil in sun or shade
Antitrichia californica	
MNIACEAE	On oak bark
Epipterygium tozeri	
Leucolepis acanthoneuron	
Plagiomnium venustum	On moist bare soil with mosses
Pohlia wahlenbergii	On moist soil along stream
Rhizomnium glabrescens	On decaying humus and roadbed
	On shaded wet soil
NECKERACEAE	Moist to wet soil along stream
Neckera douglasii	
Porotrichum bigelovii	
	Epiphytic on California nutmeg
ORTHOTRICHACEAE	On wet shaded rock along streams
Orthotrichum lyelii	
PLAGIOTHECIACEAE	On bark of tanoak, Quercus sp.
Plagiothecium laetum	
POLYTRICHACEAE	On damp rotten wood and soil
Atrichum selwynii	
Polytrichym juniperinum	
	On bare mineral soil, roadcuts
POTTIACEAE	On bare or humusy soil
Didymodon vinealis	
Timmiella crassinervis	
	On soil or rock, sun or shade
RHABDOWEISIACEAE	On bare soil in sun or shade
Amphidium californicum	
SELIGERIACEAE	In shaded underhangs of outcrops
Dicranoweisia cirrata	
	On dead log

LIVERWORTS	
FRULLANIACEAE	
Frullania nisquallensis	
Marchantia polymorpha	Epiphytic on Red Alder
PORELLACEAE	On rocks and soil along streams
Porella navicularis	
HORNWORTS	On shaded hardwood bark
ANTHOCEROTACEAE	
Anthoceros sp	
	On moist to wet bare soil
LICHENS	
Cladonia coniocraea	
Cladonia furcata	On shaded soil banks
Cladonia pyxidata	On shaded soil and old wood
Cladonia transcendens	
Cladonia verruculosa	lower tree trunks near creek
Leptogium platynum	
Parmelia sulcata	Moist soil of old roadbed
Tuckermannopsis orbata	
Usnea filipendula	On conifer branches
Usnea sp.	Epiphytic on conifers
	Epiphytic

Attachment F (of Botanical Resouce Assessment, Appendix F)

Rare plant populations and terrestrial communities located on the Big River and Salmon Creek Properties

List compiled from CNDDB records and THPs reviewed at Howard Forest California Department of Forestry

Scientific Name	**Common Name**	**CNPS List**	**Location and notes**
Calamagrostis bolanderi	Bolander's reed grass	List 4.2	**Salmon Creek** and **Big River**. Found at many locations around the properties
Campanula californica	Swamp harebell	List 1B.2	**Salmon Creek**. Bogs and fens, Meadows and seeps North Coast coniferous forest
Coastal Freshwater Marsh		No CNPS list, S2.1, G3	**Big River**
Coptis laciniata	Oregon goldthread	List 2.2	**Salmon Creek** and **Big River** Meadows and seeps, forest stream banks
Cupressus goveniana ssp. pigmaea	Pygmy cypress	List 1B.2	**Salmon Creek**. and **Big River**, Closed-cone forests. (podizol-like soil)
Lilium rubescens	Redwood lily	List 4.2	**Big River**. Broad leafed upland forests, North Coast coniferous forests, sometimes roadsides.
Mitella caulescens	Leafy stemmed mitrewort	List 4.3	**Salmon Creek**. North Coast coniferous forest, mesic
Pinus contorta ssp. bolanderi	Bolander/s beech pine	List 1B.2	**Salmon Creek**. Closed cone coniferous forest (podizol-like soil)
Piperia candida	White-flowered rein orchid	List 1B.2	**Big River** and Salmon Creek. Broadleaved upland forest, North Coast coniferous forest.
Pityopus californica	California pinefoot	List 4.2	**Salmon Creek**. North Cost coniferous forests, mesic
Mendocino Pygmy		none	**Salmon Creek**

Cypress Forest			
Sidalcea malachroides	Maple-leaved checkerbloom	List 4.2	**Big River** near Two Log Cr. in the river floodplain.Broadleafed upland forest
Veratrum fimbriatum	Fringed false hellebore	List 4.3	**Salmon Creek.** Riparian areas in low gradient streams, Closed-cone coniferous forests, North Coast coniferous forests
Usnea longissima	Long bearded lichen		**Salmon Creek** and **Big River,** North Coast coniferous forests

Attachment G: (of Botanical Resouce Assessment, Appendix F) **Exotic Plants of the Big River and Salmon Creek Properties and Associated Vegetation Types**

California Invasive Plant Council ratings:

High-these species have severe ecological impacts on physical processes, plant and animal communities and vegetation structure; Their biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.

Moderate-these species have substantial and apparent but generally not severe_ ecological impacts on physical processes, plant and animal communities, and vegetation structures. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal through establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.

Limited- these species are invasive but their ecological impacts area minor on a statewide level or there was not enough information to justify a high score. Their reproductive biology and other attributes result tin low to moderate rates of invasiveness. Ecological amplitude adn distribution are generally limited, but the species may be locally persistent and problematic.
From Callifornia Invasive Plant Inventory February 2006

H=high, M=moderate,L=limited

Scientific name	Common name	Vegetation types Mixed Hardwood =MH Redwood/Douglas Fir =RD Grassland =G Riparian=R Roadcuts, Cliffs, Outcrops=RC Wet seep=WS S=scrub	Rating High=H Moderate=M Limited=L	Property Salmon Creek (SC Big River (BR)
Anthoxanthum ordoratum	Sweet vernal grass	G, RC	M	SC,BR
Avena barbata	Wild oat	G, RC	M	SC, BR
Bellis perennis	English daisy	G, RC		SC, BR
Brasica rapa	Field mustard	G, RC	M	BR
Briza maxima	Rattlesnakegrass	G, RC	L	SC, BR
Bromus diandrus	Ripgut brome	MH, RD, G, RC	M	BR
Bromus hordaceus	Soft brome	G	L	SC, BR
Carduus pycnocephalus	Italian thistle	MN, RD, G, RC, S	M	BR
Cirsium arvense	Canada thistle	RD, R, G,	M	SC, BR
Cirsium vulgare	Bull thistle	R, WS	M	SC, BR
Cortadaria jubata	Jubata grass	RD, RC	H	SC, BR
Erechtites glomerata	Australian fireweed	RD, S	M	SC
Erichtites minima	Australian burnweed	RD, S	M	SC, BR
Erodium cicutarium	Redstem filaree	RC, G	L	BR
Festuca arundinacea	Tall fescue	G	M	SC
Genista monspessulana	French broom	MH,G,S	H	SC, BR
Holcus lanatus	Common velvet grass	G, WS	M	SC, BR
Hypochaeris glabra	Smooth cat's ear	MH, RC, S	L	BR

Hypochaeris radicata	Rough cat's ear	MH, RC, S	M	SC, BR
Lolium multiflorum	Italian rye grass	MH, G	M	SC, BR
Medicago polymorpha	California bur clover	RC, G	L	BR
Mentha pulegium	Penny royal	WS	L	SC, BR
Myosotis latifolia	Common forget-menot	RD, R	L	BR
Parentucellia viscosa	Yellow glandweed,	G	L	BR
Phalaris aquatica	Harding grass	G	M	SC, BR
Plantago lanceolata	English plantaini	RC, G	L	SC, BR
Ranunculus repens	Creeping buttercup	RD,R	L	BR
Rumex acetosella	Sheep sorrel	RD, G, R,WS	M	SC, BR
Rumex crispis	Curly dock	G, WS, R	L	BR
Senecio jacobaea	Tansy ragwort	G, R	L	SC, BR
Silybum marianum	Sblessed milkthistle	G, R	L	BR
Torilis arvensis	Hedge parsley	MX, RD, RC	M	SC, BR
Vulpia myuros	Rattail fescue	RC,S	M	BR

Attachment H (of Botanical Resouce Assessment, Appendix F)

Schedule and Cost Estimate for Big River and Salmon Creek
Botanical Field Survey Including bryophytes and macrolichens.
Invasive plant mapping and vegetation type descriptions and assessment
will be included in the survey

Person days	Month	Person Hours		Cost ($65/hr)
		Botanist hrs	Bryologist hrs	
Big River				
8	April	60	20	5,200
8	May	60	20	5,200
4	June	40	0	2,600
4	July/Aug	40	0	2,600
		200	40	15,600
28				
Salmon Creek				
3	April	20	10	1950
6	May	40	20	3900
2	June	20		1300
2	July/Aug	20		1300
13		100	30	$8,450
Task Description				Cost
Field surveys				24,050
Lab (Plant identification, voucher preparation, GIS maps, photos				1,950
Final report				4,000
Travel approx 12 trips for (8 botanist/4				600

bryologist) at				
Copy, FAX, etc.				25
TOTAL				**30,625**

APPENDIX G: NORTHERN SPOTTED OWL
MIKE STEPHENS

The spotted owl is a medium sized owl, about 20 inches long with an average wingspan of 40 inches. Spotted owls have large dark eyes, lack ear tufts and the legs and feet are fully feathered. Spotted owl's diet generally consist of rodents and small birds and with a smaller component of other various animals such as insects, bats and lizards (Forsman 1984). Spotted owls hunt for food, or forage, by perching and swooping on prey items. The spotted owl's range occurs from southern British Columbia to the southern part of the Sierra Madre Occidental and Oriental mountains. The spotted owl is comprised of 3 subspecies within this range. The Mexican spotted owl's range is the largest occurring from the southern Rocky Mountains in Colorado; the Colorado Plateau in southern Utah; southward through Arizona, New Mexico, and far western Texas; in Mexico through the Sierra Madre Occidental and Oriental mountains and the southern end of the Mexican Plateaus range. The California spotted owl occurs throughout the Sierra Nevada mountain range in addition to the coastal mountain ranges of southern California north to the San Francisco peninsula. The Northern spotted owl range is north of the San Francisco peninsula throughout the coastal and inland ranges of California and throughout the coastal and Cascade mountain ranges of Oregon and Washington to southern British Columbia. The redwood region accounts for only about 9% of the northern spotted owl's range. The northern spotted owl (hereafter referred to as NSO) was listed as a threatened species under the Endangered Species Act (ESA) in 1990 as concern mounted over the continuing loss of habitat that NSO's appeared to require for survival and reproductive success (Federal register 1990). As part of the ESA listing it was required by landowners within the range of the NSO to survey for their presence if any kind of habitat altering activities were proposed. The United States Fish and Wildlife Service (USFWS) is in charge of administering and consulting with species protected under the ESA. The USFWS developed a protocol for surveying for NSO's in 1991 and revised it in 1992. It is the 1992 revised protocol that is presently used and followed today for surveying for NSO's.

United States Fish and Wildlife Service northern spotted owl survey protocol

The 1992 USFWS NSO survey protocol is a 20 page document, which requires landowners to survey areas that lie within the range of the NSO for the presence of NSO's if any "habitat altering, or significant disturbance" project is proposed. The method of surveying for presence requires covering the project area with survey stations that are spaced approximately ¼ - ½ mile apart. Each survey station is "called" for 10 minutes. Calling requires imitating a NSO's call either using a pre-recorded playback system or having the surveyor perform the call. The project area will be called 3 times each year for 2 or more years or 6 times in 1 year to meet the protocol. If a NSO is detected during one of these surveys it must be determined if there is a NSO territory in the area of the detection. If NSO's are found it must then be determined if they are nesting and if not, where they are roosting. If an owl or pair of owls is determined to occupy the area protection measures and habitat retention measures will be enacted and presented to the USFWS who will then make a determination if the proposed project will or will not result in an incidental "take"(harming or harassment) of a NSO. This survey protocol is also used to determine the presence or absence of NSO's in an area, whether the area is associated with a habitat-altering project or not.

Habitat requirements

When the NSO was listed under the ESA in 1990 it was generally believed that they required large tracts of old growth or late seral stage forests for survival and reproductive success (Thomas et al 1990). This was primarily a result of interpreting habitat conditions that existed around nest sites, at the time little was known about the habitat that was used or needed for foraging (LaHaye et al, 1999). Recent studies have shown that NSO's require a mixture of forest conditions for reproductive success and long-term survival (Franklin, 2000 and Irwin et al, 2000). Generally, NSO's require nesting habitat that consists of well stocked, mixed-conifer dominated, dense canopy stands often close distances to year-round water and riparian habitat (Irwin et al. 2007) These stands can be of varying ages but what is important is retained structure from older stands (Forsman et al. 1984, Solis and Guitierrez 1990, Ripple et al. 1991, Lehmkuhl and Raphael 1993, Hunter et al. 1995, Meyer et al. 1998). Features including branch deformities, cavities, mistletoe clumps, broken tops, debris platforms, old squirrel, vole and raptor nests provide nesting possibilities within such stands (Blakesley et al. 1992 and Thome et al. 1998). Also factors such as north facing slopes, providing cooler temperatures during the breeding season and areas on the lower 1/3 of slopes also seem to provide refuge from adverse environmental conditions (Irwin et al. 2007). NSO's can utilize a wide range of prey species across their range however, in the redwood region the main prey item is the dusky-footed woodrat (Ambrose, 1991 and Mendocino Redwood Company, 1989, 2001 unpublished),. In the redwood region dusky-footed woodrats occur in high densities in early successional stages "brushy-stage" clearcuts and in the ecotones between late and early successional forests (Franklin et al. 2000). The distance relationship between stand conditions used by NSO's for nesting and foraging may well determine whether NSO's will occupy a site and/or have reproductive success. It is presumed that if NSO's have to travel great distances between nest sites and foraging locations it may result in poor reproductive success or exclusion of NSO's from an area altogether (Franklin et al. 2000 and Irwin et al. 2007).

Past timber harvesting activities on TCF lands have created a patchwork of stands with varying ages and sizes classes. The majority of the area was first clearcut in the late 19^{th} and early 20th centuries. This round of harvesting left some trees that were either too difficult to log or were defective in some way and thus not "commercially viable". These "residual" old growth trees that exist in the area today often account for a number of NSO nesting structures. Clearcutting was the most widely used silvicultural method and it is perhaps only in the last 40 years or so that other silvicultural methods were significantly implemented. The residual second growth that exists on the property is approximately 30 to 100+ years old. These second growth stands make up the majority of NSO activity centers on the TCF tracts. The older, second growth component contains forest "structure" that is providing, or will provide, nesting habitat and structures. Also, with the NSO's listing under the ESA in 1990, which provided protection measures for activity centers as well as providing habitat retention requirements outside of these activity centers, activity centers will have the opportunity to mature and develop some decadence that will allow for additional nesting structures.

Protection measures are centered on nest tree locations and if nest tree locations are not known or surveys determined that a pair was non-nesting the roost locations would be used for activity centers. Protection measures involve a 500ft no-cut zone around a current nest tree or daytime roost location, a 1,000ft zone where a majority of nesting/roosting habitat is retained. There is next a .7 mile radius where a mixture of nest/roost and foraging habitat is to be maintained. Another 1.3 mile radius where another mixture of acres in nest/roost and foraging habitat is required. Below are the current habitat description and retention rules for NSO's as required by the USFWS;

U. S. Fish and Wildlife Coastal Northern Spotted Owl Habitat Description:
1. Definitions of nesting-roosting and foraging habitat.
a. Nesting-Roosting Habitat includes the following:
A. ≥60% canopy cover of trees ≥11 inches diameter at breast height (dbh).
b. Foraging Habitat includes the following:
A. ≥40% canopy cover of trees 11 inches dbh.
B. Basal area = ≥75 ft^2/acre of trees ≥11 inches dbh.
2. Priority Ranking of Habitat Retention Areas.
a. Tree Species Composition.
Mixed conifer stands should be selected over pine-dominated stands.
A. Abiotic Considerations include the following:
i. Distance to Nest.
I. Nesting-roosting and foraging habitat should be located closest to identified nest tree(s), or closest to roosting tree(s), if no nesting trees are identified.
ii. Contiguity.
I. Nesting-roosting habitat within the 0.7-radius circle around an activity center must be as contiguous as possible.
II. Fragmentation of foraging habitat must be minimized as much as possible.
iii. Slope Position.
I. Habitats located on the lower one-third of slopes provide optimal microclimatological conditions and an increased potential for the presence of intermittent or year-round water resources.
iv. Aspect.
I. Habitats located on northern aspects provide optimal vegetation composition and cooler site conditions.
v. Elevation.
I. Habitat should be located at elevations of less than 6000 feet, although the elevation of some activity centers (primarily east of Interstate 5) may necessitate inclusion of habitat at elevations greater than 6000 feet.
3. Habitat Quantities.
a. Within 1000 feet of each activity center:
a. Outside of the breeding season (August 1 through January 31), no timber operations shall occur within 1000 feet of an activity center other than use of existing roads.
b. During the breeding season (February 1 through July 30), no timber operations shall occur within 1000 feet of an activity center other than use of existing, permanent, year-round roads.
b. Within 0.7-mile radius (1000 acres) of, and centered on, each activity center:
A. Habitat shall be retained to maximize attributes desirable for NSOs described in (2) above.
B. At least 500 acres of suitable habitat must be present, as follows:
i. 200 acres of nesting-roosting habitat.
I. No timber harvest shall occur within the 100 acres of nesting-roosting habitat immediately surrounding each activity center.
II. If the remaining 100 acres of nesting-roosting habitat is contiguous with the activity center or is located within the same drainage, harvest shall not reduce the pre-harvest basal area of these acres by more than 33%.

III. If the remaining 100 acres of nesting-roosting habitat is not contiguous with the activity center or is not located within the same drainage, ≥60% canopy cover of trees ≥11 inches dbh shall be retained.
ii. ≥300 acres of foraging habitat.
C. No more than 1/3 of the remaining suitable habitat shall be harvested during the life of the plan.
c. Between the 0.7-mile and 1.3-mile radius circles centered on each activity center:
A. Retention of habitat should follow the ranking guidelines contained in (2) above.
B. ≥836 acres of suitable habitat must be present.
C. No more than 1/3 of the remaining suitable habitat shall be harvested during the life of the plan.
4. Size and Shape of Habitat Patch
a. Narrow strips of habitat (WLPZs, retention areas between clearcuts, etc.) may contain the characteristics of nesting-roosting habitat. However, when these narrow strips of habitat are surrounded by unsuitable or low quality habitats, they function as foraging habitat at best.
b. Narrow strips of habitat (100 meters or less) provide for a lot of edge habitat and little or no interior habitat. Franklin et al (2000) describe interior habitats as the amount of spotted owl habitat ≥100 meters from an edge. They describe edge habitat as edge between spotted owl habitat and all other vegetation types.
c. Because WLPZs, for example, are 100 meters or less in total width, they are considered edge habitats surrounded by unsuitable habitat. Edge habitats do not provide for protection from predators nor do they provide the microclimates of interior habitats.

From California Department of Forestry and Fire Protection" Important Information for Timber Operations Proposed within the Range of the Northern Spotted Owl", Feb. 2008

TCF's silvicultural policies and objectives and how it relates to habitat retention/creation

TCF's overall silvicultural objectives " to develop stands that have high canopy closure, some large mature trees, and a high degree of structural diversity", specifically with the preferred silviculture being "high retention (150sf/acre basal area) single tree selection with re-entries every 10-20 years to remove most trees that exceed the target crop-tree size and thin the smaller size classes", will ensure the maintenance and creation of NSO nest/roost habitat for the long-term future. Also, many stands are in a younger age class and will need a more aggressive silvicultural prescription, such as commercial thinning, these post-harvest stands will most likely create adequate foraging habitat. The key will be the proximity of these foraging stands to the nest/roost stands. Also, TCF will retain all current NSO territories and will only pursue abandoning NSO territories that were given territory status erroneously. This will ensure that the most important nest/roost habitat is protected and allowed to age and "develop" insuring that there will be areas NSO's can immigrate into.

Spotted Owls on TCF property

At the time of the NSO's listing in 1990 The Big River and Salmon Creek tracts were owned by The Georgia-Pacific Corporation. Surveys for NSO's began in 1989 mainly in conjunction with timber harvesting plans and the impending listing under the ESA. Areas would only be surveyed for NSO's if there were to be some kind of timber harvesting activity; this led to the continuing discovery of new additional NSO territories. In 1994 Georgia – Pacific biologists claimed that they had found all NSO territories within the Salmon creek tract. In fact they found additional territories for a few years after 1994. Their assumption was probably based on early estimations of home ranges that were quite large (>1,200 ha) (Thomas et al 1990). Currently, there are 7 known NSO territories on the Salmon Creek tract with a density of 1 NSO territory per 630 acres. On the Big River tract there are currently 11 known NSO territories with a density of 1 territory per 1,060 acres.. These numbers and densities should be viewed as a “snapshot” of current conditions with the likelihood that numbers will change in the future as survey efforts increase and population estimates are improved.

Surveys first conducted by Georgia-Pacific and then continuing with the Campbell Group involved calling THP areas and also monitoring most of their known territories for occupancy and reproductive success. They also captured NSO’s and fitted them with aluminum USFWS numbered bands in addition to unique color bands. This provided a wealth of demographic data that can be used to determine turn-over at territories, survival rates, productivity, and to a lesser extent, an idea of foraging locations and home ranges when band information is observed on NSO’s away from their activity centers. Many of the individual NSO’s that were banded by the previous owners are still present on the property today. However many territories have been replaced with new NSO’s and are not now currently banded.

Surveys on TCF tracts

Surveys on the Salmon Creek and Big River properties under TCF contract began in April 2007. Surveys in 2007 were primarily concentrated on THP areas with minimal efforts made to obtain occupancy and reproductive status at territories outside of THP areas Six individual NSO’s were captured and fitted with bands to continue with the banding efforts of the past. TCF survey efforts in 2007 included a higher density of calling stations and partly resulted in “re-discovering” 2 territories that had been determined to be abandoned by the previous landowner in 2006. This higher density of calling stations is the basis for future proposed survey efforts.

Future surveys

The most effective way to determine all territories on a tract of land is to survey that whole tract of land consistently for a number of years (Forsman, 1983, Franklin et al 1996), this is often referred to as “blanket calling”.

NSO surveys proposed for the Salmon Creek Tract include “blanket” calling the entire tract with additional occupancy and reproductive status visits to all known territories whether active or not. This effort will most likely determine all of the territories and provide benefits for future planning activities on the tract. Approximately 80 survey stations have been laid out on the Salmon Creek tract with their locations GPS’s and imported into GIS. The GPS’ing of survey stations greatly assists in plotting nocturnal NSO auditory detections. It is estimated that after active territories are located in the beginning of the survey season that possibly more than half of the survey stations could be dropped from that year’s calling effort.

On the Big River tract a different approach is proposed, because blanket surveys covering The Big river tract would be cost prohibitive. It is proposed that the Big River tract will be broken down into management compartments of 300-700 acres. The idea being that each management block would be managed for timber harvesting, restoration and maintenance within a time frame of 1-3 years With this strategy NSO surveys can be concentrated in 1 or 2 management blocks per year, in effect blanket calling the management block(s) under current management or planning. In addition, all known territories within the Big River tract will be surveyed for occupancy and/or reproductive status.

TCF has contracted with consulting biologist Mike Stephens who is permitted to capture and band NSO's. Banding efforts are currently on an opportunistic basis with the hopes that as many individual NSO's will be banded as possible to aid in management and to provide valuable data. TCF will not be able to commit to banding efforts in perpetuity as there are a limited number of contracting consultants that are qualified and permitted to perform such duties.

Also, compiling past survey efforts from the previous landowners as well as from adjacent landowners has proven essential in understanding the NSO situation that exists on both tracts today. Good communication with adjacent landowners has also proven to be essential, with both landowners sharing survey information and providing access to territories. This effort will continue in the future to ensure future cooperation and to be a good neighbor.

Additional Threats to NSO's

Aside from the habitat issues associated with NSO reproduction and survival, there is a more ominous threat to NSO's emerging presently which is the invasion of the Barred Owl into the range of the NSO. In the last 8 years the numbers of Barred Owls in Mendocino county has steadily increased. Most Barred Owls are located in the state parks of Mendocino County that have relatively large tracts (>100 acres) of old growth forests. So far, no Barred Owls have been detected on TCF lands in Mendocino County, yet in 2008 Barred Owls have been detected in Navarro River Redwoods State Park only 5-7 miles from the headwaters of Salmon Creek. Also a Barred owl has been detected off of Cameron road in Elk, which is also in the Navarro watershed adjacent to the Salmon Creek watershed. There has been a pair of Barred owls at the Mendocino Woodlands state park for almost 2 decades. This Park borders the TCF Big River tract on its western boundary. There has been a pair of Barred Owls at Maillard state reserve for a number of years, this state park property borders the Garcia tract on its eastern boundary. It may just be a short period of time before Barred Owls start moving onto TCF property and displacing spotted owls. Currently there is nothing a landowner can do if Barred owls move onto their property, in terms of removing and relocating or other lethal and non-lethal control measures. TCF is currently working on drafting a letter with other landowners to petition lawmakers to change the Fish and Game code to allow for the possibility of Barred Owl control measures in the future. Barred owls are displacing NSO's (Kelly et al. 2003) as well as suppressing the calling behavior of NSO's, which can make NSO survey efforts increasingly difficult and possibly ineffective (Crozier et al. 2006).

