SOQUEL DEMONSTRATION

STATE FOREST

DRAFT

GENERAL FOREST

MANAGEMENT PLAN

This final General Forest Management Plan is intended to set the goals and guide the development of programs and facilities on Soquel Demonstration State Forest (SDSF). It was approved by the SDSF Advisory Committee on xxx and by the Board of Forestry on xxx.

CALIFORNIA DEPARTMENT OF FORESTRY
AND FIRE PROTECTION

SOQUEL, CALIFORNIA
March 4, 1998
Revision date: January 14, 2013 ~~April 2, 2012~~

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EXECUTIVE SUMMARY

BACKGROUND INFORMATION ON SOQUEL DEMONSTRATION STATE FOREST

TOTAL ACRES: 2,681
VEGETATION TYPES PRESENT: Redwood, Montane Hardwood-Conifer, Coastal Oak Woodland, Douglas-fir, Mixed Chaparral, Annual Grassland, Riparian Community, and Freshwater Marshes
MILES OF ROADS: 19
MILES OF TRAILS: 12.2
PRIMARY MANAGEMENT GOALS: Watershed protection, monitoring, and study; public education about forestry, timber production, and the environment; and protection of old-growth redwoods.

The Soquel Demonstration State Forest (SDSF) was established in 1990 by Assembly Bill 1965 1965 (now Public Resources Code (PRC) Sections 4660-4664). The basic objective of the enabling legislation is to protect and preserve SDSF as an intensively managed, multifaceted research forest. The Public Resources Code Sections 4660-4664 state that SDSF will do all of the following:

- Provide watershed protection for local communities and base-line monitoring and studies studies of the hazards, risks, and benefits of forest operations and watersheds to urban areas.
- Provide public education and examples illustrating compatible rural land uses, including including sustained yield timber production, as well as the historic development of timbering and forestry machinery, within the context of local community protection and nearby pressures.
- Provide a resource for the public, environmental groups, elected officials, environmental environmental planners, the educational community, and the media as an open environment for the inspection and study of environmental education, forestry practices, practices, and effects thereof.
- Protect old-growth redwood trees.

Soquel Demonstration State Forest is located near the center of Santa Cruz County, California, approximately eight miles northeast of the city of Santa Cruz. Positioned in the southern portion of the Santa Cruz Mountains, SDSF is eighteen air miles south of San Jose and within a two-hour drive of the San Francisco and Oakland metropolitan areas.

SDSF is bordered by both state and privately-owned properties. These include the Forest of Nisene Marks State Park, timberland managed by Redwood Empire, the Olive Springs Quarry, and private rural-residential parcels that range in size from 1 to 80 acres.

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Public access is currently limited to a road access point off Highland Way or entry through The Forest of Nisene Marks State Park. The inability of the public to drive to the forest when county roads are closed and problems with trespass are challenges limiting accomplishment of SDSF's mission to provide for public education and access.

Between the late 1920's and early 1940's, previous owners managed on an even-aged basis with with clearcutting and natural regeneration. Since 1990 SDSF has been managed on an uneven-aged basis, utilizing either single tree and/or small group selection. Watershed, soil, fisheries, and wildlife resources are monitored and protected before, during, and after all timber harvesting activity. Funds derived from timber harvest are utilized for forest staff, facilities, operations and maintenance.

Existing old-growth redwood areas in the Forest have been excluded from timber harvesting, as as mandated by SDSF's authorizing legislation. In addition, late-succession areas are managed to promote the development of old-growth habitat. These areas make up 15 percent of the overall forest, and protect 300 feet on each side of the East Branch of Soquel Creek, Amaya, and Fern Creeks. The East Branch of Soquel Creek provides valuable steelhead trout spawning and rearing habitat, and is part of the domestic water supply for the local community.

BACKGROUND INFORMATION ON THE GENERAL FOREST MANAGEMENT PLAN

In 1988 the Nature Conservancy acquired the lease to manage the SDSF property. The lease and management responsibilities were transferred to CAL FIRE in 1990. The first General Forest Management Plan was developed with input from the public, resource management professionals, and members of the Advisory Committee.

The Board of Forestry and Fire Protection (the Board) approved the original General Forest Management Plan on May 18, 1998. The environmental impacts of the 1998 management plan were investigated in a programmatic environmental impact report (EIR). Mitigation measures identified in the EIR have been incorporated into a Monitoring Plan located in Appendix C.

The SDSF General Forest Management Plan remains in effect until it is amended or a new plan is adopted. In 2003, the Board reviewed and reauthorized the plan. No revisions were made at that time. This revision of the plan incorporates the results of new studies, monitoring and research pertaining to fisheries, wildlife habitat, watershed issues, archeology, and timber management.

CAL FIRE plans to work with the Advisory Committee to reexamine the General Forest Management Plan every five years and determine what changes are needed. These will be developed by CAL FIRE and the Advisory Committee in accordance with Public Resources Code Sctions 4660 – 4664 and the California Environmental Quality Act.

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CHAPTER ONE: INTRODUCTION

CALIFORNIA'S DEMONSTRATION STATE FOREST SYSTEM

The demonstration state forest system of the California Department of Forestry and Fire Protection (~~CDF~~CAL FIRE) was established in the mid-1940's to meet ~~furnish~~ local needs for ~~of~~ research, demonstration, and education related to forest management. Currently, the demonstration state forest (DSF) system encompasses over 71,000 acres of land in the form of eight state forests. DSFs are healthy, living forests which demonstrate conservation and protection of wildlife, fisheries, vegetation, soil, and watershed resources as well as sustained-yield forest management activities.

The Soquel Demonstration State Forest (SDSF), when established in 1990, was the first addition to the DSF system in over 40 years. SDSF~~,~~ contains ~~approximately~~ 2,681 acres; including mostly ~~of~~ coast redwood and mixed evergreen forest types. Former Assemblyman Sam Farr authored SDSF's enabling legislation, Assembly Bill 1965 of 1987 (now Public Resources Code (PRC) Sections 4660-4664), which provided for the protection and preservation of the SDSF as an intensively managed educational and research forest. ~~, and~~ It also contained special provisions for the use of SDSF, including a limited amount of commercial timber operations on the property within the SDSF in order to provide funds for the maintenance and operation of SDSF, reasonable capital costs, and other expenses incurred in fulfilling the objectives of PRC Section 4660 on SDSF. AB 1965 is reprinted in Appendix A of this plan.

SDSF was formally transferred from its interim managers, The Nature Conservancy (TNC), to ~~CDF~~CAL FIRE on July 13, 1990. Former ~~CDF~~CAL FIRE Director Harold Walt, former Assemblyman Sam Farr, a representative of State Controller Gray Davis, and Steve Johnson of TNC dedicated the Forest, emphasizing the nature and purpose of this addition to the DSF system.

SDSF was the first of~~is unique among~~ California's demonstration state forests to have~~in that~~ an advisory committee ~~was~~ formed to assist the Department in planning future management of the Forest. The Advisory Committee, also required by AB 1965, met monthly during the planning process to facilitate the creation of the original 1998 General Forest Management Plan. T~~to discuss draft chapters and offer suggestions to the Forest staff. While the intent of t~~he Advisory Committee ~~will be~~~~was~~ reconvened in 2011 and ~~will~~ plays a vital role in reviewing the revisions to this updated version of the plan. ~~to facilitate the creation of this General Forest Management Plan , the group will continue to meet periodically to discuss plan implementation and additional management designs.~~

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THE GENERAL FOREST MANAGEMENT PLAN

Following the acquisition of the SDSF property (see the Administration chapter), TNC created an interim management plan for what they called the Soquel Creek Forest. Recognized as a temporary plan, TNC's document provided direction for current and future management decisions involving SDSF. Th~~is~~e 1998 ~~new~~ General Forest Management Plan incorporate~~s~~d element~~s~~s of the TNC plan and information from other sources. It was~~The General Forest Management Plan has been~~ developed with input from the public and resource professionals. Public workshops were held to obtain feelings, opinions, and factual information about the management of SDSF's forest resources. Furthermore, individuals representing many interests contributed data, publications, and personal knowledge for consideration through conversation with Forest staff. Public comments and concerns relating to various subjects are summarized in each chapter. A supplemental document, titled Public Input to the Soquel Demonstration State Forest General Management Plan, presents all input received during the development of the draft plan. ~~which was completed in October, 1993.~~

Local resource professionals contributed a significant amount to ~~this~~the 1998 plan. Knowledgeable individuals served on the Advisory Committee, provided factual information about various resources, and composed elements of the plan itself. Without their assistance and experience, this management plan could not have been written.

The environmental impacts of ~~this~~the 1998 management plan ~~have been~~were thoroughly investigated by Jones and Stokes Associates, Inc. in a program environmental impact report (EIR) which was completed in compliance with the California Environmental Quality Act (CEQA). A primary objective of this program EIR ~~is~~ was to identify mitigation measures to reduce or avoid adverse environmental impacts that could result from implementation of any SDSF projects. As required by CEQA, mitigation measures identified from this EIR have been incorporated into a Monitoring Plan located in Appendix C.

FUTURE PLANNING

The Board of Forestry and Fire Protection (the Board) approved the original General Forest Management Plan on May 18, 1998. In 2003, the Board reviewed and reauthorized the plan. No revisions were made at that time.

As indicated throughout this plan, SDSF staff ~~will~~ continue to formulate more specific management guidelines and planned actions. This revision of the plan includes new studies and the results of monitoring and research regarding ~~Detailed plans for~~ the management of components such as ~~recreation, education,~~ fisheries, wildlife, watershed, archeology, and timber. ~~fire protection, will be developed in the future~~.

This SDSF General Forest Management Plan will be in effect until it is either amended or a new plan is adopted in accordance with the procedures prescribed in PRC Section 4663. Working with the Advisory Committee, CAL FIRE ~~CDF~~ will reexamine the General Forest Management Plan every ~~ten~~five years, as per the policy of the Board of Forestry, and determine whether any

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changes are necessary or desirable. This plan embodies the legislative intent of PRC Sections 4660-4664, and any subsequent amendments of this plan or any new plan must be consistent with the ~~interpretations of~~ PRC ~~Sections 4660-4664 contained in this plan~~ except to the extent, if any, that subsequent legislation changes that intent. If changes are desired, the changes will be developed by CAL FIRE~~CDF~~ and presented to the Advisory Committee for consideration at one or more public meetings. The changes shall be approved by the Advisory Committee prior to review and adoption by the Board~~Department~~. (Statutory authority for final adoption of the plan rests with the Board per 0351.10 and PRC 4645.) Any changes will be subject to environmental review as provided by the California Environmental Quality Act.

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CHAPTER TWO: MANAGEMENT GOALS

SDSF's management goals represent a combination of legislation, policy, and public input. PRC Sections 4660-4664, the enabling legislation for Soquel Demonstration State Forest, is the preeminent authority with regard to the management of the SDSF. Consistent with the objectives of that legislation to protect and preserve SDSF as an intensively managed, multifaceted research forest and to the extent not in conflict with that enabling legislation, the SDSF will be managed in accordance with the state forest system legislation (PRC Sections 4631-4658) and Board of Forestry and Fire Protection policy.

Public Resources Code Section 4660 states that the intent of the Legislature in establishing the Soquel Demonstration State Forest is to provide an environment that will do all of the following:

* Provide watershed protection for local communities and base-line monitoring and studies of the hazards, risks, and benefits of forest operations and watersheds to urban areas.

* Provide public education and examples illustrating compatible rural land uses, including sustained yield timber production, as well as the historic development of timbering and forestry machinery, within the context of local community protection and nearby pressures.

* Provide a resource for the public, environmental groups, elected officials, environmental planners, the educational community, and the media as an open environment for the inspection and study of environmental education, forestry practices, and effects thereof.

* Protect old-growth redwood trees.

~~As is common in legislation, these objectives contain many potential conflicts and will require trade offs in implementation.~~

Section 4661 further states that CAL FIRE~~the CDF~~ may permit a limited amount of commercial timber harvesting in order to provide the funds needed for the maintenance and operation expenses of SDSF, reasonable capital costs, and other expenses incurred in fulfilling the objectives of PRC Sections 4660-4664 on SDSF.

Below is a listing of SDSF's general management goals which elaborate on the legislative intent. Other subjects and greater detail relating to the topics listed here can be found throughout the following chapters of this General Forest Management Plan.

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RESOURCE PROTECTION AND ENHANCEMENT

1. Protect, restore, and enhance the significant natural values of the Soquel Demonstration State Forest.

2. Provide watershed protection and conduct baseline studies and monitoring of hydrological resources.

3. Demonstrate fire protection using a coordinated fire prevention and control system which includes education and enforcement of fire prevention guidelines, Forest patrol, and vegetation management including prescribed fire, fuelbreak construction, pre-attack strategies, and suppression tactics.

4. Improve fisheries and wildlife habitat to foster healthy populations and promote biodiversity.

5. Monitor, study, and implement controls for various forest pests using Departmental and outside specialists.

6. Monitor, study, and implement controls for invasive plant species.

7. Identify all significant archaeological and historical features and protect them during all management activities.

8. Conserve soil resources by reducing erosion resulting from flooding, earthquakes, logging activities, roads, and trails.

DEMONSTRATION AND EDUCATION

1. Conduct innovative demonstrations and education in forest management including silviculture, habitat diversity, logging methods, hydrology, resource protection, and recreation.

2. Provide forestry education opportunities for the public, forest landowners, the educational community, the media, natural resource professionals, and environmental groups.

3. Develop interpretive resources to help Forest visitors understand the various coast redwood forest communities and the basics of forest land management.

4. Establish a volunteer program to assist forest staff in providing forestry interpretation for visitors.

5. Provide suitable public access and parking.

~~5 .~~6. Plan for ~~Design and construct aa~~ Forestry Education Center to serve as the Forest's focal point for demonstration and education activities.

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RESEARCH

1. Conduct research in forestry and natural resource management, including the benefits and risks of forest operations in watersheds close to urban areas.

2. Serve as a laboratory for in-house projects and encourage research by other agencies, interest groups, and educational institutions.

3. Disseminate information obtained from the State Forest to appropriate individuals in an effective and timely manner.

TIMBER MANAGEMENT

1. Demonstrate sustained-yield ~~with examples of~~ timber harvest~~ing~~ practices through harvest operations that balance harvest rates with growth over time and are ~~at a level that is~~ compatible with rural land use in Santa Cruz County, while promoting ~~and~~ recreation~~al~~ ~~use of SDSF and promotes~~ opportunities, forest health, watershed protection, wildlife, and fisheries values as well as aesthetic enjoyment.

2. Protect old-growth redwood and Douglas-fir trees and recruit additional late-successional forest stands.

3. Incorporate demonstration, research, and restoration objectives into timber management activities whenever possible.

4. ~~Study~~ Research and implement ~~-~~hardwood stand management alternatives including modification to enhance wildlife habitat, utilization for various forest products, and conversion to softwood timber stands consistent with the legislative goals of PRC Sections 4660-4664.

~~RESEARCH~~

~~1 . Conduct research in forestry and natural resource management, including the benefits and risks of forest operations in watersheds close to urban areas.~~

~~2 . Serve as a laboratory for in-house projects and encourage research by other agencies, interest groups, and educational institutions.~~

~~3 . Disseminate information obtained from the State Forest to appropriate individuals in an effective and timely manner.~~

~~RESOURCE PROTECTION AND ENHANCEMENT~~

~~1. Protect, restore, and enhance the significant natural values of the Soquel Demonstration~~

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~~State Forest.~~

~~2. Provide watershed protection and conduct baseline studies and monitoring of hydrological resources.~~

~~3. Demonstrate fire protection using a coordinated fire prevention and control system which includes education and enforcement of fire prevention guidelines, Forest patrol, vegetation management, fuelbreak construction, pre-attack strategies, and suppression tactics.~~

~~4. Improve fisheries and wildlife habitat to foster healthy populations and promote biodiversity.~~

~~5. Monitor and study controls for various forest pests using Departmental and outside specialists.~~

~~6. Study all significant archaeological and historical features and protect them during all management activities.~~

~~7. Conserve soil resources by reducing erosion resulting from flooding, earthquakes, logging activities, roads, and trails.~~

RECREATION

1. Provide for recreational opportunities which are oriented toward foot, bicycle, and equestrian traffic and include trails, roads, and picnic areas. Limited camping may be permitted ~~in the future~~ if consistent with Forest objectives.

2. Integrate recreation management, forestry education, resource protection and examples of timber harvesting so as to demonstrate how they can be compatible.

3. ~~Control~~Prohibit unauthorized fishing, the use of motorized vehicles, shooting, and hunting to provide for public safety and forest protection. Prohibit unauthorized camping, fires, and night time use.

~~*PUBLIC COMMENTS AND CONCERNS*~~*THE FOLLOWING PUBLIC COMMENTS WERE RECEIVED DURING REVIEW OF THE 1998 GENERAL FOREST MANAGEMENT PLAN*

Throughout the planning process, members of the public have indicated that adherence to SDSF's enabling legislation, AB 1965, is legally required. Neighbors and visitors of the Forest have communicated that management goals and actions should abide by the written legislation. ~~CDF~~ CAL FIRE intends to abide by this plan and to act consistently with the intention of the enabling legislation as expressed in this plan.

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CHAPTER THREE: PROPERTY DESCRIPTION

LOCATION AND BOUNDARIES

Soquel Demonstration State Forest is located ~~in~~near the center of Santa Cruz County, California, approximately eight miles northeast of the city of Santa Cruz (Figure 1). Positioned in the southern portion of the Santa Cruz Mountains, SDSF is eighteen air miles south of San Jose and within a two-hour drive of the San Francisco and Oakland metropolitan areas. Access to the property is via State Highway 1 or 17 and local county roads. The entrance to the Forest is from Highland Way, a county road in the Santa Cruz Mountains that connects State Highway 17 with Watsonville. Virtually all of the Forest's 2,681 acres are located within the East Branch of Soquel Creek watershed.

SDSF's boundaries were originally established by metes and bounds rather than the more familiar township and range system. Formerly part of the Soquel Augmentation Rancho (a Mexican land grant), this area has always been defined differently than the land which surrounds it. ~~Most~~ Some of the corners listed in the survey, prepared by George Dunbar of Dunbar Land Surveys, have been verified and are in place. The Santa Cruz County parcel numbers for the Forest are 098-101-04; 098-161-06; 098-351-01[1]; and 099-181-02, 03, 04, 06.

ADJACENT OWNERSHIP

SDSF is bordered by both state and private property (Figure 2). The Forest Of Nisene Marks State Park borders the State Forest for three and one-half miles along Santa Rosalia Ridge to the south. Approximately three-hundred-forty acres directly east of the Forest boundary are owned by Roger and Michelle Burch. This land is managed by Redwood Empire and includes the main entrance and parking area for the Forest off Highland Way. To the north and west, the adjacent ownerships are private rural-residential parcels, including the large holding of Spanish Ranch. Most of these parcels range in size from 1 to 80 acres. On the southwest border is the property containing the Olive Springs Quarry, owned by the CHY Company.

With the considerable amount of private property surrounding the Forest, public access is currently limited. The only undisputed public access points into the Forest are from Highland Way and The Forest of Nisene Marks State Park.

HISTORY OF OWNERSHIP

Prior to the arrival of Europeans, the Costanoan (also known as Ohlone) Indians inhabited the area. In the mid-1800's, the title to the 32,000-acre Soquel Augmentation Rancho was awarded to Martina Castro de Depeaux viuda de Lodge viuda de Cota, the daughter of a Spanish Colonial

[1] Note that historic parcel number 098-161-02 was changed to 098-351-01 by the Santa Cruz County Assessor in 1998.

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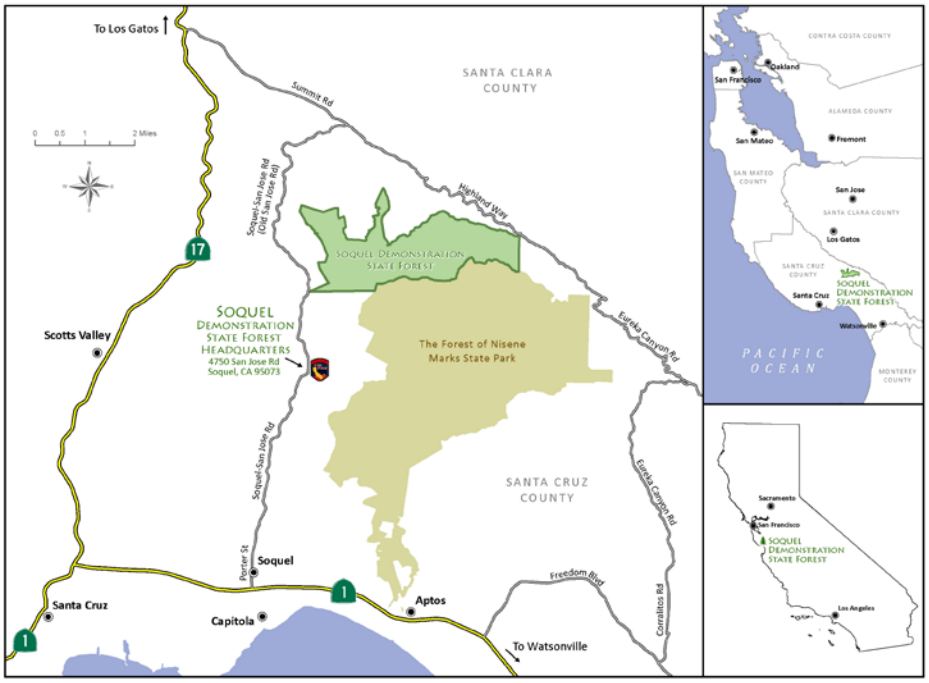
FIGURE 1 – Locator map for SDSF



soldier. SDSF was contained within the rancho, and Martina gave this portion to her daughter, Antonia Lodge de Peck. Frederick A. Hihn, a German-born entrepreneur, was able to acquire portions of the Soquel Augmentation through a discrepancy in legal title. He was particularly interested in Lodge de Peck's parcel and purchased it in 1863.

In the 1880's, Hihn established the Valencia-Hihn Company and began selectively logging the old-growth redwood on his lands to produce shingles, posts, and rails. Upon his death in 1913, Hihn's heirs assumed management of his lands and continued to harvest the area. In 1924, the Valencia-Hihn Company sold their land to the Monterey Bay Redwood Company (MBRC). The MBRC owned the State Forest property for 37 years and performed extensive harvest in the 1920's and '30's. They sold their property to the Glenco Forest Products Company of Sacramento in 1961, which later changed its name to the CHY Company. Eighteen years later, in 1979, CHY sold the State Forest portion of their land to the Pelican Timber Company. Additional details about the history of the Forest can be found in ~~Brian Dillon's~~ Archaeological and Historical Survey of Soquel Demonstration State Forest (Dillon, 1992).

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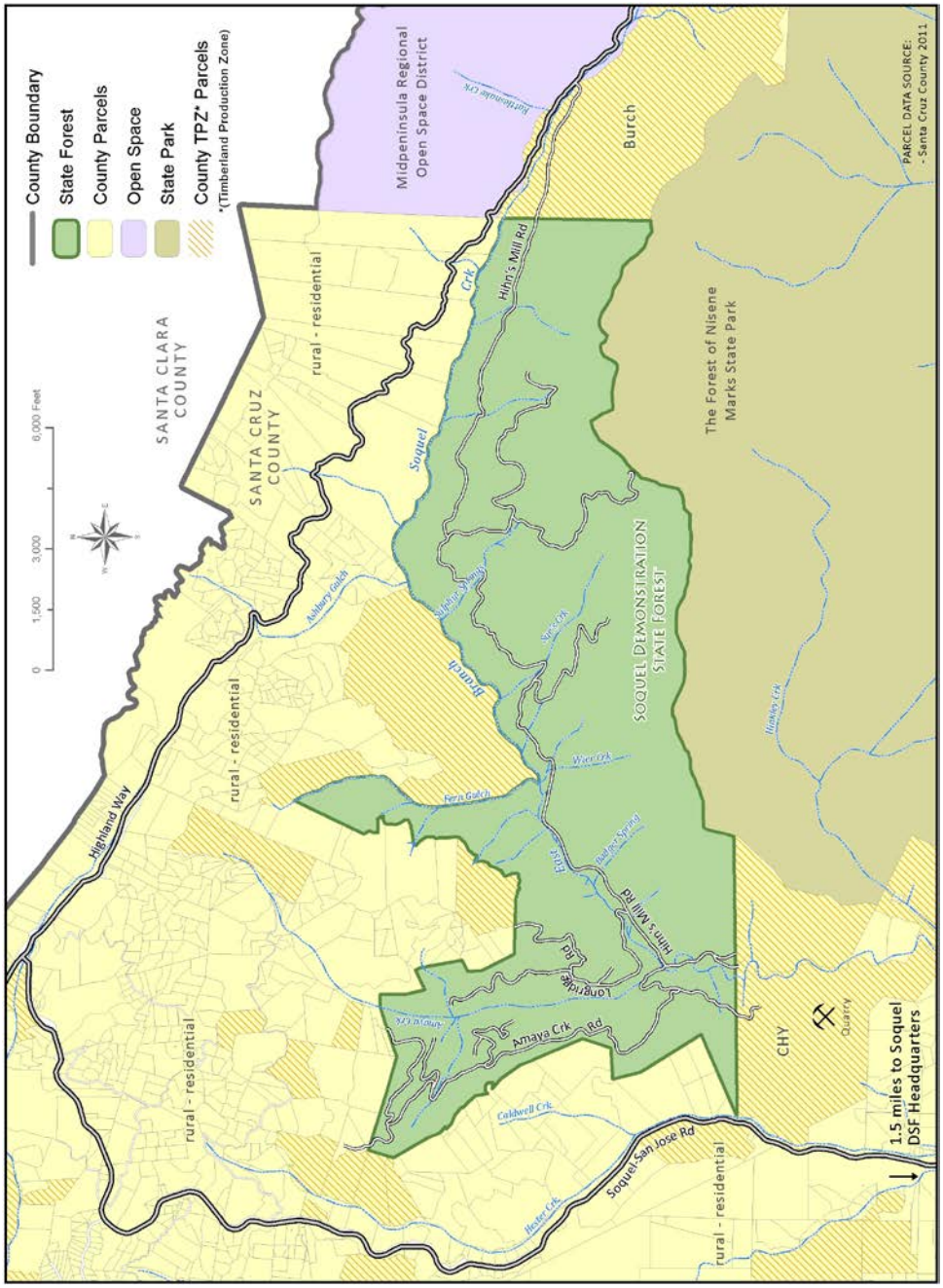

Figure 2: SDSF and adjacent ownerships

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In 1988, Pelican was involved in a debt-for-nature land swap with the State of California and the Bank of America (see the Administration chapter for more details). A result of this land swap was the creation of SDSF as authorized by former Assemblyman Sam Farr's Assembly Bill 1965. The Nature Conservancy acted as the interim managers of the Forest until its transfer to ~~CDF~~CAL FIRE in 1990.

CLIMATE

The climate of the Santa Cruz Mountains is Mediterranean, characterized by dry, warm summers and wet, cool winters. SDSF is usually cool and damp because of the dense canopy of forest vegetation and its location on a north-facing slope. The average minimum January temperature is 38 degrees Fahrenheit, and the average maximum July temperature is 76 degrees Fahrenheit.

Most of the precipitation in the area occurs from November through April. The average annual rainfall for the East Branch of Soquel Creek is 44 inches (Linsley et al., 1992). At elevations above 2,000 feet, snowfall occurs about every other year and averages less than five inches total.

During the late spring and early summer months, Santa Cruz County often has foggy or cloudy skies. In the Forest, this marine layer is generally limited to early morning and late evening hours. Winds generally blow from the west or southwest (onshore) and are mild to moderate throughout the year. Strong winds, however, come in with winter storms and are strongest at higher elevations. Pressure gradients inland may occasionally cause strong northeasterly winds to occur.

SOILS AND GEOLOGY

SOIL TYPES

The parent material of soils found in SDSF is primarily sedimentary and consists of fine and coarse-grained sandstone, consolidated shale, weathered mudstone, and siltstone. Schist and intrusions of granitic rock are also present. There are nine soil series which developed from these parent materials; see ~~(~~Table 1 and Figure 3 (USDA ~~Department of Agriculture~~, 2004)). They are all deep and well-drained soils except for the Maymen Stony Loam which is a shallow, well-drained soil. According to the ~~Soil~~Natural Resources Conservation Service ~~(US Department of Agriculture, 1980)~~, most of the soils support watershed, recreation, and wildlife resources. Five of the soils (Ben Lomond, Felton, Lompico, Nisene, and Aptos) also support timber production, with the primary species being coast redwood and Douglas-fir.

GEOLOGIC ACTIVITY

In 1992, a detailed geologic study was completed by ~~Michael Manson and Julie Sowma-Bawcom of~~ the California Geologic Survey ~~Division of Mines and Geology~~ (Manson and Sowma-Bawcom, 1992). This investigation resulted in a report which focuses on the process and degree of instability in both the State Forest and surrounding areas. The report, titled Geology, Slope Stability, and Earthquake Damage in Soquel Demonstration State Forest, includes maps of

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general geologic and geomorphic characteristics, landslide features (indicating the relative degree of stability), stream orders, roads to be considered for abandonment, and Alquist-Priolo Special Studies Zones[2]. ~~(Alquist-Priolo Special Studies Zones are areas along traces of the San Andreas Fault where geologic investigations are required prior to development.)~~

SDSF is seismically very active. The San Andreas Fault runs through the northeastern boundary and along the East Branch of Soquel Creek to the mouth of Ashbury Gulch, where it turns north. The Zayante Fault, part of the San Andreas Rift Zone, runs through the southwest edge of the Forest. The epicenter of the 1989 Loma Prieta Earthquake was located approximately ~~2~~ two miles south of SDSF, in The Forest of Nisene Marks State Park. Numerous cracks and fissures dating from the 1989 earthquake have been located in the State Forest.Geologic activity, coupled with past fires and severe rain storms, has helped form the steep terrain found throughout the Forest. These events have also contributed to the many landslides present within the inner gorges of streams and along steep roadcuts. The numerous natural springs and sag ponds found throughout the Forest are also the result of past geologic activity.

FIGURE 3 – Location of soils series in SDSF

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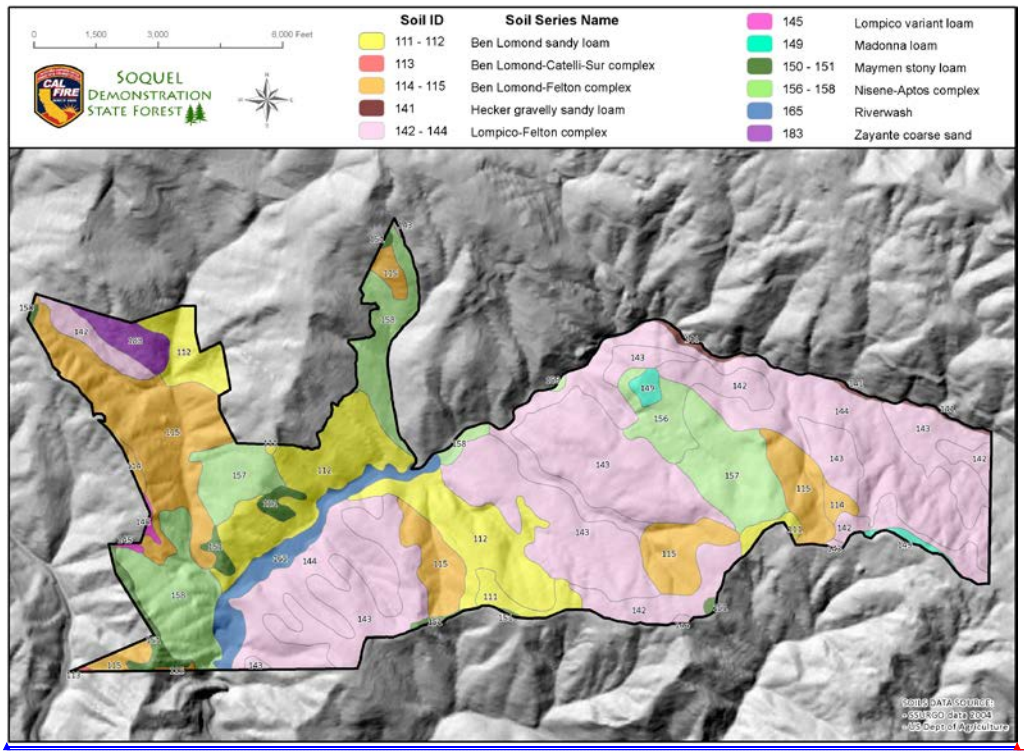
[2] Alquist-Priolo Special Studies Zones are areas along traces of the San Andreas Fault where geologic investigations are required prior to development.



The elevation of SDSF ranges from 500 feet at the East Branch of Soquel Creek to 2,500 feet at the southeast corner on Santa Rosalia Ridge. The higher elevations occur in the southeast portion of the Forest and decrease along the ridge going southwest.

WATER RESOURCES

The East Branch of Soquel Creek is a perennial stream that flows through the entire length of the Forest. It is fed by the perennial stream of Fern Gulch and Amaya Creeks from the north, and numerous unnamed intermittent and ephemeral streams. The total size of the East Branch watershed is approximately 19 square miles or 12,240 acres.

As previously mentioned, natural springs and sag ponds can be found in the Forest. The two largest springs are Sulpher Springs, located on the Sulphur Springs Trails, and Badger Springs, located near the main picnic area. Badger Springs was at one time a developed water source as is evident by the remains of a spring box and steel pipes scattered around the area. A third spring, located east of Sulphur Springs along Hihn's Mill Road, was created by the 1989 earthquake. The

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Table 1. Soil types and associated erosion hazard of SDSF*

SOIL TYPE	PERCENT SLOPE	PERCENT ACRES	EROSION HAZARD
Ben Lomond sandy loam	15-50	1.77	moderate to high
Ben Lomond sandy loam	50-75	11.61	very high
Ben Lomond-Felton Complex	30-50	0.66	High
Ben Lomond-Felton Complex	50-75	15.81	very high
Hecker gravelly loam	50-75	0.48	very high
Lompico-Felton Complex	5-30	7.44	moderate to high
Lompico-Felton Complex	30-50	23.95	High
Lompico-Felton Complex	50-75	14.71	very high
Madonna loam	15-30	0.88	High
Maymen stony loam	15-30	0.06	High
Maymen stony loam	30-75	1.97	high to very high
Nisene-Aptos Complex	15-30	1.90	moderate to high
Nisene-Aptos Complex	30-50	6.76	High
Nisene-Aptos Complex	50-75	7.62	very high
Riverwash	-	2.94	-
Zayante coarse sand	30-50	1.44	moderate to high

*From Soil Survey of Santa Cruz County, California (~~SCS~~US Department of Agriculture, 2004~~1980~~)

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natural springs of Sulphur and Badger, as well as other unnamed springs, are also special to SDSF. These springs, plus Amaya Pond, enhance particular biotic communities and offer various research opportunities.

Amaya Pond, a seasonal body of water, is located in the northwestern arm of the Forest. Approximately one-half acre in size, it is located on the east side of Amaya Road, approximately one-third of the way down from Comstock Mill Road. (See Preliminary Biological Assessment of Soquel Demonstration State Forest, Santa Cruz County, California, [Holland et al., 1992] for more details about Amaya Pond.)

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The portion of the East Branch that runs through the Forest is well known for its steelhead rearing habitat. The California Department of Fish and Game prohibits angling in this part of the Soquel Creek watershed in order to protect this important resource. The Fisheries chapter of this report contains more information on the creek and its fisheries assets.

Soquel Creek, including the East Branch, is also part of the domestic water supply for the local community. The lower portion of Soquel Creek serves as part of the natural groundwater recharge system for residents' wells and supplies surface water to a number of intakes along the creek. Soquel Creek is within the Central Coast California (CCC) Coho Salmon Evolutionarily Significant Unit (ESU). (See the Fisheries and Watershed chapters for additional information on watershed condition, use, and management.)

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ZONING AND GENERAL PLAN

The Santa Cruz County General Plan (1994) can be described as the county's "blueprint" for future development. It is a long-range policy document that looks at the future of the community and takes into account the types of development that will be allowed, the spatial relationships among land uses, and the general pattern of future development. The stated objective for timber production (Santa Cruz County General Plan, Chapter 5, and Objective 5.12) is to encourage the orderly economic production of forest products on a sustained yield basis under high environmental standards, to protect the scenic and ecological values of forested areas, and to allow orderly timber production consistent with the least possible environmental impacts.

Under the concept of zoning, various kinds of land uses are grouped into general categories or "zones". A zoning ordinance is the local law (refer to County Code) that spells out the immediate, allowable uses for each parcel within the County. Zoning regulates present development through specific standards such as lot size, building setbacks, and a list of allowable uses. Zoning must comply with the general plan. The purpose of zoning is to implement the policies of the general plan. The Santa Cruz County General Plan allows timber harvesting and associated operations, requiring approval of a Timber Harvesting Plan by the California Department of Forestry and Fire Protection for the following zoning designations: Timber Production (TP), Parks, Recreation and Open Space (PR) (except in the coastal zone), Mineral Extraction Industrial (M-3), and the Commercial Agriculture (CA) (except in the coastal zone).

SDSF is entirely classified as Timber Production Zone (TPZ). This statewide zoning designation

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was created by the Forest Taxation Reform Act of 1976 and counties throughout the State were required to rezone parcels that met the definition of Timberland. A as defined in Government Code Section 51104(g) and consistent with Sections 51112 and 51113. . TPZ land is devoted to and used for growing and harvesting timber and other compatible uses as defined in Section 51104(h). Compatible uses include but are not limited to watershed management, fish and wildlife habitat management, and outdoor education and recreation activities, as well as and a residence or other structure as necessary for management of land zoned as timberland production.

Any development must not only meet the specific requirements of the zoning ordinance, but also the broader policies set forth in the local general plan. For the purpose of determining the development potential of rural parcels, T the Santa Cruz County General Plan designates the Forest land as Mountain Residential. Objectives of this use include designation are to provide for very low density residential development in areas which are unsuited to more intensive development due to the presence of physical hazards and development constraints, the lack of public services and facilities to support higher densities, the protection of natural resources, retention of rural character, and to maintain enance of a healthy environment sustainable use of natural resources.

CHARACTERISTIC FEATURES

A distinctive feature of SDSF is its proximity to the large urban areas of San Francisco Bay, Monterey Bay, and San Jose. This provides prime opportunities for urban children to experience forestry education on a first-hand basis.

The natural springs of Sulphur and Badger, as well as other unnamed springs, are also special to SDSF. These springs, plus Amaya Pond, enhance particular biotic communities and offer various research opportunities.

The presence of steelhead trout and in a portion of the Soquel Creek watershed also contribute to the special characteristics of SDSF. The watershed, second only in size to that of the San Lorenzo rRiver in Santa Cruz county, represents a system limited to the coastal side of the Santa Cruz Mountains. One of the largest reasons for this is the presence of steelhead trout, an anadromous fish species. Once abundant along the entire west coast, steelhead populations have declined due to habitat loss and several other factors. The East Branch of Soquel Creek, the portion of Soquel Creek that flows through the Forest, supports a steelhead population and its required habitat. Although A very limited number of coho salmon are not currently present, and their habitat still existsare also present in the watershed.

As mentioned above, the San Andreas Fault and Rift Zone are directly associated with SDSF. The effects of both ancient and contemporary seismic activity are apparent throughout the Forest. The history and future of this very active system make for an interesting addition to SDSF's abundant natural features.

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Finally, the Forest contains ~~six~~ archaeological and historical sites ~~which were~~ discovered during on-going ~~the~~ archaeological surveys (Dillon, 1992). The Archaeology Chapter of this plan ~~report~~ describes the sites and their significance in detail. Both prehistoric and historic, these sites will enhance SDSF's demonstration and education programs.

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CHAPTER FOUR: ADMINISTRATION

THE LEASE

On March 7, 1988, State Controller Gray Davis and the Bank of America settled a ~~thirteen~~ 13-year long lawsuit over unclaimed bank accounts. The settlement included $35.7 million in cash and four undeveloped natural parcels in Tehama and Sonoma Counties. The property that is now SDSF was acquired during the settlement process and added to the package.

The settlement properties are held in a trust with the State as the beneficial owner and the Exchange Bank ~~of Tehama County and the Bank of California~~ as ~~co-~~trustee~~s~~. The properties can be sold to pay unclaimed funds if they exceed the $35.7 million in cash set aside for this purpose. It is doubtful, however, that this will ever happen.

At the time of the settlement, The Nature Conservancy (TNC) volunteered to act as steward for these properties. A 25-year lease was developed which stated that TNC would manage these properties and that past land use practices could continue. Any revenues generated from these activities were to pay for property taxes, operations and maintenance, natural resource enhancement, and access improvement projects.

The Nature Conservancy transferred their lease of the Santa Cruz county property (now SDSF) to ~~CD~~CAL FIRE~~F~~ on April 18, 1990. ~~CDF~~ CAL FIRE assumed management at that time and a dedication ceremony for SDSF was held on July 13, 1990. In 2013, ~~A~~ at the end of the 25-year lease, the property will be transferred permanently to the State, free and clear.

Under the terms of the lease, both the ~~co-~~trustees and the Controller have certain rights and responsibilities. The trustee's~~'~~ primary responsibility is to monitor the lessee's performance as managers of the properties. The Controller is responsible for the sale of any or all the properties in the event that cash assets are insufficient to satisfy all claims. As previously mentioned, this is unlikely to occur~~ ever happen~~.

CAL FIRE~~CDF~~ ADMINISTRATION

Authority to *administer and operate* state forests in California comes from the Legislature and is contained in the Public Resources Code (Sections 4631-4664 and 4701-4703). Rules and regulations governing *use* of state forests are contained in the California Code of Regulations (Title 14, Sections 1400-1439 and 1510-1521). The State Board of Forestry and Fire Protection gives policy direction to the Demonstration State Forest Program, which is administered by the Director of ~~CDF~~CAL FIRE.

~~CDF~~CAL FIRE is administratively broken into two Regions, each with a Region Chief who reports to ~~CDF~~CAL FIRE's Director. Each region includes ~~ranger~~ units, and state forests are administered by a local ~~Ranger~~ Unit Chief. SDSF is in the Northern California~~Coast/Cascade~~

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Region (with headquarters in Redding~~Santa Rosa~~) and is within the San Mateo-Santa Cruz ~~Ranger~~ Unit (headquartered in Felton). The State Forest office is located next to the ~~CDF~~CAL FIRE Soquel Forest Fire Station at 4750 Soquel-San Jose Road in Soquel, California. When fully staffed, SDSF has a staff of five ~~four~~: Forest Manager, Assistant Forest Manager, half-time Office Technician ~~Assistant~~, and two seasonal Forestry Aides. The Forest Manager is supervised by the ~~Ranger~~ Unit Chief.

The Forest staff is responsible for the on-site operation of the Forest as provided for by the Public Resources Codes, California Code of Regulations, and the State Board of Forestry and Fire Protection. Forest regulations, policy, and other issues prescribed by the Director of ~~CDF~~CAL FIRE are used to develop plans and procedures to govern development and perform maintenance of the Forest. The General Forest Management Plan will be reviewed and approved by SDSF's ~~S~~ Advisory Committee (described below) and ultimately approved by the ~~Director of CDF~~CAL ~~FIRE and the~~ Board of Forestry and Fire Protection.

SDSF is an important resource for CAL FIRE training as well as for other agencies and affiliated organizations. CAL FIRE specifically uses SDSF for training of state personnel in chain saw operations, off highway driving for fire apparatus, wilderness first aid, search and rescue operations, swift water rescue, Forest Practice Regulations, Resource Management training for Joint Apprenticeship Committee requirements, archaeology, and erosion control practices.