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APPENDIX H: ROAD MANAGEMENT PLAN

The Conservation Fund owns and manages approximately 40,000 acres of forestland in Mendocino County, California, consisting of the 11,770-acre Big River Forest, the 4,250-acre Salmon Creek Forest, and the 23,780-acre Garcia River Forest. The Conservation Fund acquired the Big River and Salmon Creek tracts in 2006 from Hawthorne Timber Company, an investment management firm, which actively managed the forest for timber production. The Conservation Fund intends to manage the forest resources to improve stocking and growth across the ownership and to accelerate watershed and habitat restoration and recovery. Therefore, it has become a priority to improve and maintain access to the forestland from the existing road system.

It has been documented that forest roads can contribute significant sediment to streams. Increased stream sediment can result in cemented gravels reducing salmonids ability to spawn and/or inhibiting salmonid 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 and pool depth. Near stream roads also reduce stream shading where the road is very wide or very close to the stream. Reduced stream shading has also been shown to be linked to increased water temperature.

Big River is listed as threatened and impaired by the EPA and is on the 303(d) list of impaired water bodies. Placement of a water body on the 303(d) list acts as the trigger for developing sediment control plans, including determining the Total Maximum Daily Load. Past management practices on the Property have reduced road related stream sedimentation. For example, many bridges have been installed to replace standard culverts on Class I streams. Class II watercourse crossings have been rock armored and new culverts have been set to stream grade. Many 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 and crossings have been properly constructed with culverts set to grade and critical dips installed to control runoff in the event of a culvert failure.

The Conservation Fund is committed to continuing this trend of road improvement over time and has developed and will continue to refine this Road Management Plan to: 1) reduce sediment inputs resulting from the existing road network as well as reduce inputs from new roads; 2) develop proactive measures to help reduce stream sedimentation as a result of road runoff and cooperate with regulatory agencies involved with timber harvest planning; 3) develop a timeline for road maintenance activities; and 4) act as a guide to foresters who are actively developing timber harvest plans on the Properties.

Planned road maintenance will be in conformance with The Conservation Fund's overall forest management policies. The Conservation Fund's immediate goal is to maintain access by grading and maintaining existing mainline roads. These roads form the core of the road system and provide access for fire suppression, log hauling, wildlife surveys, and other management activities. Maintenance and improvements of secondary roads will be carried out in conjunction with Timber Harvest Plans or as part of larger watershed improvement projects.

Initial Road Assessments and Baseline Data

Road assessments gather baseline data and prioritize reconstruction and repair needs as well as identify roads which can be decommissioned. The Conservation Fund has secured cost share funding through the California Department of Fish and Game (DFG) and subsequently contracted with Pacific Watersheds Associates (PWA) to conduct the initial road assessment on the Salmon Creek Forest. A similar cost-share funding agreement has been reached with Mendocino County Resource Conservation District and DFG to conduct a detailed road assessment on the East Branch of the Little North Fork Big River. The assessments are expected to be completed in the 2009-2010 field season. PWA has agreed to train one or more TCF staff or subcontractors in the DFG-approved assessment process so that TCF can complete road inventories on the Big River Forest. The road assessments will utilize the DFG-approved "Upslope Assessment and Restoration Practices" methodologies described in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 2002). The methodologies provide a uniform, standardized and accepted protocol for identifying existing and potential erosion problems, and prescribing cost-effective treatments. The goal of the road assessment is to develop an erosion control and erosion prevention plan that, when implemented, will: 1) substantially reduce or minimize the potential for future sediment delivery to nearby streams by improving road surface drainage and upgrading or decommissioning road drainage structures to accommodate the 24-hour, 100-year storm discharge (ie., to conform with current NOAA Fisheries, CAL FIRE, North Coast Regional Water Quality Control Board and DFG standards); 2) provide recommendations for upgrading or decommissioning the inventoried road routes; 3) where roads are recommended for upgrading, provide for year-round and safe use of the inventoried road routes; and 4) lower long-term road maintenance requirements and associated landowner costs.

A cursory road assessment of the Big River and Salmon Creek Forests was conducted by TCF contractor Chris Blencowe shortly after the Property was acquired to identify any controllable road related sediment sources. The results showed that the accessible roads surveyed are well drained and maintained and no major problems existed that needed immediate repair. Based on the initial property survey, road grading to open inboard ditches and clean out culverts was conducted during 2008 on the Big River and Salmon Creek Forests.

Implementation Plan

Road improvement and repairs will be conducted annually as part of TCF's ongoing maintenance plan, in conjunction with THP-specific Erosion Control Plans or projects implemented through grant funding. The Fund will proceed to upgrade the roads in an orderly manner consistent with THP General Waste Discharge Requirements (GWDRs) and priority repairs identified during the road assessments, however it is anticipated that upgrades may take up to fifteen years to complete on Big River and up to ten years to complete on Salmon Creek. Depending on available funding and the sites discovered during the road assessment process, implementation will be accelerated whenever possible.

Previously Identified Controllable Erosion Sites

Upon the purchase of the Forests, the Fund assumed numerous THPs with prescribed road maintenance practices and timelines in the form of General Waste Discharge Requirement (GWDR) enrollments. THPs are enrolled into the GWDR program after THPs have been approved by CAL FIRE. An Erosion Control Plan (ECP), which represents an inventory of controllable sediment discharge sites with proposals for controlling the sites, is a requirement of the GWDR. The GWDR may be waived by the NCWQCB if the plan submitter meets certain baseline requirements in a THP, which the water board considers to minimize impacts.

The following table lists GWDRs and/or Categorical Waivers on the Forests (either assumed from the previous landowner or enrolled in since the acquisition), which require annual inspection and maintenance until sites are deemed stable and enrollment is terminated by the NCWQCB. The Fund is currently assessing remaining active THPs enrolled under the GWDR for completion and termination of coverage.

Table 1: List of GWDRs and Categorical Waivers on the Big River and Salmon Creek Properties

THP # & Name	**Watershed**	**WDID#**	**Enroll Date**	**Target End Date** (+/- 2 winters from completion)
1-06-017 Elf River	Big River	1B106017 MEN	5/01/06 *(CTM)*	Terminated
1-06-083 Hatch Gulch	Big River	1B106083 MEN	8/03/06 *(CTM)*	Terminated
1-05-096 Pond East	Big River	1B105096 MEN	8/10/2005 *(CTM)*	Terminated
1-05-100 Tunzi's East 40	Big River	1B105100 MEN	8/10/2005 *(CTM)*	Terminated
1-07-083 Jarvis Camp	Big River	1B107083 MEN	9/12/2007	Terminated
1-07-060 Riverbends	Big River	Cat. Waiver	NA	NA
1-06-099 Lower Salmon	Salmon Creek	1B106099 MEN	6/7/2007	TBD
1-07-191 Pullen Gulch	Salmon Creek	Cat. Waiver	NA	NA
1-04-061 Upper Salmon	Salmon Creek	1B104061 MEN	3/18/2005 *(CTM)*	Terminated
1-08-037 North of 20	Big River	Cat. Waiver	NA	NA
Wheel Gulch	Big River	Cat. Waiver	NA	NA
Laguna Pass	Big River	TBD	NA	NA

Road Maintenance and Improvement Guidelines

This section is included to aid resource professionals in identifying logging road attributes that will assist in determining whether a road should be maintained in its current configuration, reconfigured with upgraded drainage structures, permanently decommissioned, or decommissioned and replaced with a new road in an alternate location. The Property has many rocked roads with a durable running surface such as the mainline road in Big River which will be maintained in its current condition; other unimproved roads will be evaluated and upgraded as described below.

Some of the primary objectives identified during land management planning were: 1) to improve fisheries and wildlife habitat; and 2) to maintain or improve the current level of access as opposed to reducing access. The Fund is willing to bear higher management costs in the future that arise from reconfiguring the roads, so a cost benefit ratio will be used to help prioritize projects, but is not the determining factor when evaluating road improvements.

To reduce sediment delivery from the road system, emphasis will be placed on increasing the number of drainage points along roads and reducing the potential for diversion at culverted watercourse crossings. On low gradient roads (0-4% grade) roads will be primarily drained by outsloping with occasional dips or ditch relief as necessary. On higher gradient roads (5-10+% grade) roads will be drained primarily with rolling dips in combination with outsloping and ditch relief culverts as necessary. It is expected that within a fifteen-year period on Big River and ten-year period for Salmon Creek, most roads will be drained by a combination of outsloping with rolling dips. It is however, recognized that ditch relief culverts cannot be completely abandoned and will be used as drainage structures on roads where necessary. Reducing diversion will be implemented be employing the following management practices:

- New culverts and culverts proposed for replacement will be sized to meet the 100-year storm event.
- New or replaced culverts will be installed at stream grade with a critical dip.
- A trash rack or stake shall be installed upstream of the culvert to catch or turn debris prior to reaching the pipe. The stake shall be centered upstream of the culvert a distance equal to the culvert diameter; e.g. the stake shall be two feet upstream of a 24-inch diameter culvert.
- Rock armored fill or temporary crossings will be used on secondary roads, which see only periodic activity, to reduce maintenance requirements. Minor crossings on permanent roads may be converted to rock armored fill crossings over time.
- New roads will be designed with gentle grades, and long rolling dips will be constructed into the road and outsloped to relieve surface runoff. Where possible, watercourse crossings will be designed such that road grades dip into the crossing and then climb out of the crossing eliminating the need for abrupt critical dips.

- Where necessary all permanent roads within 100 feet of Class I and II streams or within 50 feet of Class III watercourses (including permanent crossings) shall be surfaced with competent rock to a sufficient depth prior to their use for log hauling to prevent road fines from discharging into watercourses. Seasonal or temporary roads shall be treated with rock, rolling dips, waterbars, grass seed or slash mulch to prevent sediment discharge.

- Any new soil exposure within the WLPZ of a Class I or II watercourse caused by land management activities shall be stabilized with the application of grass seed, mulch, slash packing or rocking before October 15 of the year of disturbance. Stabilization measures shall achieve at least 90 percent coverage of all soil within the Riparian Management Zone exposed by land management activities.

The Handbook of Forest and Ranch Roads prepared by Weaver and Hagans (1994, with updates) 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 project will be included in the road assessment and/or within THPs as appropriate.

Permanent Roads: Roads used year-round shall be designed, constructed, reconstructed or upgraded to permanent road status with the application of an adequate layer of competent rock for surface material and the installation of permanent watercourse crossings and road prism drainage structures. These roads shall receive regular and storm period inspection and maintenance as required throughout the winter period.

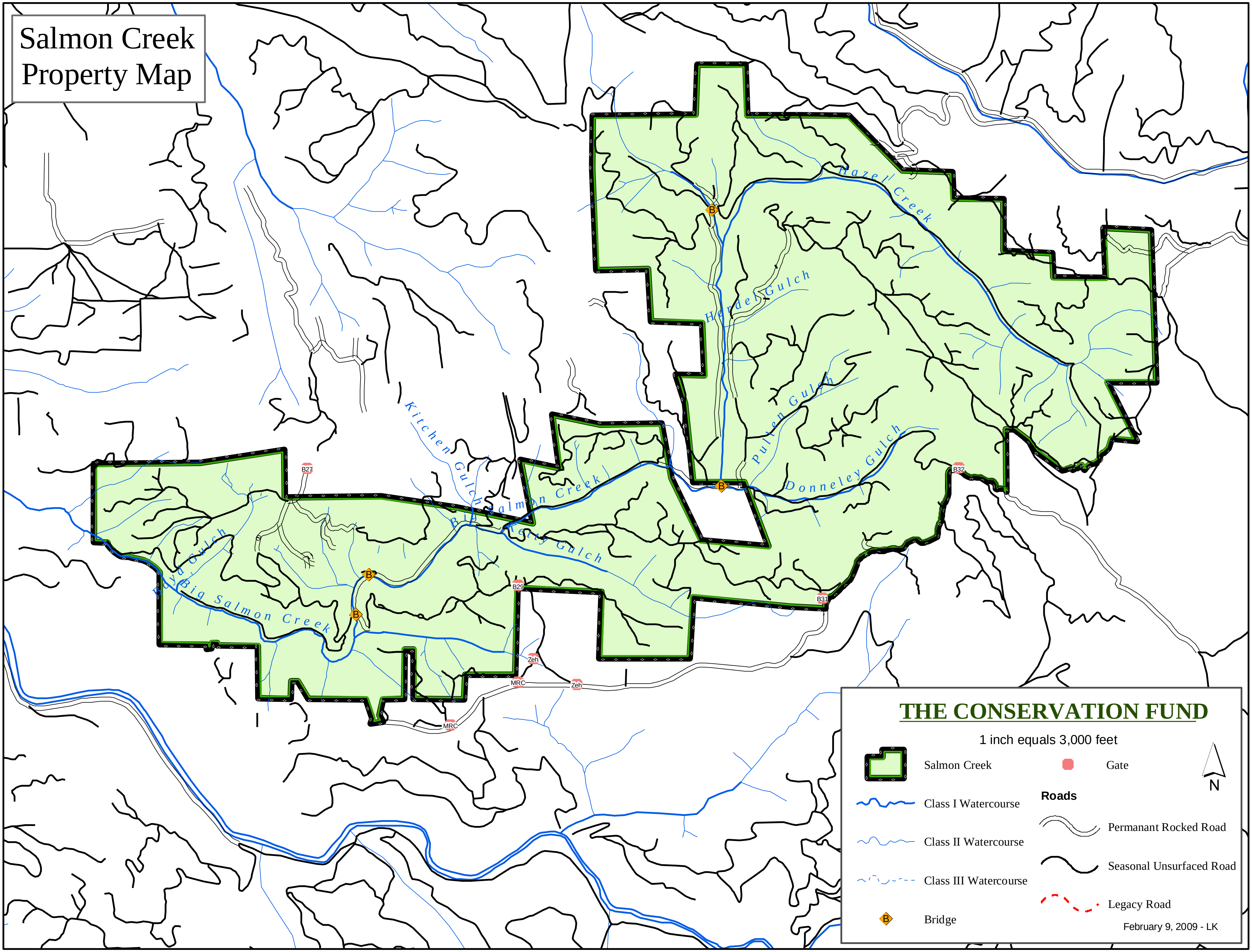
Seasonal Roads: Roads used primarily during the dry season but to a limited extent during wet weather shall be designed, constructed, reconstructed, and upgraded to provide permanent watercourse crossings - either culverts or rock armored fill crossings and road surface drainage structures. Roads shall be upgraded as necessary with the application of spot-rocking where needed to provide a stable running surface during the specified period of use. These roads shall receive inspection at least once during the wet weather period and shall receive at least annual maintenance.

Temporary Roads: Roads designated as temporary shall be designed to prevent erosion such that regular and storm period maintenance is not needed to prevent sediment discharges to a watercourse. All watercourse crossings, except rock armored fill crossings,, shall be removed prior to October 15 of each year of installation. Inspections of these roads will occur for three years after use. Ordinary maintenance will be performed when the road is opened for use.

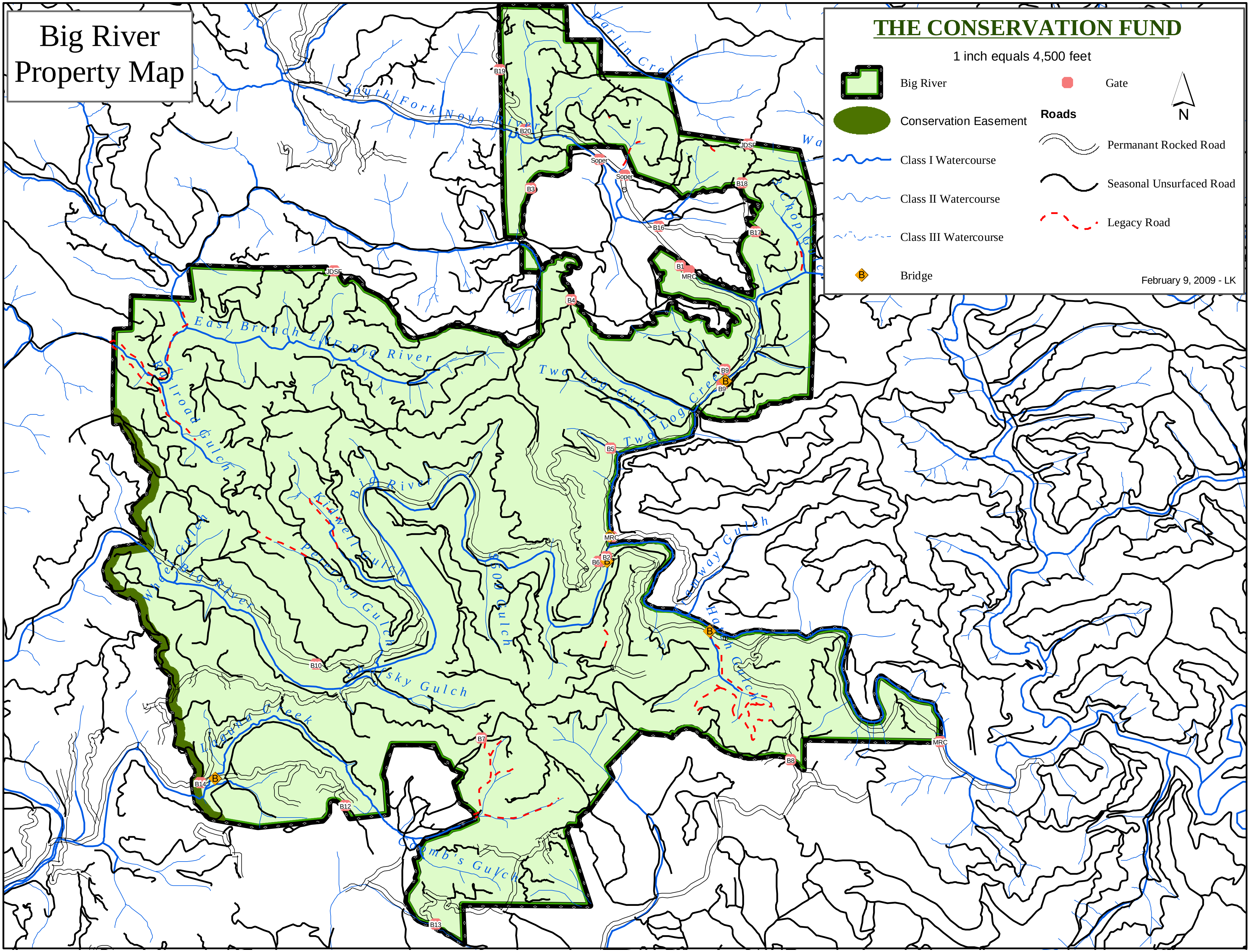
Legacy Roads: Roads mapped as legacy roads have been previously decommissioned or abandoned in place due to lack of use. They will be assessed for sediment sites during property wide road assessment activities.

“The Handbook of Forest and Ranch Roads” prepared by Weaver and Hagans (1994, with updates) will be used as a guideline for all proposed road construction and improvement projects.

All watercourse road crossings shall, at a minimum, utilize the standards described on pages 64 - 79 of the *Handbook for Forest and Ranch Roads*. These standards include but are not limited to the design and installation of permanent crossings using a culvert with a minimum diameter designed to pass at least a 100-year storm event. All crossings shall be designed and installed to prevent the diversion of stream flow down or through the road prism in the event of culvert failure, and to provide free passage to fish at all flow regimes. All watercourse road crossings that do not meet these minimum standards must be scheduled as necessary for upgrade as Sediment Delivery Sites under a Erosion Control Plan.



Salmon Creek
Property Map
THE CONSERVATION FUND
1 inch equals 3,000 feet
Salmon Creek
Gate
N
Class I Watercourse
Roads
Permanant Rocked Road
Class II Watercourse
Seasonal Unsurfaced Road
Class III Watercourse
Legacy Road
Bridge
February 9, 2009 - LK
Hazel Creek
Pullen Gulch
Donneley Gulch
Kitchen Gulch
Salmon Creek
Big Salmon Creek
B27
B29
B31
B32
MRC
Zeh


Big River Property Map
THE CONSERVATION FUND
1 inch equals 4,500 feet
Big River
Gate
N
Conservation Easement
Roads
Class I Watercourse
Permanant Rocked Road
Class II Watercourse
Seasonal Unsurfaced Road
Legacy Road
Class III Watercourse
Bridge
February 9, 2009 - LK
Parlin Creek
South Fork Noyo River
East Branch L.N.F. Big River
Railroad Gulch
Two Log Gulch
Two Log Creek
Big River
Kidwell Gulch
Peterson Gulch
Soda Gulch
Big River
Laguna Creek
Halfway Gulch
Coombs's Gulch
JDSF
MRC
Soper
B3
B4
B5
B6
B7
B8
B9
B10
B12
B13
B14
B16
B17
B18
B19
B20

All road design, construction, and reconstruction shall use, at a minimum, the standards described on pages 39 - 54 and 81 - 120 of the *Handbook for Forest Ranch Roads*. These standards include but are not limited to the outsloping of the road prism (whenever feasible and safe) and the installation of rolling dips (rather than water bars) for additional road drainage. If insloped roads are necessary, ditch relief culverts shall be installed, at a minimum, at the distances described in Table 20 of the *Handbook for Forest and Ranch Roads*, and located to prevent discharge of road drainage directly onto erodible soils. Typical construction diagrams for various watercourse crossing, rolling dips, critical dips, and other common erosion prevention implementation measures are attached.

Road Decommissioning

There are three criteria to consider in determining which roads can be decommissioned. The first is focused on environmental considerations. 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. They pose an ongoing maintenance problem caused by frequent bank sloughing which block roads and plug ditches and culverts.

The second criterion is that roads to be decommissioned must not remove or substantially reduce access to areas where future management is anticipated. In the case where a road has been determined to be undesirable due to its location but access is still required the landowner is obliged to maintain the existing road or find another route. Reconfiguring the road network is a difficult task that requires consideration of the surrounding geology, proposed or anticipated silviculture and expected logging method. The likely result is that the new road system will be higher in the watershed and designed for yarder logging.

The third criteria is that road decommissioning does not result in the construction of a new road that is also environmentally unsound. Removing a road from a stream zone with the intent of moving upslope can require that the landowner make 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 should be considered before constructing an alternate route.

In areas with excess roads it may be desirable to permanently or temporarily decommission roads to reduce potential sediment delivery and increase growing space.
These types of roads are considered to be a low priority for correction because they do not pose an immediate adverse environmental threat and they do not meet the above mentioned criteria for decommissioning. Roads reduced to temporary status are generally decommissioned after timber harvest has occurred or by simple lack of use.

The economics of road decommissioning also contribute to the decision-making process.

Unfortunately it is not practical to use a "one size fits all" prescription for road decommissioning. Some roads, which appear to be poorly located, may have to remain in place because they service a larger area with good arterial roads. While it may be physically possible to relocate a road it may not be in the best interests of the landowner to do so due to the excessive cost involved. The types of roads which will be a priority to evaluate as potential candidates for decommissioning are listed below.

1. Roads that parallel watercourses and dead end in landings are good candidates for decommissioning because of their proximity to streams and their lack of arterial roads. These are the highest priority because they can have immediate environmental benefits and usually can be decommissioned without impact to future management.

2. Roads that cross unstable areas or headwall swales can be decommissioned 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. Roads crossing unstable areas are deemed to be the second priority for decommissioning 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.

3. Long term plans should include upgrading or decommissioning and replacing roads that are poorly located but are necessary in the short term for forest management.

The Handbook of Forest and Ranch Roads prepared by Weaver and Hagans 1994 with updates will be used as a guideline for all proposed road decommissioning.