FUNDING AND TAXES

The Demonstration State Forest Program, including SDSF, is funded through the regular annual state Budget Act. AB 1965 did not establish a separate fund for SDSF and it is not listed as a line item in the state budget. Revenues from all state forests are deposited in a special fund called the Forest Resources Improvement Fund (FRIF), providing money for the annual budgets of state forests.~~, the Forest Practice Program, the California Forest Improvement Program (CFIP), and other CDF programs.~~

Expenditures for all state forests are included in a single budget line item in the Department's annual budget. Soquel State Forest was added to the Department's state forest budget in the 1990-91 fiscal year with a minimum of staffing and operating expense. The Budget Change Proposal recognized that there would be little revenue from SDSF for the first few years and that FRIF would need to contribute over one million dollars in operating expense before the Forest could produce revenue. It was also recognized that many years would pass before revenues would equal expenses.

The Department may permit a limited amount of commercial timber operations on SDSF in order to provide funds on a cumulative basis as necessary for the maintenance and operation expenses of SDSF, reasonable capital costs, and other expenses incurred in fulfilling the objectives of PRC Sections 4660-4664 on SDSF. The enabling legislation requires a minimum level of timber harvesting, ~~that we call a~~ or "floor", to provide income for all costs of operation and for research and educational purposes of SDSF. The legislation authorizes a higher level of harvesting, ~~which~~

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~~we call a~~ or "ceiling", which shall not exceed long-term sustained yield (LTSY) and on a cumulative basis shall not exceed the level of timber harvesting necessary to provide the funds needed for the maintenance and operation expenses, reasonable capital costs, and other expenses incurred in fulfilling all the objectives identified in PRC Sections 4660-4664 on SDSF. These additional objectives include watershed protection and monitoring, ~~and~~ demonstrations of compatible rural land uses, and historic development of timbering and forestry machinery.

As a practical matter, the various objectives overlap and cannot be completely separated. For example, demonstration or experimental timber harvesting could qualify as research and public education as well as being an example of compatible rural land uses. The protection of old-growth redwood trees will occur under normal operations of SDSF and does not need to be identified as a separate purpose with separate funding.

Funding for SDSF needs to be increased over time in order to fulfill the objectives of PRC 4660-4664. In order to adhere to the administrative and budgeting processes currently in place while simultaneously assuring compliance with the limitations placed on the Department by the enabling legislation, the Department will publish accurate annual reports which will compile revenues~~,~~ and expenses itemized by program. ~~, and cumulative balances.~~ The Department will post the Annaul Report on the CAL FIRE website. ~~maintain a mailing list for requests of annual distributions of the report.~~ Large capital expenses (e.g., for additional properties to provide proper access to SDSF or for construction of a Forestry Education Center and administrative facility) will be funded through the FRIF fund or any fund source approved by the Legislature. Amortization of these capital outlays may be included in the computation of cumulative expenses in the annual reports.

The State pays property taxes to the County of Santa Cruz on land values within SDSF. Additionally, purchasers of state forest timber are liable for payment of timber yield taxes according to Public Resources Code, Section 4654. SDSF's timber sale purchasers are required to file quarterly tax returns with the California Board of Equalization.

ADVISORY COMMITTEE

The legislation which created SDSF (AB 1965) called for the establishment of an advisory committee to assist with the development of SDSF's General Forest Management Plan. A main function of the committee is to act as a critical link between CAL FIRE~~CDF~~ and the community in the planning effort. This allows SDSF to learn what the community expects and their opinions regarding relevant ~~how they feel about certain~~ issues.

The original Advisory Committee ha~~s~~d nine members appointed by the Director of CAL FIRE~~CDF~~ in August of 1991. Five positions were specified by the legislation and four were added by the Director. The original committee consist~~s~~ed of one representative from each of the following:

* State Board of Forestry and Fire Protection
* Santa Cruz County Board of Supervisors

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* California Department of Parks and Recreation
* California Department of Fish and Game
* The Forest of Nisene Marks State Park Citizens Advisory Committee
* The Nature Conservancy
* Soquel Creek Water District
* Neighborhood Representative
* Local Registered Professional Forester

The Committee held monthly meetings during the development of the ~~draft~~1998 General Forest Management Plan. The Advisory Committee became inactive following the approval of the 1998 Plan. The Advisory Committee reconvened in 2011 to provide input on updating the Plan. Most of the groups listed above continue to be represented on the Committee. However, the Soquel Creek Water District removed itself from the Committee and the State Park Citizens Advisory Committee has been disbanded. The latter groups have been replaced with representatives from the Stewards of Soquel Forest and from the Resource Conservation District of Santa Cruz County. ~~Following its approval, the group will meet twice a year or as needed to review progress on plan implementation and contribute to on-going planning activities.~~ Each member serves a three-year term or until the General Forest Management Plan updating process is completed (whichever is longer). Once these conditions have been met, one third of the members' terms shall expire on the last day of each year. Following the approval of the updated Plan, the group will meet twice a year or as needed to review progress on plan implementation and contribute to on-going planning activities.

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SAFETY

The remote and rustic character of SDSF makes safety an important management consideration. Forest visitors need to be informed of safety issues and hazards inherent to the Forest. Roads, trails, and facilities are maintained in safe condition. The staff coordinates with local CAL FIRE Emergency Command Center, ~~CDF~~ ~~forest fire stations~~, the Loma Prieta Volunteer Fire and Rescue, ~~and~~ the county sheriff's office, and other agencies and groups, for emergency medical response.~~;~~ Forest personnel, including volunteers, are ~~will be~~ trained in first-aid; permanent Forest personnel maintain certification as Emergency Medical Responders. Additionally, search and rescue organizations are allowed to train in the Forest so as to develop their skills and better acquaint themselves with the terrain.

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The following safety protocols are currently in place:

* Restriction and regulation signs are posted at Forest entrances. Hazards, safety issues, and the primitive nature of the area are stated on signboards and in the SDSF brochure.

* The staff works with the California Department of Parks and Recreation to provide trail maintenance, safety, and coordinated emergency response along the common boundary.

* All trails, ~~and~~ roads, and emergency helicopter landings are regularly inspected and maintained. Fallen trees and other hazards are removed as needed to maintain safe conditions.

* Motorized vehicles owned by the public are prohibited beyond designated parking areas. Exceptions are made through special permission and for management, patrol, and emergency purposes.

- Coordination with CAL FIRE~~CDF~~'s Emergency Command Center in Felton and the county sheriff's office ensures effective emergency response in the Forest. All responses for emergency assistance will be recorded and compiled, including calls for police, fire, medical, or search and rescue services. (Refer to Appendix C, Monitoring Plan.)

* Volunteers from the Stewards of Soquel Forest and the SDSF chapter of the International Mountain Bike Association provide trail maintenance and patrols, assistance to forest visitors, and support for emergency response.

LAW ENFORCEMENT

Forest regulations and policies are posted on signs and enforced through patrol and citation ~~seizure~~ ~~apprehension~~ of violators (also see the Resource Protection chapter). CAL FIRE~~CDF~~ peace officers, authorized under the California Penal Code, will be used to detain violators, with local law enforcement agencies providing backup when necessary. The Department of Fish And Game wardens will enforce fishing, hunting, and trapping laws. ~~Seizure~~ Apprehension and prosecution of violators shall be actively pursued. Violators will generally be cited and expected to appear in court, but may be taken into custody if warranted. Methods to prevent illegal activities and alternatives which curtail unwanted behavior will be explored and developed to reduce law enforcement problems.

State Forest trespass violators will normally be cited under sections of the California Code of Regulation (Title 14). Illegal trespass includes removal of trees without a permit and parking, camping/campers, or building in the Forest.

Marijuana cultivation in the Forest has been relatively minor. Since the dedication of the Forest, the remnants of ~~six~~ nine old gardens have been found and ~~three~~ four active gardens have been eradicated. The general inactivity of marijuana cultivation is due in part to the majority of the Forest being south of the East Branch of Soquel Creek with a northern exposure. Furthermore, SDSF is inaccessible by vehicles and, therefore, is not readily available for use.

Detection of marijuana gardens will occur during normal patrol activities or as leads are developed. Most detection efforts will depend on flights by the Santa Cruz County Sheriff's Marijuana Eradication Program. Information about gardens found in SDSF will be referred to the sheriff's office.

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ACCESS NEEDS

As stated in the Soquel Demonstration State Forest Recreation Study Final Report (McNally and Hester, 1993) and the Recreation chapter, Forest access is a significant problem and complex issue. The inability of the public to drive to the forest when county roads are closed and ~~T~~ trespass across private property to and from the Forest are challenges. ~~comprises the bulk of these problems.~~

The SDSF property came into state management with two verified legal access routes (see the Roads and Other Improvements chapter for more details). The first is an administrative and public right-of-way through the Burch property off Highland Way. The second is across CHY Company property, through the Olive Springs Quarry, which includes a right-of-way for administrative use only.

Many visitors come in via Ridge Trail from The Forest of Nisene Marks State Park. Some recreationists, particularly equestrians, have permission to pass through private property to enter the Forest. The public's use of Comstock Mill Road is prohibited due to neighbors' opposition. ~~because road conditions are unfavorable.~~

There is an obvious need to develop improved ~~better~~ access into the State Forest, particularly along the south and west ends where most trespassing occurs. It is important to provide Forest visitors with additional safe and legal access in order to reduce trespass onto private property. Furthermore, alternative access points are necessary when landslides close Highland Way and/or Eureka Canyon Road.

LAND ACQUISITION PRIORITIES

Land acquisition to ~~which would~~ improve access to SDSF is a top priority. This has been actively pursued since the dedication of the Forest. Negotiations with various neighboring property owners regarding appropriation and/or easements have been ongoing. ~~Acquisition of p~~Parcels formerly owned by the Noren family were purchased in 2005~~6~~. These parcels make up about 9.5 acres and are shown on the Acquisition Map ~~below~~ (Figure 4).The State acquired the properties for the express purpose of providing an improved access to SDSF in anticipation that successful negotiations with the CHY Company would eventually add the other key piece needed for this access. This parcel is adjacent to the Noren properties and would provide a suitable road alignment into the SDSF ownership, as well as a site for the Forestry Education Center and other facilities (see the Demonstration and Education chapter for more information). ~~and thepurchasing land from CHY Company are currentlywill being considered. Any land acquisitions funded by timber harvest revenues from SDSF shall be limited to those which improve access to SDSF or otherwise directly enhance SDSF. All acquisitions for SDSF will comply with CEQA~~.

Another potential acquisition parcel ~~priority~~ is the Burch property which contains the entrance to the Forest (see Figure 2 in the Property Description chapter). The benefits of this procurement would include access control, additional areas for resource management and recreational visitor use, and a location for an informational kiosk and restroom. There would also be clear authority

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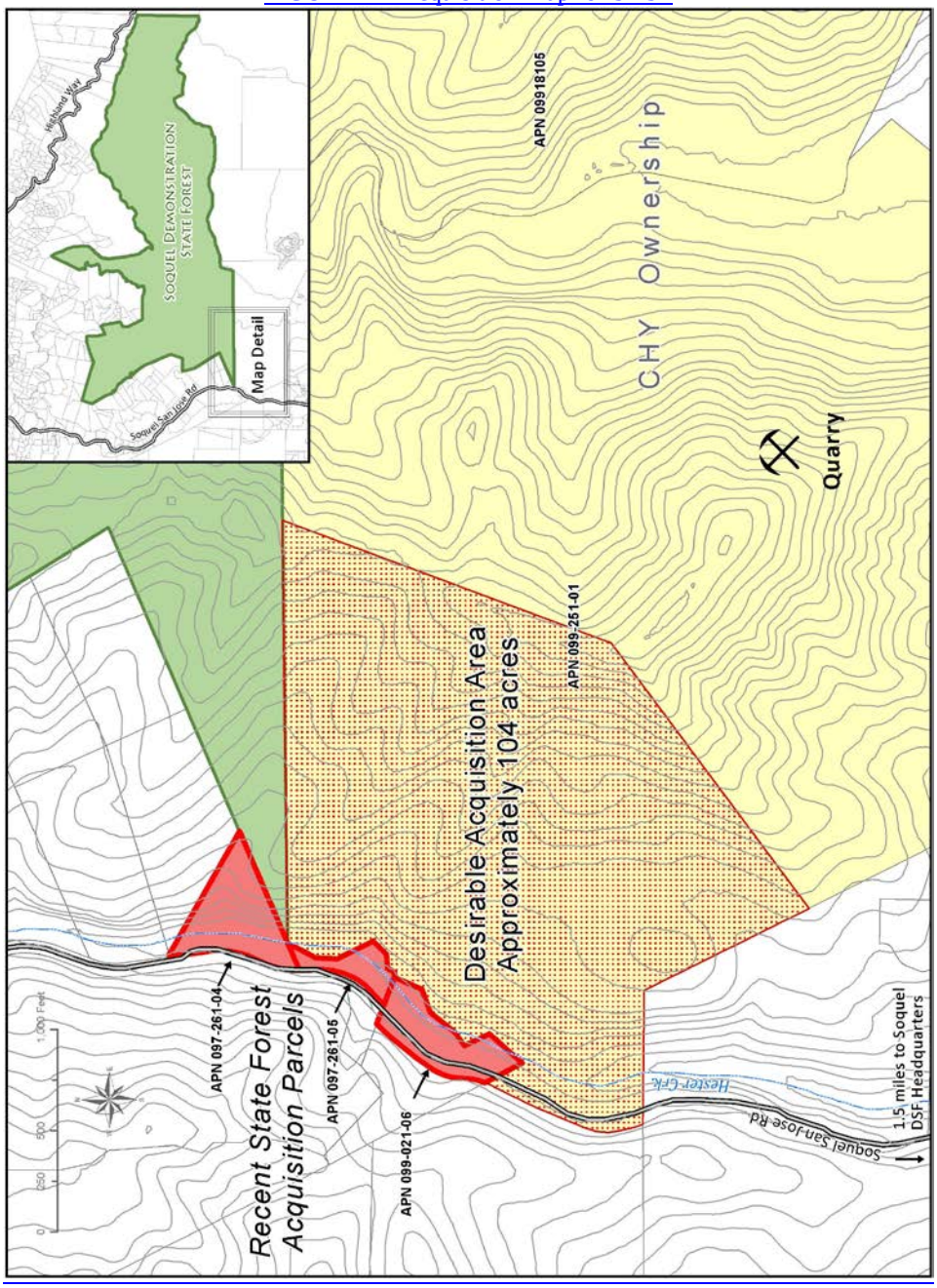
FIGURE 4 – Acquisition Map for SDSF



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and responsibility for maintenance of and improvements to the bridge, roads, and parking area.

~~A third priority is the purchase of an area for SDSF's Forestry Education Center (FEC; see the Demonstration and Education chapter for more information). Further study is needed, however, to determine the overall function of the FEC and the facilities and programs necessary to render it successful. Once this has been completed, the amount of property needed and the best site can be determined~~.

Other options for improving public access aside from direct land purchases will be considered. These could include purchase or trade of rights of way or easements, lot line adjustments or land trades. Any land acquisitions funded by timber harvest revenues from SDSF shall be limited to those which improve access to SDSF or otherwise directly enhance SDSF. All acquisitions for SDSF will comply with CEQA.

COOPERATION WITH ADJACENT LANDOWNERS

As the previous ~~CDF~~CAL FIRE Director, Harold Walt, indicated at SDSF's dedication ceremony in 1990, it is important for SDSF to cooperate with their neighbors. Forest staff will continually work with the community regarding local issues. These issues include but are not limited to fire prevention, trespass, watershed impacts, fisheries restoration in the East Branch of Soquel Creek, ~~and~~ mitigation of recreational and timber harvest impacts, emergency response and invasive species management. ~~The~~ SDSF staff ~~already~~ works with local schools in forestry education and also coordinates fire prevention programs with the local ~~CDF~~CAL FIRE ~~forest fire stations~~ Unit.

COOPERATION WITH OTHER AGENCIES AND INSTITUTIONS

SDSF cooperates with other agencies in resource protection, fire prevention and suppression, law enforcement, and safety. Cooperation is also encouraged for demonstration, forestry education, and university research projects. Other agencies that work with SDSF include the California Department of Parks and Recreation, California Department of Fish and Game, California Geological Survey, National Ocenic and Atmospheric Administration Southwest Fisheries Science Center, National Marine Fisheries Service, US Fish and Wildlife Service, US Geological Service, the ~~and~~ County of Santa Cruz, and the Resource Conservation District of Santa Cruz County. Cooperative institutions of learning and research include UC Santa Cruz, Cabrillo College, California Polytechnic State University at San Luis Obispo, San Jose State University, UC Berkeley, UC Cooperative Extension, ~~University of~~ Washington State University, and local public schools.

~~PUBLIC COMMENTS AND CONCERNS~~ *THE FOLLOWING PUBLIC COMMENTS WERE RECEIVED DURING REVIEW OF THE 1998 GENERAL FOREST MANAGEMENT PLAN*

Public comments and concerns involving the administration of SDSF have largely been focused on the issue of safe and legal access but have also touched upon the FRIF program and Advisory Committee composition.

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Suitable public access into SDSF is a major concern for neighbors, users, and Forest staff. As previously stated, there is an obvious need to develop adequate entry and exit points and to stop illegal trespass. Several individuals have made specific requests regarding the location of access points, usually focusing on the area from Olive Springs Quarry to Comstock Mill Road. However, neither end is owned or controlled by the state and only administrative access is allowed. SDSF will continue working with its neighbors and on potential access acquisitions to alleviate this complex and pressing issue.

During the process of establishing SDSF and creating the General Forest Management Plan, questions regarding the purpose and use of FRIF monies have been raised. As required by the Public Resources Code, all revenues from SDSF's timber sales must go into FRIF to be managed and allocated. As part of a state agency, SDSF will adhere to the requirements of FRIF as outlined by law.

Finally, neighbors of the State Forest have expressed that they would like greater representation on SDSF's Advisory Committee. Letters were written to former CAL FIRE~~CDF~~ Director Richard Wilson by both neighbors and the committee chairman requesting a review of the public's concerns. After a careful and lengthy evaluation, the Director determined that the committee composition was adequate due to strong current local representation.

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CHAPTER FIVE: BIOTA

INTRODUCTION

Biota are defined as the flora (vegetation) and fauna (wildlife) which inhabit a particular area. When people envision forests, such as SDSF, biotic elements are what generally come to mind. Biota, however, are only one element of an ecosystem, small pieces of the larger puzzle.

An ecosystem has been defined ~~by Hunter (1990)~~ as "the interacting populations of plants, animals, and microorganisms occupying an area, plus their physical environment." (Hunter, 1990). The physical environment consists of abiotic factors such as soil, water, space, and climate. The presence and actions of humans make up a yet another component of ecosystems. Though humans often consider themselves to be separate entities, at a basic level they are part of the biota and are intricately connected to everything in an ecosystem. When biotic, abiotic, and human components of a forest ecosystem are working together in dynamic balance, diverse biota and healthy forests are attained. (Dynamic balance refers to the continual interaction of ecosystem components which leads to a balanced yet constant state of change.) In real life, there are rarely clear boundaries between adjacent habitat communities or even ecosystems. Ecosystems and habitats blend and overlap but can be given a label based on general wildlife, vegetation, and location features. Management planning for ecosystems or habitat communities which looks at landscape patterns caused by this overlap can benefit all inhabitants, whether they be stationary (e.g., plants) or mobile (e.g., animals).

Prescribed fire plays an important role in reducing fuel loads, recycling nutrients and sustaining plant communities. Prescribed burning has been a tradition, ritual and tool since prehistoric times in the Santa Cruz Mountains and has shaped the environment that we see today. Many species and habitats have become rare due to the suppression of fire. By conducting prescribed burns under controlled conditions, hazardous forest fuels are reduced which limits the risk of a catastrophic wildfire while at the same time providing for ecological benefits. Further discussion about prescribed burning is discussed in the Resource Protection Chapter.

In this chapter, the biota are described for each habitat type, or community, found in the Forest. Only the most common plants and animals found in these communities are mentioned, but complete flora and fauna lists are located in Appendix B. For a ~~more~~ detailed account of the biota of SDSF, refer to Preliminary Biological Assessment of Soquel Demonstration Forest, Santa Cruz County, California (Holland et al., 1992). For specific information about trees (size, abundance, etc.), see the Timber Management chapter.

Fisheries resources are described in a separate chapter. ~~that also deals with aquatic invertebrates. Though terrestrial invertebrates (e.g., terrestrial insects) are critical to terrestrial vertebrate communities, very little inventory or monitoring work has been done to date in SDSF. In the future, more work will be completed in this field. In fact, the State Forest offers prime~~

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~~opportunities for study and research involving terrestrial invertebrates~~.

HABITAT COMMUNITIES

Communities consist of the living organisms collectively found in an ecosystem (Hunter, 1990). Even though considerable overlap often occurs, communities are individually labeled and classified for research, inventory, and education purposes. They are generally named for the dominant plant species within each community. The dominant plant species is dependent on specific environmental conditions (e.g., soil, climate, water) that further characterize the community. Because communities overlap, plants indicative of one habitat type may be found in others. Poison oak, for example, can be found growing in virtually all of the communities of SDSF but is most abundant in drier habitat types. Also, some fauna considered to be permanent residents of a particular community actually travel through several communities. These animals, including large mammals (deer, bobcat, gray fox, mountain lion), can be found throughout SDSF as they search for food, water, and shelter.

In 2006 an inventory was completed which gathered tree data on plots located on a grid layout. This data was analyzed along with digital image segmentation and aerial imagery to classify the vegetation using the California Wildlife Habitat Relationship (CWHR) habitat classification system. Using this protocol six CWHR habitats were classified on SDSF. These are by order of abundance; Redwood, Montane Hardwood-Conifer, Coastal Oak Woodland, Douglas-fir, Mixed Chaparral and Annual Grassland. The CWHR system further classifies each type by the amount of canopy closure. The amount and extent of tree canopies are used in the CWHR system to help predict which wildlife species may be supported by these ecosystems. On SDSF there is Moderate density (40% to 59% canopy closure) and Dense (60% to 100% canopy close). The CWHR system then further categorizes by the average tree size classes. On SDSF the size classes correspond to 3 (pole size, 6 to 11 inches diameter at breast height), 4 (small tree size, 11 to 24 inches diameter breast height) and 5 (medium/large tree size, greater than 24 inches diameter breast height). Figure 5~~, showing~~ displays these types with their corresponding locations and acreages~~, appears below~~.