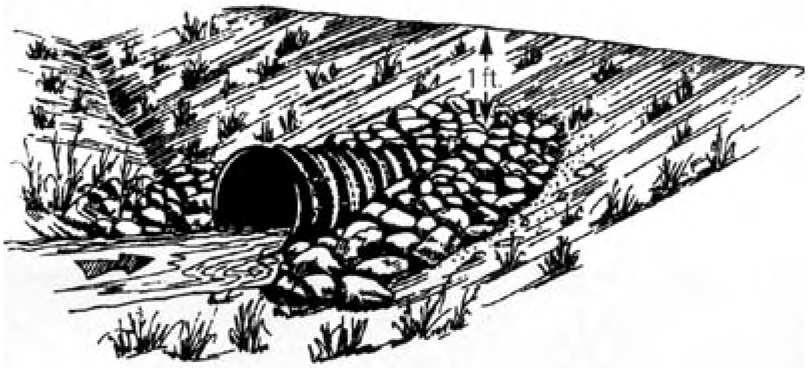
Road Improvement Monitoring

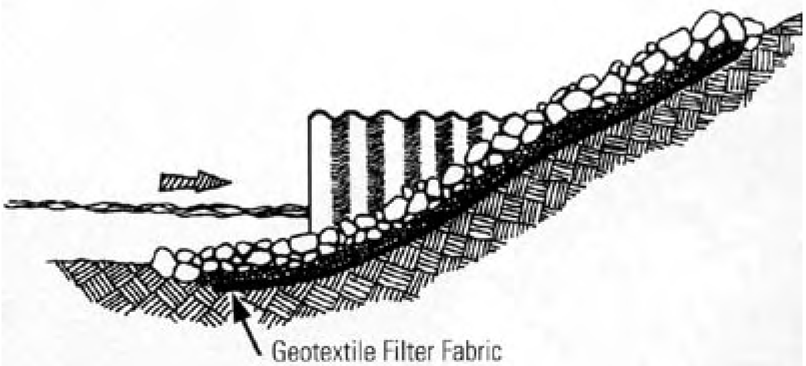
Effectiveness monitoring to evaluate road upgrades and sediment inputs associated with THPs are conducted annually in keeping with the NCWQCB's GWDR enrollment program. Annual monitoring reports are sent to the NCRWQCB every June (for plans that have not been closed) describing the condition of each site identified during the THP process, any new sites created or discovered and whether or not the mitigation action proposed is working as designed. To the extent possible all permanent and seasonal roads will be checked for erosion problems after large storm events and all opened roads will be checked at least once a year for erosion problems. Corrective action will be taken as necessary to maintain crossings in a condition that will not deliver sediments.

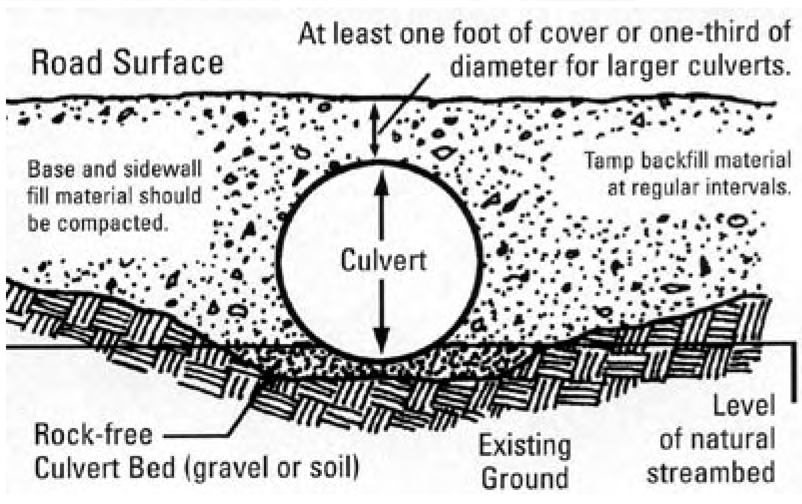
Long term monitoring will consist of mapping and tracking watercourse crossings using the Geographic Information System (GIS) in which each crossing will be mapped with Global Positioning System tools and the condition of the crossing shall be noted. Any changes made and the year they were made shall also be noted in the GIS database. Over time a complete inventory of all the road watercourse crossings will exist in the GIS database. The data can then be used to detail annual or cumulative sediment reduction activities on the Forests.

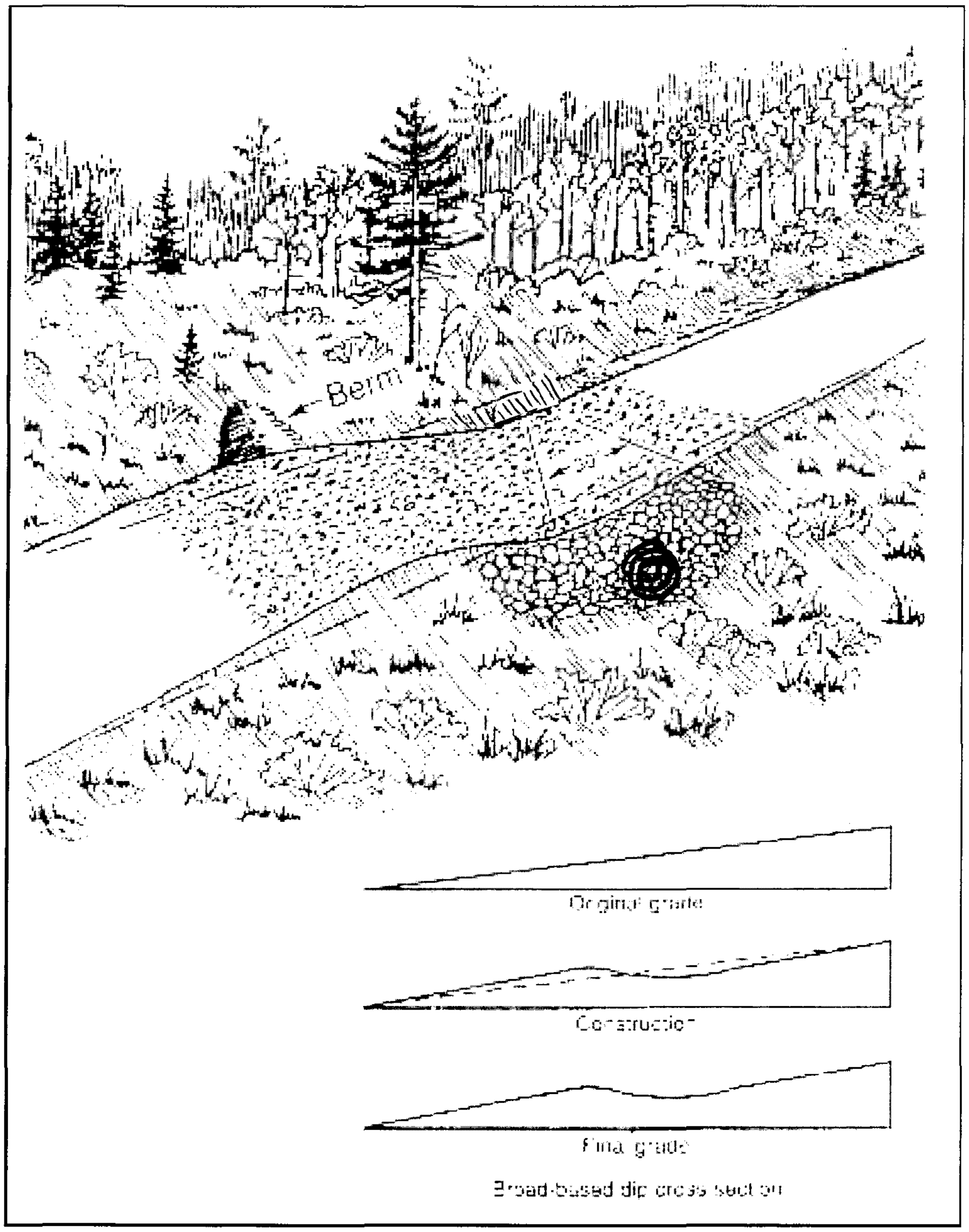
Typical Construction Diagrams

Culvert construction









ROLLING DIP / CRITICAL DIP W/ CULVERT

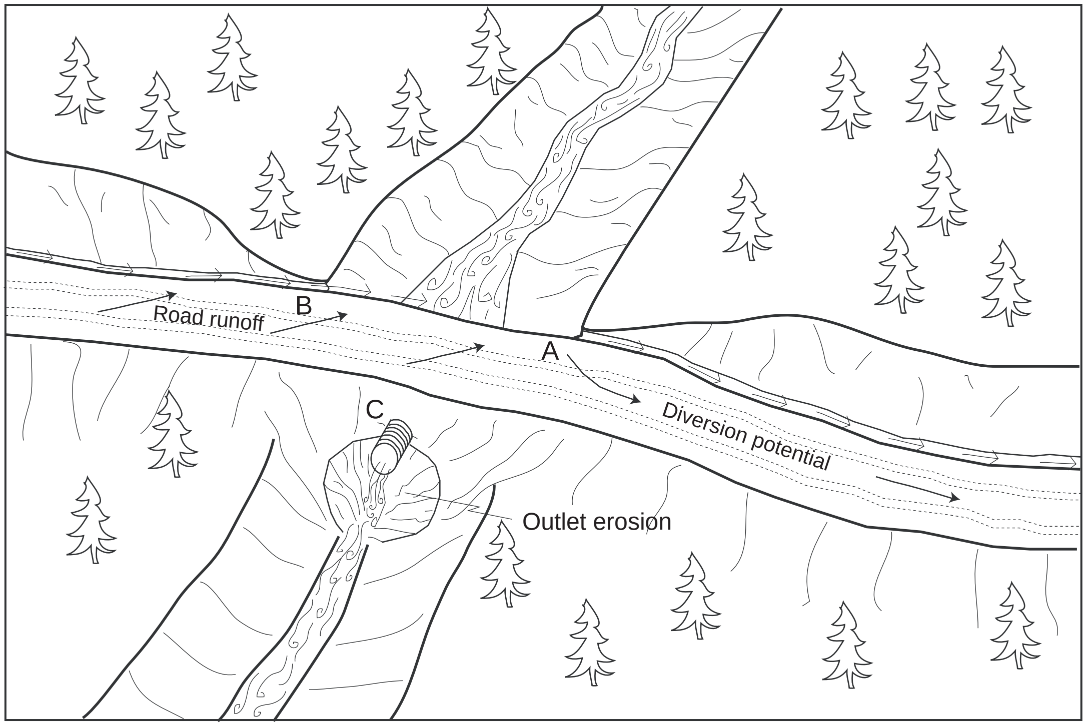
Typical Problems and Applied Treatments for a Non-fish Bearing Upgraded Stream Crossing

Problem condition (before)

A - Diversion potential

B - Road surface and ditch drain to stream

C - Undersized culvert high in fill with outlet erosion

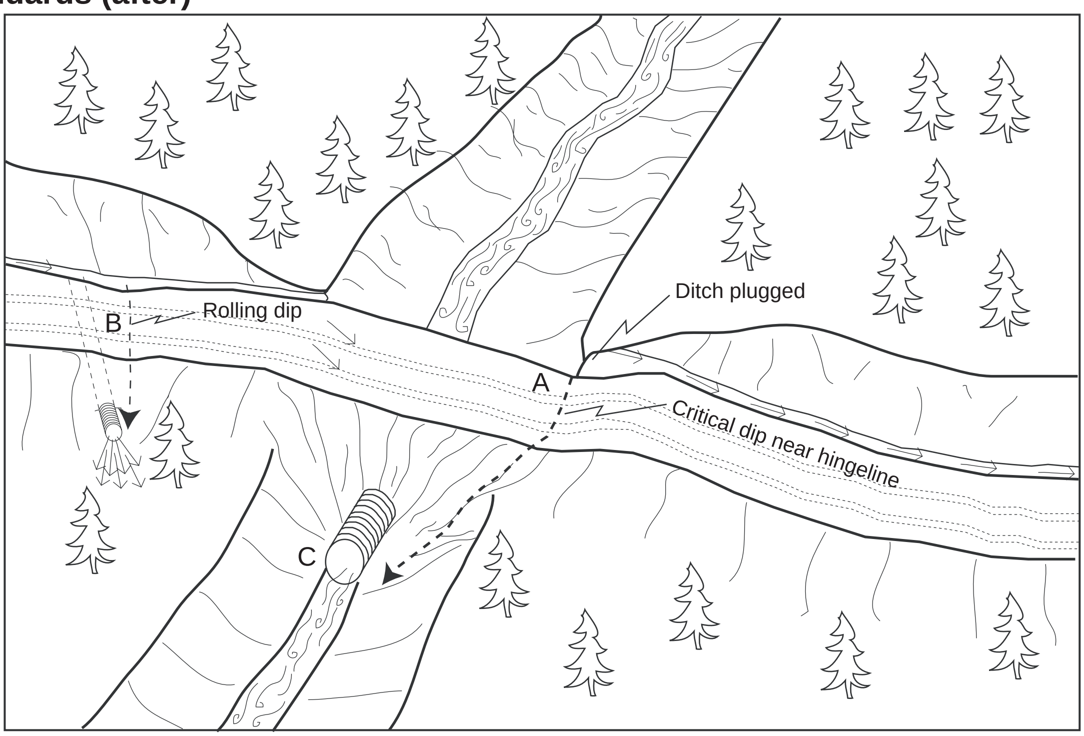


Treatment standards (after)

A - No diversion potential with critical dip installed near hingeline

B - Road surface and ditch disconnected from stream by rolling dip and ditch relief culvert

C - 100-year culvert set at base of fill



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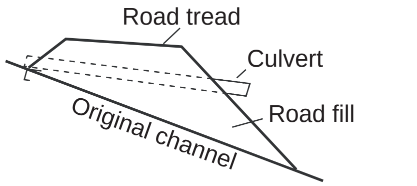
Typical Drawing #1

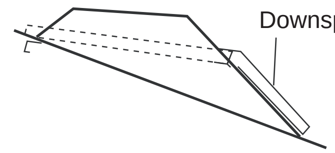
Typical Design of a Non-fish Bearing Culverted Stream Crossing

Existing



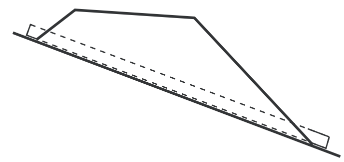
1. Culvert not placed at channel grade.
2. culvert does not extend past base of fill.

Upgraded



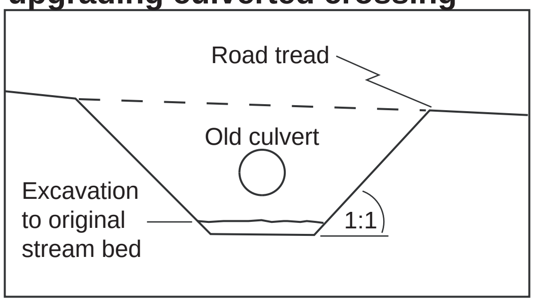
1. Culvert not placed at channel grade.
2. Downspout added to extend outlet past road fill.

Upgraded (preferred)

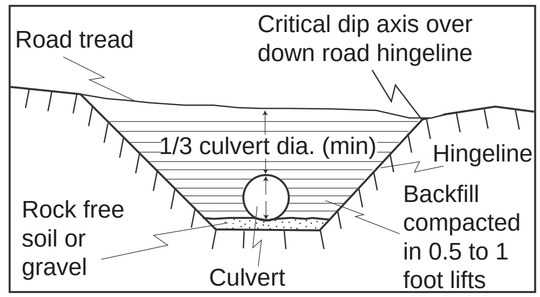


1. Culvert placed at channel grade.
2. Culvert inlet and outlet rest on, or partially in, the originial streambed.

Excavation in preparation for upgrading culverted crossing



Upgraded stream crossing culvert installation



Note:
Road upgrading tasks typically include upgrading stream crossings by installing larger culverts and inlet protection (trash barriers) to prevent plugging. Culvert sizing for the 100-year peak storm flow should be determined by both field observation and calulations using a procedure such as the Rational Formula.

Stream crossing culvert Installation

1. Culverts shall be aligned with natural stream channels to ensure proper function, and prevent bank erosion and plugging by debris.
2. Culverts shall be placed at the base of the fill and the grade of the original streambed, or downspouted past the base of the fill.
3. Culverts shall be set slightly below the original stream grade so that the water drops several inches as it enters the pipe.
5. To allow for sagging after burial, a camber shall be between 1.5 to 3 incher per 10 feet culvert pipe length.
6. Backfill material shall be free of rocks, limbs or other debris that could dent or puncture the pipe or allow water to seep around pipe.
7. First one end then the other end of the culvert shall be covered and secured.;The center is covered last.
8. Backfill material shall be tamped and compacted throughout the entire process:
   - Base and side wall material will be compacted before the pipe is placed in its bed.
   - Backfill compacting will be done in 0.5 - 1 foot lifts until 1/3 of the diameter of the culvert has been covered. A gas powered tamper can be used for this work.
9. Inlets and outlets shall be armored with rock or mulched and seeded with grass as needed.
10. Trash protectors shall be installed just upstream from the culvert where there is a hazard of floating debris plugging the culvert.
11. Layers of fill will be pushed over the crossing until the final designed road grade is achieved, at a minimum of 1/3 to 1/2 the culvert diameter.

Erosion control measures for culvert replacement

Both mechanical and vegetative measures will be employed to minimize accelerated erosion from stream crossing and ditch relief culvert upgrading. Erosion control measures implemented will be evaluated on a site by site basis. Erosion control measures include but are not limited to:

1. Minimizing soil exposure by limiting excavation areas and heavy equipment distrubance.
2. Installing filter windrows of slash at the base of the road fill to minimize the movement of eroded soil to downslope areas and stream channels.
3. Retaining rooted trees and shrubs at the base of the fill as “anchor” for the fill and filter windrows.
4. Bare slopes created by construction operations will be protected until vegetation can stabilize the surface. Surface erosion on exposed cuts and fills will be minimized by mulching, seeding, planting, compacting, armoring, and/or benching prior to the first rains.
5. Excess or unusable soil will be stored in long term spoil disposal locations that are not limited by factors such as excessive moisture, steep slopes greater than 10%, archeology potential, or proximity to a watercourse.
6. On running streams, water will be pumped or diverted past the crossing and into the downstream channel during the construction process.
7. Straw bales and/or silt fencing will be employed where necessary to control runoff within the construction zone.

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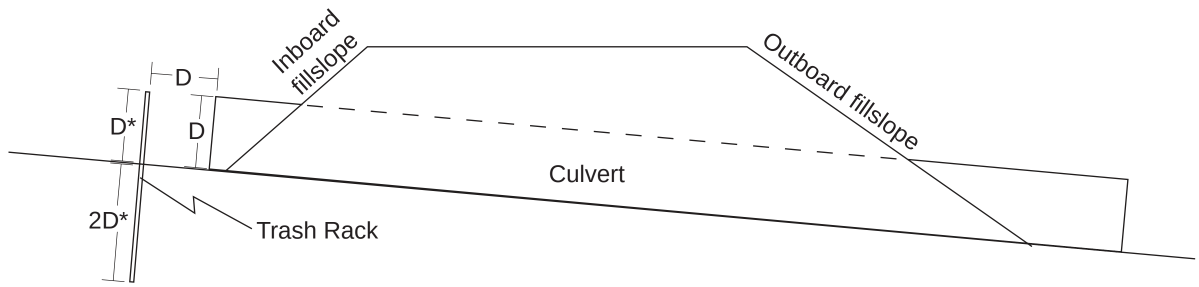
Typical Drawing #2

Typical Design of a Single-post Culvert Inlet Trash Rack

Cross section view



D - Culvert diameter

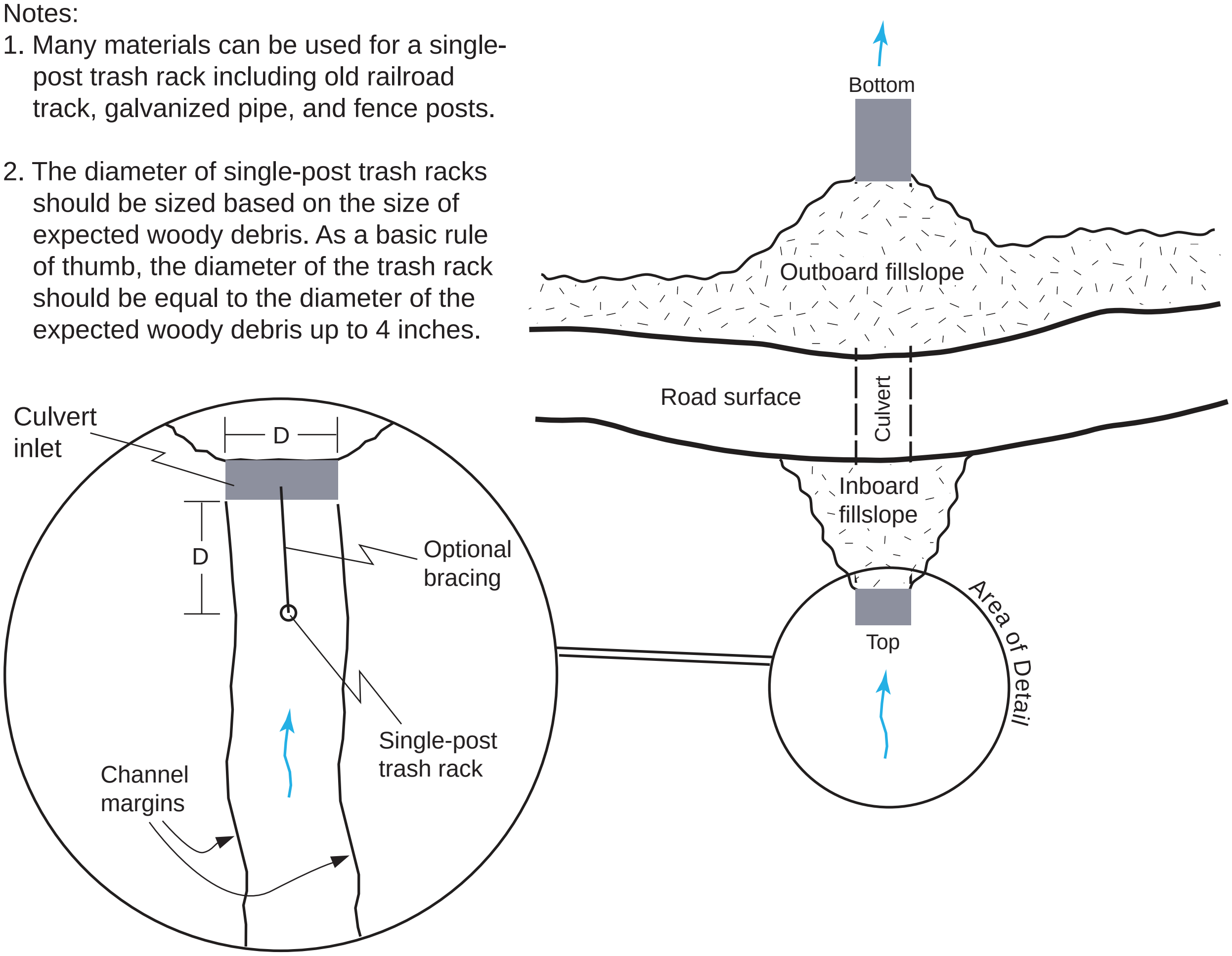
D* - If the culvert is designed for the 100-year peak storm flow, the trash rack height above the streambed should equal D.
If the culvert is undersized, then the trash rack needs to be extended vertically above the streambed to match or exceed the expected headwall height.

Plan view

Notes:

1. Many materials can be used for a single-post trash rack including old railroad track, galvanized pipe, and fence posts.

2. The diameter of single-post trash racks should be sized based on the size of expected woody debris. As a basic rule of thumb, the diameter of the trash rack should be equal to the diameter of the expected woody debris up to 4 inches.



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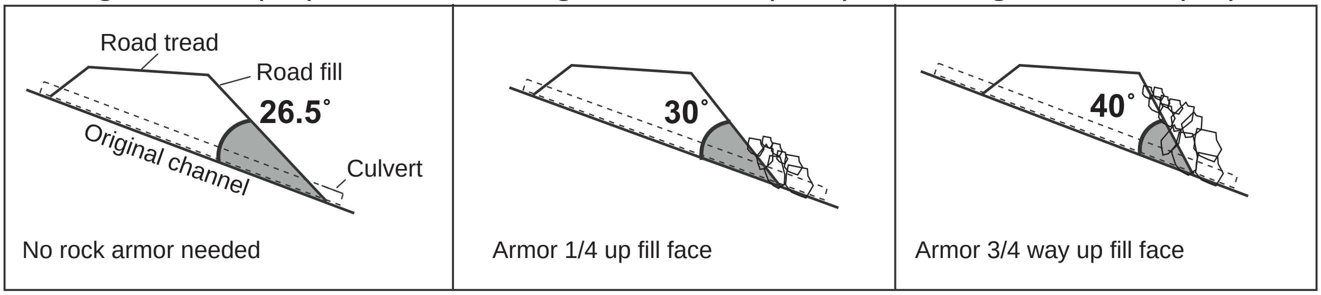
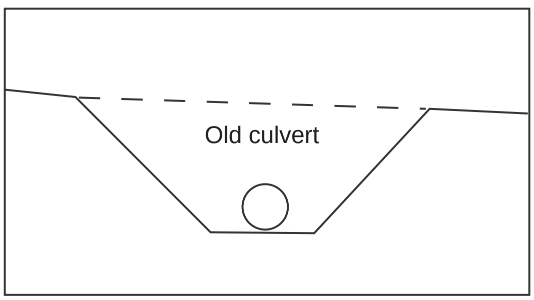
Typical Design of Stream Crossing Fill Armor

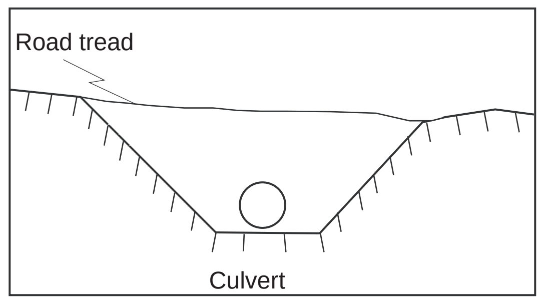
Fill angles ≤26.5° (2:1) **Fill angles 26.5° - 35° (1.5:1)** **Fill angles 35° - 45° (1:1)**



Fill angles 26.5° - 35° (1.5:1)



Fill angles 35° - 45° (1:1)



Note:
Road upgrading tasks typically include upgrading stream crossings by installing larger culverts and inlet protection (trash barriers) to prevent plugging. Culvert sizing for the 100-year peak storm flow should be determined by both field observation and calculations using a procedure such as the Rational Formula.