COAST REDWOOD FOREST COMMUNITY

The coast redwood forest is dependent on areas of high moisture and comprises about 1,229 acres of SDSF. In its northern range, large continuous stands of redwood are formed. Southern redwood forests are restricted to moist canyon slopes and riparian zones since more moisture is available in these areas. As its name suggests, the dominant tree of this community is coast redwood, the majority of which in the State Forest are second growth (regrowth after original clearcutting). Small groves of old-growth redwoods occur at Badger and Sulphur Springs, and individual old-growth redwood trees are scattered throughout the Forest. Other common trees of this community are tanoak, Douglas-fir, and madrone. Understory species found in the redwood community of SDSF are redwood sorrel, California hazel, wild ginger, and western sword fern. Common wildlife residents ~~are~~ include pygmy nuthatch, Steller's jay, and Trowbridge's shrew. The redwood community provides nesting habitat, cover, and food for birds and a variety of small mammals. Redwood forests have comparatively little forage value for deer and other large

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mammals, however, limiting use of this habitat type.

~~MIXED EVERGREEN FOREST~~ MONTANE HARDWOODS-CONIFER COMMUNITY

This forest community is dominated by both conifers and hardwoods, often in a closed canopy. About 969 ~~978~~ acres of the Forest are categorized as Montane Hardwoods-Conifer. Primary tree species include ~~tanoak and~~ Douglas-fir,~~;~~ Shreve oak, and redwood; and to a lesser extent ~~secondary tree species are~~ madrone, ~~and~~ California bay, black oak, and big leaf maple (Holland et al., 1992). ~~Mixed evergreen~~ Montane Hardwoods-Conifer forests are on the drier slopes above

FIGURE 5 – Vegetation Type Map for SDSF

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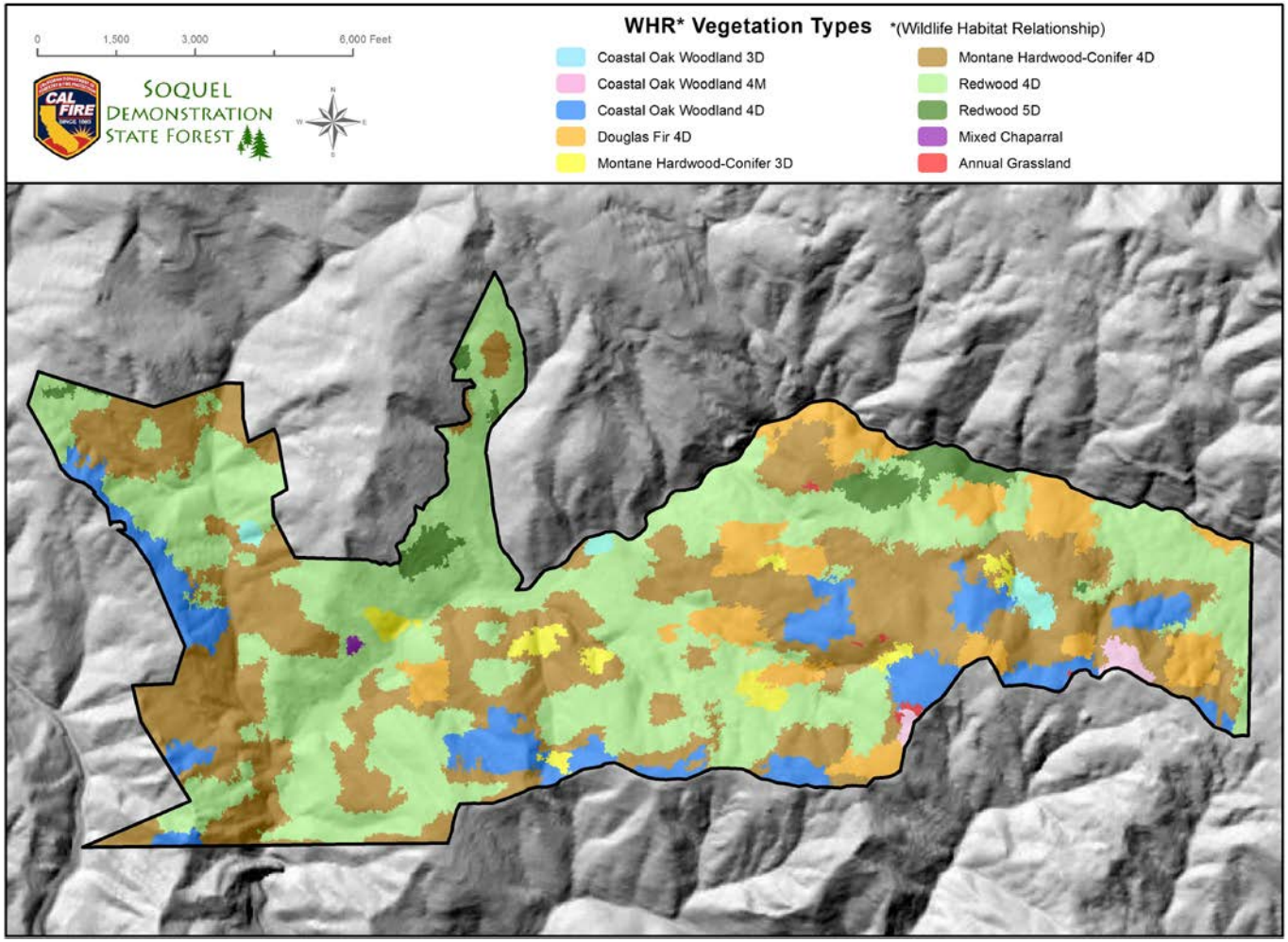
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Coastal Oak Woodland 4M
Coastal Oak Woodland 4D
Douglas Fir 4D
Montane Hardwood-Conifer 3D
Montane Hardwood-Conifer 4D
Redwood 4D
Redwood 5D
Mixed Chaparral
Annual Grassland

the redwood community, though the two overlap considerably. Also included in this community are stands with significantly more Douglas-fir which are classified as ~~t~~ CWHR Douglas-fir and compose about 214 ~~213~~ acres. ~~In fact, the presence or absence of redwood is the only significant difference in dominant vegetation (Holland et al., 1992). Mixed evergreen refers to a combination of conifer and hardwood trees that do not drop their leaves in the fall~~.

Common understory species include poison oak, California blackberry, vetch, toyon, and yerba buena. Familiar wildlife species ~~residents~~ are Merriam's chipmunk, dusky-footed woodrat, western gray squirrel, California slender salamander, acorn woodpecker, sharp-shinned hawk, and screech owl. Evidence of feral pig activity is also found throughout the community. Oak trees ~~of~~ located in these areas have very high value for wildlife, providing both nesting and roosting substrates and a food source through acorn production.

Some stands in this community historically supported a more significant conifer component than exists today. These stands failed to regain the original species distribution following intensive harvesting during the 1930's and 40's. Theses stands are dominated by tanoak and Shreve oak. Understory vegetation is typically minimal except for occasional conifers where canopy openings permit (See the Timber Management Chapter for additional hardwood management discussion).

COASTAL OAK WOODLAND COMMUNITY

The coastal oak woodland community is composed primarily of hardwoods and covers about 262 ~~254~~ acres. These hardwood stands appear to be long dominated by a combination of coast live oak, Shreve oak, and tanoak. They occupy sites less favorable to conifers. As with the coast redwood and montane hardwoods-conifer communities, other hardwoods such as madrone, bay (laurel) and black oak are also present. These stands include large senescent oaks with unique structural features beneficial to wildlife. Acorn production is important to many species, especially as winter range. Understory species are similar to the Montane Hardwoods-Conifer community. Any management activities conducted in these stand types will be conducted solely for long term maintenance. Management activities may include selective harvesting of hardwoods for fuelwood as well as tree planting where conditions are favorable for increasing the diversity of species and stocking. Several research opportunities exist in the Coastal Oak Woodland Community especially related to Sudden Oak Death Death (*Phytophthora ramorum*) and other hardwood specific pathogens. See Research Chapter for research projects on hardwoods.

RIPARIAN COMMUNITY

Riparian communities are named for the intermittent or continual presence of fresh water rather than the vegetation of such areas. Riparian communities are located along the edges and floodplains of streams or surrounding lakes. In SDSF, an abundant riparian community exists

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along the floodplain of the East Branch of Soquel Creek and to a lesser degree along Amaya Creek. This community is dominated by deciduous hardwoods such as white alder, bigleaf maple, black cottonwood, and California sycamore. Along with these trees, red and yellow willows grow in dense clumps along the banks of the East Branch. Horsetails and hedge nettles are common ground cover along the edges. Wildlife residents include vireos, warblers, Pacific-slope flycatcher, long-tailed weasel, and raccoon. Pacific newts, brown-colored salamanders with bright orange bellies, are abundant in the riparian community and a great delight to young forest visitors. The Pacific tree frog, thought to be common, is only found in a few locations (Holland et al., 1992). Additionally, large colonies of ladybug beetles gather along creeks to overwinter and breed.

Riparian communities are the most productive and resilient terrestrial habitat type for wildlife because of structural diversity and the presence of water. Many migratory songbirds are dependent on riparian habitat for breeding and foraging. Large mammals use the riparian zone as a water supply, and incorporate it into their home ranges. The riparian community is probably the most significant habitat type in the Forest due to its high value to wildlife and limited regional occurrence.

OTHER COMMUNITIES AND ADDITIONAL SPECIES

There are a few other limited communities present in SDSF. Freshwater marshes are areas where the soil stays wet ~~a good portion~~ the majority of the year, supporting characteristic vegetation. These marshes usually occur along the perimeter of ponds, at springs, near shallow pools of streams, or in areas of high water tables. The freshwater marsh community in SDSF is scattered, including only Amaya Pond and a few natural springs (Sulphur, Badger, and a couple of small, unnamed springs caused by or increased from the Loma Prieta earthquake). Wildlife residents include migratory waterfowl, great blue heron, black phoebe, belted kingfisher, and garter snakes.

Less than five acres of SDSF are comprised of grassland and mixed chaparral communities. Some of the grassland ~~se~~ areas are natural, due to soil conditions conducive to permanent grassland establishment. Other grassland areas are the result of past disturbance. SDSF's grasslands primarily contain wild oats and annual fescue grasses. Most grasslands are being encroached upon by coyote brush, lupine, poison oak, and Douglas-fir. Common wildlife residents of the grasslands are the gopher snake and Botta pocket gopher.

There is one significant chaparral stand located in the Longridge Road area on the south facing slope above Soquel Creek. Chaparral species are also found mixed in the Montane Hardwood-Conifer and Coastal Oak Woodland vegetation types ~~The chaparral community exists~~ along the exposed ridge tops and on south-facing slopes at higher elevations. These dry locations support the fire- adapted ~~resistant~~ woody shrubs of manzanita, buck brush, coyote brush, and chamise. Common wildlife residents are Bewick's wren, California towhee, scrub jay, western fence lizard, and brush rabbit.

~~Exotic (i.e., non-native) plant species occur in disturbed areas along roads and the picnic area at~~

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~~Badger Springs. The most common exotics are French broom, periwinkle, and pampas~~ jubata ~~grass, and *Eupatorium*. Most exotic species have little value for native wildlife and displace native plant species that have higher intrinsic and wildlife values~~.

FUNGAL RESOURCES

A local mycological organization has identified a wide variety of mushrooms in the Forest (refer to Appendix B). Fungi are broken into three categories based on their relationship to the immediate environment: mycorrhizal, saprophytic, and parasitic. Saprophytic fungi occur on wood that is already dead whereas parasitic fungi attack and can kill live trees. The most common fungi found in SDSF are mycorrhizal.

Mycorrhizal species form a symbiotic relationship with the trees they grow under. These organisms grow around the rootlets and collect water and trace nutrients for use by trees. The trees in turn provide carbohydrates to the fungi. Trees and mycorrhizae, therefore, depend on one another for optimum health. According to a representative of the Fungus Federation, ~~Nathan Wilson (1993)~~, SDSF is a reasonably healthy forest because of the wide occurrence of mycorrhizal fungi (Nathan Wilson, personal communication, 1993).

In general, mycological research of California's wildlands has been minimal, particularly regarding conditions conducive to fungi growth. SDSF provides ample opportunities for mycological research including fungi population analysis and succession of fungal species in the Forest. To protect the fungal resources of SDSF, a permit system for mushroom collection is ~~will be~~ maintained that prohibits any collection for commercial purposes. ~~and the effects of collection monitored.~~

FERAL PIGS

Since the establishment of SDSF, feral pigs (*Sus scrofa*) have been observed throughout the Forest. Feral pigs are an introduced species and are present throughout the Santa Cruz Mountains. Their populations shift from year to year based on weather patterns and forage availability, and seem to be transient between the Forest and the surrounding areas. The pigs are a problematic species because they can cause damage and/or alter the Forest's native communities. They frequently wallow in soft soil and wet, marshy areas which can contribute to sediment in watercourses and disturb flora and fauna that use these habitats. Their rooting/foraging behavior often damages roads and encourages invasive plant species. Feral pigs also aggressively defend themselves and under certain conditions may pose a threat to Forest users. In the past, the Forest has received complaints about damage done to neighboring properties because of the belief that the feral pigs reside in SDSF. Requests were made for increased monitoring and management of the feral pig population.

The population is managed through the Department of Fish and ~~&~~ Game's Wild Pig Depredation permitting process. When increased pig activity is noted during patrols (rooting along roads, tree damage, wallowing at sumps and ponds), depredation permits are issued.

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CORVIDS

Corvids are birds from the genus *Corvus*, and in the Santa Cruz Mountains include common species such as crows, ravens and jays. Unlike many other bird families, corvids fitness and reproduction, increases with human development. Corvids are especially significant in the Santa Cruz Mountains because they are major predators on eggs and chicks of the endangered marbled murrelets. Large populations of corvids are frequently associated with campgrounds in forests where unnatural foodstuffs are found. Big Basin State Park a nesting site for murrelets, works specifically to contain trash and food at campgrounds as well as inform the recreating public about the sensitivity of nesting murrelets. Corvid populations are unlikely to be higher for SDSF than for the surrounding privately managed timberlands. Camping is not allowed on a regular basis at SDSF and visitors are expected to pack out all trash. Signs are posted to pack your trash and Forest staff makes a great effort to pick up any trash left behind in the parking area on a regular basis. Marbled murrelets have never been detected at SDSF, although the old-growth stand near Badger Springs is considered suitable habitat for the species. Surveys were conducted in 2003 and 2004 by biologist David L. Suddjian, and no murrelets were detected on any of the surveys.

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INVASIVE SPECIES

Invasive species control is an ongoing process at SDSF. Forest staff along with Ben Lomond Conservation Camp Crews and volunteers log hundreds of person hours each year to reduce and control French broom. The primary method to reduce invasive species (predominanty French broom and jubata grass) has been a continuous mechanical removal approach by pulling plants and roots or cutting stems. Other control methods such as herbicide applications and flaming have not been employed extensively, however ~~although it is clear that a~~ more efficient and cost effective approachs will ~~needs to~~ be considered. Herbicide use is part of the overall invasive species control program and efforts to control large continuous infestations of French broom with herbicides began in 2013. Combining hand-pulling with herbicide spraying every other year has proven effective for controlling French broom on Santa Cruz Water District properties.

Efforts will be made to control existing invasive plant populations, reduce opportunities for further spread of existing species, and prevent the introduction of other species not currently present on SDSF. During the preparation of the Fern Gulch THP a botanical survey was conducted where 24 ~~twenty four~~ non-native species were indentified which are representative of species found throughout SDSF (Table 2). Approximately half of the species identified are considered a high priority for control.

Many non-native plant seeds prefer bare mineral soil to germinate. Preventing the establishment of new or expansion of established populations is emphasized through THP mitigations that minimize soil disturbance and the amount of exposed mineral soil following operations. Additional project mitigations include avoiding the introduction of weedy grasses into project areas, avoiding the use of invasive ~~grass~~ seeds for erosion control, and using only certified weed-free straw (preferably rice straw) for mulching to prevent erosion. The use of short lived cereal crops like barley and rye for erosion control in Santa Cruz County has not been found to be

invasive.

PLANT SPECIES OF CONCERN

The Natural Diversity Data Base (NDDB) was queried on May 10, 2010 to collect information on listed species and species of concern known to occur in the Laurel Quadrangle that contains the Soquel Demonstration State Forest. A total of eight plant species are state and/or federally listed as threatened or endangered. In addition six plant species are categorized as CNPS (California Native Plant Society) List 1B. The plants of List 1B are rare throughout their range with the majority of them endemic to California. Most of the plants of List 1B have declined significantly over the last century. List 1B plants constitute the majority of the plants in CNPS' Inventory with more than 1,000 plants assigned to this category.

All of the plants constituting List 1B meet the definitions of Sec. 1901, Chapter 10 (Native Plant Protection Act) or Secs. 2062 and 2067 (California Endangered Species Act) of the California Department of Fish and Game Code, and are eligible for state listing. These species must be fully considered during preparation of environmental documents.

A nine quad search of processed CNDDB data, centered on the Laurel quadrangle identified 48 plant species. One plant species is CNPS List 1A, 32 CNPS List 1B, and 15 are federal and/or

Table 2 Invasive exotic plant species occurring at Soquel Demonstration State Forest

Common Name	Scientific Name
*French Broom	*Genista monspessulana*
*Periwinkle	*Vinca major*
*Poison hemlock	*Conium maculatum*
*Jubata Grass	*Cortaderia jubata*
*English Ivy	*Hedera helix*
*Eupatory	*Ageratina adenophora*
*Subterranean clover	*Triflorium subterraneum*
*Italian thistle	*Carduus pycnocephalus*
*Italian ryegrass	*Lolium multiflorum*
*Forget me not	*Myosotis latifloria*
*Bermuda buttercup	*Oxalis pes-capre*
*Orchard grass	*Dactylis glomerata*
Bull thistle	*Circium vulgare*
Cutleaf geranium	*Geranium dissectum*
Rough cat's-ear	*Hypochaeris radicata*
Common chickweed	*Stellaria media*
Field bindweed	*Convovulus arvensis*
Broadleaf fleabane	*Conyza sumatrensis*
Spiny sowthistle	*Sonchus asper*
Soft chess	*Bromus hordeaceus*

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Bur-Chevril	*Anthriscus caucalis*
Sticky chickweed	*Cerastium viscosum*
Fiddle dock	*Rumex pulcher*
Olive	*Olea europaea*

* The survey botanist recommended these species have the highest priority for control.

state listed as threatened or endangered. Although there is no suitable habitat for most of these taxa on Soquel Demonstration State Forest, the number of species listed provide a rough indicator of the extent of plant species of concern in the general vicinity of the State Forest (see Appendix B for a list of plant species known to occur at SDSF).

SPECIAL-STATUS WILDLIFE SPECIES

Although ~~T~~ the biological assessment of the Forest conducted in 1991-92 found no threatened or endangered plant or wildlife species, this is not the case today. The Central California Coast (CCC) ~~Steelhead and~~ coho salmon Evolutionarily Significant Unit (ESU) was ~~were~~ ~~have subsequently been~~ federally listed as threatened in 1996 ~~2006~~. ~~In 1994, however, there was an unconfirmed sighting of a California red-legged frog during a stream habitat survey (Anderson and Brown pers. comm.).~~ and relisted as endangered in 2005. In 2012 the range of CCC coho was extended to the south include Soquel and Aptos Creeks. Coho salmon south of the San Francisco Bay were listed as endangered under the California Endangered Species Act in 1995. Steelhead within the CCC Distinct Population Segment (DPS) were federally listed as threatened in 1997. See the Fisheries Chapter for more information about the status and recovery plans for coho and steelhead.

The California red-legged frog has also been found on the Forest and is now federally listed as threatened. Additionally, a few wildlife species of special concern to the State of California have been seen in SDSF (Holland et al., 1992 and ~~CDF~~CAL FIRE, 1994). Those species observed were the foothill yellow-legged frog, western pond turtle, sharp-shinned hawk, Cooper's hawk, and golden eagle. The long-eared owl and yellow warbler may also occur in the Forest, but they have not been observed (Table ~~2~~3). Suitable breeding, nesting, or foraging habitats exist in the Forest for all species observed except the golden eagle.

The Laurel Quadrangle CNDDB query for animal species indicates the occurrence of two federally listed endangered insects and two federal or state listed threatened and endangered fish species. In addition, one amphibian is federally listed as threatened and one amphibian, one reptile, and one mammal species are presently California Department of Fish and Game Species of Special Concern. See Table 3~~2~~ for further information.

THE FOLLOWING PUBLIC COMMENTS WERE RECEIVED DURING REVIEW OF THE 1998 GENERAL FOREST MANAGEMENT PLAN

A major focus in the management of SDSF's biota involves species evaluation and monitoring,

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particularly for special status species. Comments have largely focused on fauna though concern about edge vegetation and introduced plant species has been expressed. As stated in the Management Guidelines and Planned Actions below, SDSF plans to monitor selected biotic elements of the Forest and evaluate effects of forest management activities on the condition of those resources.

Another primary concern is the restoration of degraded habitats and maintenance of exceptional resource values in SDSF. Emphasizing this concern are comments regarding management of habitats individually (e.g., manage riparian habitats separately from mixed evergreen habitats)

and management activities which allow interior forest species to thrive. Many commenters feel that development and management of SDSF should be performed in such a way that biotic resources are preserved or improved. The Management Guidelines and Planned Actions deal with these issues as well.

Finally, input has been received regarding the desire for details on exactly how SDSF will manage and maintain its biotic resources. Since this management plan is intended to be general, specific information on the what, how, why, and when of SDSF management activities will be outlined in other formats. More specific management strategies will be developed for different areas and habitats based on anticipated management endeavors and research and monitoring results.

Table 3. Special-status vertebrate fish and wildlife species occurring or with potential to occur at Sqouel Demonstration State Forest

SPECIES	LEGAL STATUSa FEDERAL/STATE	HABITAT	OCCURRENCE IN SDSFb

American peregrine falcon	/FP	Nests in cliffs, forages in a variety of habitats	4
Merlin	/WL	Wintering only, frequents open habitats	2
Marbled murrelet	T/E	Nests in old-growth conifer forest; forages in pelagic habitats	4
Golden eagle	BCC/FP	Nests in cliffs and trees in forests and woodlands; forages in grasslands, shrublands, and chaparral	2
Osprey	--/WL	Nests in snags and spike-top trees;forages in open water	2
Cooper's hawk	--/WL	Nests and forages in woodlands and forests; also forages in open habitats	2
Sharp-shinned hawk	--/WL	Nests and forages in conifer forest habitats	1
Long-eared owl	--/CSC	Nests and forages in riparian and woodland habitats	2
Olive-sided flycatcher	--/CSC	Tall conifers used for nesting,perching; Forages over open/low vegetation	2
Purple martin	--/CSC	Nests and forages in woodland and forest habitats in tree cavities	42
Vaux's swift	--/CSC	Nests in large tree cavities with a Preference for redwood and Douglas-fire habita	2
Black swift	--/CSC	Nests on cliffs,steep rocky outcrops, Canyons near water	2
Yellow warbler	--/CSC	Nests and forages in riparian habitats	2
Foothill yellow-legged frog	--/CSC	Occurs in streams with rocky substrate	2
California red-legged frog	T/CSC	Occurs in slow-moving streams, pools and ponds	2
Western pond turtle	T/CSC	Occurs in pools, ponds, and lakes	2
Steelhead (Central CA Coast ESU)	T/CSC	East Branch Soquel Creek	4
Coho salmon(Central CA Coast ESU)	E/E	East Branch Soquel Creek	3
Pallid Bat	--/CSC	Buildings, rock outcrops	3
San Francisco dusky-footed woodrat	--/CSC	Forested habitats of moderate canopy and Moderate to dense understory	2

a Status codes:
Federal: T = threatened E = endangered P = proposed for listing as threatened or endangered BCC = bird of conservation concern USFWS
State: CSC = species of special concern T = threatened E = endangered WL = Watch List

b 1 = confirmed nesting/reproduction, 2 = observed, 3 = not observed, 4 = unlikely to occur.

Sources: Jones and Stokes Associates, Inc., 1996

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California Department of Fish and Game Special Animals List, July 2009

California Department of Fish and Game State and Federally Listed Endangered & Threatened Animals of California, January 2010

California Department of Fish and Game, California Natural Diversity Database, Laurel Quadrangle, May 10, 2010

MANAGEMENT GUIDELINES

1. Ongoing monitoring will be performed to detect listed and special status species. Monitoring will include keeping current with state and federal lists as well as conducting periodic floral and faunal surveys. Inventories will emphasize special-status species expected to be present but not yet observed in SDSF. New findings will be added to current species lists. Every consideration will be given to protecting these species and their habitat as required by law and determined by a qualified biologist.

2. Old-growth trees will be protected as outlined in SDSF's authorizing legislation, AB 1965. Areas of old-growth redwood have been located and protection will be provided in all phases of forest management. Additionally, areas have been designated to promote late-succession stands of trees (see the Timber Management chapter for more details).

3. Restore, maintain, or enhance resource values of native habitat communities to promote natural diversity and stability. Measures to achieve this include:

   * snag recruitment and retention
   * preservation of appropriate logs and other woody debris
   * maintenance of natural ponds and springs
   * protection of riparian zones for use as movement corridors for wildlife

4. Achieve mutual benefit with timber harvesting, demonstration and education, and recreation programs while respecting native biotic elements. Wildlife habitat improvements, such as those mentioned in Management Guideline 3 above, will be considered during the planning and implementation of timber sales, demonstration and education activities, and recreational facilities. Conversely, possible impacts of present or future wildlife and vegetation management projects on other management objectives will be studied prior to project approval and implementation.

5. ~~5.~~ Control and/or eradication of exotic invasive plant species utilizing Integrated Pest management techniques will be incorporated into management activities, as appropriate. Ben Lomond ~~Youth~~ Conservation Camp crews are utilized for hand pulling and cutting. Forest -

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~~California Conservation Corps members, and~~ volunteers also ~~will~~ help with the removal of invasive plants. ~~exotics whenever possible.~~ Additional efforts including herbicides or flaming where and when appropriate will be employed.

Flaming uses a propane torch to kill plants when they are very small by applying heat. This method is very effective for controlling weeds such as broom, is faster and cheaper than pulling, and is more selective than herbicide use. This method can be safely used without risk of fire hazard during periods with cool temperatures and high vegetation moisture levels in the targeted vegetation.

6. Control mushroom collection by issuing permits for scientific, educational, and personal use. Mushroom gathering for commercial purposes is ~~will be~~ prohibited.

PLANNED ACTIONS

1. ~~1.~~ Encourage researchers to study wildlife habitats, populations and unique characteristics at SDSF. Continue to support the UC Santa Cruz Puma Project and the newly developed herpafauna survey efforts; both are described further in the Research chapter.
~~Develop a detailed wildlife plan that focuses on the needs of SDSF's biotic community. The plan will provide for habitat and population assessments, management recommendations, and monitoring techniques. Recommendations from the Preliminary Biological Assessment of Soquel Demonstration Forest, Santa Cruz county, California (Holland, et al, 1992) will be incorporated as appropriate along with information from CDF CAL FIRE, California Department of Fish and Game, and local biologists~~.

2. ~~Work with computer databases for long range planning monitoring. The Wildlife Habitat Relationships (WHR) and~~ Examine the California Natural Diversity Database (CNDDB) reports during project planning and incorporate measures into all project development and ~~systems will be examined and incorporated into the planning~~ monitoring processes for all known species as well as special status species that may be present. Submit CNDDB Field Survey forms to DFG for any sightings of listed, rare or special status species.

3. Conduct preharvest and post-project surveys to identify active nest sites of all special-status bird species that may occur in the Forest. Those species that may occur in SDSF are Cooper's hawk, sharp-shinned hawk, long-eared owl, and yellow warbler. In addition, preharvest surveys will be conducted for California red-legged frog, foothill yellow-legged frog, and southwestern pond turtle.

4. Continue to ~~E~~evaluate the feral pig situation, and develop management strategies and actions to diminish existing problems.

6. Continue to build the inventory of old-growth trees across SDSF (further described in the

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Old Growth section of the Timber Management chapter).

6. Continue to use mechanical methods for controlling invasive species with Ben Lomond crews and volunteers each year. Use additional follow up treatments to improve effectiveness, such as herbicide application or flaming* where and when appropriate. Extra effort will be concentrated on new populations prior to them becoming established established and producing seed banks.

7. Biological Assessments will be conducted incrementally in new project areas. These will include results of CNDDB reports, botanical surveys, and other site specific assessments.

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CHAPTER SIX: FISHERIES

INTRODUCTION

Approximately ~~8~~ 7.5 miles of fish-bearing streams flow through SDSF, including the East Branch of Soquel Creek (5 ~~.5~~ miles), Amaya Creek (2 miles), and Fern Gulch Creek (0.5 miles). The East Branch ~~is one of the few remaining~~ currently provides valuable steelhead trout spawning and rearing habitat and could provide essential habitat to promote reintroductions and recovery of coho salmon. Based on the amount of stream miles within SDSF and the high pontetial for ecological restoration of lost or degraded habitat components such as instream compleximity and floodplain connectivity, SDSF provides a unique opportunity to support recovery of this invaluable fisheries resource.~~areas in the county. This, along with their legally protected status and cultural values, makes the fisheries of SDSF an important resource~~.

RANGE AND LEGAL STATUS: STEELHEAD TROUT AND COHO SALMON

The fishery resources of greatest concern in SDSF are the steelhead trout and coho salmon. Anadromous fish such as steelhead and coho spawn (mate and lay eggs) in freshwater creeks or rivers but spend most of their adult lives in the ocean.

~~The cycle begins with the development of eggs into young fish in streams where the adults spawned. Once the eggs hatch, young fish develop in the watercourse and gradually make their way to the ocean. Steelhead trout in this area typically spend their first two years in fresh water although a few may spend additional two or three years inland before migrating. The length of time spent in streams depends on environmental and genetic factors, and some individuals may never migrate at all (Barnhart, 1986). Coho salmon spend one year in freshwater before going to the ocean. Due to the abundance of food, anadromous fish species experience most of their growth once they have reached the ocean. Steelhead and coho along the California coast usually spend two years in salt water, attaining sexual maturity and storing fat for their journey back up streams. As with all anadromous fish, steelhead trout and coho salmon usually return to the stream from which they hatched to mate and lay eggs. Coho die following spawning, but steelhead swim back to the ocean. Steelhead may repeat the cycle and spawn up to four times, but most repeat spawners do so only twice.~~

Historically, ~~steelhead trout and~~ coho salmon spawned in coastal streams from the Bering Sea of the Arctic and the coast of Japan to the Monterey Bay in California. The steelhead's range extended ~~s~~ further to the north coast of Baja California. Steelhead and coho populations have been declining throughout their entire range, both in fresh and salt water, for decades due to a number of factors including habitat loss. In California, numbers decrease from north to south, with the southernmost population of steelhead and coho at the greatest risk of extinction. This is particularly important since Soquel Creek and Aptos Creek represent the southernmost watershed along the Pacific Coast with recent confirmed observations of coho salmon.~~in the Ventura River (Barnhart, 1986), and coho in Soquel Scott Creek. T~~ While the Soquel Creek watershed is within the steelhead and coho's range ~~but,~~ as discussed below, there has been ~~met with~~ a considerable

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decline in numbers for both species with coho observations limited to a few individuals in 2008.

Legal Status: Steelhead

While steelhead were technically removed from the genus *Salmo* (trout) nearly 40 years ago and incorporated in the genus *Oncorhynchus* (salmon), they are often still referred to by their traditional common name steelhead trout. For the purposes of this document, we will simply refer to the species as "steelhead". The genus and species for steelhead is *Oncorhynchus mykiss*. It should be noted that steelhead are genetically identical to rainbow trout with the fundamental difference between the two fish having to do with life history. While steelhead are anadromous and move between the ocean and freshwater, rainbow trout are year-round residents in freshwater and do not migrate to or from the ocean. Steelhead within Soquel Creek are part of the Central California Coast (CCC) Distinct Population Segment (DPS) and were federally listed as Threatened under the Endangered Species Act in August of 1997. The CCC DSP stretches from the Russian River in the north to Aptos Creek in the south. As such, Soquel Creek is near the southernmost portion of the range of this DPS. Steelhead from the Pajaro River south to the Santa Maria River are within the South Central California Coast (SCCC) DPS and are considered to be a different genetic population. The National Marine Fisheries Service (NMFS), which is charged with protection of federally listed anadromous fish, is in the process of developing a recovery plan for the CCC steelhead and the draft plan is expect to be released to the public in early 2014. According to Jon Ambrose (pers com) of NMFS, plan recommendations will closely overlap with the recommendations put forth in the recently published CCC Coho Recovery Plan (NMFS, 2012). The steelhead plan will provide additional details and recommendations for recovery of steelhead within this DPS and, in conjunction with the coho plan, can be used to identify and guide recovery actions on SDSF. While steelhead are not technically listed under the California Endangered Species Act, the Department of Fish and Wildlife (formerly Department of Fish and Game) issued the 1996 "Steelhead Restoration and Management Plan for California" in an effort to focus conservation actions on the protection of this species. Finally, the Department of Fish and Wildlife also develops an annual "Statewide Steelhead Task List" to support and guide funding actions through the Fisheries Restoration Grants Program (FRGP).

Legal Status: Coho

Legal Status: Coho

Coho salmon within Soquel Creek belong to the CCC Evolutionarily Significant Unit (ESU) of the species. This ESU was first listed under the Federal Endangered Species Act as Threatened in October of 1996 (61 FR 56138) and then relisted as Endangered in June of 2005 (70 FR 37160). At the time of listings the ESU extended from Punta Gorda in the north to the San Lorenzo River in the south. In March of 2012, the NMFS extended the southern range of the ESU to include Soquel and Aptos Creeks. This decision was based on, "observations of coho salmon in Soquel Creek in 2008, genetic analysis of tissue samples indicating that the fish from Soquel Creek were closely related to nearby coho salmon populations in the ESU, and the ecological similarity of Soquel and Aptos creeks with other nearby creeks that support coho salmon" (77 FR 19552). Coho salmon south of the San Francisco Bay were listed as endangered under the California Endangered Species Act in 1995. California Fish and Wildlife Commission extended the range of the listing designation north to Punta Gorda, Humboldt County in 2005.

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Both the State and Federal governments have developed recovery actions for this species. The Recovery Strategy for California Coho Salmon was adopted by the California Fish and Game Commission in February 2004. The primary objective of the Recovery Strategy is to coho salmon to a level of sustained viability, while protecting the genetic integrity of the ESU. For the Big Basin Hydrological Study Unit, of which Soquel is a part, the key recovery recommendations focus on protection of instream flows, upgrading of culverts for fish passage and mobilization of Large Woody Debris (LWD), and implementation of high priority actions for coho from watershed plans. NMFS published the "Final CCC Coho Recovery Plan" September of 2012 and this plan provides specific data and recovery recommendations for Soquel Creek. The plan identifies SDSF as a recovery partner for restoration actions in the East Branch of Soquel Creek, including Amaya Creek, which are considered core areas for species recovery. The Plan calls for a recovery target of 1,122 returning adult coho and highlights the following five high priority immediate restoration actions:

- Delineate reaches possessing both potential winter rearing and floodplain areas
- Implement a long term study project in Soquel Demonstration State Forest to demonstrate effective LWD projects to citizens of Santa Cruz County
- Promote conjunctive use of water for water projects whenever possible
- Provide incentives to water rights holders willing to convert some or all of their water rights to instream use
- Re-establish a naturally reproducing run of coho salmon.

~~LOCAL FISH POPULATIONS~~

~~Anadromous fish populations in Soquel Creek and along most of the Central Coast have declined significantly since the late 1960's. According to Dave Hope, resource planner for the County of Santa Cruz, past steelhead runs in Soquel Creek may have had up to 1,000 fish, while today runs are estimated to be no more than 100. (Runs are groups of fish that swim upstream around the same time of year to spawn.) Steelhead has been proposed for listing as endangered under the federal Endangered Species Act.~~

~~Coho salmon were also historically present in Soquel Creek and reports estimate that runs included from one to two hundred fish. Over the last 30 years, however, the coho population of Soquel Creek has vanished with the last known run in 1968 (Anderson, 1995). On November 6, 1995, the coho salmon was listed as threatened under the California Endangered Species Act. It was also listed on December 30, 1996 athe federal Endangered Species Act~~

~~Anadromous fish populations in Soquel Creek and along most of the Central Coast have declined significantly since the late 1960s. Large numbers of coho salmon were historically present in Soquel Creek, and reports estimate that runs may have included from one to two hundred fish (Runs are groups of fish that swim upstream around the same time of year to spawn.) According to Dave Hope, resource planner for the County of Santa Cruz, past steelhead runs in Soquel Creek may have had up to 1,000 fish. Coho salmon were planted into the East Branch of Soquel~~

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Creek in the 1930s originating from the Brookdale, Big Creek, Prairie Creek and Fort Seward hatcheries (Anderson, 1995).

In 1995, the California Fish and Game Commission listed coho salmon south of San Francisco Bay as endangered. That listing designation was extended from San Francisco Bay to Punta Gorda, Humboldt County in 2005. Coho salmon along the Central California Coast were also listed under the federal Endangered Species Act as endangered in August of 2005 (NMFS, 2010).

No production/mitigation hatcheries (hatcheries that produce fish with the goal of increasing recreational and commercial harvest or for mitigation purposes) for Central California Coast coho salmon currently exist. The two hatchery operations in the Central California Coast Evolutionarily Significant Unit are captive broodstock facilities operated expressly for conservation and recovery purposes with significant oversight by the California Department of Fish and Game and the National Marine Fisheries Service. Coho salmon reared at these two facilities are listed under the Endangered Species Act. In Santa Cruz County the goals of the captive broodstock program include increasing population size, maintaining genetic diversity, and producing sufficient numbers of fish to promote straying into neighboring streams (Sturm, 2009). Coho salmon were thought to be extinct in Soquel Creek in the 1990s and most of the first decade of this century, until a small population of young of the year fish was observed in 2008 near the entrance of Hinckley Creek below SDSF.

Central California Coast steelhead occurs in Soquel Creek in greater numbers. In February, 2006 this species was listed under the federal Endangered Species Act as threatened for coastal basins from the Russian River, south to and including Soquel Creek (CDFG, 2009) and for naturally spawning populations (e.g., not a product of hatchery operations). The listing excludes the Sacramento-San Joaquin River Basin, as well as two artificial propagation programs: the Don Clausen Fish Hatchery, and Kingfisher Flat Hatchery/ Scott Creek (Monterey Bay Salmon and Trout Project) steelhead hatchery programs. Principal hatchery production for the Cental California Coast steelhead originates from the Warm Springs Hatchery on the Russian River and the Monterey Bay Salmon and Trout Project on a tributary of Scott Creek. The most recent planting of hatchery-raised steelhead in SDSF (i.e., the East Branch of Soquel Creek) occurred in the 1930s. Steelhead trout from the Brookdale and Big Creek hatcheries were released in the East Branch of Soquel Creek (M. McCaslin pers. comm.). The Monterey Bay Salmon and Trout Project stocked steelhead annually in the main stem of Soquel Creek (downstream of the SDSF) until recently, and in the early 1980s, released fish near the quarry (just south of the SDSF) (M. McCaslin pers. comm.) Estimated run size for the Central California Coast steelhead in Soquel Creek was 500-800 fish in 1982, but declined to less than 100 fish in 1991 (Reavis, 1991) and 50-100 fish in 1994 (Shuman, 1994). The basis for the estimates put forward by Shuman (1994) is, however, considered questionable by Good et al (2005).

Other species of fish within the boundaries of SDSF include the Pacific lamprey and a small resident rainbow trout population above Ashbury Gulch. According to biologist Jerry Smith, additional species likely to be found in the East Branch include prickly sculpin, coast range sculpin, California roach, Sacramento sucker, and northern threespined stickleback.

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~~In order to help protect remaining steelhead trout populations in Soquel Creek, the California Department of Fish and Game prohibits angling in the East Branch of Soquel Creek (Fish and Game South Central District Regulation, Title 14, Section 7.00 [e] [4]). This regulation was adopted by the California Fish and Game Commission in December of 1981 and became effective in March, 1982. In spite of this regulation, poaching of adult steelhead during winter spawning is prevalent and continues to affect fish populations. To avoid adverse impacts of public use on fish in SDSF, forest staff and the California Department of Fish and Game will conduct ongoing patrols to enforce prohibitions on fishing and fish harassment.~~

~~The most recent planting of hatchery raised steelhead in SDSF (i.e., the East Branch of Soquel Creek) occurred in the 1930's. According to Matt McCaslin of the Monterey Bay Salmon and Trout Project (MBSTP), steelhead trout from the Brookdale and Big Creek hatcheries were released in the East Branch at that time. Coho salmon planting also occurred in the 1930's from the Brookdale, Big Creek, Prairie Creek,and Fort Seward hatcheries (Anderson, 1995). Currently, the MBSTP stocks steelhead annually in the main stem of Soquel Creek (downstream of the Forest) and, in the early 1980's, released fish near the quarry (just south of the Forest).~~

~~HABITAT AND RESOURCE CONSIDERATIONS~~

~~HABITAT ATTRIBUTES~~

LIFE HISTORY AND HABITAT USE

As anadromous fish species, both steelhead and coho utilize freshwater for mating/spawning, egg development and early maturation and move to the ocean for a period of rapid growth and weight gain prior to returning to freshwater to spawn. The life cycle begins with the development of eggs into young fish in freshwater streams. Once the eggs hatch, young fish develop in the watercourse and gradually make their way to the ocean. Steelhead trout in this area typically spend two years in fresh water although a few may spend additional years inland before migrating out to sea. The length of time spent in streams depends on environmental and genetic factors, and some individuals never migrate (Barnhart, 1986). Research by Smith (2005) suggests that one of the key environmental factors may be food supply and growth. According to these data, size is a critical factor in determining when a juvenile steelhead will leave freshwater, and once juveniles reach approximately 3.5 inches in forklength by the fall, they tend to out-migrate the following spring. While growth in freshwater habitats in the SDSF may require at least two years due to slow growth rates, steelhead growth can increase substantially in food rich lagoon environments like the Soquel Lagoon (Alley 2010).

In order to acclimate to saltwater, both steelhead and coho go through a process of smoltification prior to entering the ocean and juvenile fish leaving freshwater are referred to as smolts. Steelhead and coho along the California coast usually spend two years in salt water, attaining sexual maturity and storing fat for their journey back up their natal streams to spawn and restart the life cycle process. While females of both species and most males spend two years in the ocean, a portion of male coho, called jacks, are known to return to freshwater after one year in the ocean. Due to the abundance of food, anadromous fish species experience most of their

growth once they have reached the ocean. Therefore, jacks are generally identified due to their smaller size and weight.

While there are many similarities in the life cycle for these species, there are some key differences that should be highlight. These include:

- Timing of adult return to freshwater and spawning- Coho are known to return to their natal streams in the southern portion of the ESU between November and January with the height of spawning peaking in February and March (NMFS 2012, from Moyle 2002). Steelhead spawners generally return to their natal streams later in the winter and spawn through April or May depending on climatic conditions
- Juveniles freshwater rearing- Whereas steelhead often spend multiple years as juveniles in freshwater, the vast majority of juvenile coho salmon only spend one year in freshwater before going to the ocean. As such, coho smolts are generally younger and smaller than most steelhead smolts.
- Post spawning adults - While coho adults always die following spawning, some steelhead adults can return to the ocean after spawning, and may repeat that cycle to spawn up to four times, though most repeat spawners do so only twice.