Stream crossing culvert Installation

1. Culverts shall be aligned with natural stream channels to ensure proper function, and prevent bank erosion and plugging by debris.
2. Culverts shall be placed at the base of the fill and the grade of the original streambed or downspouted past the base of the fill.
3. Culverts shall be set slightly below the original stream grade so that the water drops several inches as it enters the pipe.
5. To allow for sagging after burial, a camber shall be between 1.5 to 3 incher per 10 feet culvert pipe length.
6. Backfill material shall be free of rocks, limbs or other debris that could dent or puncture the pipe or allow water to seep around pipe.
7. First one end and then the other end of the culvert shall be covered and secured. The center is covered last.
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9. Inlets and outlets shall be armored with rock or mulched and seeded with grass as needed.
10. Trash protectors shall be installed just upstream from the culvert where there is a hazard of floating debris plugging the culvert.
11. Layers of fill will be pushed over the crossing until the final designed road grade is achieved, at a minimum of 1/3 to 1/2 the culvert diameter.

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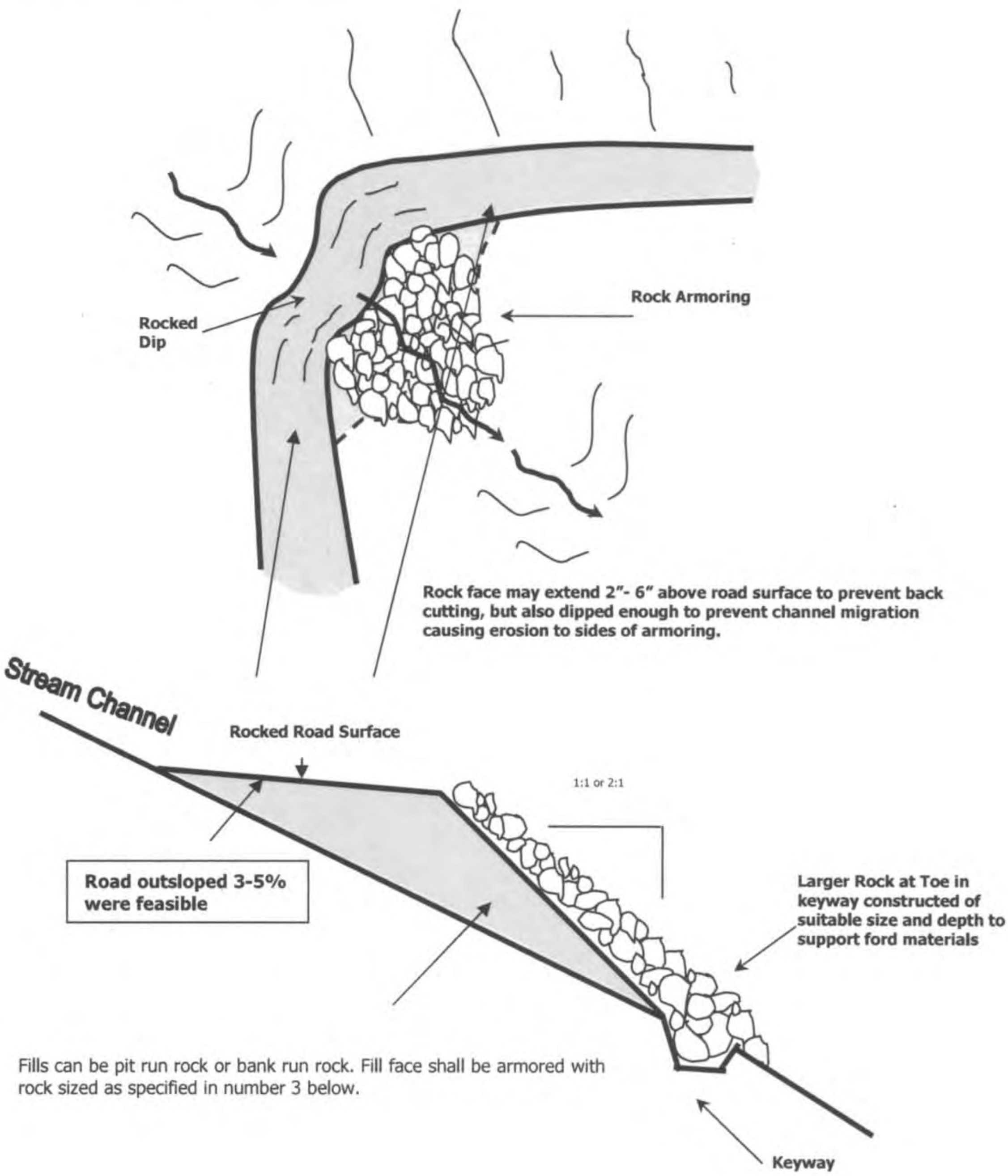
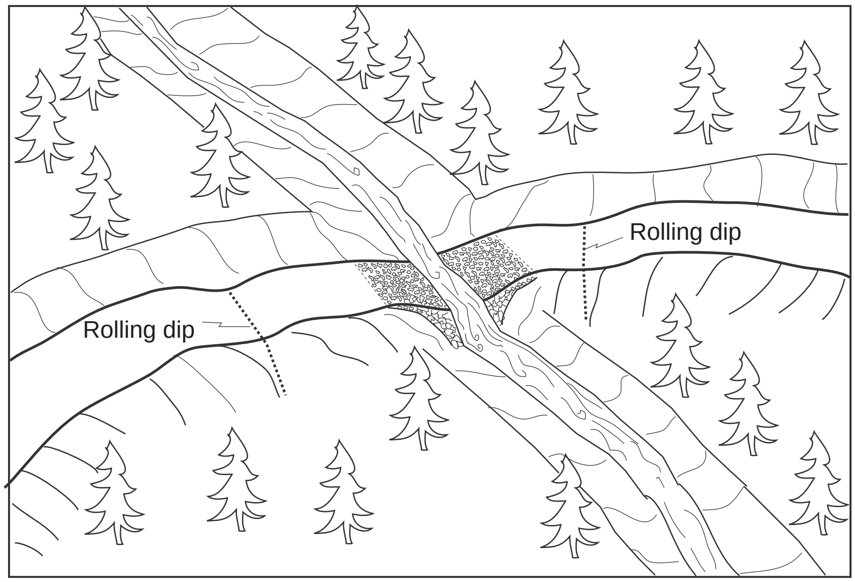
ROCK ARMORED FILL (RAF)

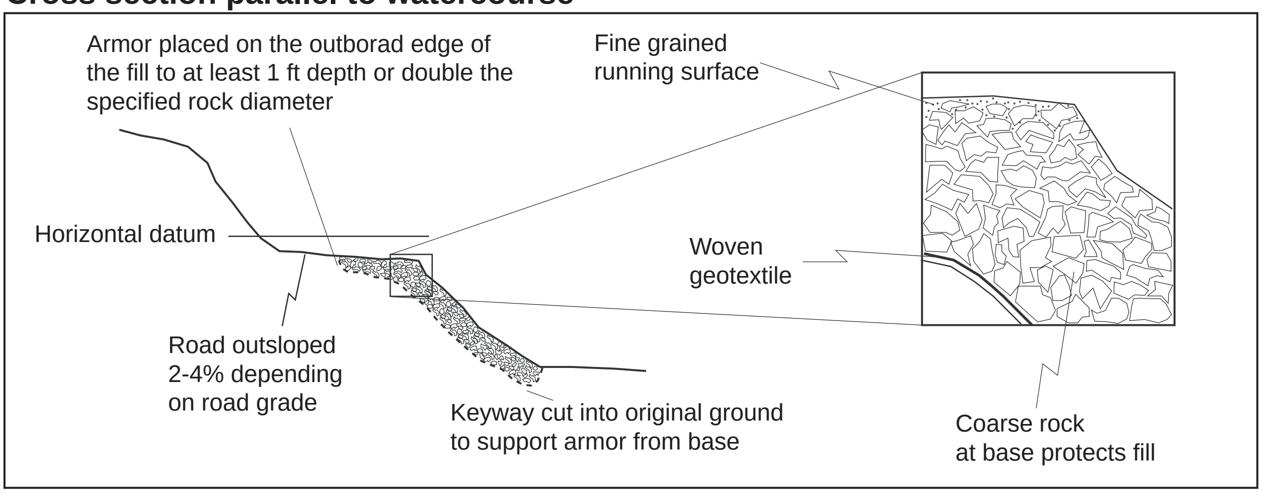


1. Road surface to be rocked 5 times the channel width. i.e. if channel width is 2 feet, rock 10 feet each side of channel, or up to 25 feet each side of channel on well traveled roads. The channel width to be determined upstream of the crossing. The road surface is rocked with 4" minus rock approximately 6" deep and compacted into the channel at crossing. Mulch from end of rock, to the first water bar.
2. I RAF should be constructed by subexcavating the roadbed to form an exaggerated dip and spillway through the crossing. The dip shall be as least 1.5 times the width of the upstream channel or wider. By increasing the width this will slow down the water prior to going over spill way and also prevent back cutting.
3. The downstream fill face shall be armored with adequately sized large rock capable of handling a 100 yr flood event. The rock is sized to be non-transportable and the size is determined by reviewing the stream substrate up and down stream of the crossing. Generally this is 6" to 24" with a mean diameter of 12". There shall also be a mix of different size rocks to fill the voids between the large rock. A fill face over 50% will require rocks that shall be placed into a deepened keyway at the bottom of the fill prism.
4. For a rock armored fill, fill material cab be pit run rock or bank run rock.
5. The down stream fill face should be rocked at least 1.5 times the width of the channel width or wider, so that it will accommodate the flow of a 100 year storm. The width of the channel should be determined upstream of the crossing. The armoring should be wide enough to accommodate the over widened channel, to prevent erosion to the sides of the armoring.
6. Rock armoring may extend 2" - 6" above the outside edge of the road surface. Armoring must be wide enough to prevent erosion to the sides of the armoring. This is to prevent back cutting.

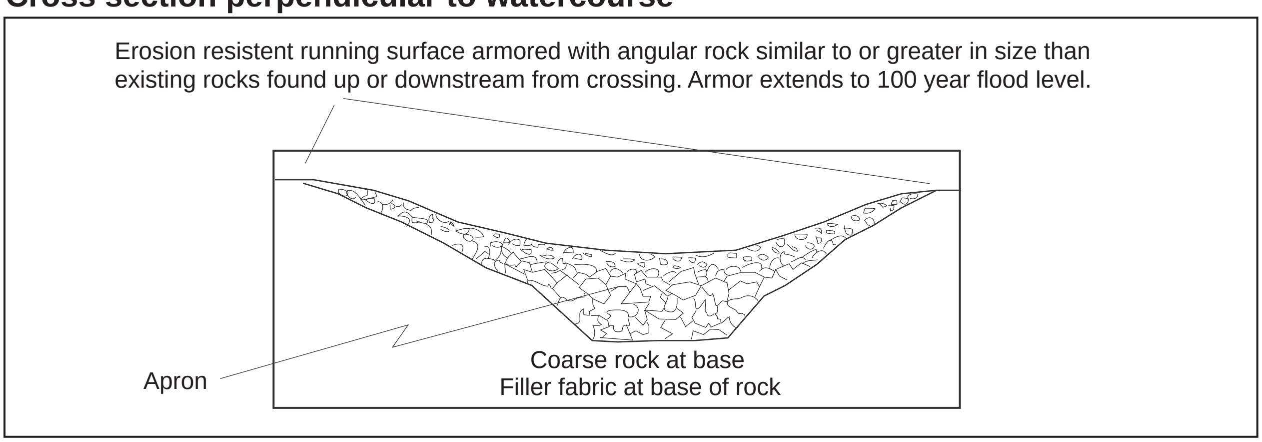
Typical Armored Fill Crossing Installation



Cross section parallel to watercourse



Cross section perpendicular to watercourse



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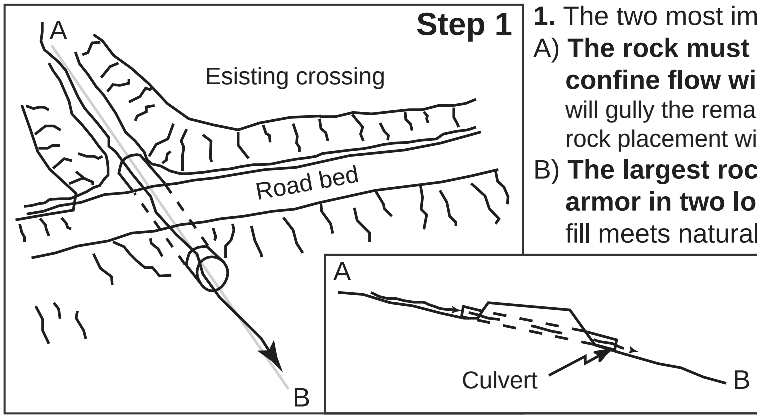
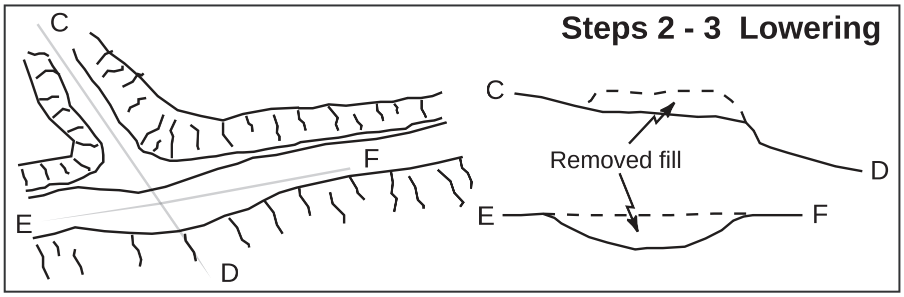
Ten Steps for Constructing a Typical Armored Fill Stream Crossing



1. The two most important points are:

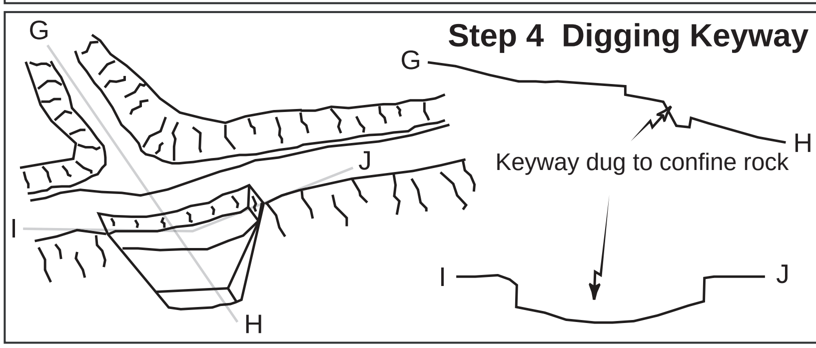
A) **The rock must be placed in a "U" shape across the channel to confine flow within the armored area.** (Flow around the rock armor will gully the remaining fill. Proper shape of surrounding road fill and good rock placement will reduce the likelihood of crossing failure).

B) **The largest rocks must be used to buttress the rest of the armor in two locations:** (i) The base of the armored fill where the fill meets natural channel. (This will butress the armor placed on the outboard fill face and reduce the likelihood of it washing downslope). (ii) The break in slope from the road tread to the outer fill face. (This will butress the fill placed on the outer road tread and will determine the "base level" of the creek as it crosses the road surface).



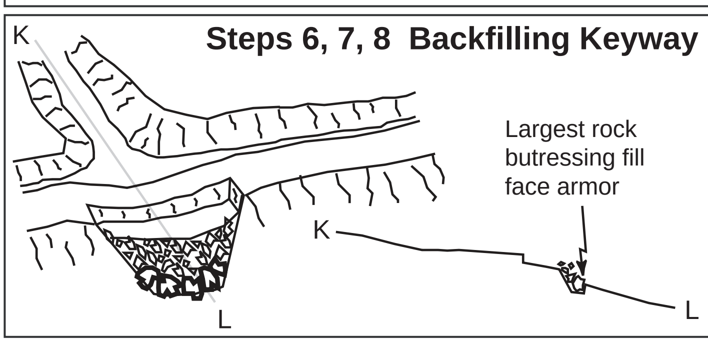
2. Remove any existing drainage structures including culverts and Humboldt logs.

3. Construct a dip centered at the crossing that is large enough to accomodate the 100-year peak storm flow and prevent diversion (C-D, E-F).



4. Dig a keyway (to place rock in) that extends from the outer 1/3 of the road tread down the outboard road fill to the point where outbaord fill meets natural channel (up to 3 feet into the channel bed depending on site specifics) (G-H, I-J).

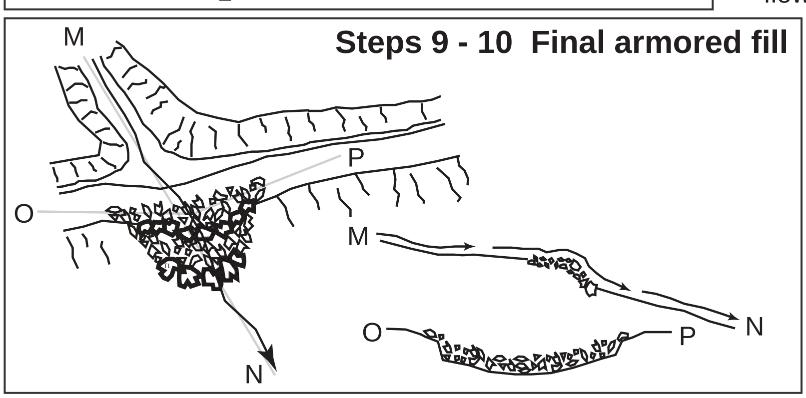
5. Install geofabric (optional) within keyway to support rock in wet areas and to prevent winnowing of the crossing at low flows.



6. Put aside the largest rock armoring to create 2 buttresses in the next step.

7. Create a buttress using the largest rock (as described in the site treatments specifications) at the base of fill. (This should have a "U" shape to it and will define the outlet of the armored fill.)

8. Backfill the fill face with remaining rock armor making sure the final armored area has "U" shape that will accomodate the largest expected flow (K-L).



9. Install a second buttress at the break in slope between the outboard road and the outboard fill face. (This should define the base level of the stream and determine how deep the stream will backfill after construction). (M-N)

10. Back fill the rest of the keyway with the unsorted rock armor making sure the final armored area has a "U" shape that will accommodate the largest expected flow (O-P).

Typical Drawing #7

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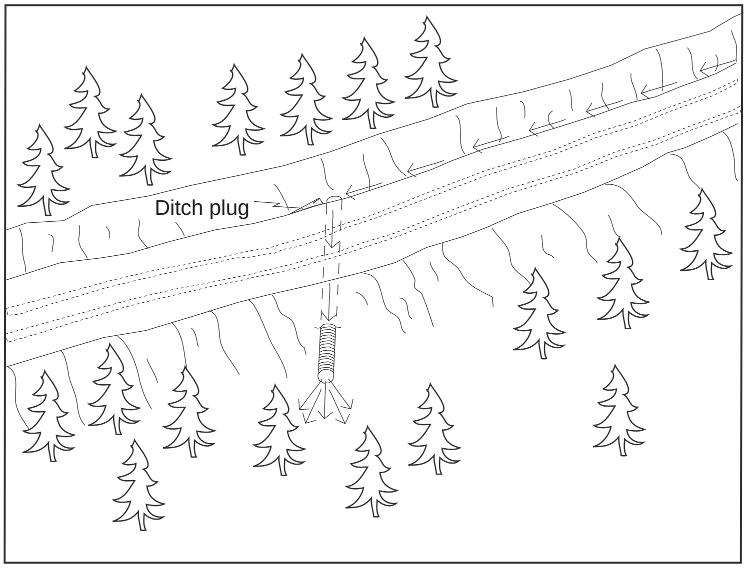
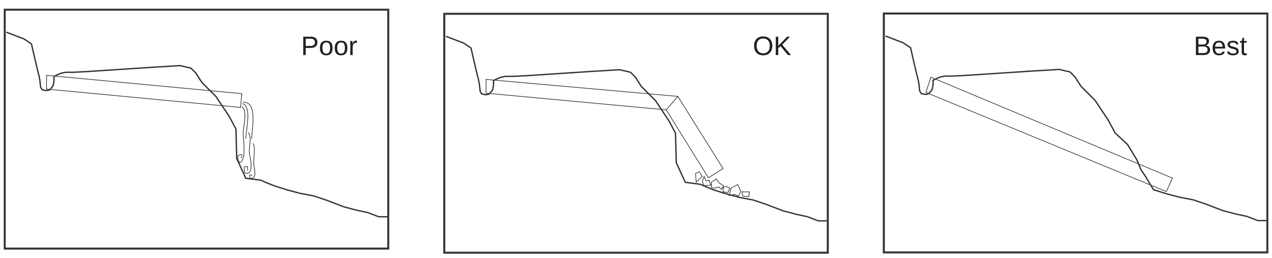
Typical Ditch Relief Culvert Installation





Ditch relief culvert installation

1) The same basic steps followed for stream crossing installation shall be employed.
2) Culverts shall be installed at a 30 degree angle to the ditch to lessen the chance of inlet erosion and plugging.
3) Culverts shall be seated on the natural slope or at a minimum depth of 5 feet at the outside edge of the road, whichever is less.
4) At a minimum, culverts shall be installed at a slope of 2 to 4 percent steeper than the approaching ditch grade, or at least 5 inches every 10 feet.
5) Backfill shall be compacted from the bed to a depth of 1 foot or 1/3 of the culvert diameter, which ever is greater, over the top of the culvert.
6) Culvert outlets shall extend beyond the base of the road fill (or a flume downspout will be used). Culverts will be seated on the natural slope or at a depth of 5 feet at the outside edge of the road, whichever is less.