The basic stream attributes for steelhead and coho spawning, rearing, and migration include cool water temperature, high concentrations of dissolved oxygen, adequate water depth, sufficient pool space, and low sediment levels (Barnhart, 1986 and Anderson, 1995). ~~In addition, suitable hiding cover, food supplies, and access to spawning areas can influence the survival of steelhead and coho. All of these habitat conditions need to be considered when working to restore, maintain, or enhance anadromous populations.~~ Riparian habitat also can play a major role in either supporting or degrading habitat for these fish. Riparian zones are strips of water-loving vegetation and associated organisms that follow the path of watercourses. Essential to healthy aquatic ecosystems, these zones help maintain favorable water quality and provide important food and habitat conditions. Trees along the water's edge shade the water, maintaining cool temperatures for anadromous fish spawning and rearing, as well as maintaining a favorable micorclimate for amphibians. Riparian vegetation also stabilizes streambanks and intercepts eroded materials from upslope, minimizing the amount of sediment that enters the stream. Additionally, vegetation adds food and nutrients to the water for use by both fish and aquatic invertebrates. Large woody debris falling into the water provides cover for fish, collects and controls the movement of sediment, and creates deep scour pools favored by rearing juveniles. ~~Consistent with the Anadromous Salmonid Protection Forest Practice Rules approved in 2009, Cconifers will be planted in riparian zones, in areas where none exist, to promote long-term recruitment of large instream woody debris. Small intertwined pieces of debris, such as branches and twigs, act as collectors of leaf litter and provide more food for invertebrates.~~

Water temperature is a critical habitat component that can have dramatic effects on growth and development of steelhead and coho. A complication to understanding the effect of temperature on salmonids is that food availability is the key variable that governs how water temperatures affect fish. While both salmonid species have mortality thresholds with respect to water temperature, higher water temperatures do not always directly relate to lower growth and productivity. Water temperatures above 21.1ºC make it difficult for coho salmon and steelhead

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to extract oxygen from the water. Optimal rearing temperatures for juveniles are 7.22-14.4ºC for steelhead and 11.67-14.4ºC for coho (Reisner and Bjornn, 1979). Temperatures between 14ºC and 21ºC may have a positive impact on growth if there is ample food supply to keep up with the increased metabolic demand of fish caused by higher water temperatures. Conversely, temperatures at and below the lower end of optimal can slow metabolism significantly and result in muted growth rates; translating to lower ocean survival rates.

Table 4 Habitat Requirements and Vulnerability by Each Salmon Life Stage (2012, NMFS)

Comment [AB4]: Jill – Feel free to reformat this table. It is from the 2012 Recovery Plan, table 4, page 71, Chapter 3

Eggs: Incubation requires clean water, free of contamination and siltation. Disturbance of a single "redd" (nest of eggs) could result in the death of thousands of salmon embryos.	**Freshwater Streams**
Alevins: After hatching, alevins remain nestled in the small spaces between the gravels, and feed from their attached yolk sacs. They are highly vulnerable to siltation and scour. Once the yolk is absorbed, the young salmon emerge from the gravels.	**Freshwater Streams**
Juveniles: Deep cool pools are critical for the summer rearing juvenile's survival. Riparian vegetation helps support some of the insects consumed by juveniles, provides cover from predators (when recruited to streams can create wood formed pools), and limits solar radiation to streams keeping water temperatures cool. Tree roots stabilize streambanks and create habitat structure. Large woody debris or downed wood creates cover and refugia for the tiny salmon to reside during high velocity flows. Pools and wetlands provide shelter from high flows, predators, and help filter sediments from the water column.	**Freshwater Streams**
Smolts: Juvenile salmon undergo a physiological change known as "smoltification" enabling them to transition, in estuaries or lagoons, for a life adapted to saltwater. Smoltification can occur primarily within the freshwater areas, or in the nearshore environment. Smolts need adequate flow from upstream rearing areas to be able to travel downstream to estuaries. Estuaries should provide cover and adequate feeding habitats to facilitate the transition into the ocean. Estuaries should be deep to provide cool temperatures and buffered with freshwater to dilute seawater (Moyle 2002). The quality of these areas has implications to the survival of smolts entering the ocean environment.	**Freshwater Streams, Estuaries, Lagoons, and Ocean**
Sub-Adults/Adults: Maturation occurs during ocean residency over a two year period leading up to the adult salmon's return to streams of their birth. The patterns of migration in the ocean vary, and shifts in ocean conditions affect food, migration patterns and survival. Fish in the ocean need adequate supplies of food to facilitate rapid growth. As the salmon return to their natal stream to reproduce, they once again undergo change from saltwater to freshwater; they depend on the near shore and estuarine environments for this transition.	**Ocean**

Spawners: Migration begins after heavy late fall or winter rains breach sand bars of coastal streams, allowing fish to move into lagoons (Moyle 2002). Once the adult spawners arrive at their home river or stream they need adequate flows, cool water temperatures, deep pools and cover to rest and hide as they migrate upstream. Females seek clean, loose gravel of a certain size in highly oxygenated riffle type flow water for laying their eggs. The site must remain stable throughout egg incubation and emergence, and allow water to percolate through the gravel to supply oxygen to the developing embryo.	**Ocean, Estuaries, Freshwater Streams**

Table 4 provides details linking fish life stage with habitat requirements. All of these habitat conditions need to be considered when working to restore, maintain, or enhance anadromous populations. Data from the 2012 CCC Coho Recovery Plan highlights the need to prioritize restoration actions that increase the extent and availability of "off-channel" habitats such as floodplains, backchannels, alcoves and tributaries. The Plan also calls for implementation of projects that increase the amount of LWD in the stream. Both LWD and off-channel habitats are particularly important for coho, but also valuable to steelhead, for providing refuge to adult and juvenile fish during high flows in the winter and low flows in the summer. In the winter, when flashy flows result in high instream velocities, off-channel habitats and LWD can provide slow water sheltering areas for fish of all sizes. During the summer, deep pools formed through scour downstream of LWD provide salmonids with cool water refuge and cover from predation. Perennial off-channel habitats such as ponds, alcoves and back-channels can provide some of the highest quality summer rearing habitat with high levels of primary productivity and insect production.

LOCAL FISH POPULATIONS

Anadromous fish populations in Soquel Creek and along most of the Central Coast have declined significantly since the late 1960s. While steelhead declines have been significant, the 2012 CCC Coho Recovery Plan sums up the status of CCC coho as, *"... gravely close to extinction. Despite being listed under the Federal and California Endangered Species Acts, populations of CCC coho salmon continue to decline precipitously. Immediate and focused action is essential to increase the survival of, and provide the highest protection for, remaining populations (NMFS, 2012)."*

While there is scant data on coho population numbers in Soquel Creek over the past 50 years, there is a significant body of archaeological data that indicates the historic range of this species extended as far south as the Pajaro River and possibly the Salinas River. In addition to natural runs, we also know that coho salmon were planted into the East Branch of Soquel Creek in the 1930s originating from the Brookdale, Big Creek, Prairie Creek and Fort Seward hatcheries (Anderson, 1995). Coho salmon were thought to be extinct in Soquel Creek in the 1990s and most of the first decade of this century, until a small population of juvenile fish was observed in 2008 near the entrance of Hinckley Creek below SDSF. For the purposes of the Final CCC Coho Recovery Plan (NMFS, 2012) these juvenile coho form the basis of the estimate of two adults in Soquel in 2008 (i.e. at least one spawning pair of coho were in Soquel for these juveniles to

exist). Genetic analysis of tissue samples indicates that the 2008 coho salmon in Soquel Creek were closely related to nearby wild coho salmon populations in the ESU.

There is a significant amount of data on the historic steelhead populations in Soquel Creek. Soquel Creek was historically considered one of the most important steelhead spawning and rearing streams in Santa Cruz County (Titus *et al*., 2005). Based on data collected during surveys in 1959, the juvenile abundance in this system corresponded to an adult steelhead run of approximately 500-1,000 spawning pairs or 1,000-2,000 adult fish (Becker and Reining 2008). A 1996 estimate of the steelhead run size in Soquel Creek was about 100 individuals (Becker and Reining 2008). Alley (2006) calculated adult steelhead population indices for Soquel Creek between 1997 and 2005 as an average of 523 with a range between 360-780 adults. These data were calculated based on estimates of juvenile population size and an application of an adult return model and these estimates are considered the best available data for the watershed.

Local fish population inventories began in 1993 and are conducted annually in cooperation with NMFS. This work is conducted by electrofishing at five sites: four on the East Branch of Soquel Creek and one on Amaya Creek (Sogard, et al, 2009). The surveys assist with monitoring the fish populations in fish bearing creeks that run through SDSF and also support research performed by biologists from NOAA's SWFSC to monitor steelhead growth and migration. The graph below (Figure 6) shows a summary of data for the past 18 years[3].

[3] No data were collected in 2000.

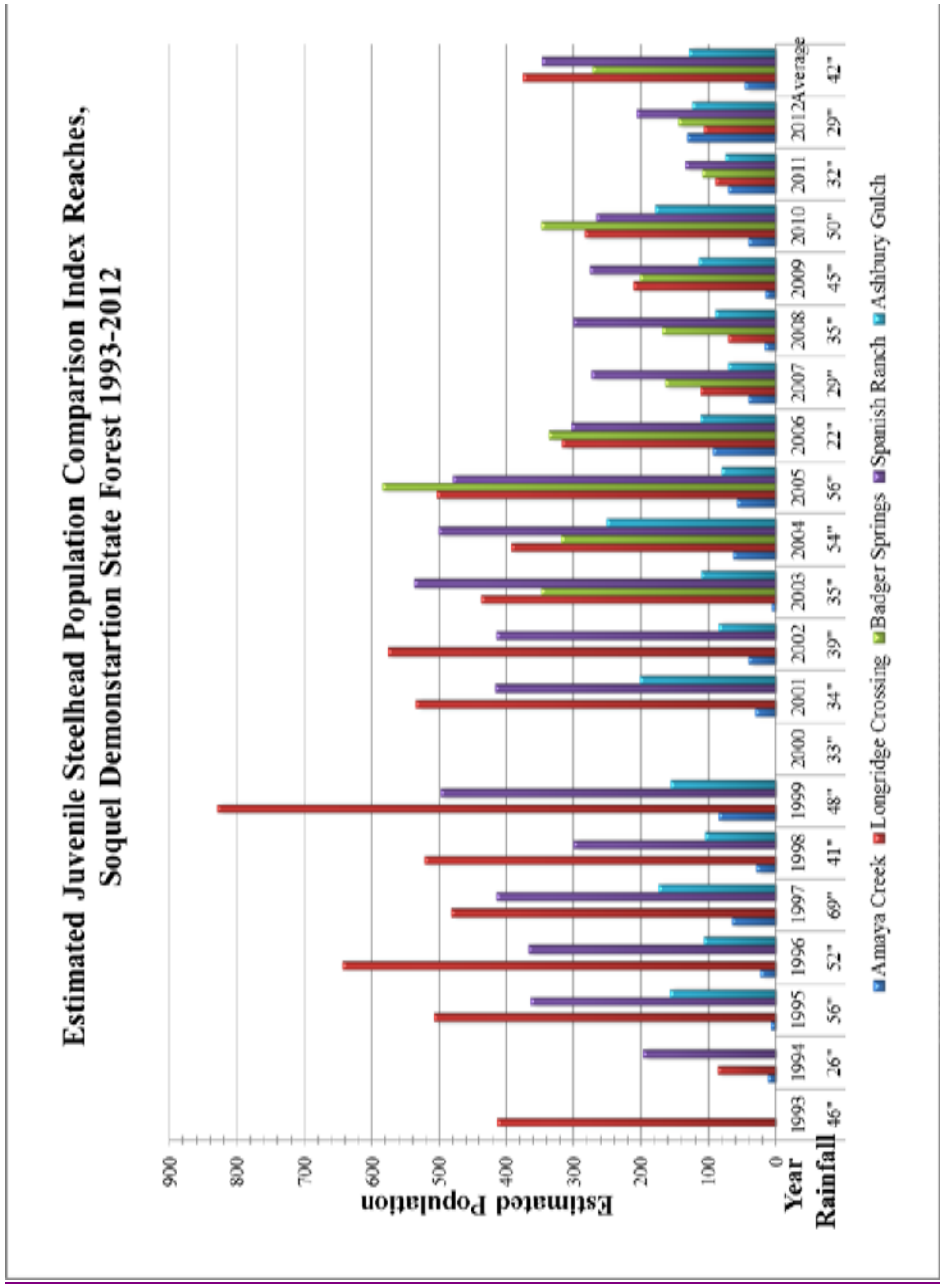
Estimated Juvenile Steelhead Population Comparison Index Reaches,
Soquel Demonstartion State Forest 1993-2012
Estimated Population
900
800
700
600
500
400
300
200
100
0
Year
Rainfall
1993
46"
1994
26"
1995
56"
1996
52"
1997
69"
1998
41"
1999
48"
2000
33"
2001
34"
2002
39"
2003
35"
2004
54"
2005
56"
2006
22"
2007
29"
2008
35"
2009
45"
2010
50"
2011
32"
2012
29"
Average
42"
Amaya Creek
Longridge Crossing
Badger Springs
Spanish Ranch
Ashbury Gulch

FIGURE 6

Historic populations of both coho and steelhead throughout most of California were supplemented through much of the 20th century by releases of hatchery fish for commercial or recreation purposes. Principal hatchery production for the Central California Coast steelhead originates from the Warm Springs Hatchery on the Russian River and the Monterey Bay Salmon and Trout Project on a tributary of Scott Creek. The most recent planting of hatchery-raised steelhead in SDSF (i.e., the East Branch of Soquel Creek) occurred in the 1930s when steelhead trout from the Brookdale and Big Creek hatcheries were released in the East Branch of Soquel Creek (M. McCaslin pers. comm.). The Monterey Bay Salmon and Trout Project stocked steelhead annually in the main stem of Soquel Creek (downstream of the SDSF) until recently, and in the early 1980s, released fish near the quarry (just south of the SDSF) (M. McCaslin pers. comm.). Hatchery steelhead planting was discontinued in Soquel Creek in 2001 because of CDFW's concern regarding genetic integrity of planting fish that originated in the San Lorenzo River stock (Alley, 2001 and 2002).

No production/mitigation hatcheries (hatcheries that produce fish with the goal of increasing recreational and commercial harvest or for mitigation purposes) for CCC coho salmon currently exist. The two hatchery operations in the CCC ESU are captive broodstock facilities operated expressly for conservation and recovery purposes with significant oversight by the California Department of Fish and Wildlife and the National Marine Fisheries Service. Coho salmon reared at these two facilities are listed under the Endangered Species Act. In Santa Cruz County the goals of the captive broodstock program include increasing population size, maintaining genetic diversity, and producing sufficient numbers of fish to promote straying into neighboring streams (Sturm, 2009).

In order to help protect remaining steelhead trout populations in Soquel Creek, the California Department of Fish and Wildlife prohibits angling in the East Branch of Soquel Creek (Fish and Wildlife South Central District Regulation, Title 14, Section 7.00 [e] [4]). This regulation was adopted by the California Fish and Game Commission in December of 1981 and became effective in March, 1982. In spite of this regulation, poaching of adult steelhead during winter spawning is prevalent and continues to affect fish populations. To avoid adverse impacts of public use on fish in SDSF, Forest staff and the California Department of Fish and Wildlife will conduct ongoing patrols to enforce prohibitions on fishing and fish harassment.

Other species of fish within the boundaries of SDSF include the Pacific lamprey and a small resident rainbow trout population above Ashbury Gulch. Additional fish species likely to be found in the East Branch include prickly sculpin, coast range sculpin, California roach, Sacramento sucker, and northern threespined stickleback.

HABITAT AND RESOURCE CONSIDERATIONS

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HABITAT LOSS AND DEGRADATION

The loss of habitat, ~~particularly that~~ for winter and summer rearing is thought to have~~ has~~ had a significant impact on the anadromous fish populations of the Soquel Creek drainage. Habitat availability and quality has declined due to diversion and overdrafting of water by residents, past logging practices, flood control measures (including LWD removal), increased development along the creek (including vegetation removal), pollution, and naturally unstable hillslopes. These ~~elements~~ impacts have syndergistically increased water temperature and~~, added~~ sediment inputs ~~to the creek~~, altered natural streamflow patterns, reduced habitat complexity,and decreased the amount of surface water ~~levels~~ during the critical summer months and periods of drought. (See the Watershed Assessment chapter for details on SDSF's watercourse conditions.)

Over the years, the combination of increased sediment and lowered water levels have resulted in a considerable loss of pool ~~space~~ habitat and a simplification of the channel throughout the Soquel Creek watershed. Making matters worse, wholesale removal of LWD over the past 20-30 years further exacerbated the loss of pools as well as the disconnection of the channel from many "off-channel" habitats. With systematic removal of LWD, channels tend to incise with the removal of the natural grade control that LWD can create, leading to decreased bank stability/increased bank erosion as well as disconnection from side channels, alcoves, and floodplains that have not experienced the same rate of incision. Since formation of habitat complexity elements like sheltered pools for winter refuge and summer rearing or gravel bars for spawning are directly linked to changes in streamflow velocity (i.e., sediment deposition where water is slow and scour where water is fast), loss of LWD and its natural ability to affect water velocity can result in simplification of the stream, loss of pools and more uniform water velocities. Loss of covered ~~This loss of~~ pool ~~space~~ habitat and disconnection of off-channel habitats, along with general fresh and saltwater habitat degradation (producing low marine survival rates), ~~may have~~ are believed to have directly contributed to the nearly complete disappearance of the coho salmon along California's central coast. Extremely low population numbers make it clear human intervention and cooperation with recovery actions are essential for coho to become viable again and existing steelhead populations to rebound (NMFS, 2012). Restoration of overwintering refuge from high water velocities both in the channel and "off-channel", as well as summer rearing habitat, will benefit recovery of both steelhead and coho populations.
~~Coho population densities along the central coast are extremely low and would will need vast assistance and human cooperation to become viable again (NMFS, 2010).~~

~~An additional habitat problem in the East Branch involves access to spawning areas. A few log jams within SDSF may not be passable by fish. During periods of high water, fish may be able to overcome these barriers, but conclusive evidence of this does not exist. Careful study and evaluation of the steelhead population and barriers may reveal ways to improve steelhead access. Log jams and other barriers will not be removed unless it is evident that such removal will do more good than harm. Furthermore, removal of log jams would be reviewed and approved by the California Department of Fish and Game.~~

The diversion and overdrafting of water are significant problems in the Soquel Creek drainage,

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especially along its lower reaches. Near the town of Soquel, a portion of the creek has dried up on various occasions, including the summers of 1991, 1992, and 1994. Some residents along the creek use the water for agricultural as well as domestic needs. The Soquel Creek Stream System was formally adjudicated by Decree No. 57081, Superior Court for Santa Cruz County. The Decree was entered March 14, 1977 in Book 2731, page 581 of Official Records. There are water allotment requirements, but the requirements of fish were not considered when maximum amounts for residences and businesses were allocated. Although Soquel Creek was adjudicated, no water master was appointed and no diversion rates were independently measured to confirm that the adjudication is being followed. Because young steelhead (and coho) will move both upstream and downstream as upper portions of streams dry out in the summer, ~~additional~~ drying of downstream reaches limits both access and available space and foraging areas for the entire population and could limit the ability of juvenile salmonids to gain access to wetted reaches and habitat in the SDSF.

Greater public awareness and response regarding value and current status of the aquatic resources of the Soquel drainage are essential for garnering support for implementation of fish-friendly management actions and implementation of ecological restoration projects~~maintaining a healthy anadromous population~~. Information, education and programs to help ~~R~~residents need to conserve water, allow the creek to flow in its natural channel ~~path~~, preserve riparian corridors, understand the value of LWD, and prevent accelerated erosion should be pursued. While improving the anadromous fish resource within SDSF is a start, it is not enough~~:~~ because Soquel Creek's fisheries require enhanced ~~good~~ habitat conditions along every reach of the watercourse and throughout the watershed. ~~All creek users and neighbors should consider the consequences of their actions and how they can help improve the resource.~~

~~MONITORING~~ HABITAT RESTORATION AND ENHANCEMENT

Fish habitat at SDSF will be enhanced through ~~monitoring of fish populations and their habitat, and~~ implementation of habitat enhancement projects in conjunction with ongoing timber operations. The NMFS 2012 ~~0 Draft~~ Recovery Plan for Central California Coast Coho Salmon (NMFS, 2012 ~~Recovery Plan~~) recommends increasing the quantity of large wood in the channel as one of the highest priorities for Soquel Creek. In response, a Large Woody Debris (LWD) and Habitat Complexity Project has been designed for the East Branch of Soquel Creek. The proposed project is also part of the Integrated Watershed Restoration Program (IWRP) for Santa Cruz County and designed collaboratively with NMFS, CDFW ~~C~~, CAL FIRE, the California Geological Survey, NOAA's Southwest Fisheries Science Center (SWFSC), *Alnus* Ecological and the Resource Conservation District of Santa Cruz County. In an effort to collaboratively identify the best opportunities for fisheries habitat restoration along the creeks of SDSF, a group of fisheries scientists, resource specialist, and ecosystem restoration experts from the agencies list above, walked nearly two miles of East Branch in November of 2010. The group agreed that these reaches were lacking complexity, that channel incision had left large areas of floodplain disconnected from the channel, and that CAL FIRE had a unique opportunity to implement an array of different type projects to benefit fisheries. The group identified eight potential project

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sites and then refined the project list down to five sites. The final project, as designed, entails placing LWD along a 0.7 mile section of the creek in four, 200-foot reaches. Three of the four reaches each contain three LWD elements, and the fourth has one LWD structure. Each element will include one to four pieces of LWD. In order to address the potential of LWD to mobilize and move far downstream, beyond the boundaries of SDSF, the project was designed to use a significant number of trees that are between 1.5 times and 2 times the width of the streambank and have their rootwads still attached. Between the heavy rootwads and long trunks, restored structures will closely mimic trees naturally falling in the stream due to landslide or bank undercuts and the structures will be unlikely to move a significant distance downstream, even in major storm events. Due to the size of the LWD required for each site (60 feet long or longer and up to approximately 50 inches diameter breast height) and the desire for the project to be a demonstration for private landowners, SDSF excavated 12 existing riparian redwood trees and dropped the entire tree and roots into the stream. A pilot project to determine the feasibility of this type of activity was successfully implemented in 2012 at one of the four sites. The other three sites were constructed in the late summer/early fall of 2013. Two additional rootwads with 25foot logs attached were imported from the Fern Gulch timber sale for use in the project area.

Preliminary data from California Geological Survey indicates that the LWD projects at the pilot site have already had a significant effect on channel complexity with pools developing, the channel becoming more sinuous, and gravel bars forming between the wood structures (Reynolds, 2013). A fifth site for this LWD project is a stream bank repair site just east of Hihn's bridge where a fish-friendly revetment system will be installed with rootwads and other components that will serve the dual purpose of repairing the road and providing shelter and pools for fish. This road repair project is scheduled for construction in the late summer of 2014. ~~majority of the LWD pieces will be imported from the Fern Gulch timber sale. . Implementation of the Large Woody Debris and Habitat Complexity Project is dependent on the Fern Gulch timber sale and the installation is expected to be done in 2012.~~ A long term monitoring plan has been developed by ~~NMFS~~ NOAA's Southwest Fisheries Science Center ~~and is expected to be grant funded through the SWFSC.~~(see Monitoring Section below for more details). Note that the baseline data collection for the monitoring work was funded by the State Coastal Conservancy and will aggregate biological and physical effectiveness data from LWD restoration sites on Soquel Creek at SDSF with those from a site on San Vicente Creek in northern Santa Cruz County.

While these first five sites represent an important start to the process of reversing historic trends in loss of habitat and significant impacts to salmonid populations, a number of other fisheries restoration opportunities have been identified along the East Branch of Soquel Creek on SDSF including two potential sites to reconnect historic backchannels/alcoves and a number of opportunities to enhance and reconnect floodplains. That said, a complete halt to removal and/or cutting of LWD within SDSF is perhaps the lowest cost and most effective action CAL FIRE can take to improve conditions for listed salmonids within the Forest. Finally, CAL FIRE also has the unique opportunity to take the lesson's learned from these projects and the related changes in management and work across the landscape with private forest landowners to use THP's and other means to implement additional stream and floodplain restoration projects.

MONITORING

A fisheries resources assessment was completed and used to develop a draft Fisheries Management Plan in 1995 (Berlekamp and Sutfin, 1995). The assessment inventoried the condition of the fisheries population as well as habitat status within SDSF. The management plan includes prioritized improvements, monitoring systems, research opportunities, and funding sources. (Refer to Appendix C, Monitoring Plan.) Subsequent fisheries assessments in the watershed have been completed by the Santa Cruz County Resource Conservation District (Alley, D.W. and Associates, 2003) and by the National Marine Fisheries Service (NMFS, 2010). ~~This ongoing inventory, which began in 1993, will provided information needed to identify goals and objectives and result in for a Fisheries Management Plan. Potential habitat enhancement sites will be were identified and mapped. Proposed enhancement structures will be reviewed and approved by the California Department of Fish and Game and a qualified hydrologist before installation. To evaluate the success of enhancement activities, regular monitoring will check levels of effectiveness. If any structure is functioning improperly or is adversely affecting aquatic habitat, fForest staff will redesign, repair, or remove the structure, as needed.~~

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Local fish population inventories began in 1993 and are conducted annually in cooperation with NMFS. This work is conducted by electrofishing at five sites: four on the East Branch of Soquel Creek and one on Amaya Creek. The surveys assist with monitoring the fish populations in fish bearing creeks that run through SDSF and also support research performed by biologists from NOAA's SWFSC to monitor steelhead growth and migration (Sogard, 2009).

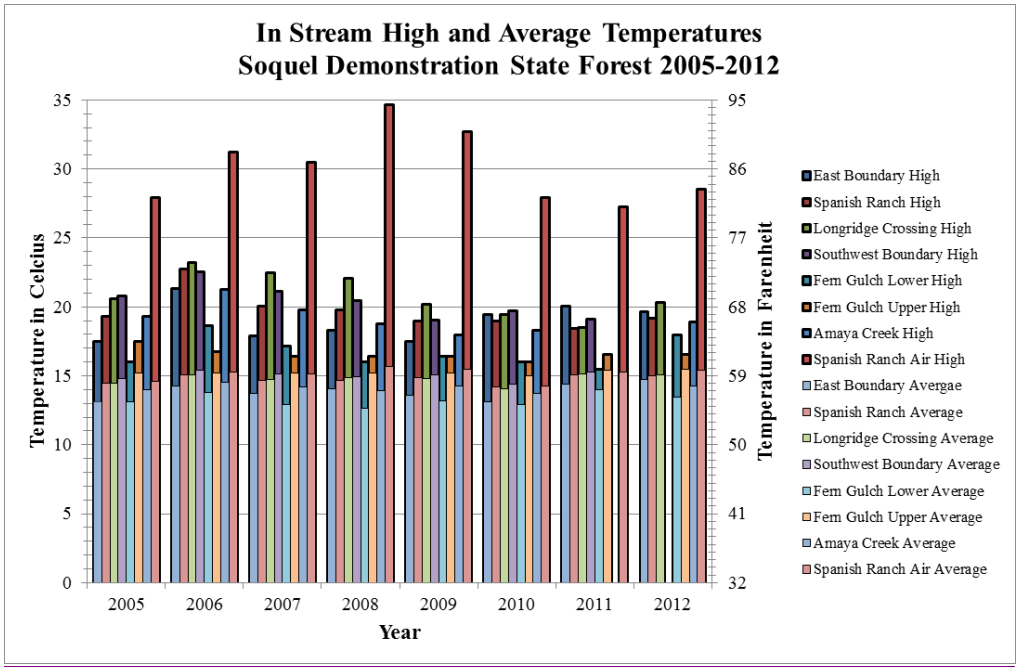

FIGURE 7. Water Temperature Data for SDSF.

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In stream temperature loggers are installed at various locations in SDSF to measure and record stream water temperatures throughout the dry season. An additional temperature logger is also installed at one site to measure and record air temperature during the same time period. In 2006, the California Regional Water Quality Control Board for the Central Coast Region released a set of protocols for continuous water temperature monitoring for their timber harvesting water quality waiver program. SDSF's methods are consistent with these protocols. ~~Water temperatures above 21.1ºC make it difficult for coho salmon and steelhead trout to extract oxygen from the water. Optimal rearing temperatures for juveniles are 7.22-14.4ºC for steelhead and 11.67-14.4ºC for coho (Reisner and Bjornn, 1979).~~ An analysis of the number of days with temperature readings exceeding 21.1°C and 14.4°C provides valuable information for fisheries management in SDSF. No temperatures greater than 21.1 ºC were recorded in 2009 - 2011. In 2008 Longridge Crossing had ~~2~~two days over 21.1°C. Temperatures over 21.1ºC were recorded on 11 days in 2007. Detailed reports and temperature data analysis are compiled annually. The graph below (Figure 7) is a summary of the high temperatures recorded from 2005 to 2012 ~~1~~. In 2011 the Amaya Creek logger was defective and in 2012 the Southwest Boundary logger was defective.

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AQUATIC INVERTEBRATES

Aquatic invertebrates are organisms that lack an internal ~~with external~~ skeleton~~s that~~ and live in water for at least part of their life cycle, They include insects (e.g., mayflies, stoneflies, caddisflies), crustaceans (e.g., crayfish), mollusks (e.g., snails), and freshwater earthworms. An important component of aquatic ecosystems, aquatic invertebrates are an essential part of the food web. They typically act as indicator species of fishery habitat quality and water pollution.

When tree litter falls into the water, microorganisms such as bacteria and fungi colonize and decompose the coarse particulate organic matter~~material~~, creating a much more nutritious material~~slime substance~~. This substance, algae, and other invertebrates becomes~~s~~ food for invertebrates, which in turn become food for fish. In this way, aquatic invertebrates provide a link in the food chain between decomposers ~~microorganisms~~ and fish, a connection crucial to fish survival.

In fresh water such as the East Branch, juvenile steelhead feed primarily on immature, aquatic stages of insects, but will also feed on adult terrestrial insects (Barnhart, 1986). Steelhead prefer the larvae of mayflies, true flies (e.g., midges ~~gnats~~), and caddisflies. They are often opportunistic, however, and may feed on any available insect. Adult steelhead typically do not eat during migration and spawning, instead utilizing ~~obtaining~~ energy from fat accumulated while living in the ocean.

Since ~~Because~~ they function as food, aquatic invertebrates, particularly insects, are key indicators of good fish habitat. In most cases, large amounts and diverse species of aquatic invertebrates signify an adequate food supply, increasing the ability of the stream to support larger and healthier populations of fish. Similarly, invertebrates need adequate amounts of leaf litter falling into the stream (therefore, adequate riparian vegetation) and appropriate conditions to support the bacteria and fungi ~~microorganisms~~ which convert the litter to a usable form. Because of their specific roles and different, species-specific ~~narrow~~ habitat requirements, invertebrates are useful indicators of stream conditions and changes. Through inventory and monitoring the composition of aquatic invertebrate communities, the health of aquatic ecosystems can be carefully evaluated. ~~The first inventory occurred in October, 1995. M Periodic monitoring will continues on a regular basis.~~ Regular inventory and monitoring has not occurred at SDSF. Some aquatic invertebrate data have ~~s~~ been collected through various Department of Fish and Game studies, but the data have ~~s~~ not been made available. Future plans for studies of aquatic invertebrates are included in the monitoring plan by the NMFS for the Large Woody Debris and Habitat Complexity Project. This work would monitor the habitat, including aquatic invertebrates, for the restored sites as well as control sites along the East Branch Soquel Creek.

~~PUBLIC COMMENTS AND CONCERNS~~ *THE FOLLOWING PUBLIC COMMENTS WERE RECEIVED DURING REVIEW OF THE 1998 GENERAL FOREST MANAGEMENT PLAN*

Comments and concerns regarding the aquatic resources of Soquel Creek were numerous and often passionate ~~fervid~~. Given the condition of California's CCC coho salmon and steelhead resource and the significance of the Soquel Creek watershed, one would expect a great concern for its future. The comments, concerns, and suggestions received as a result of this concern are represented by two major categories.

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The first and probably most important concern involves the maintenance and enhancement of fisheries and other aquatic resources within SDSF. Individuals have stated that, at the very least, SDSF should maintain the resources as they currently exist. Additionally, suggestions for improving the habitat and, therefore, the steelhead fishery touched on in-stream improvements and careful logging methods. SDSF will assuredly work to enhance all wildlife resources and habitats, including those of steelhead.

The second category of concern is really an extension of the first. Comments related that, in order to maintain and enhance SDSF's aquatic resources, inventories and monitoring of these resources must be performed. Specifically, commentators expressed that biologists familiar with the Soquel Creek watershed should set up and maintain a monitoring system which tracks the effects of SDSF's management activities on the resource. Strategies to ensure maintenance and enhancement of aquatic organisms could in turn be developed from the results of inventory and monitoring activities. SDSF plans to conduct the activities mentioned above, as well as research and habitat improvement projects, in order to satisfy these concerns (see Planned Actions below). Consistent with the Anadromous Salmonid Protection Forest Practice Rules approved in 2009, conifers will be planted in riparian zones, in areas where none exist, to promote long-term recruitment of large instream woody debris. Small intertwined pieces of debris, such as branches and twigs, act as collectors of leaf litter and provide more food for invertebrates.

MANAGEMENT GUIDELINES

1. Protect stream channels, streambanks, and riparian zones during all management activities. Late-succession management areas (see the Timber Management chapter) have been established along all fish-bearing streams and receive specialized management designed to enhance the riparian zone. This will ensure protection of stream integrity, including the channel, bank, and vegetation as well as fisheries resources.

2. Increase the fisheries potential by improving the spawning and rearing conditions of the East Branch of Soquel Creek within SDSF by implementing projects to increase winter high flow refuge, summer rearing, and increase general habitat complexity as well as projects that reduce production of fine sediments. ~~reduce~~ ~~Methods for improvement will be identified by the assessment discussed above but may encompass actions such as sediment, reduction,~~ remove fish migration ~~barriers~~ ~~removal~~, ~~and create pools~~, ~~creation~~.

3. Demonstrate that other forest management activities are compatible with the maintenance of healthy fisheries populations and habitats through educational programs and ~~. For example, educational displays will be used in recreation areas to inform visitors of the need to practice special care along watercourses. Also,~~ tours of harvested areas and stream enhancement projects. ~~could show standard and advanced erosion control techniques utilized to reduce impacts on watercourses.~~

4. Help residents of the East Branch watershed learn about the components of a healthy watershed and the importance of stewardship as it relates to LWD management,

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management of rural roads, and water conservation ~~its maintenance~~. Educational programs, either formal or informal, will focus on stream health, riparian zones, and the impacts of human use. Once established, the Forestry Education Center (refer to the Demonstration and Education chapter) will likely be the setting for these programs, allowing residents and other interested individuals to learn about the significance of aquatic ecosystems.

5. Continue to work with NMFS and CDFW on means and methods to help incentive and facilitate private landowners playing an active role in recovery of threatened and endangered salmonids (e.g. assistance with permitting, including LWD projects as part of THP's, etc)

PLANNED ACTIONS

1. Implement mitigations through the timber harvest plan process that benefit anadromous fish. ~~Complete aA fisheries resources assessment was completed and used to develop develop a draft Fisheries Management Plan (Berlekamp and Sutfin, 1995)by December 31,1998. The assessment will inventoryied the condition of the fisheries population as well as habitat status within SDSF. The management plan generated from the results will includes prioritized improvements, monitoring systems, research opportunities, and funding sources. (Refer to Appendix C, Monitoring Plan.) Subsequent fisheries assessments in the watershed have been completed by the Santa Cruz County Resource Conservation District (Alley, D.W. and Associates, 2003) and by the National Marine Fisheries Service.~~

2. ~~Implement~~ Monitor the Large Woody Debris and Habitat Complexity Project in cooperation with the California Department of Fish and Game, National Marine Fisheries Service, California Geological Survey, Resource Conservation District of Santa Cruz County, SWFSC and local qualified biologists.

~~2~~3. Continue to support ~~Provide additional~~ aquatic ecosystem research opportunities in the East Branch and its tributaries. ~~Likely subjects for examination include fisheries populations and habitat, aquatic invertebrate communities, and riparian zone studies. Research opportunities for local high school or college students will be emphasized but professional research will not be discouraged.~~

~~3~~4. Coordinate with the County of Santa Cruz, the Resource Conservation District of Santa Cruz County, National Marine Fisheries Service, California Department of Fish and Game, and other groups to complete habitat restoration and maintenance projects, including installing large wood in Soquel Creek and control of invasive plants. Private groups such as the Monterey Bay Salmon and Trout Project or crews from the Ben Lomond ~~Youth~~ Conservation Camp may help with projects such as channel stabilization, ~~hiding cover retention~~, channel complexity and pool creation, retention of existing instream cover via LWD, riparian vegetation maintenance and enhancement, and ~~barrier~~

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~~removal~~ reconnection of floodplains and off-channel habitat.

5. Restoration and enhancement projects for the Forest will be prioritized based on recommendations ~~ed~~ in the Soquel Creek Watershed Assessment and Enhancement Project Plan (~~DW~~ Alley, et al, 2003), the DFG Recovery Strategy for Coho (DFG, 2004), ~~and~~ the National Marine Fisheries Service (NMFS) in their ~~draft~~ Final Recovery Plan for the Evolutionarily Significant Unit of Central California Coast Coho Salmon (NMFS, 2012 ~~0~~) and the forthcoming Recovery Plan for the Distinct Population Segment of Contral California Steelhead. In addition, the Forest will continue dialogue with biologists from NMFS as well as NOAA's Southwest Fisheries Science Center, CDFW and private biologists to identify critical opportunities for restoration and enhancement of fisheries resources. Projects will be implemented over time as funding, equipment, and/or personnel become available.

~~4~~5~~6~~. Continue fish sampling in Amaya Creek and the East Branch of Soquel Creek in cooperation with NOAA's Southwest Fisheries Science Center ~~MFS~~. Electrofishing will be the primary method but other procedures such as underwater observation may be incorporated. Fish will be evaluated for species, size, health, and location. (Refer to Appendix C, Monitoring Plan.)

7~~6~~5Continue to monitor in stream temperatures in the East Branch of Soquel Creek and Amaya Creek at the seven sites that have been established. ~~Conduct aquatic habitat surveys at least once every ten years in accordance with the California Department of Fish and Game methodologies. Monitor ecological condition of aquatic habitats by sampling invertebrates using the protocol developed by the U.S. Environmental Protection Agency in cooperation with the California Department of Fish and Game. (Refer to Appendix C, Monitoring Plan.)~~

8. Build on existing funding from the Integrated Watershed Restoration Program to develop baseline fisheries, macroinvertabrate, water quality, and habitat data prior to implementation of fisheries restoration projects to assess effectiveness. Aquatic habitat surveys will be conducted in accordance with CDFW methodologies as funding allows.

~~7~~9. Monitor projects that are implemented in accordance with the California Department of Fish and Game methodologies. (Refer to Appendix C, Monitoring Plan.)

~~Monitoring work completed on the Forest to date includes annual steelhead trout population surveys from 1993 to 2010 and annual instream temperature monitoring from 1997 to 2010.~~

10. Explore opportunities for working with Monterey Salmon and Trout, NMFS, NOAA, and CDFW on the potential to add sites within SDSF to the introduction list for coho from the broodstock hatchery program.

11.~~8~~6. ~~Fish habitat enhancement structures will be reviewed and approved by the California Department of Fish and Game and a qualified hydrologist before installation. The~~

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~~removal of fish barriers will be reviewed and approved by the California Department of Fish and Game. Where possible, logging equipment will be utilized to assist in barrier removal and enhancement structure development. (Refer to Appendix C, Monitoring Plan.)~~ Conduct ongoing patrols with the assistance of the California Department of Fish and Game to enforce prohibitions on fish poaching and harassment. Incidents will be recorded, compiled, and evaluated annually to determine significant adverse effects on SDSF fisheries. (Refer to Appendix C, Monitoring Plan.)

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CHAPTER SEVEN: WATERSHED ASSESSMENT

PHYSIOGRAPHY OF THE WATERSHED

SDSF is located almost entirely within the drainage of the East Branch of Soquel Creek, its landbase covering approximately 21 percent of the basin. For the most part, the Forest is underlain by fine grained sedimentary rocks that are highly weathered and easily eroded. The headwater channel of the East Branch follows the San Andreas Fault Rift Zone and is heavily disturbed from landslides triggered by earthquake activity. Hillslopes throughout the Forest are commonly steep and prone to large, deep-seated landslides. Even greater instability occurs in active inner gorge zones near stream channels. When compared to mass erosion events (e.g., large landslides), surface erosion of the loamy soils is of minor significance.

As stated in the Property Description chapter, the Soquel Creek watershed (see Figure 8 below) has a Mediterranean climate with cool, wet winters and warm, dry summers. Mean annual precipitation in the East Branch watershed varies from 30 to 46 inches and takes place primarily between November and April. Discharge records from the USGS stream gauging station located immediately upstream from the bridge in the town of Soquel show that the average discharge is 1.05 cubic feet per second per square mile. High intensity, long duration winter storms, however, produce extreme levels of runoff. Major floods occurred during December, 1955 and January, 1982, producing log jams and flooding in the town of Soquel (Lassettre and Kondolf, 2003; see Figure 9). Singer and Swanson (1983) state that Soquel has a chance of being flooded once every seven to ten years.

Since 1996 streamflow has been measured at a gauge on the East Branch of Soquel Creek just below the Olive Springs quarry. This gauge and the data is maintained by the Soquel Creek Water District. The watershed area above the gauge represents a 13.9 square miles and essentially the entire SDSF area (a very small percentage of SDSF drains to Hester Creek). Data from this gauge has been coupled with data from a permanent rainfall gauge located just outside the Forest on Longridge Road and is represented on Figure 10 below.