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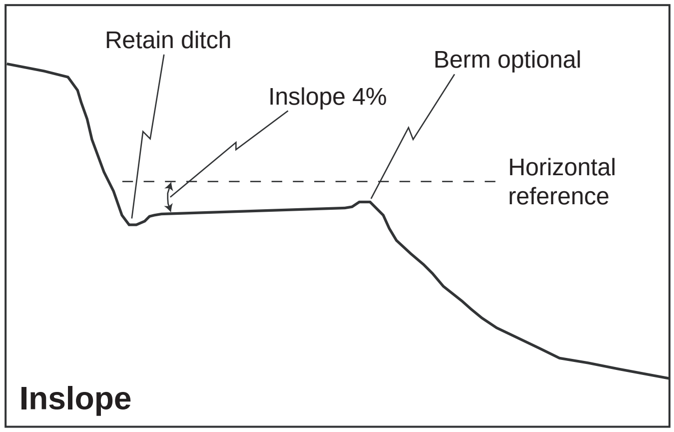
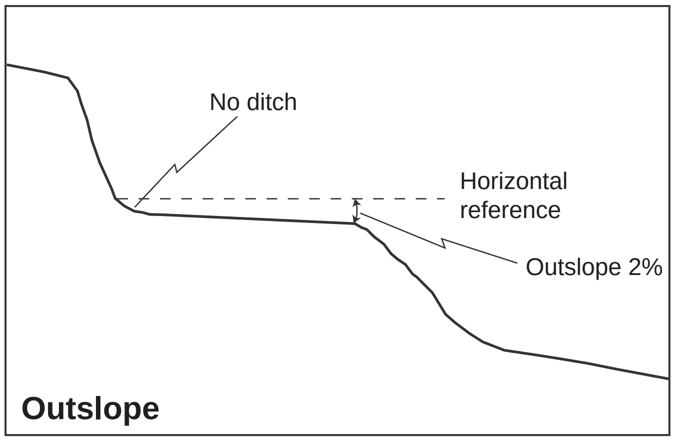
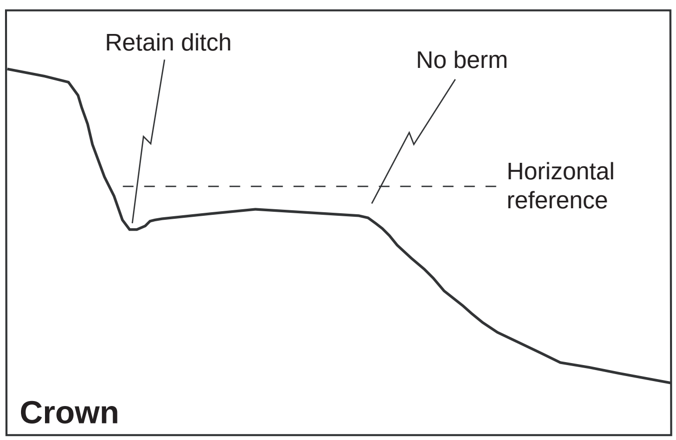
Typical Designs for Using Road Shape to Control Road Runoff







Outsloping Pitch for Roads Up to 8% Grade		
Road grade	**Unsurfaced roads**	**Surfaced roads**
4% or less	3/8" per foot	1/2" per foot
5%	1/2" per foot	5/8" per foot
6%	5/8" per foot	3/4" per foot
7%	3/4" per foot	7/8" per foot
8% or more	1" per foot	1 1/4" per foot

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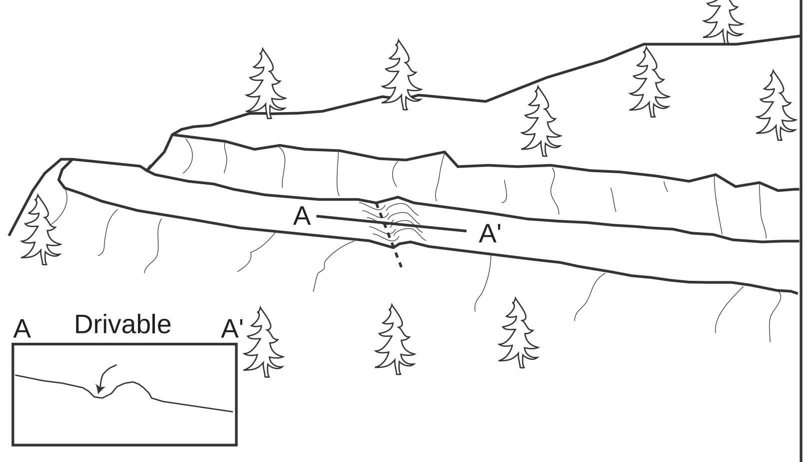
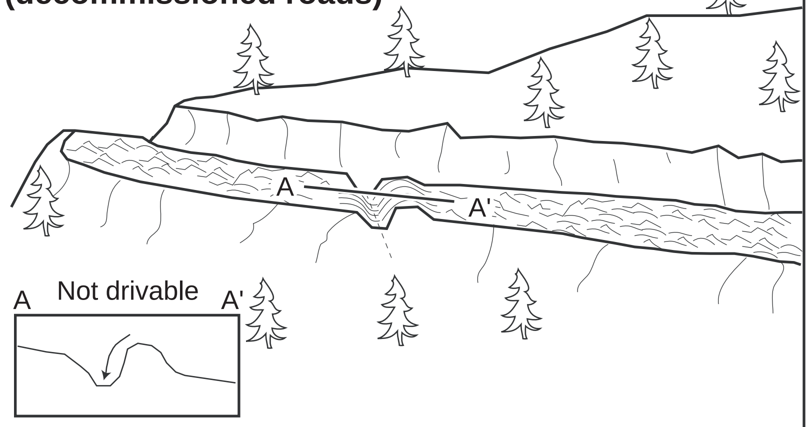
Typical Methods for Dispersing Road Surface Runoff with Waterbars, Cross-road Drains, and Rolling Dips

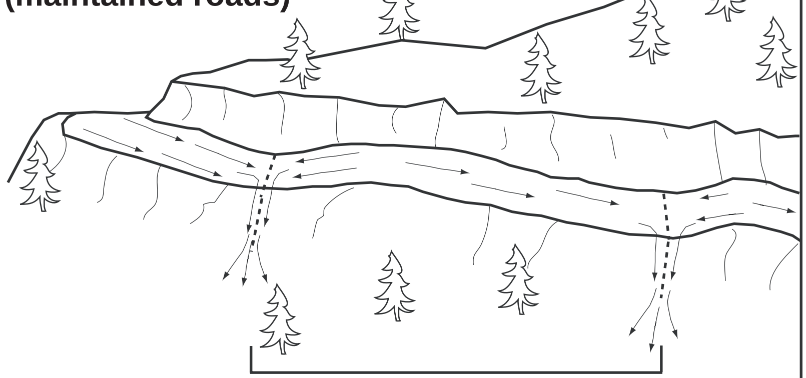
Waterbars (seasonal roads)



Cross-road drain and decompaction (decommissioned roads)



Rolling dips (maintained roads)



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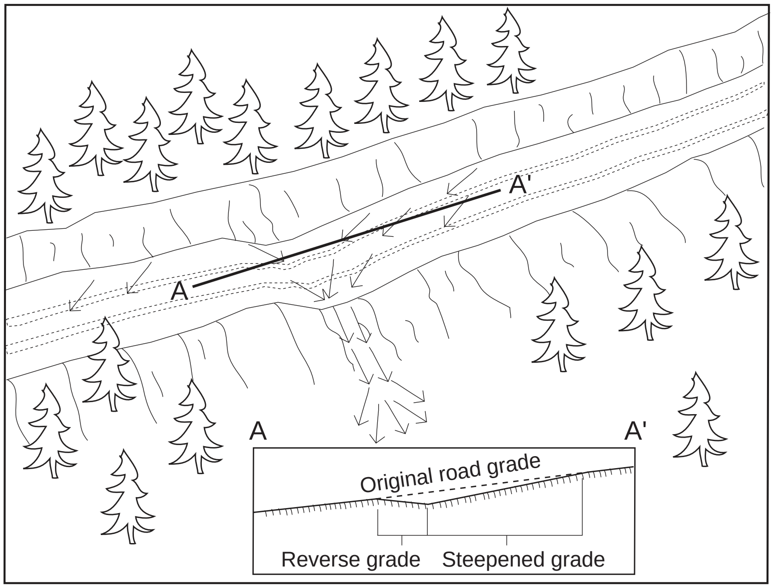
Typical Drawing #10

Typical Road Surface Drainage by Rolling Dips



Rolling dip installation:

1. Rolling dips will be installed in the roadbed as needed to drain the road surface.
2. Rolling dips will be sloped either into the ditch or to the outside of the road edge as required to properly drain the road.
3. Rolling dips are usually built at 30 to 45 degree angles to the road alignment with cross road grade of at least 1% greater than the grade of the road.
4. Excavation for the dips will be done with a medium-size bulldozer or similar equipment.
5. Excavation of the dips will begin 50 to 100 feet up road from where the axis of the dip is planned as per guidelines established in the rolling dip dimensions table.
6. Material will be progressively excavated from the roadbed, steepening the grade unitl the axis is reached.
7. The depth of the dip will be determined by the grade of the road (see table below).
8. On the down road side of the rolling dip axis, a grade change will be installed to prevent the runoff from continuing down the road (see figure above).
9. The rise in the reverse grade will be carried for about 10 to 20 feet and then return to the original slope.
10. The transition from axis to bottom, through rising grade to falling grade, will be in a road distance of at least 15 to 30 feet.

Table of rolling dip dimensions by road grade

Road grade %	**Upslope approach distance** (from up road start to trough) ft	**Reverse grade distance** (from trough to crest) ft	**Depth at trough outlet** (below average road grade) ft	**Depth at trough inlet** (below average road grade) ft
<6	55	15 - 20	0.9	0.3
8	65	15 - 20	1.0	0.2
10	75	15 - 20	1.1	0.01
12	85	20 - 25	1.2	0.01
>12	100	20 - 25	1.3	0.01

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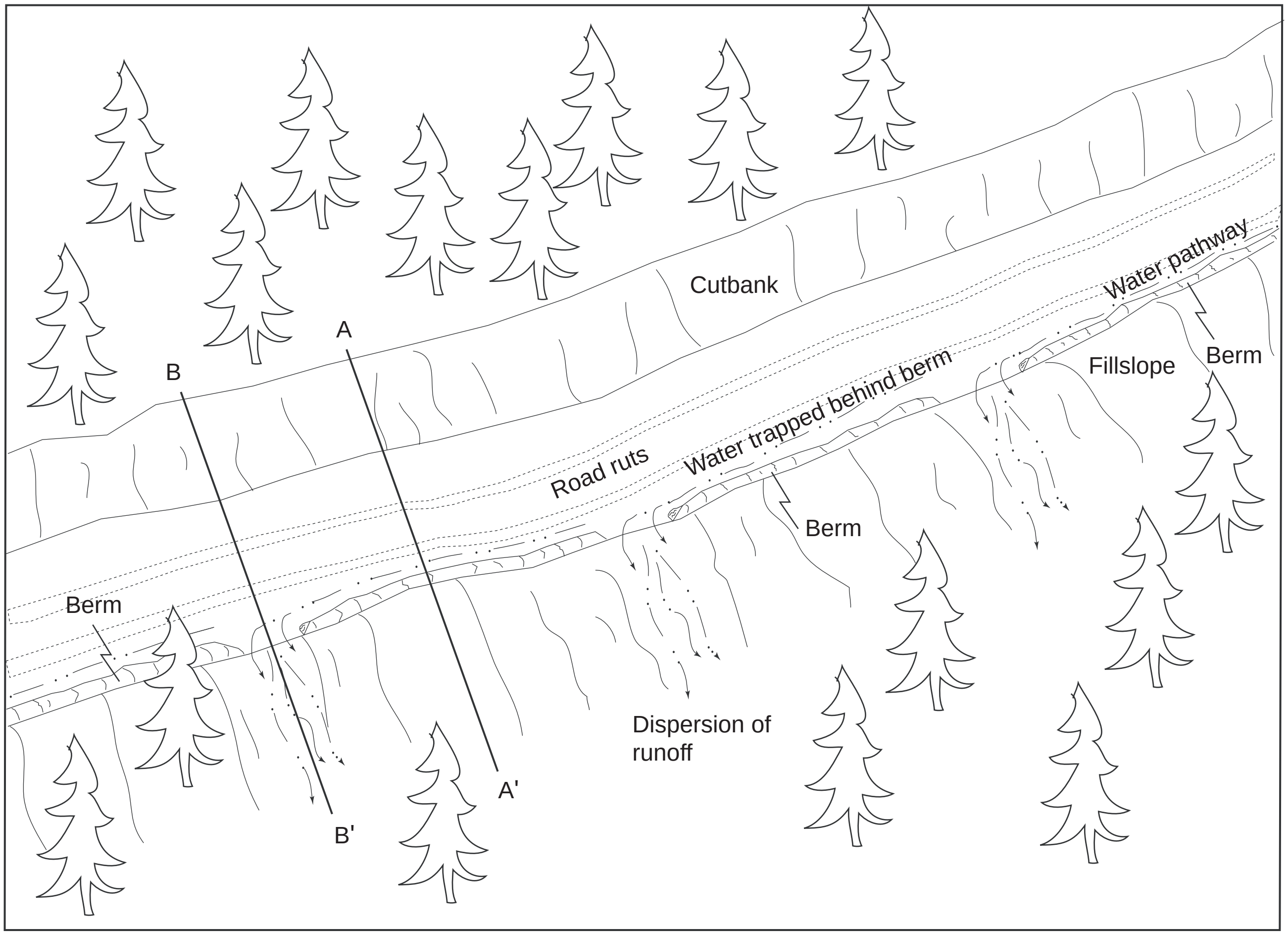
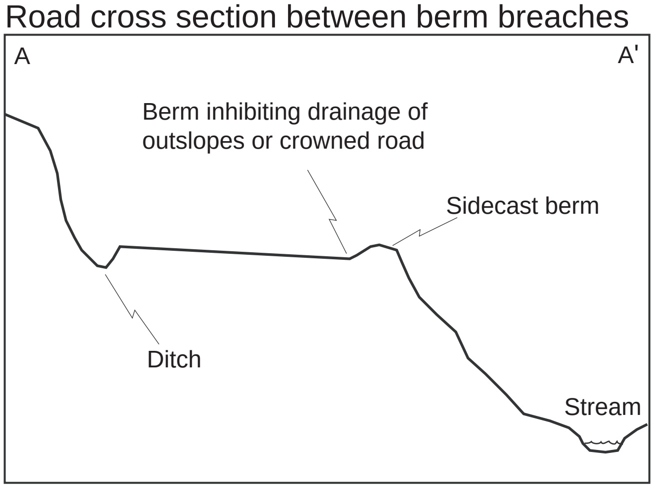
Typical Sidecast or Excavation Methods for Removing Outboard Berms on a Maintained Road

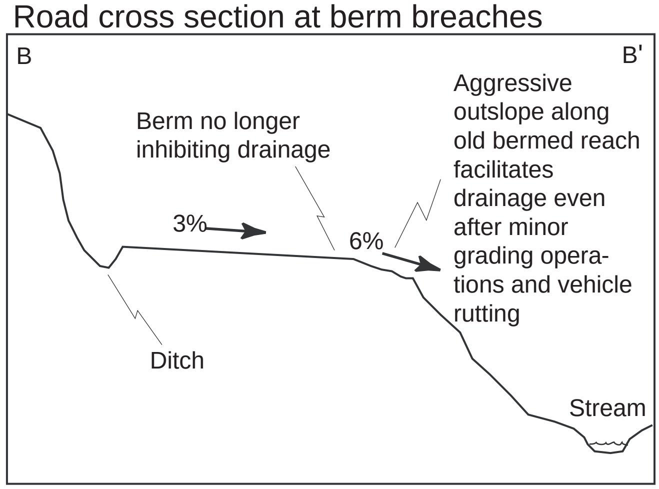
1. On gentle road segments berms can be removed continuously (see B-B').
2. On steep road segments, where safety is a concern, the berm can be frequently breached (see A-A' & B-B') Berm breaches should be spaced every 30 to 100 feet to provide adequate drainage of the road system while maintaining a semi-continuous berm for vehicle safety.



Road cross section between berm breaches



Road cross section at berm breaches



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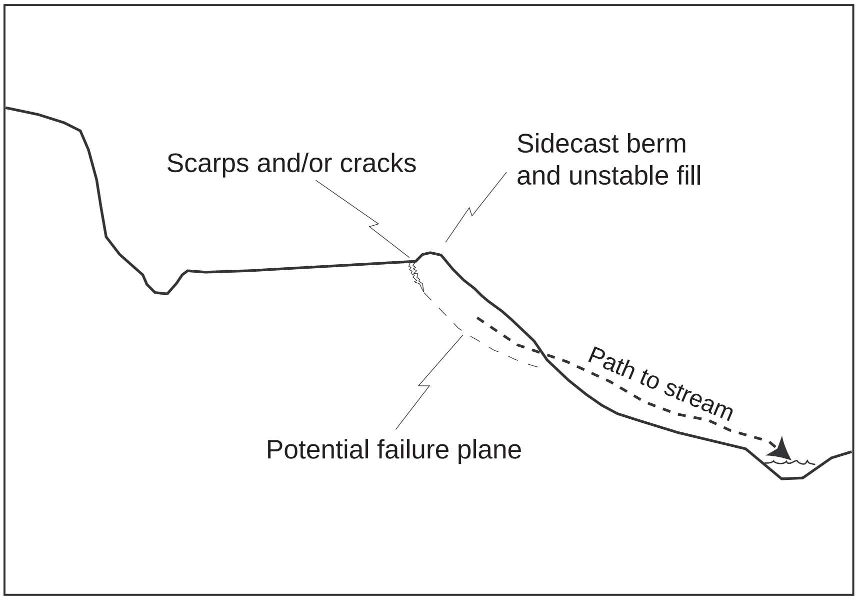
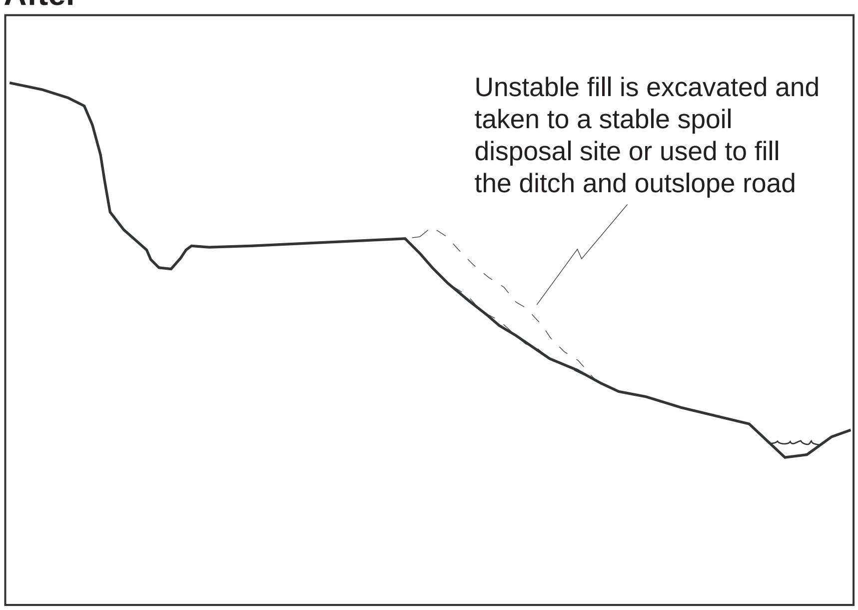
Typical Excavation of Unstable Fillslope on an Upgraded Road

Before



After



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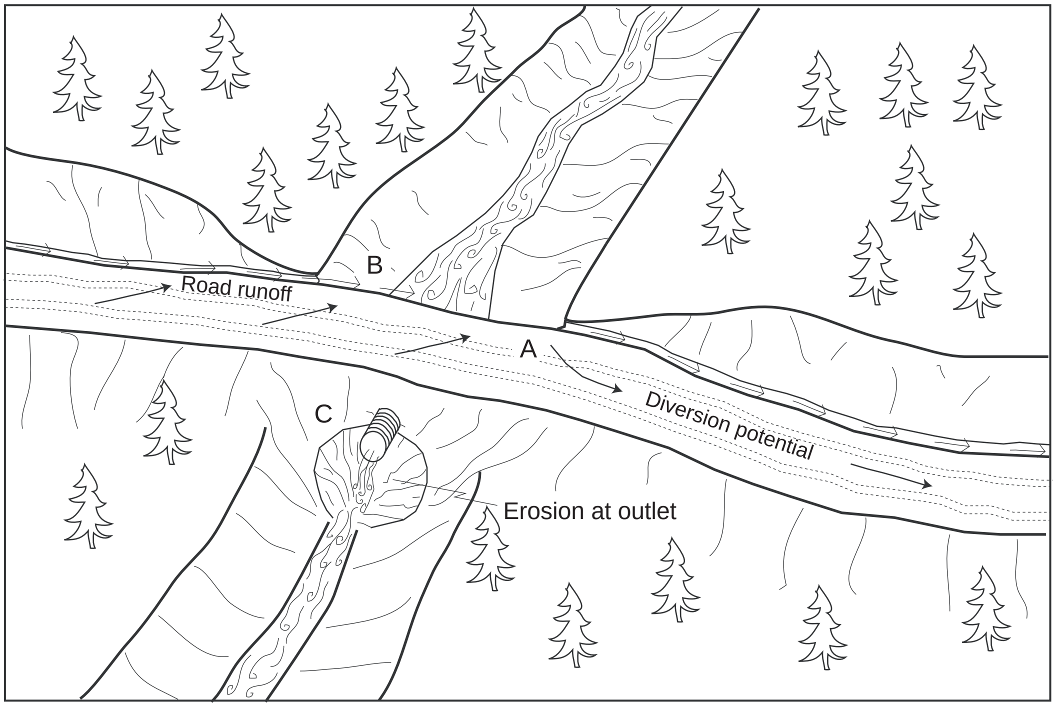
Typical Problems and Applied Treatments for a Decommissioned Stream Crossing

Problem condition (before)

A - Diversion potential

B - Road surface and ditch drain to stream

C - Undersized culvert high in fill with outlet erosion

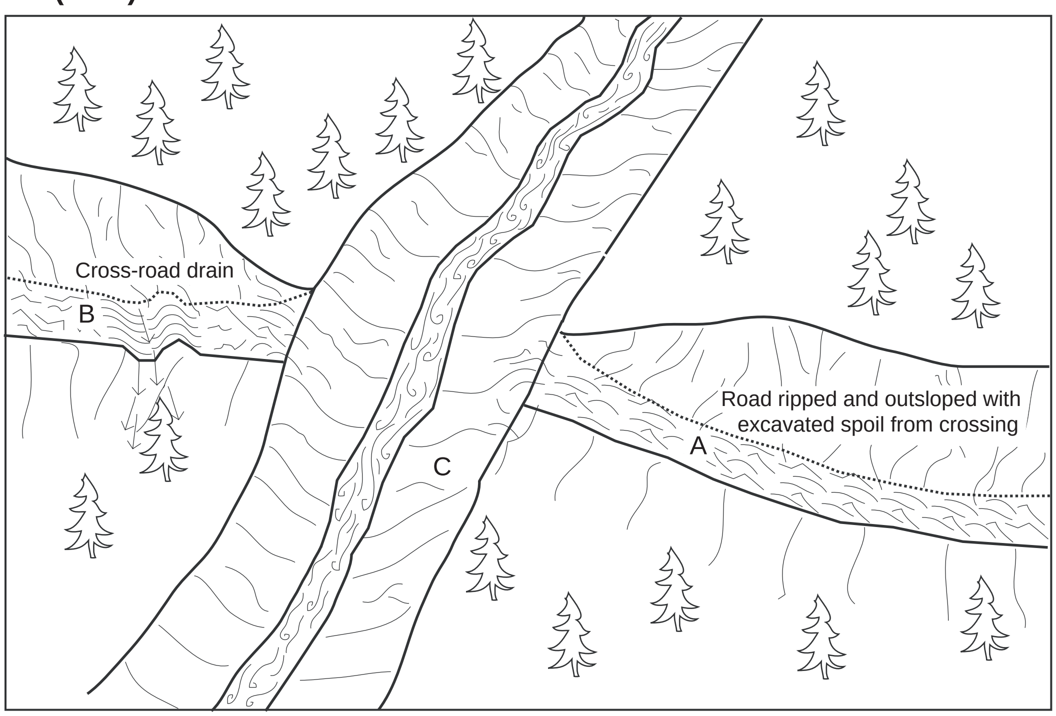


Treatment standards (after)

A - Diversion prevented by road surface ripping and outsloping using excavated spoils

B - Road surface and ditch disconnected from stream by road surface decompaction and cross-road drains

C - Stream crossing fill completely excavated



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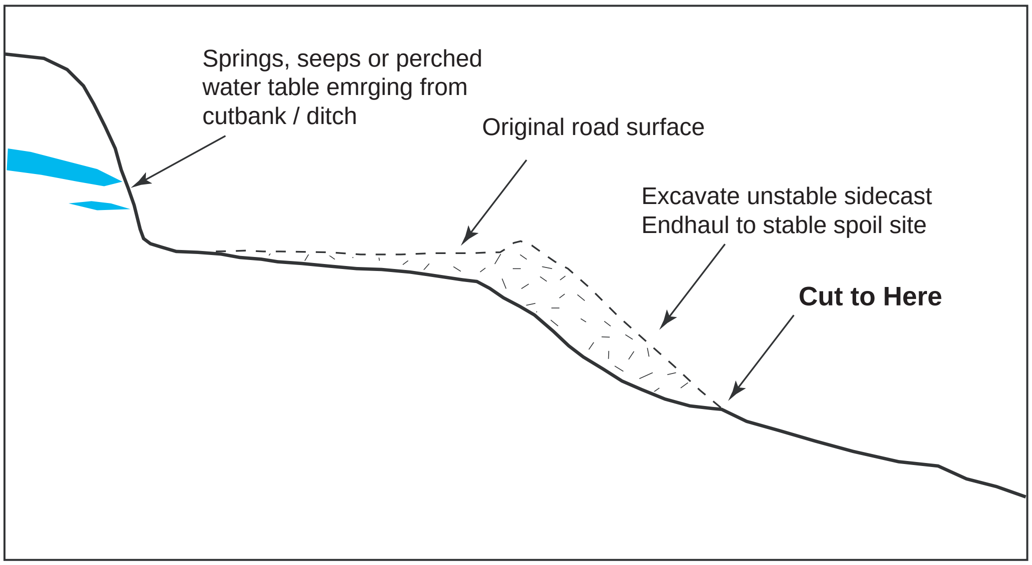
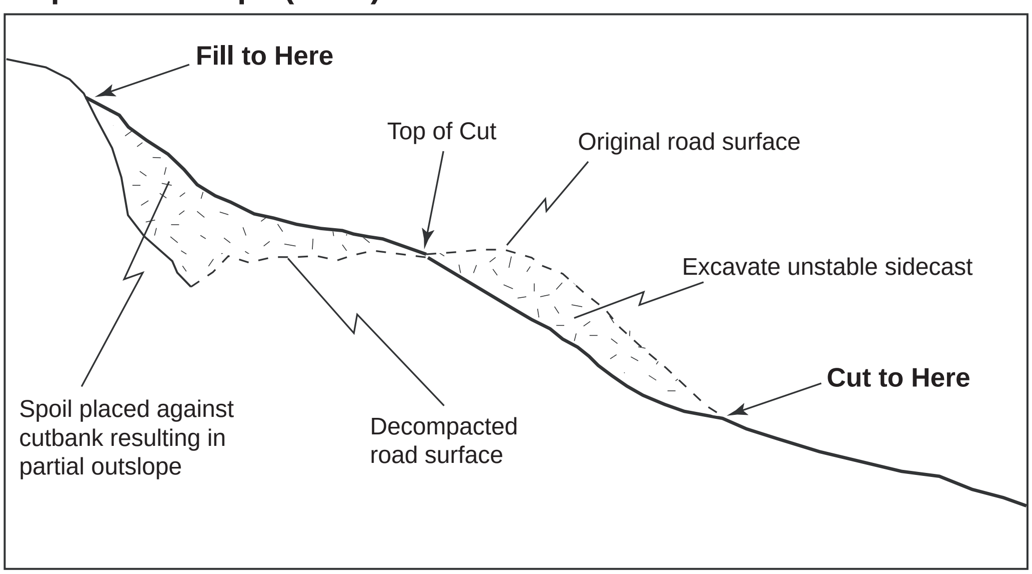
Typical Drawing #14

Typical Design for Road Decommisioning Treatments Employing Export and In-Place Outsloping Techniques

Export outslope (EPOS)



In-place outslope (IPOS)



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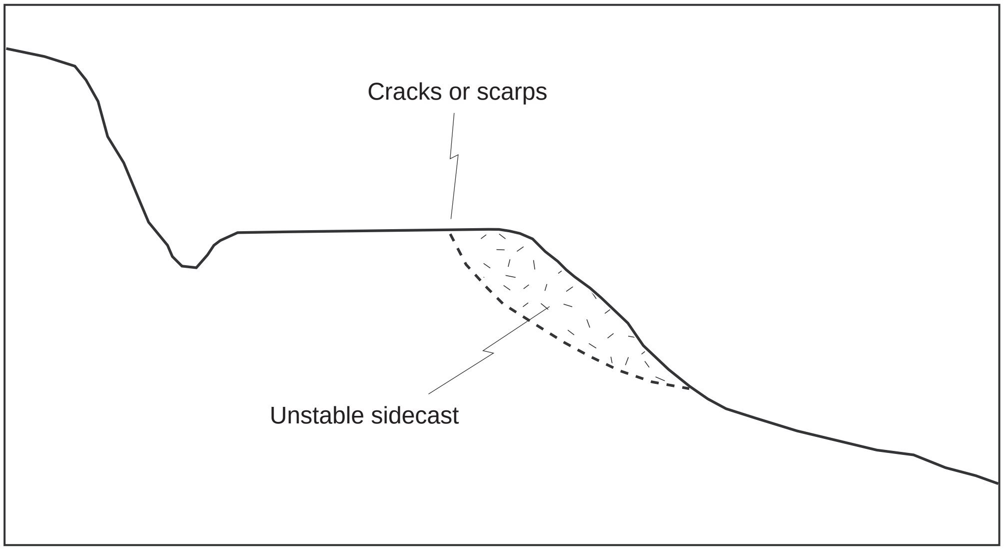
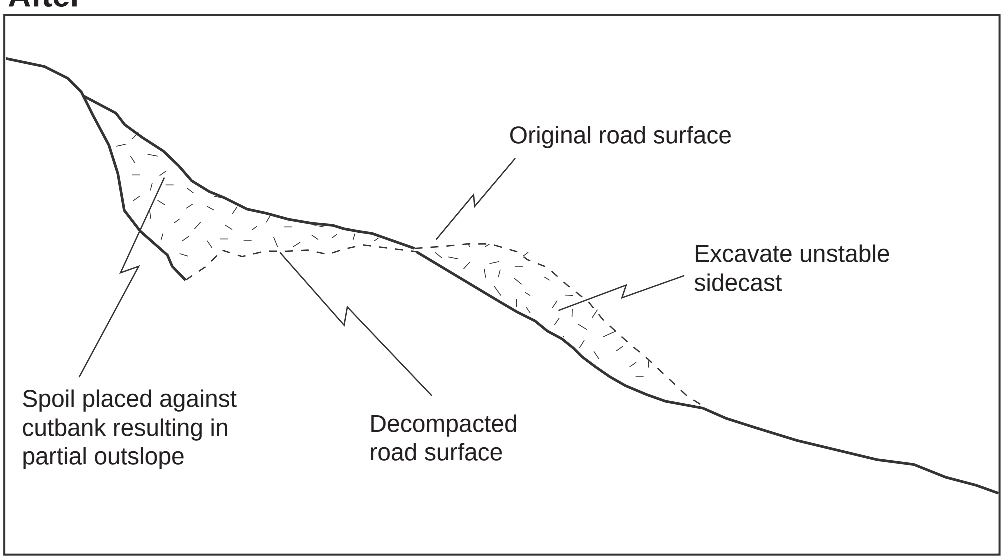
Typical Excavation of Unstable Fillslope on a Decommissioned Road

Before



After



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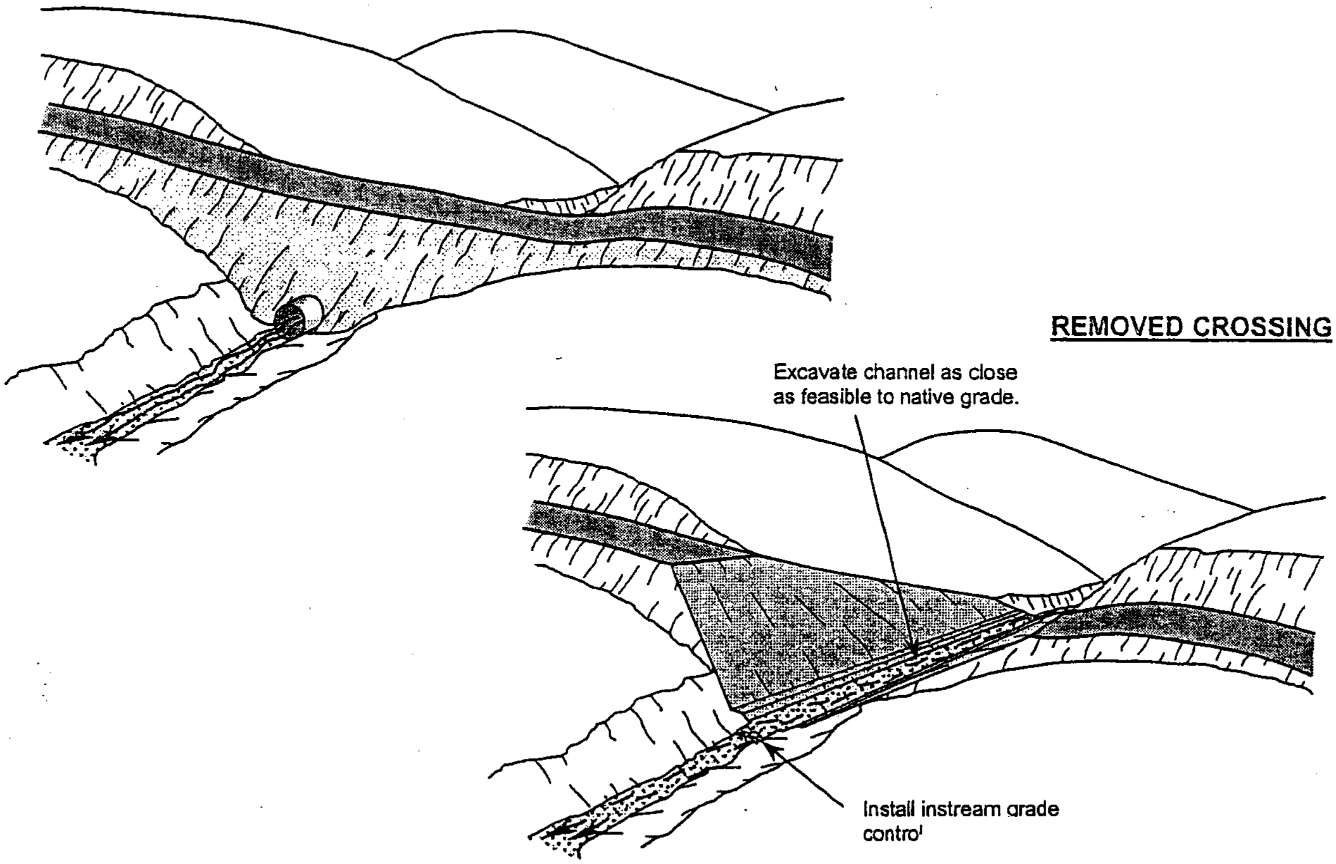
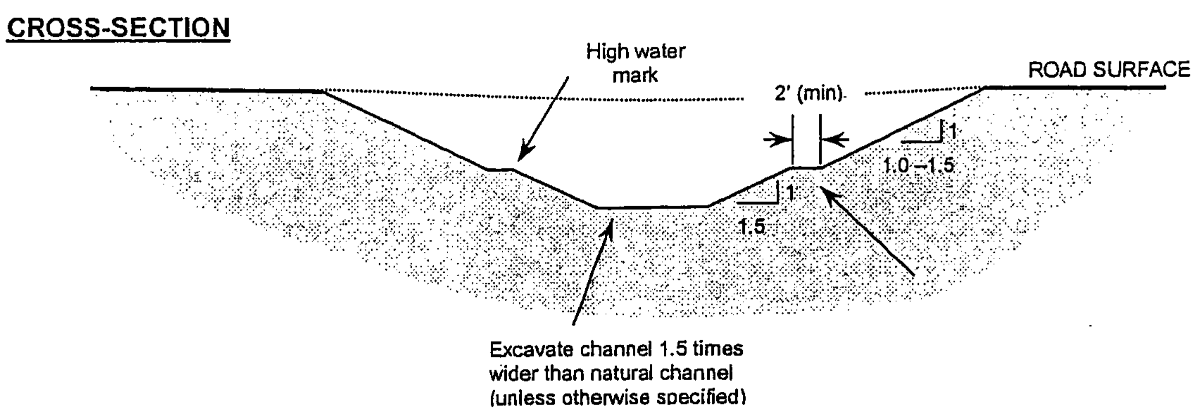




NOTES

1. Excavate a channel that is 1.5 times wider than the natural channel (unless otherwise specified).
2. Excavated channel shall be as close as feasible to the grade and orientation of the natural channel
3. Channel banks shall be excavated to a 1.5:1 slope unless otherwise specified in the plan
4. Where specified, remove fill to create a 2' wide bench paralleling the excavated bench shall be located above the high water mark as specified in the THP The bench is intended to intercept debris that may slough off of the excavated channel bank and to accommodate flood flows.
5. Spoils shall be placed and compacted along a stable portion of the inboard edge of the road, unless otherwise specified. Fill shall be placed in a manner to prevent future erosion.
6. Install instream grade control if directed by the RPF. Grade control shall consist of large wood or rock and is intended to prevent stream down cutting.
7. Where specified, cull logs shall be placed against both channel banks to protect the bank from erosion
8. Exposed soils shall stabilized seed, mulch and/or slash packing or other suitable methods.
9. Conform to requirements Department of Fish and Game 1600 permits where applicable.

Date: Apr 2005	Typical Crossing Abandonment And Watercourse Realignment	Figure: 3
No Scale		

Temporary Humboldt or "Spittler Crossing"

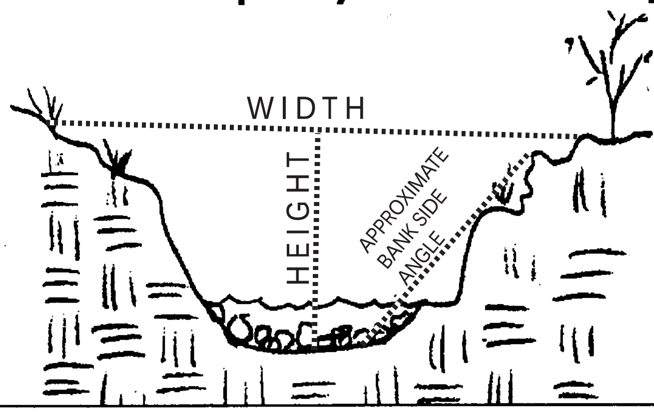


Figure A: Crossing Before Installation

For areas where channels and banks are well defined (**Figure A**), an alternative to installing a culvert and soil fill at temporary crossings is a temporary log fill (**Figure B**).

Prepare a diagram that shows the measured width, height, and bank side angles of the channel.

Sound logs take up most of the volume of the fill. The logs must be cabled together in bundles that can be pulled with the equipment that is available on-site. Where surface flow is expected in the stream channel, a culvert should also be used. A 6-inch thick or greater layer of straw is needed to separate the fill logs from the top layer of soil running surface.

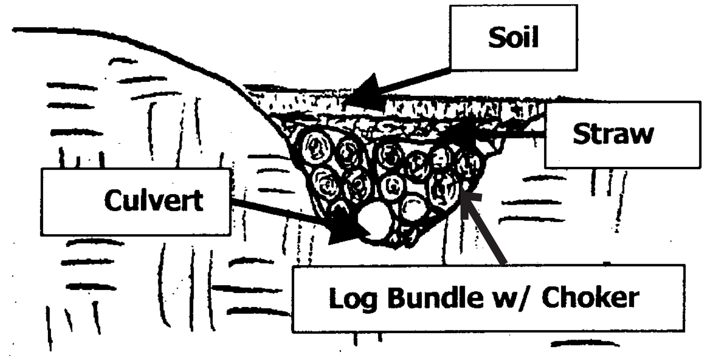


Figure B: Crossing in place.

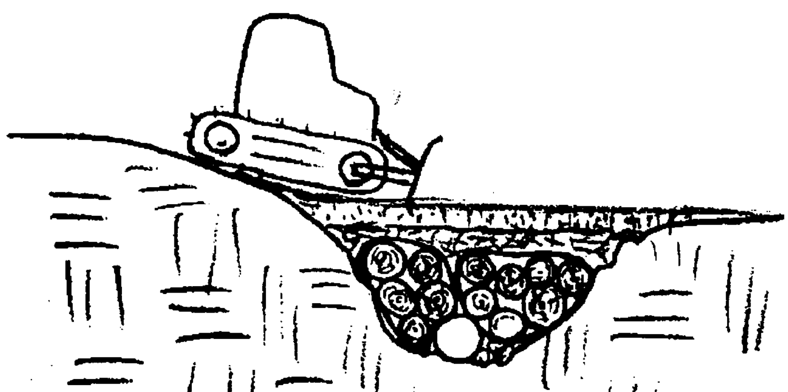
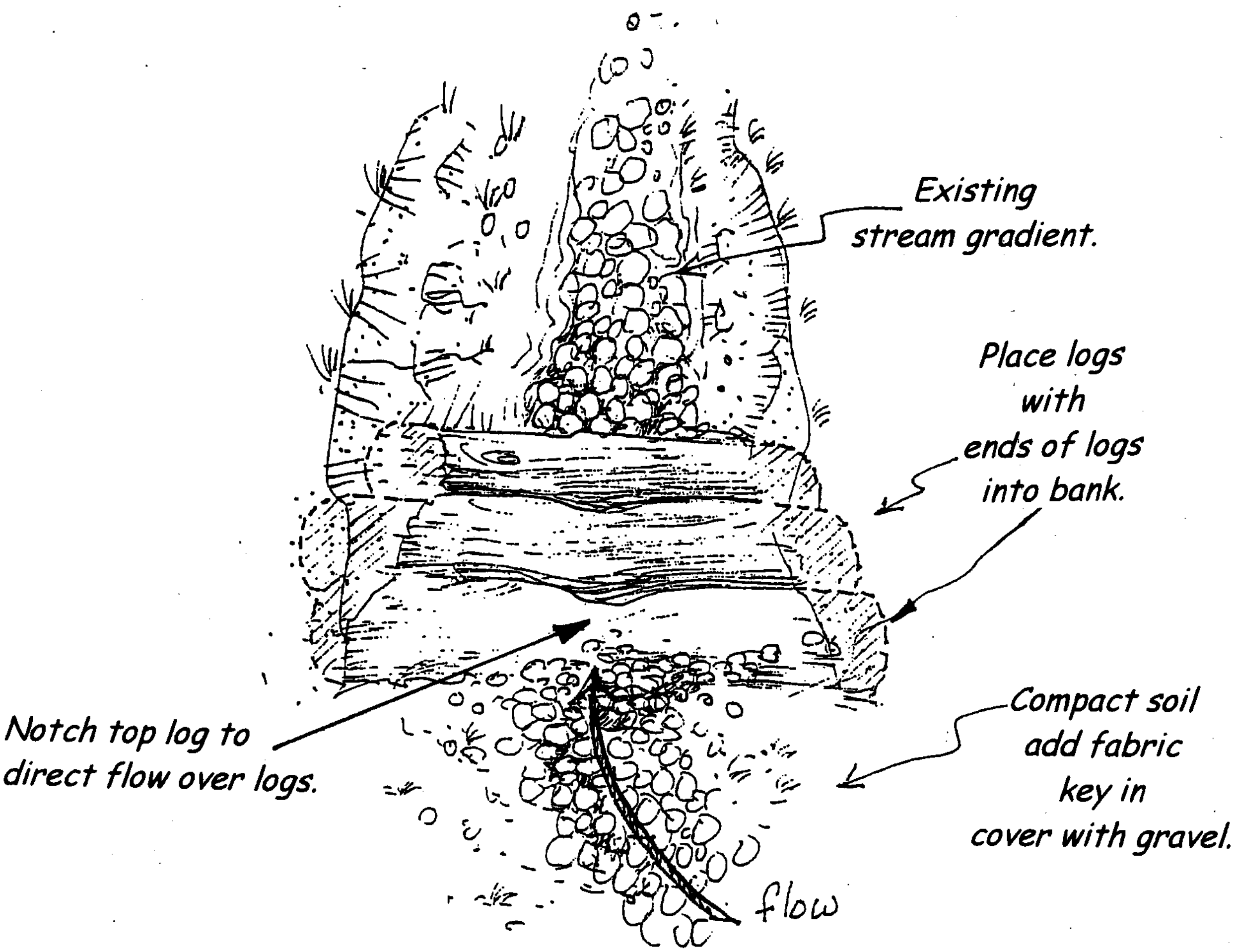


Figure C: Removal with Tractor

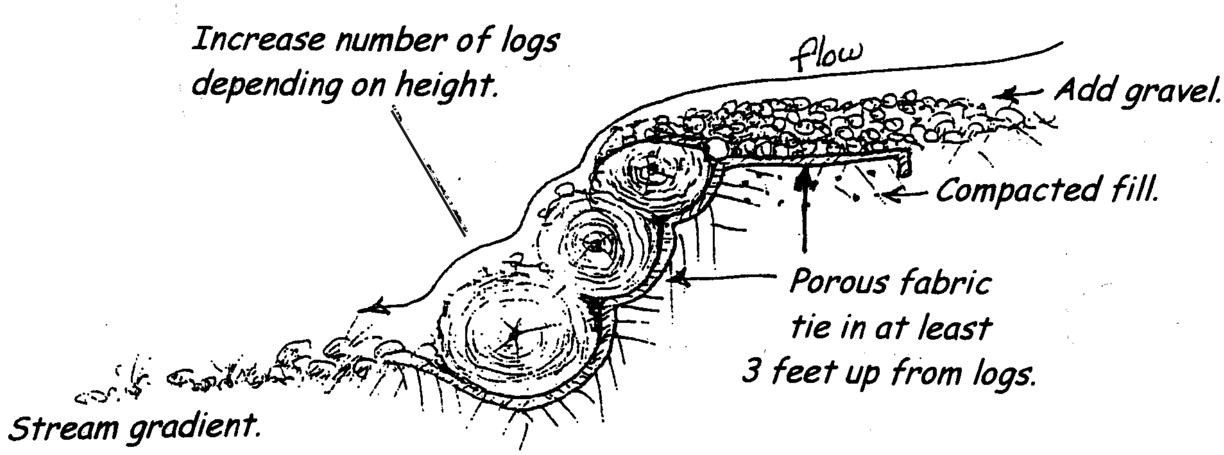
Upon completion of use and before the start of the winter period, the soil can be easily removed with a tractor (**Figure C**) and the logs and culvert pulled to restore the channel to preoperations condition.

TEMPORARY HUMBOLDT CROSSING OR "SPITTLER CROSSING"

PLAN VIEW



CROSS SECTIONAL VIEW



Date:	SKETCH SCHEMATIC OF LOG ARMORED OUTFALL	

TYPICAL STRAW BALE SEDIMENT FILTER

HOW TO INSTALL A HAY BALE BARRIER

1 Dig a trench the width of the bales and 4 inches deep.
2 Place the bales in a row with the ends tightly together. The bales will be embedded. Gaps between bales should be chinked with straw to prevent water from escaping from between them.
3 Drive stakes or re-bars through the bales (two per bale). The first stake in each bale should be angled toward the previously laid bale to force the two bales together.
4 Sprinkle loose hay over the area immediately uphill from the barrier. This will increase barrier efficiency.

SEDIMENT BARRIER MAINTENANCE

1 Inspect barriers after each rainfall and repair any damage.
2 Remove sediment deposits once they reach 1/2 the height of the barrier. Dispose of the sediment wisely (in a location far away from sensitive areas on the property).
3 Replace sections of the barrier that decompose or no longer filter properly.

CONSTRUCTION OF A HAY BALE BARRIER

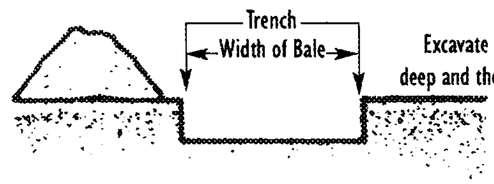


FIGURE 1
Excavate a trench 4" deep and the width of a straw bale.

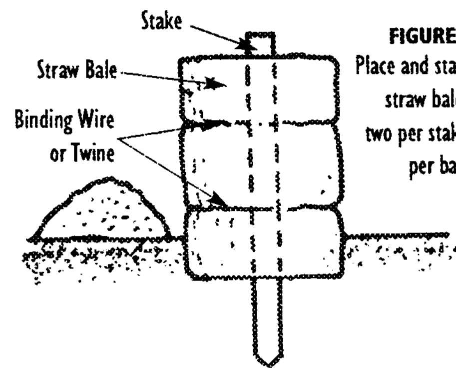


FIGURE 2
Place and stake straw bales, two per stakes per bale.

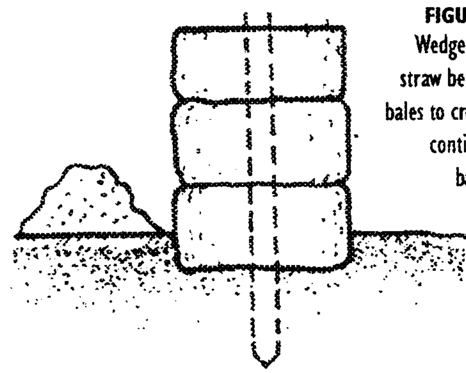


FIGURE 3
Wedge loose straw between bales to create a continuous barrier.

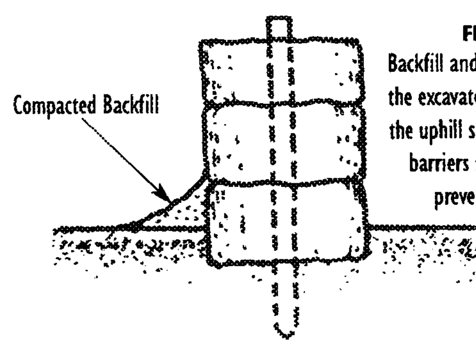


FIGURE 4
Backfill and compact the excavated soil on the uphill side of the barriers shown to prevent piping.

NO SCALE

APPENDIX I: FOREST MANAGEMENT POLICIES, SUPPLEMENTAL INFORMATION

Contents

VII. Silvicultural Decisions

To the extent that it is possible to generalize types of stands and approaches, we have attempted to describe likely decision pathways below. Forests are highly variable so it is impossible and unwise to prescribe "one-size fits all." Further, each of the forests reflects a management legacy that limits our silvicultural options. For example, prior management of the Garcia River Forest has left very young stands with limited commercial volumes. For the most part, these stands are growing well—they just have limited silvicultural options in the short-term. On Big River and Salmon Creek, a history of clear-cuts will force difficult choices between the remaining well-stocked stands and stand classes that are several years away from supporting our preferred silvicultural methods. Additionally many of the partial harvests of the past did not always leave the high-quality trees we desire. Finally, we are learning more every day about how to manage forests for both economic and environmental objectives and our approaches will change with future scientific research and operational realizations.

Our preferred silviculture will be high retention (150sf/acre basal area) single tree selection with re-entries every 10-20 years to remove most trees that exceed the target crop-tree size and thin the smaller size classes. Stands that have reached this condition (referred to as stand condition A) will be maintained indefinitely through thinning, individual tree selection, and small group selection harvests. Most stands are not anywhere near the desired stand condition A. Some stands may consist of smaller diameter classes or be less dense but generally have good form and growth (referred to as stand condition B). These stands might be dense even-aged stands of 40-60 years or they may be more open stands of indeterminate age that have had past selection harvests; regardless, the key silvicultural criteria is that they have good material to work with. (The Garcia LNF THP, the BR Riverbends THP, and the selection units of LSC THP are good examples of B conditions.) B stands are in an excellent position because they can support commercially-viable selection harvests and with a few decades of growth and just one or two intermediate harvests that maintain high-quality trees and increasing stocking, they will reach A condition. The silviculture to go from B to A is similar to the selection silviculture to maintain A (although in B we are not particularly concerned with creating a new age class). These are "easy" decisions, because the stands have good stocking and growth and the pathway to the desired conditions is evident and readily achievable.

However because of past harvesting practices, very few stands are currently in A or B condition (because of lower stocking, smaller diameters and/or poorer-quality trees). Most stands will take several decades to reach this steady-state condition with multiple intermediate harvest entries to guide this development. Until we reach the ideal steady-state condition, the silviculture focus will be on creating and/or building stands of higher quality and better growth potential. Many stands (especially on Big River) are young and even-aged, from clearcuts or aggressive selection harvests in the last thirty years (referred to as stand condition C). C stands are, for the most part, growing quickly and with good-quality stems—but they are small in diameter (average 12" or less) and lack structure from a habitat perspective. C stands will receive thinnings to accelerate stand development and concentrate growth on high-quality stems. These selective harvests will occur every 10-20 years with the long-term objective of moving the C stands into B and then A condition. These thinnings will yield low harvest volumes and small average piece sizes so they will need to be carefully-designed to be economically-viable. These low-value harvests will be a good source of employment in the local community and will also allow us to shape the stand at an early age to better achieve our long-term growth and habitat objectives. (The better-stocked parts of the Jack's Opening THP fit this generalization.) In some cases pre-commercial thinning will be considered.

A different category of stands (condition D) has resulted from the merchantable trees having been excessively "picked over": most of the dominant trees were removed leaving uneven regeneration, a low-quality overstory and often a high degree of tanoak competition. The overstory may be of average to large diameter but the entire stand is usually less than 100 square feet of basal area per acre and not comprised of the high-quality stems we desire (and therefore not growing in value). In most of these cases the younger "regeneration" age classes exhibit good growth, height, form and stocking. Harvests in D stands need to balance the removal of the poor-quality overstory (to accelerate the development of the higher-quality regeneration and pole-sized trees) with the need to maintain habitat structure and late-seral elements. (The "seed tree removal" units in the LSC THP and the variable retention units in the Jarvis Camp THP fall into this category.) This is not "easy" silviculture as it will feel like an aggressive harvest. The residual stand will be open-looking and often we will need to reduce hardwood competition and/or plant additional conifers. A good indication for this type of harvest is that given twenty years without harvest the stand would not be appreciably improved (hence the need for an intervention). In the short-term it is easy to think, "maybe it would be better to not harvest here," but it should be obvious that in the long-term the stand and the program will benefit from this harvest. These D harvests result in a good-quality young stand that is growing well and has some late-seral elements. Given two to three decades to develop without commercial harvest they will become C and B stands.

Of course not all stands fit these generalizations. In some stands, especially on the east side of the Garcia, it is more appropriate to manage primarily for Douglas fir than redwood and since Douglas fir lacks redwood's remarkable abilities to release and sprout, these will likely have long-term management through group selection, although the first couple of entries will look more like B thinnings. And some stands, again on the east side of Garcia, are completely dominated by tanoak. While it might be better ecologically and financially to be growing more conifers on these sites the short-term cost of such a rehabilitation will likely preclude much action.

VIII. THP Operational Realities

The complexity of forest regulations and the high cost of harvesting operations impose additional constraints on our operations, beyond simply what silviculture we want to apply. For example, almost all of our harvests are some type of thinning (a selective harvest not designed to introduce another age class) but under the Forest Practice Rules (FPR) they may need to be called Selection, Group Selection, Commercial Thinning, Transition, Variable Retention, Rehabilitation, or Alternative Prescription because of the differing requirements for initial and post-harvest stocking and diameters. And in the Timber Harvest Plan (THP) document we will commit to meeting only the FPR stocking requirements (rather than a voluntary higher standard) to avoid risk of violation in areas where initial stocking is low prior to harvest. Regardless of what the prescription is called, we will only implement the silviculture that enables us to meet our long-term project goals and follows the retention requirements and tree marking guidelines below.

Another operational reality relates to the distribution of THPs across the landscape. Our THPs will need to be fairly large (200-500 acres) and geographically-concentrated because of the high costs of THP development and maintenance. The goal is to increase operational efficiency by concentrating planning and road costs. We will try to treat all the eligible stands within a selected area (rather than cherry-picking across the property). Thus THPs will often include several types of FPR silviculture but almost all of them will meet stocking requirements immediately following the harvest. In the future we will not use amendments to increase THP area (unless there is a significant market or regulatory shift) but in 2007 as part of adapting the approved LSC THP to our preferred approach we will use an amendment as an expedient means. Another important constraint is that currently we have limited ability to cable-thin young Douglas fir stands because of high logging costs and low Douglas fir prices.

IX. THP Development and Review Process

Our goal is to develop clear and consistent THPs that incorporate the concerns of the public and conservation partners before they are submitted to the state agencies. THPs are, by requirement, cumbersome documents and long-term legal obligations; we do not expect to revolutionize THP writing. We have adopted the following procedures for the development and review of THPs:

1. General harvest locations will be identified by Evan Smith (TCF's Director of Forestry Projects), harvest scheduling plans, and Area Forester.
2. Field forester will review past materials and field conditions, decide on likely unit layout, silvicultural prescriptions, access needs, road improvements, etc., and consult with project consultants and partners on habitat and restoration implications and opportunities.
3. Evan will field review harvest unit selection and general operation strategy.
4. Field forester will coordinate necessary surveys and access (geologist, botanist, NSO).
5. Field forester will begin unit layout and stand marking.
6. "Field Consultation"-- Other Area Foresters and advisors will discuss, in the field, the proposed operation.
7. Garcia only—notice to TNC will be provided and field review scheduled if desired.
8. Stakeholder tour. Ideally this will occur once per year for each property and should occur just prior to CDF submittal (when all the potential THP issues are well-identified and resolved). Jenny Griffin, North Coast Program Manager, will coordinate.
9. ECP will be reviewed by Water Board and other project components will be reviewed by relevant experts. Can be part of or prior to stakeholder tour or if necessary concurrent with THP submittal.
10. Field forester will complete drafting of the THP.
11. THP will be submitted to Evan and/or another Area Forester for review.
12. Field forester will prepare final version and submit to CDF, with copy for TCF office.

We feel the Field Consultation is a very important step in our review process because it leverages the combined experience of our foresters and biologists to ensure that only sound and well-planned THPs go forward and because it offers an opportunity for everyone to learn from each other, thus helping our fledgling enterprise grow efficiently.

XIII. Timber Marking Guidelines

Timber marking is the art of extracting merchantable forest volume while protecting and enhancing wildlife habitat such that the end result is a forest that is well-stocked, rapidly-growing, and healthy with abundant and diverse wildlife habitat. Given the variations in stand conditions, it is very difficult to come up with universal policies. We offer the following criteria drafted by experienced local foresters which strives to capture some of the art of achieving the desired balance between habitat recruitment and retention while removing sufficient conifer volume to satisfy the economic needs of the project. Timber marking will be conducted with these criteria in mind. [Editorial comments, i.e. not by Craig Blencowe or Jim Able, are shown in brackets.]

Timber marking criteria by Craig Blencowe—

Marking can vary according to two criteria: the type of stand and the management objectives. These two factors permit flexibility to the extent that the marking adheres to the overall management goal of maintaining a productive sustainable-producing forest.

To this end, what we leave is more important than what we cut. Following a harvest, a stand should have a higher proportion of high-quality trees with well-developed crowns (high potential for increased growth). The key question we must answer before marking a tree is, "What is the potential for the tree to grow in the future?" Trees with little or no potential to grow (ie. put on recoverable volume) should be removed [unless they are retained for wildlife trees]. The difficult questions arise when a tree's potential is not readily apparent (often in the case of co-dominants). For this reason, beginning timber markers (and even experienced ones) benefit from boring trees and comparing recent growth with crown size, color, and form.

There are factors other than maximum growth which determine which trees we mark. We place as much emphasis upon high quality and high future value as we do upon maximizing growth rate. For that reason, trade-offs exist and while our stands may be maximizing annual value growth, they may not necessarily be growing at the maximum rate.

In addition to the wildlife tree retention requirements, our "normal" marking scheme for selection harvests involves the following:

1. Removal of defective, dying, and diseased trees, except those retained for snags and wildlife trees [Also see Jim Able comment #4].
2. Removal of suppressed and intermediate trees with little or no growth potential.
3. Removal of Douglas-fir or white fir to specifically release redwood. [Although it is appropriate to maintain a percent of fir and whitewoods relative to the pre-harvest proportions—we will be managing for mixed-species stands.]
4. Removal of 25-30% of the stand volume with a re-entry of 10-15 years. In the field, this usually works out to marking perhaps 30-40% of a clump's volume, and leaving the well-formed trees growing in the open.
5. Focus on attaining "target sizes" of 30-36" in redwood and 26-28" in Douglas-fir. This means that you must be very careful about marking in the 24-28" dbh classes (redwood) and the 22-24" dbh classes (fir), since these will be your "crop trees" at the next entry.

6. Remove trees in all size classes, but once crop tree size has been attained, you will likely be cutting 40% (by number) of the larger trees.
7. You can always opt to allow trees to grow larger than crop size, as we often do. However, when leaving trees 40" dbh +, you must carefully weigh your decision. Are they to be a legacy tree? If not, how will they be felled to avoid breakage in the future?
8. Retained trees should be thrifty and of good quality (e.g. minimum 30% crown ratio). You might also leave a slower-growing very high-quality tree, banking on a higher future price for the quality wood.
9. Green culls, conk-infected fir, and large rough wolf trees are usually retained for wildlife.
10. Where only one large tree (e.g. 26"dbh+) occurs in a clump of smaller (12-14" trees), we mark it, especially if it is on the south side of the clump.
11. In windy areas, we try to leave some kind of a wind buffer on the windward side of the stand (usually these trees are wind-beat anyway).
12. Spacing improvement becomes more important when we are returning for the 2nd or 3rd time to a stand.
13. By the time we have been through a stand three times, most of the harvest volume is comprised of trees from the larger crop size and thinnings in the smaller dbh classes. There tends to be less volume in the mid-range dbh size class.
14. Do not "give up" WLPZ areas and mark them to the extent it is appropriate.
15. Mark hardwoods for removal where small redwood trees or a sprouting stump will receive more light.
16. It is sometimes necessary to have logistics trump silviculture (e.g. we may have to mark the tree that can be physically felled or yarded, even though it may not be the one we really want to cut).
17. Likewise, aesthetics may also trump silviculture in given locations.

Additional timber marking criteria by Jim Able—

Primary objective should be to maintain or increase current growth.

1. Leave best formed trees regardless of diameter. Diameter cannot be your determination of leave.
2. Leave trees should have 30% or better of crown.
3. Do not become "hung up" on whether you are doing "all age" or "even age" management. You are probably doing both.
4. Suppressed trees (even redwood) do not release significantly (volume wise) or at least do not count on them to add significant growth. Cutting suppressed trees does not generally benefit growth and timber recovery, but it will significantly increase logging costs. Cut a few now, some later, and some more later than that. Do not only thin from below unless you have a very good reason and are prepared to not make money.
5. In areas of high windthrow and heavy bear damage, like Humboldt County, 40% or less cut of the basal area is the maximum cut per acre.
6. Group selections work in places where there are few if any good trees to leave or where you need to cut volume across a low-to-medium volume stand. Better to lose the growth on 2.5 acres than to over cut 50 acres. You do not want to obligate yourself to agreeing to individual tree selection only. You need choices!
7. Where high defect trees are present use them as wildlife trees and/or as part of the stocking. Unless there is a market for them, leave them.

8. Spacing of trees is a LOW priority, form and crown is a HIGH priority.
9. Consider that this method is usually "light" enough to allow you to re-enter the stand in 7 - 10 years. So if you enter an area that is growing well and there is "nothing to take" then leave it alone and go to the next area.
10. Assume that 20% of the trees are doing 80% of the growing so it's not which trees to cut, it's which trees should be left to grow. Figure out which of the trees are in this 20% grower category.

XV. Harvesting Operations

One of the key planning aspects for timber harvest operations is choice of yarding method—ground or tractor-based and cable or skyline systems. The yarding method choice for a specific harvest unit should be based on the silvicultural system, and the site-specific topography and access. The two primary yarding methods most commonly employed are tractor yarding and cable skyline yarding.

Tractor yarding includes tractors with winches and chokers, tractors equipped with grapples or rubber tired skidders with grapples or winches. Tractor yarding is generally used on gentle terrain up to 55% slope. Tractors may be used on steeper slopes where cable yarding is infeasible due to access problems or on long corners where deflection for skyline logging is inadequate. Cable skyline yarding consists of a running skyline or preferably a standing skyline with a carriage, either system should be capable of elevating the logs above the existing tree canopy. Cable logging is used on steep slopes, generally over 50%, where slopes are long and planer or concave. Cable yarding on convex slopes can result in a ground lead situation which can cause unnecessary damage to residual timber or the logging equipment. The key to successful cable yarding is to ensure that there is adequate deflection in the logging unit to suspend the logs above the ground and tree canopy.

The decision to use cable or tractor logging systems is generally an easy one to make. The coast range is very steep and highly dissected with many drainages which make for easy cable logging settings and the ridge tops are reserved for tractor logging.

There is a range of slopes between 50-65% where either method may be judged to be adequate in the eyes of the forester laying out the timber harvest unit. Cable logging may be used on shallow slopes were the logs would otherwise be adverse skidded to a landing above the harvest area and conversely tractors may be employed where there are adequate roads and landings downhill of the harvest area. The decision to use one method over the other in this "gray" area is generally made by using the equipment that is required on the rest of the job for example a shallow slope may be cable logged if the rest of the job is predominately cable logging. Or tractors may be used on steeper slopes if there is so little steep ground that bringing in a cable yarding machine for a few acres is deemed infeasible or uneconomical. Tractor long lining is a common practice where winch lines are pulled down hill and the logs are winched up to the tractor sitting in a stationary position. This technique is generally used when the slopes are very short and do not justify the expense of a cable machine and the tractor itself does not operate on the steep slope.

Other methods which are suitable for unevenage management techniques are helicopter or balloon yarding which are used when access is limited or there is no access because of excessive road construction or stream crossings requirements to get road access to a harvest unit.

Yarding method decisions are reviewed by the Senior Forester and are discussed in the field consultations. Yarding method and any unusual access situations are described in THPs and are also included in our more readily-available THP summaries.

XVI. Contractor Selection

TCF will utilize contractors in several roles in the management of these properties—from forestry and wildlife surveys to logging and road maintenance. There are several reasons for this—as a new enterprise TCF is not in a position to take on significant staff obligations and many of the most experienced professionals already have contract businesses set up. Additionally we can not guarantee year-round work in some areas. We will strive to use the highest quality professionals available—from owl calling to bridge repair. At least initially we will put most logging jobs out to bid, although we will select the firm that offers the best combination of price, performance, and experience. Other contracts, such as for road maintenance and security, will likely be negotiated directly with the professionals who have the most experience in the area and want the work. Especially for logging, road, and security contracts, ensuring safe working conditions and selecting contractors with good safety records will be an important concern. Supervisory foresters have already been selected for Garcia (Scott Kelly) and Salmon Creek (Craig Blencowe and Darcie Mahoney); we will likely advertise an Area Forester position for Big River during the summer of 2007. Additional forestry project work (e.g. owl surveys, preparing and supervising a THP) will be drawn from the area's experienced consulting biologists and foresters. In those situations we will seek to utilize the consultant as a full team member to solicit their ideas on how to meet our objectives. In all roles we have a strong preference for local expertise because it helps support local communities and the timber-based economy. We are concerned about the relative lack of young professionals in the field and will seek to create opportunities that encourage viable business opportunities for young loggers and technicians. In all our efforts we will strive to pay a good and fair wage, to reward performance, and to encourage professional development.

XVII. Forest Certification

The Conservation Fund has committed to seeking dual certification under the Forest Stewardship Council and Sustainable Forestry Initiative programs. All properties are to be managed in compliance with the 2005-2009 SFI Standard and the FSC Pacific Coast Regional Standard, version 9.0 (available at www.sfiprogram.org and www.fscus.org respectively). An initial scoping audit was completed on the Garcia River Forest in May 2006. A full audit was completed in June 2007. Should any conflicts or inconsistencies between either certification standard and applicable law or guidance from a regulatory agency will be referred to the lead auditor for resolution.

XVIII. Community Engagement

TCF seeks involvement from the local community at several stages of its activities. A public meeting will be held to review the management plan for BR/SC, much like a meeting was held in Point Arena to review the GRF IRMP prior to adoption. Interested parties are invited to participate in a tour of each THP either before or shortly after submission, and again following completion of the operation. In addition, TCF staff are available to respond to questions or concerns raised by the local community. TCF plans to prepare and broadly disseminate an Annual Report that describes major activities on the properties, changes to policies, and monitoring results. Should a dispute arise between TCF and a local citizen, neighbor, partner organization, current or potential contractor, or other interested entity, TCF will first seek to resolve the dispute through open communication, prior to more formal dispute resolution through mediation or litigation. Records of disputes will be made available to the lead certification auditor. In all situations, TCF strives to be a good neighbor and fair employer, and will hold itself to high professional standards in its dealings with the local community, contractors, Native American tribes, public agencies, and all other interested parties.

APPENDIX J: FIRE MANAGEMENT PLAN

This Fire Suppression Resource Inventory is being submitted to comply with 14CCR 918.1. Specific rule requirements cited in the plan are to be followed by contractors working in the woods at all times. This plan should not be construed to mean that untrained contractors or their personnel are required to actively fight wildland fires that occur on The Conservation Fund property.

The plan is to be kept with each employee or their assigned vehicle at all times
Copies to be hand delivered to all Conservation Fund (TCF) employees and logging/road maintenance contractors operating on company managed lands
Copies also mailed to cal fire northern region headquarters in Santa Rosa and on a cd to Mendocino ranger unit office in Willits (Howard Forest)

INTRODUCTION

The Conservation Fund (TCF) owns and manages approximately 40,000 acres of timberland in three tracts on the Big River, Salmon Creek, and Garcia River watersheds. Due to the risk that uncontrolled fire poses to its assets, The Conservation Fund manages its properties with careful and thorough consideration toward fire prevention, planning, and control. This Fire Plan is prepared for and provided to acquaint all personnel concerned with the policies and procedures involved for the current fire season. The policies and details listed in the following plan apply across the entire TCF ownership and are not specific to any tract or area. Tract and area specific issues are conveyed through the maps attached at the end of the document. These display specific fire prevention and mitigation infrastructure, such as access points, roads, drafting sites, and helicopter landing sites.

POLICY STATEMENT

The Conservation Fund (TCF) will respond within its capacity to all fires occurring within its ownership, as well as any uncontrolled fires which may threaten its ownership. TCF response will commence upon notification of a fire on or near TCF property, and with utmost concern for the safety of everyone involved.

TCF employees will take the immediate action necessary to contact appropriate fire control agencies once a fire is identified.

TCF employees will not place themselves or contractors at unreasonable risk during any response to a fire or during the course of fighting a fire. Safety is our first priority.

Appropriately-trained TCF employees and contractors may work at their discretion to contain and extinguish fires until the fire is taken over by the California Department of Forestry and Fire Protection (CAL FIRE) or some other responsible party.

TCF will cooperate with, and follow the direction of CAL FIRE or local fire protection departments responsible for fire protection on private lands.

To the extent information is available; relative humidity, temperature, wind direction and speed, overall fire season trends, and availability of resources shall be considered when determining appropriate action should an ignition occur.

TCF shall strictly enforce all laws, rules, and regulations governing logging operations during Fire Season.

TCF shall attend an Annual Fire Meeting at the beginning of the Fire Season, with representatives from CAL FIRE, logging contractors, and major adjacent forest landowners.

EMERGENCY TELEPHONE NUMBERS

TO REPORT A FIRE:

1. Call: CAL FIRE Dispatch Howard Forest (707) 459-5336 or 459-7404 or Dial 911

   a) Give CAL FIRE the legal description (Township, Range & Section no. to the nearest ¼ section) and the approximate size of fire.

   b) Name of person reporting fire.

   c) Best access route(s) to the fire.

2. Call TCF emergency contact personnel in the order delineated below:

   a) The TCF Office (707) 962-0712

   b) Scott Kelly (707) 272-4497/(707)987-3428

   c) Madison Thomson (707) 357-3919

   d) Security/fire patrolman: Rick Cooper (707) 964-1716/(707) 357-1788

   e) Lee Susan (707) 964-4566/(707) 357-0906

   f) Darcie Mahoney (707) 877-3435/(707)489-8465

   g) Evan Smith (503) 407-0301

FIRE PREVENTION PROCEDURES

General Responsibilities for Logging Contractors

All persons working on or traveling through TCF property must strictly adhere to the following Fire Prevention Procedures:

918.3, Roads to be Kept Passable. Timber operators shall keep all logging truck roads in a passable condition during the dry season for fire truck travel until snag and slash disposal has been completed.

918.4, Smoking and Matches
Subject to any law or ordinance prohibiting or otherwise regulating smoking, smoking by persons engaged in timber operations shall be limited to occasions where they are not moving about and are confined to cleared landings and areas of bare soil at least three feet (.914 m) in diameter. Burning material shall be extinguished in such areas of bare soil before discarding. The timber operator shall specify procedures to guide actions of his employees or other persons in his employment consistent with this subsection.

918.5, Lunch and Warming Fires
Subject to any law or ordinance regulating or prohibiting fires, warming fires or other fires used for the comfort or convenience of employees or other persons engaged in timber operations shall be limited to the following condition:
1. There shall be a clearance of 10 feet (3.05 m) or more from the perimeter of such fires and flammable vegetation or other substances conducive to the spread of fire.
2. Warming fire shall be built in a depression in the soil to hold the ash created by such fires.
3. The timber operator shall establish procedures to guide actions of his employees or other persons in their employment regarding the setting, maintenance, or use of such fires that are consistent with (a) and (b)of this subsection.

Under no conditions will warm-up fires be permitted on TCF property during the declared fire season. The Fire season is determined by CAL FIRE and it generally extends until sufficient rain has fallen to reduce the chance of accidental ignition.

918.6, Posting Procedures
Timber operators shall post notices which set forth lists of procedures that they have established consistent with this Fire Plan. Such notices shall be posted in sufficient quantity and location throughout their logging areas so that all employees, or other persons employed by them to work, shall be informed of such procedures. Timber operators shall provide for diligent supervision of such procedures throughout their operations.

918.7, Blasting and Welding Timber operators shall provide for a diligent fire watch service at the scene of any blasting or welding operations conducted on their logging areas to prevent and extinguish fires resulting from such operations.

918.8, Inspection for Fire The timber operator or his/her agent shall conduct a diligent aerial or ground inspection within the first two hours after cessation of felling, yarding, or loading operations each day during the dry period when fire is likely to spread. The person conducting the inspection shall have adequate communication available for prompt reporting of any fire that may be detected.

918.10, Cable Blocks
During the period when burning permits are required, all tail and side blocks on a cable setting shall be

located in the center of an area that is either cleared to mineral soil or covered with a fireproof blanket that is at least 15 ft. in diameter. A shovel and an operational full five-gallon back pump or a fire extinguisher bearing a label showing at least a 4A rating must be located within 25 feet of each such block before yarding.

Fire Boxes
A sealed fire box shall be present on every active landing during the course of logging operations. It shall contain at least 2 shovels, 2 axes or Pulaski's, a chainsaw serviced with gas and oil and 1 five gallon back pack pump full of water. Fire equipment shall only be used in case of fire.

Heavy Equipment
All tracked or rubber tired equipment over 5,000 lbs GVW shall be equipped with one serviceable shovel and one serviceable chemical fire extinguisher of at least a 2A:10B:C rating (5 lb. capacity) or water stored pressure fire extinguisher with at least a 2A rating (2½ lb. capacity). Equipment shall have and maintain the factory exhaust system or equivalent.

Vehicles
Shall keep a serviceable shovel at least 46 inch total length, an ax, and a fully charged fire extinguisher with at least a 1A:10B:C rating (2½ lb. capacity) in their vehicle and must be equipped with the factory exhaust system or equivalent.

Chainsaws
Chainsaws shall be equipped with the original factory exhaust system or equivalent. A serviceable fire extinguisher must be located within 25 feet of the point of operation.

Firearms
The discharging of firearms is not permitted on TCF property

TCF Responsibilities

~~a)~~ Monitor fire weather daily during periods of extreme fire danger

b) All active operations may be required to be shut down when the relative humidity reaches 20% or lower, or when excessively high air temperatures are present.

c) All logging and road maintenance contractors shall be inspected for fire protection preparedness during the declared fire season.

d) Maintain and have ready fire equipment for immediate mobilization

e) Use fire equipment only for fire related activities such as fire suppression and planned burning activities.

f) Each passenger vehicle shall be equipped with a fire extinguisher rated 1A:10B:C (2½ lb. capacity), shovel (46 inches in total length) and an ax.

g) TCF shall be a paid subscriber to the Mendocino County Cooperative Aerial Fire Patrol. Aerial flights are scheduled by CAL FIRE.

h) In the event that CAL FIRE announces “very high” fire danger or a “red flag warning” (extreme fire weather conditions), TCF shall determine whether any specific fire prevention measures need to be implemented and if so, shall transmit such measures to contractors for implementation.

INITIAL ACTION INSTRUCTIONS

Any action taken will be done in the safest manner possible. Your personal safety and the safety of other individuals working in the area is the highest priority.

a) Employee will report the fire to CAL FIRE and TCF personnel as described above.

b) Provide a precise location (general area, ¼ Section, Township and Range) and size of the fire.

c) Describe best access route(s) to the fire. Where possible, open gate(s) or have a TCF employee wait for CAL FIRE/local volunteer fire department at the specified gate, to lead them to the fire.

d) Determine escape routes from the fire and be prepared to evacuate nearby personnel. If no escape route exists evacuate personnel from the area to a safe location.

e) An appropriately-trained TCF employee responding to a fire on TCF lands, or a fire that is posing an immediate threat to TCF lands may at his or her own discretion assist in coordinating initial fire suppression actions. Take the lead to designate duties and remain in communication with all resources. As soon as CAL FIRE arrives, TCF personnel shall brief them and turn control of the fire over to CAL FIRE personnel.

f) Place available equipment on standby or route to the fire area.

g) Request additional appropriate equipment needs.

h) Direct all water tenders to fill up with water.
i) Place fire locator signs to mark route to the fire.

j) Leave gates on access roads to fire open until the fire is out.

k) Stop all active logging that is on or will use the access road to the fire. In extreme fire weather all active logging on the property shall be shut down.

RECOGNIZING FIRE DANGER BUILD-UP

There are many environmental factors affecting the probability of fire ignition and the rate of fire spread, including low relative humidity, high wind speeds, high atmospheric instability, and others. The Burning Index, which indicates severe fuel and atmospheric conditions for logging operations, takes these different factors into account in order to assess the potential for hazardous fire behavior. It is derived from a calculation involving the drying rate of fuels, the humidity, temperature, wind, and the state of curing of the growing plants. It cannot pinpoint the exact conditions in any one particular place. This leaves the logger with the responsibility of policing his own area and using good judgment in operating procedures. The Burning Index for coastal Mendocino County is available each day during Fire Season at (707)-459-7404.

OPERATIONAL FIRE SUPPRESSION RULES

Any action taken will be done in the safest manner possible. Your personal safety and the safety of other individuals working in the area is the highest priority. There is no requirement for untrained or unwilling personnel to fight fire on TCF property. The following rules apply to persons who find themselves actively fighting fires.

FIRE SAFETY

a) Personal Safety: The safety of yourself and crew is your highest priority if you find yourself or your crew in an unsafe situation all persons should leave the scene immediately. If you or your crew are directed by anyone including CAL FIRE to do something which you feel is unsafe you may decline to do so. Report any such incidence to the Fire Boss or the CAL FIRE incident commander.

b) Working alone on a fire shall not be permitted.

c) Only experienced and capable operators shall be placed on or operate power equipment such as bulldozers, water trucks and chain saws.

d) Hand tools will be carried and used in a safe manner. Protect yourself and the person working next to you by maintaining safe working separation. Watch your footing at all times.

e) Be alert as to what is going on around you (e.g. burning snags, rolling rocks, and logs). Rolling debris comes from above, but don't forget, burning snags do sometimes fall up the hill.

f) Snag fallers must be exceptionally thorough and accurate in their "Timber" call and must allow ample time for an answer before starting their saw for the final cut. Close correlation between hand trail crews and snag fallers is most important.

g) The Fire Boss is responsible for his/her personnel. Missing personnel is cause for alarm and an immediate investigation.

h) Tractors must be provided with lights when working at night.

OPERATION OF TRACTORS

a) Avoid carrying fire outside the lines.

b) Push hot material away from the line into the fire.

c) Don't bury fire. When casting off, scatter the fire except in a case where it is necessary to temporarily bury it to reduce the heat. Buried fire may burn undetected for weeks and break out later when thought to be under control.

d) Work the tractors in pairs when the going is rough so that one can get the other out of "jackpots".

OPERATION OF WATER TRUCKS AND PORTABLE PUMPS

a) Operate pumps at the recommended speed. Exceed this only temporarily when the emergency justifies.

b) When pumping downhill, use only the pressure needed; often times gravity is enough. Excessive pressure will burst a hose and cause dangerous and costly delays.

c) When filling water trucks or pumping directly from streams, utilize a hose with a screened inlet. Keep the intake hose in clean water. Sand and gravel will easily go through the volume pump and will foul the pressure pump.

d) Always keep a grease gun, screwdriver, pliers, and a crescent wrench with the water truck or water pump to facilitate minor pump adjustments. Good service is important with the portable pumps, which in most cases, must be carried to their place of operation.

USE OF HAND TOOLS

a) Keep hand tools sharp and ready for use at all times.

b) All hand tools must be securely handled. Axes and Pulaskis tend to dry out during the summer months. They should be checked regularly and tightened with wedges if necessary.

c) Tools rendered ineffective due to damage or use shall be removed from active use and repaired or replaced as soon as possible.

ENVIRONMENTAL PROTECTION

a) When drafting water, screens will be used to prevent the entrapment of aquatic vertebrates. Drafting sites will be located to minimize damage to the watercourse.

b) When possible, firebreaks shall be placed outside of watercourse and lake protection zones (WLPZs) and other riparian areas.

c) When possible, firebreaks shall avoid unstable areas.

d) Water bars shall be installed on tractor constructed firebreaks as a part of the final "mop-up" operation. Mulching with slash or straw shall be conducted in WLPZ's where necessary to prevent erosion.

TCF MANPOWER POOL

Contact Order	Name	Home Phone #	Cell Phone #
1.	Scott Kelly	(707)987-3428	(707) 272-4497
2.	Madison Thomson		(707) 357-3919
3.	*Holly Newberger	(707) 937-5334	(707) 280-1079
4.	*Jenny Griffin	(707) 964-4904	(707) 349-3462

*Office and administrative support only/Fire dispatcher

TCF FIRE SUPPRESSION ORGANIZATION AND DUTIES

In the event that The Conservation Fund has to maintain fire suppression activities without the aid of CAL FIRE. The following is a list of individual fire suppression roles with their associated duties. In this hierarchical system, with fire fighter as the lowest rank and dispatcher as the highest, individuals report directly to the rank above them. Roles will be distributed between staff and contractors on the basis of experience and physical capacity.

Dispatcher/Fire Operations Manager (Jenny Griffin or Holly Newberger)
Duties and Responsibilities: Maintains radio contact with TCF Fire Boss(es). Arranges for and dispatches equipment, personnel and supplies ordered by the Fire Boss. Keeps records of personnel and equipment on each fire each day. Maintains the following log/records:

• Daily log of contractor fire equipment and all personnel (TCF and Contractor) on each fire.

• Daily log of contract equipment and personnel dispatched to each fire including numbers of personnel, supervisor, numbers and type of equipment, hours worked by shift.

• Daily log of all conversations, phone calls with CAL FIRE and others including the time, person talked to, fire command job title/function or other, and substance of the discussion. (Use the Incident Report Form).

Fire Boss (Scott Kelly or designee)
Duties and Responsibilities: Overall organization and supervision of suppression operations on each fire until relieved by CAL FIRE. Develops suppression strategy. Determines and manages manpower, equipment and supplies needs. Maintains personnel roster. Directly supervises crew bosses or fire fighters on small fires. Maintains radio/cellular contact with main office every half hour. Maintain contact with Crew Bosses as conditions dictate (intervals not to exceed two hours). Interacts with CAL FIRE hierarchy when present. Completes or directs other TCF personnel to complete the Wildfire Information Report Form. Ensures that the access route to the fire location is adequately signed.

Crew Boss (Scott Kelly or designee)
Duties and Responsibilities: Responsible for direct supervision of fire fighters engaged in suppression operations (e.g. tool complement, fire line location, width and construction; hoselays, mop-up operations). Follows directions and implements strategy developed by the Fire Boss. Monitors fire suppression progress and fire behavior and reports said information to Fire Boss at intervals not to exceed two hours. Coordinates with water truck pump operators. Directs location and construction of tractor firelines. Ensures replacement of worn-out or unusable tools/equipment. Knows the location of, and ensures the safety of each fire fighter on the crew at all times.

Fire Fighters
Duties and Responsibilities: Follows directions of Crew Boss and Fire Boss. Responsible for wearing protective clothing and gear (i.e. long-sleeve shirt, pants, boots, safety glasses, gloves, handkerchief, and hard hat). Wears ear protection and chaps when operating chainsaws; only operates power saws if trained and capable. Uses the proper tool for the specific task at hand. Reports unsafe conditions to Crew Boss. Reports broken or unusable tools to Crew Boss. Paces their work to forestall fatigue. Maintains a supply of personal drinking water. Keeps alert at all times and in contact with other crew members.

TCF EQUIPMENT RESOURCES

McClouds	3
Pulaski's	2
Shovels	4
Backpack pumps	2
Nomex shirts	2
BK radios	2
Fire shelters	2
Pick-ups	2

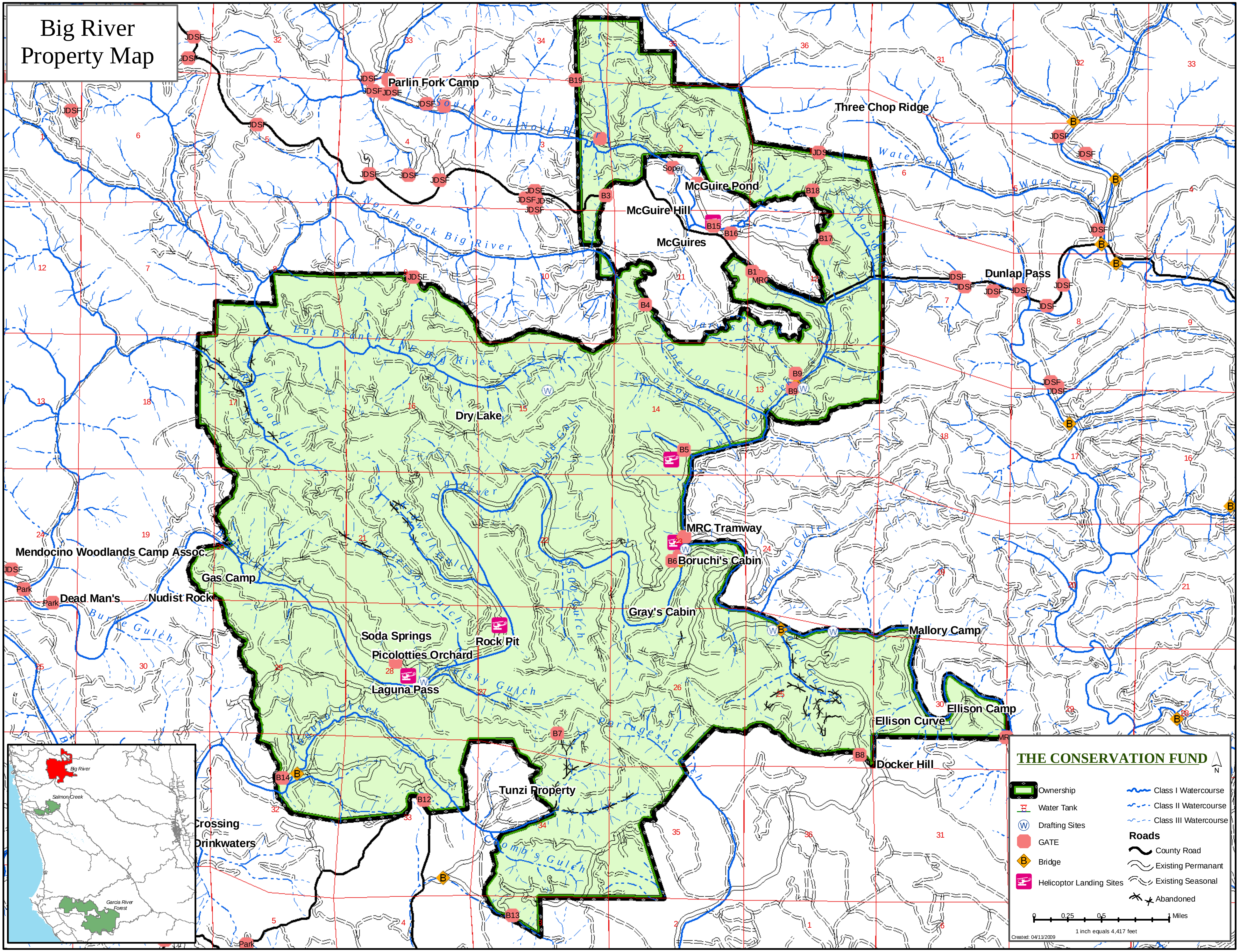
CONTRACTOR CONTACT LIST

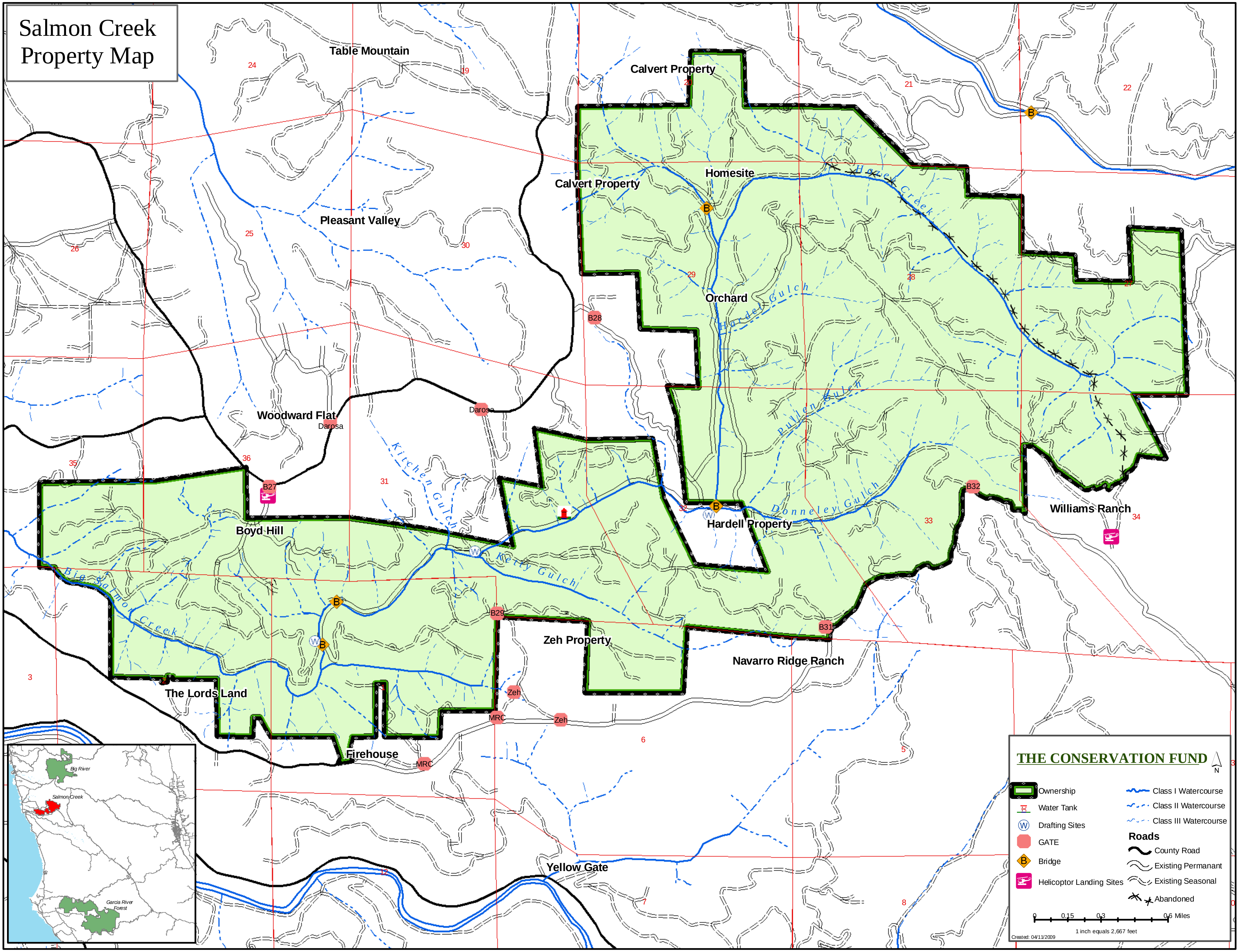
This is a partial list of potential contractors. TCF office will know which contractors are on site and who to contact, additional manpower and equipment may be ordered by the TCF office as deemed necessary by the Fire Boss.

Contractor	LTO#	Contact Persons	Home/mobile
Anderson Logging, Inc. P.O. Box 1266 Fort Bragg, CA 95437 (707)964-2770	A-7124	Mike Anderson Myles Anderson Don Sallinen Mark LeRoy Woods Office	964-0303/489-0837 964-2690/489-5805 961-0305/489-1625 964-0592/272-3706 964-4037
Barnett Logging 31651 Pudding Creek Road Fort Bragg, CA 95437	A-10343	Eddy Barnett	964-2542/357-1285
Baxman Gravel Company, Inc. 1221 N. Main Street Fort Bragg, CA 95437 (707) 964-4033		Charlie Baxman Steve Baxman Glen Beck	964-4536 357-4036 357-4035
Big River Rock Company 519 S. Sanderson Way Fort Bragg, Ca 95437 (707) 964-4387		Melvin Pyorre Sean Pyorre	964-4387/357-0579 961-1580/357-0084
Bob Baker Trucking P.O. Box 655 Gualala, CA 95445		Bob Baker	884-3318
Christopher Blencowe 633 N. Harrison St. Fort Bragg, CA 95437		Christopher Blencowe	964-1409/972-6768
Columbia Helicopters P.O. Box 3500 Portland, OR 97208 (503) 678-1222	A-8409	Mike Moore Jack Thornburg	(503) 678-1222/(503) 880-1145 (559) 877-2059/(209) 694-1803
Hautala & Mills Logging 27937 Highway #20 Fort Bragg, CA 95437	A-9276	Richard Hautala Parker Mills	964-2340/489-9556 877-3250/489-4587
Darcy Mahoney 30995 Greenwood Rd. Elk, CA 95432		Darcy Mahoney	877-3435/489-8465
Philbrick, Inc. P.O. Box 1288 Fort Bragg, CA 95437	A-5697	Jerry Philbrick John Starkey	937-5919/489-0923 964-8809/489-2514

(707) 964-2277			
William T. Piper Logging P.O. Box 295 Manchester, CA 95459 (707) 882-2561		Bill Piper Robert Piper	489-5150 489-7923
Redwood Resources P.O. Box 1477 Fort Bragg, CA 95437 (707) 961-0347		Barry McKee Jesse Feidler	834-5630 357-2677
Roach Bros., Inc. P.O. Box 1595 Fort Bragg, CA 95437 (707) 964-6673	A-6705	Gary H. Roach Andy Cuevas LeRoy Roach Gerald Roach Gary J. Roach	964-9240/357-4401 961-0339/357-4420 964-3490/357-4403 961-6012/357-4406 489-1136
Shuster's Logging Inc. 550 East Valley Street Willits, CA 95490 (707) 459-4131	A-8080	Steve Shuster Randy Yanez	456-9475/272-7120 964-7369/489-0237
Stornetta Excavating P.O. Box 225 Point Arena, CA 95468		Stan Stornetta	884-9628/357-1654
Summit Forestry 16575 Franklin Road Fort Bragg, CA 95437		Lee Susan	964-4566/357-0906
Gary Swanson 31651 Cedar Street (707) 964-3519	C-762	Gary Swanson	964-3519/489-0152
T&S Logging Inc. P.O. Box 31 Philo, CA 95466 (707) 895-3751		Ed Slotte	
Wylatti Resource Mngmnt. PO Box 575 Covelo, CA 95428	A-851	Brian Hurt Ron Brinkerhoff	(707) 983-6633 (707) 983-8184 (707) 489-1463 (707) 489-3758

Big River Property Map




Salmon Creek Property Map
Table Mountain
Calvert Property
Homesite
Calvert Property
Pleasant Valley
Orchard
Hardell Gulch
Pullen Gulch
Donneley Gulch
Hardell Property
Williams Ranch
Woodward Flat
Darosa
Darosa
Kitchen Gulch
Boyd Hill
Kelly Gulch
Big Salmon Creek
Zeh Property
Navarro Ridge Ranch
The Lords Land
Firehouse
Yellow Gate
B27
B28
B29
B31
B32
Zeh
Zeh
MRC
MRC
Big River
Salmon Creek
Garcia River Forest
THE CONSERVATION FUND
N
Ownership
Water Tank
Drafting Sites
GATE
Bridge
Helicoptor Landing Sites
Class I Watercourse
Class II Watercourse
Class III Watercourse
Roads
County Road
Existing Permanant
Existing Seasonal
Abandoned
0 0.15 0.3 0.6 Miles
1 inch equals 2,667 feet
Created: 04/11/2009

APPENDIX K: SPECIES SPECIFIC OLD GROWTH CHARACTERISTICS

http://mrc.com/issues/old_growth_policy.html

Redwood Old Growth Characteristics

- Trees generally are in the upper 20% diameter class of the species on site
- Deep, plate-like bark patterns, fire resistant
- Flattened or irregular crowns, highly complex structure
- Highly reiterated crowns (multiple sprouting, replicated growth
- patterns)
- Large limbs, in excess of 6-8 in diameter
- Crown debris accumulation
- Platforms
- Cavities, partial snag formation
- High presence of complex lichens and moss
- Cat-facing or basal burn cavities

Douglas-fir Old Growth Characteristics

- Trees generally are in the upper 20% diameter class for the species on site
- Bark deeply fissured, thick and fire resistant
- High presence of lichens and moss, where crown soils present, ferns
- Large lateral limbs in excess of 8-10 inches in diameter
- Fattened, irregular crowns with lower limbs with signs of decay and crown thinning
- Conks
- Partial sagging in tops
- Broken out tops
- Crown debris accumulation
- Specific to fir, trees along the margins of vegetation types, which represent the pioneer, tree individuals, which reoccupied the sites following disturbances. These normally will have limbs extending nearly to the ground and at times is wind shaped.

Hardwood Old Growth Characteristics (tanoak, live oak, black oak, madrone, laurel, chinquapin)

- Trees generally are in the upper 20% diameter class for the species on site
- Flattened or irregular crowns, highly complex structure
- Multiple branching crowns with few large well developed main limbs
- Large limbs, in excess of 4-12 inches in diameter
- Crown debris accumulation
- Platforms
- Cavities, partial snag formation

- Crown die-back
- Cat-facing or basal burn cavities