FIGURE 8 – Soquel Creek Watershed Map

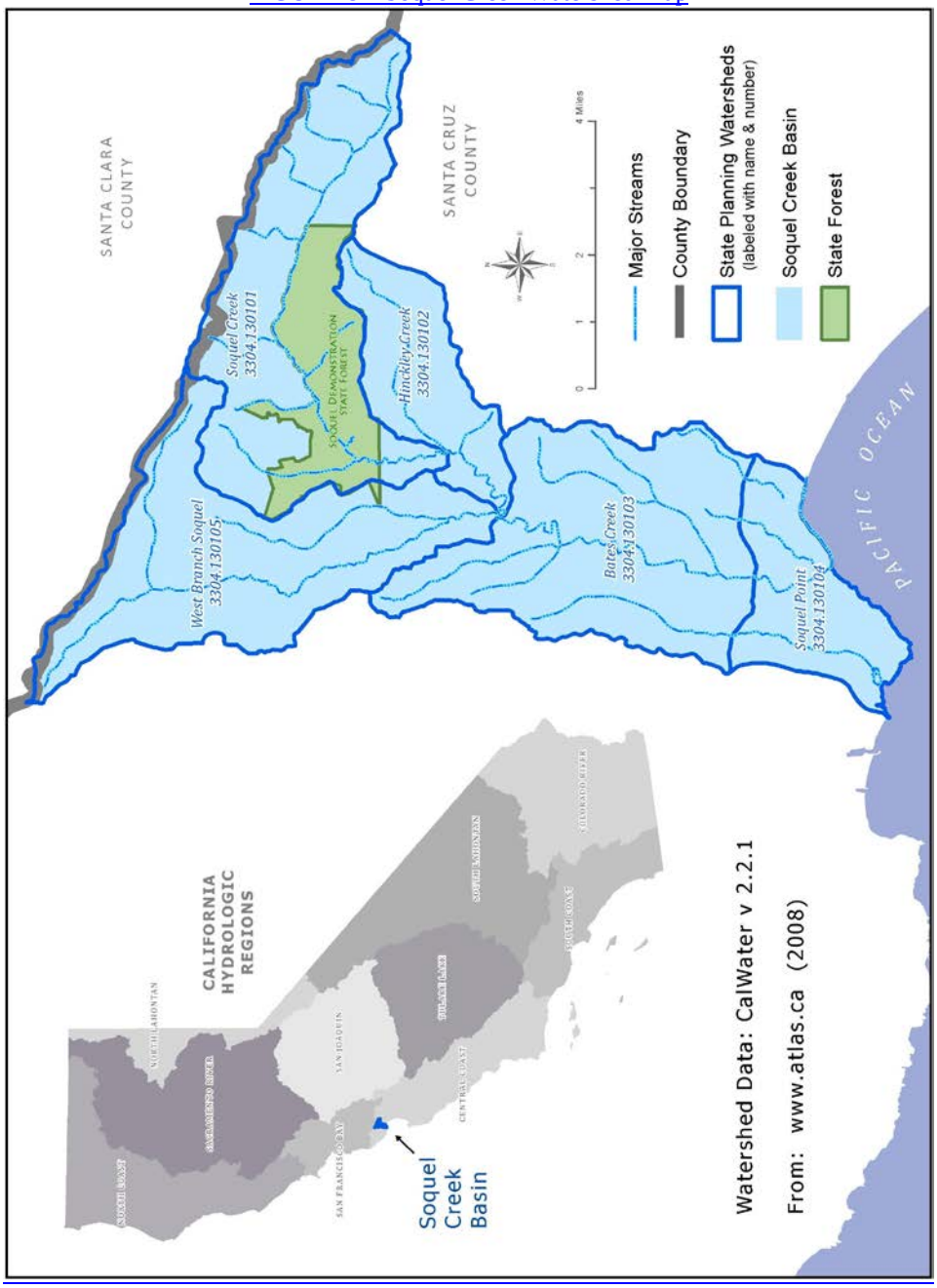
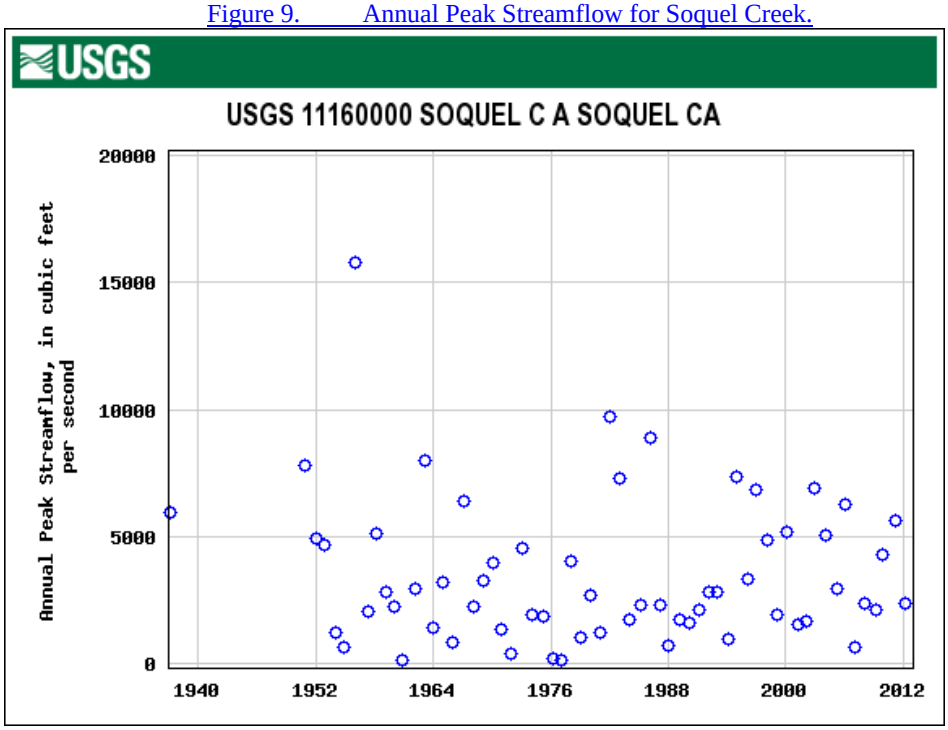


Figure 9. Annual Peak Streamflow for Soquel Creek.



BENEFICIAL USES

The two main beneficial uses of the East Branch of Soquel Creek are cold water fisheries and water supplies for various purposes. The East Branch supports spawning and summer rearing habitat for coho salmon and steelhead trout, but the number of returning fish has declined significantly in the past 40 years (refer to the Fisheries chapter). For example, in 1982 steelhead populations were only one-third to one-quarter of what they were thought to have been in the 1960s (Singer and Swanson, 1983). Coho salmon were thought to be extirpated from the Soquel Creek basin since 1968 (SCCRCD 2003, NMFS 2012 ~~0~~), but 170 young-of-the-year fish were documented during surveys conducted in a stream reach below SDSF in August 2008. The major factors limiting anadromous fish populations are believed to be low summer flows, and limited rearing habitat due to siltation of pools and removal of woody debris. Large wood loading, floodplain connectivity, and estuary function were listed as poor for the Soquel Creek watershed in the ~~draft~~ Central California Coast (CCC) coho salmon recovery plan (NMFS 201~~0~~2). ~~The East Branch of~~ Soquel Creek ~~is~~ and Aptos Creek are considered to be the southern most extent of coho salmon in California.

The other primary beneficial use in the main stem of Soquel Creek is water supply. There are

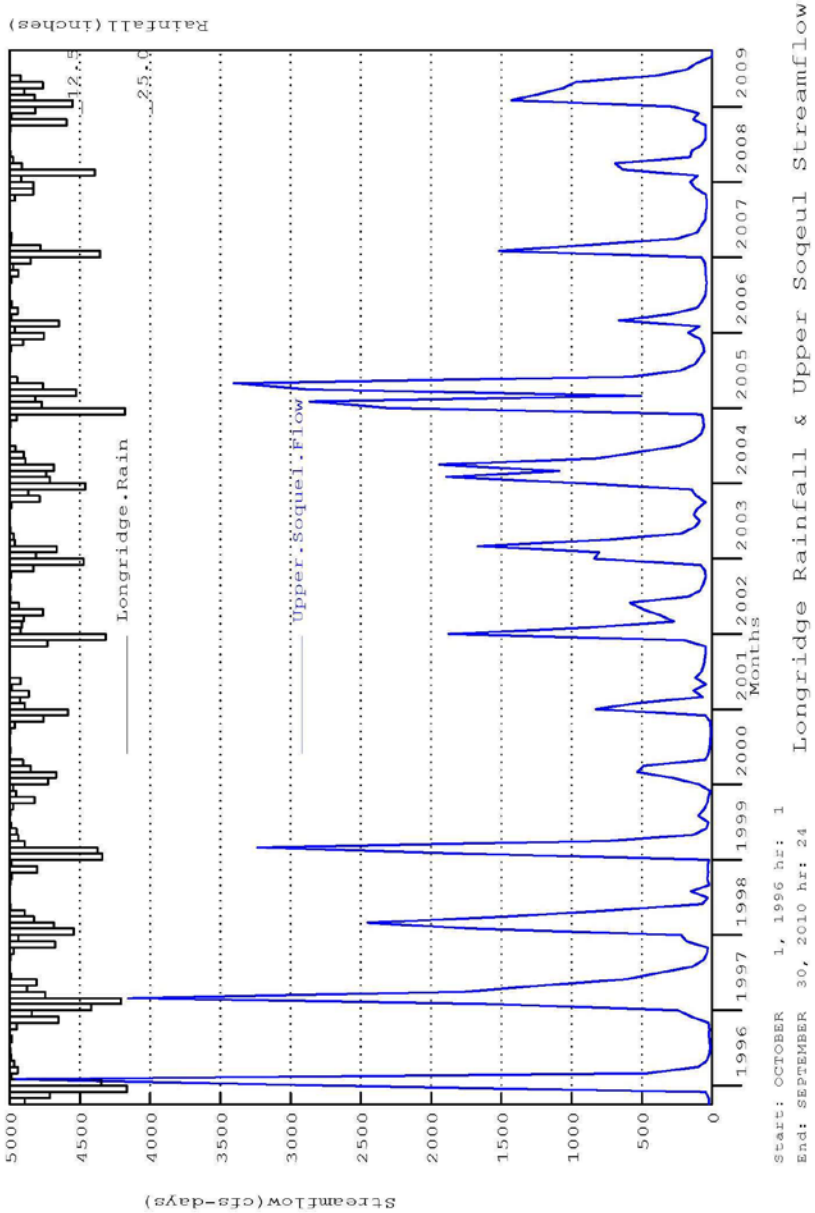


Figure 10 – Rainfall and Streamflow for East Branch of Soquel Creek

eight dams in the Soquel Creek watershed that impede or block anadromous salmonid migration (NMFS 2012~~0~~). Additionally, numerous small diversions exist that provide water for domestic, agricultural, and industrial purposes. Two permitted domestic water supply systems exist in the main Soquel Creek watershed that utilize surface flow, but there are no permitted systems utilizing surface water in the East Branch basin. The East Branch Soquel Creek watershed assessment conducted in 1993 reported that there were six surface water diversions in the East Branch basin (Cafferata and Poole, 1993). The largest diversion in the East Branch is operated by the Olive Springs Quarry.

Diversions and overdrafting of groundwater in low discharge summer months have dewatered portions of the East Branch [p.22] stream channel during drought years. This is likely to be a critical limiting factor for the fisheries resource in the lower part of the basin. Soquel Creek is a fully adjudicated stream under Decree No. 57081. After complaints by the city of Capitola in 1988, the State Water Resources Control Board concluded that a watermaster was needed to effectively regulate water use under low flow conditions, particularly during drought years, due to the complicated interrelationships of the water rights on Soquel Creek (Cafferata and Poole, 1993). To date, however, no watermaster has been appointed (Alley and Associates, 2004).

LAND USE HISTORY

The major types of land use in the East Branch watershed are timber management, recreation on public land, ranching, and residential development. The East Branch watershed's long history of timber harvesting began with clearcutting in the 1870's and continued into the 1940's. Timber was originally removed by oxen (1870-1895), then by steam donkey (1895-1930), and finally by crawler tractor. Following World War II, selective harvesting replaced clearcutting, continuing to the present day. Currently, nearly all of the old-growth timber has been harvested except for minor reserved groves and widely scattered suppressed trees. Second-growth harvesting has taken place on approximately 881 acres over the past 10 years. In recent years, cable yarding has been used along with tractor logging to selectively harvest timber in the basin. Approximately 20 percent of the Soquel Basin has never been harvested as it is in chaparral.

Recreation in the form of hiking and mountain biking takes place primarily in The Forest of Nisene Marks State Park and SDSF (SDSF also allows horseback riding). Additionally, adjacent property owners often allow friends and neighbors to utilize their lands as an access route to the park or SDSF. The Olive Springs Quarry, located near the East Branch channel, has produced sand and gravel from granitic rock exposed along the Zayante Fault for over 45 years. Residential development has occurred in the chaparral communities and has steadily expanded over the past 40 years. Over the whole Soquel Creek watershed, housing development is rated as moderate to high, with approximately 7,000 housing units present in the basin. Residential and commercial development is considered a very high threat to coho salmon (NMFS 2012 ~~0~~).

CUMULATIVE WATERSHED EFFECTS ASSESSMENT

Cumulative watershed effects (CWE) can be defined as the physical and biological impacts that result from multiple land use disturbances over space and time. These impacts occur within and away from the locations of actual land use and are transmitted through the fluvial system. When considering CWE, it is appropriate to estimate how current and future projects, when combined with impacts from past activities, will influence beneficial uses present in the basin under review. Techniques to determine whether CWE are significantly adversely impacting beneficial uses have been developed, but are generally considered to be inadequate for varying reasons. Existing CWE assessment approaches mostly range from checklists or indices that are subjective but inexpensive and simple, to complex physically based models that have large data needs and are difficult to apply (Litschert 2009).

Watershed analyses and assessments are often used to evaluate cumulative watershed effects. For example, Berg et al. (1996) found that watershed analysis was the most suitable approach for assessing cumulative watershed effects in the Sierra Nevada. While a formal watershed analysis has yet to be completed for the Soquel Creek watershed, several watershed assessments and studies have been completed over the past 30 years that contribute a considerable amount of information regarding cumulative watershed effects. These studies include: Singer and Swanson (1983), Cafferata and Poole (1993), Santa Cruz County Resource Conservation District (2003), Alley and Associates (2003, 2004), Balance Hydrologics (2003), Greening Associates (2003), Pacific Watershed Associates (2003), and Lassettre and Kondolf (2003).
Cafferata and Poole's rapid landscape-level watershed assessment for the East Branch of Soquel Creek was conducted in 1992 and 1993. It is described below in considerable detail. Since specific harvest units had not been defined, the entire Forest served as the project area for this assessment. CWE assessment guidelines suggest that assessment areas must be large enough to detect past impacts and small enough to determine what the impacts of the proposed projects will be on the area. This assessment completed for the East Branch watershed evaluated the current condition of stream channels in the basin and determined how they would likely be altered with future timber operations.

The watershed assessment for SDSF was broken down into two main tasks: a stream channel inventory and a hillslope erosion/sedimentation evaluation. The stream channel inventory was completed in 1992 and illustrated the current condition of the channel network within the assessment area. Channel stability was rated with the U.S. Forest Service's Pfankuch Method, while channel condition was evaluated with ~~CDF~~ CAL FIRE's Guidelines for Assessment of Cumulative Impacts (CDF, 1994). Due to limited personnel and time constraints, stream channels within SDSF were analyzed in greater detail than channels located in other areas of the basin (Poole, 1992).

The hillslope component of the CWE evaluation was completed in the summer of 1993. Quantitative estimates of erosion risk and erosion volumes associated with anticipated activities (e.g., timber harvesting and road building) were made based on the results of the Critical Sites Erosion Study (CSES; Lewis and Rice, 1989; Rice and Lewis, 1991). A selected number of random sample locations were installed on existing, planned, and abandoned roads, as well as

past harvest areas. The resulting data were ~~was~~ input into equations to estimate the risk of generating critical, or large, erosion sites (i.e., a large erosion event producing more than 100 cubic yards per acre). These equations are based on measurements made for slope, amount of hillslope or road curvature, soil color, and rock hardness.

On-site measurements were made to assess other sources of erosion not addressed by the CSES. Estimates were then made of the amount of sediment that could result from the approximated erosion. The significance of the estimated sedimentation was studied by comparing it with expectations of sediment yield for Soquel Creek. Since long-term sediment data from the Soquel Creek basin were ~~was~~ not available, information from the San Lorenzo River, a similar, neighboring basin, was used. The methodology utilized for the hillslope erosion and sedimentation analysis was designed by Rice (1993) and was used in several parts of the state in the 1990's.

Locations in the East Branch assessment area that were found to have poor stability and channel conditions were Amaya Creek, Hinckley Creek, and the East Branch between Ashbury Gulch and the upper SDSF boundary. The reaches with the best ratings for stability (high-fair) and channel conditions were the upper part of the East Branch above SDSF and the main stem of Soquel Creek below the junction with the West Branch. The reaches of the East Branch between Ashbury Gulch and the junction with the West Branch were reported as having intermediate stability and channel conditions.

Summarizing the results for the 10 miles of the East Branch surveyed, fair channel stability was the most frequent finding (10% good, 67% fair, and 23% poor). This compares reasonably well to the fair/poor relative overall rating for sediment ~~and log~~ contribution assigned to the East Branch by Singer and Swanson (1983). The exception was the highly impacted reach along the San Andreas Rift Zone. Additionally, the major tributaries were severely degraded by heavy landsliding activity. Very large quantities of sediment are stored in these headwater tributaries, as well as in wide, vegetated terraces along the lower reaches of the East Branch. Observation of the East Branch channel revealed that riffle stretches generally had cobble and gravel sized particles protecting the stream bottom surface. Inspection of stable pools below Ashbury Gulch, however, showed that this habitat type contained significant percentages of fine sediment.

Large woody debris was not found to be blocking anadromous fish passage in the East Branch, but was limiting habitat use in the major tributaries. Large wood was generally lacking along most of the East Branch of Soquel Creek below Ashbury Falls, except where it had accumulated in a few fairly stable locations . Large woody debris is valuable because of the pool habitat for young salmonids that forms around it in gravel dominated stream systems.

Results of the hillslope evaluation indicate that the risk of generating critical erosion sites is not significantly different from the average for the rain-dominated portions of the northern Coast Ranges in California (Cafferata and Poole, 1993). Very large amounts of existing erosion were measured on a few of the plots, however, and existing erosion was found to be considerably higher than the amount estimated from the critical site equations. For example, one of the road plots had a culvert that had carved an exceptionally large gully below its outlet, while another

had large amounts of cut and fill slope erosion 50 feet from a Class II stream. Therefore, the potential for producing large erosion events is clearly evident in this terrain, even though the critical site equations did not generate exceptionally large estimates.

The terrain slope and distance to a Class II stream were used as an index of the proportion of erosion which would become sediment. The average sediment delivery was found to be much higher than is commonly assumed in forested watersheds. This is due to very high delivery from relatively few plots with extensive amounts of existing erosion. Long-term sediment data does not exist for Soquel Creek at the USGS gaging station; the nearest station with long-term discharge records and a reasonable sediment record is found on the San Lorenzo River at Big Trees State Park. A statistical analysis indicated that peak storm discharges on Soquel Creek were significantly related to those of the San Lorenzo River. The peak storm discharge/annual sediment yield relationship generated for the San Lorenzo River was then used to estimate the annual sediment yield at Soquel Creek.

Extreme natural variability in sediment yield for Soquel Creek was found for 1952 to 1990, with the range spanning several orders of magnitude. The estimate of mean annual sediment yield based on the stream discharge record for Soquel Creek (~1,500 yd3/mi2/yr 60,392 yd^3 or 2.35 yd^3/ ac/yr) was somewhat higher than that calculated based on hillslope erosion plot measurements. Due to the assumptions involved in making these estimates, however, it is unlikely that these estimated sediment yields are significantly different. Both estimates of sediment discharge for Soquel Creek are high for forested areas and illustrate the erosive nature of the basin. Cafferata and Poole (1993) concluded that it was unlikely, however, that the limited timber harvesting and rebuilding of abandoned roads planned for SDSF would significantly elevate the erosion rate and have a significant adverse impact on the aquatic system. The anticipated sediment production from SDSF's timber production was found to be small compared to the range of variability in sediment flux observed in this basin.

More recent watershed assessment work in the Soquel Creek watershed can be compared to the results of the Cafferata and Poole (1993) rapid assessment. For example, Lassettre and Kondolf's (2003) much more detailed large wood study included the lower part of East Branch of Soquel Creek. They reported an average large wood loading for this reach of 0.005 m3/m2, which they stated lies at the low end of the range of observed values for North American streams (e.g., approximately 36 times lower than for old growth coast redwood forests in Humboldt County). Similarly, Alley and Associates (2003) reported that large wood was extremely scarce in Soquel Creek compared to other coastal streams recently surveyed.

Large wood loading in the East Branch of Soquel Creek is low due to extensive log removal efforts by Santa Cruz County from the 1950's to the 1990's. The Santa Cruz County RCD watershed assessment (SCCRCD, 2003) concluded that the scarcity of large wood limits juvenile salmonid production throughout the Soquel Creek watershed. Similar to other studies, their assessment states that large wood is scarce in the middle part of the East Branch and recruitment is low for this channel reach.

Balance Hydrologics (2003) reported that Soquel Creek has experienced prolonged periods (up to 25 to 30 years) of disturbed watershed conditions over the past 150 years. These conditions, they found, were caused by both natural processes and anthropogenic activities, with the later likely resulting in an increase in the natural, base rate of sediment production in the watershed, although small relative to natural rates. Landslides along Highland Way as well as recent wildfires (Summit Fire and Loma Fire) have also contributed sediment to Soquel Creek.

The Santa Cruz County Resource Conservation District (2003) watershed assessment project concluded that overall lateral channel stability of Soquel Creek was relatively high during the past 54 years with minor adjustment at several points of meander along the East Branch and mainstem. Major sediment production from natural sources was found to occur in both the East and West Branches and is most pronounced following earthquakes, large magnitude floods or forest fires, and is usually related to landsliding.

The SCCRCD (2003) assessment states that several factors appear to limit distribution and abundance of steelhead. These factors include passage impediments, poor spawning habitat quality (high proportion of fine sediment, number of constricting, steep riffles below spawning glides), low spring and summer baseflows, limited amount of escape cover (provided by instream wood, undercut banks, unembedded boulders, water depth ~~itself~~), elevated water temperature, and limited water depth. Throughout the watershed, low baseflows and sedimentation limit the amount and quality of rearing habitat.

PWA (2003) inventoried the SDSF road network (18.2 miles) and found 82 sites with significant sediment delivery potential. Fifty - seven of these sites were at stream crossings. Three crossing sites were identified as having a high treatment immediacy, with a potential sediment delivery of approximately 1,631 yds3. Sites requiring significant analysis, design and heavy equipment investment are upgraded and mitigated as CEQA projects are planned and implemented across SDSF. For example, one high priority culvert replacement as well as three other identified sites, were mitigated through implementation of the Rim THP and accompanying DFW ~~G~~ streambed alteration permit in 2011. Additional rocking of the main roads in SDSF has also been implemented annually. ~~Additional u~~ Upgrades and mitigations along Longridge Road and Hihn's Mill Road ~~are planned~~ were implemented as part of the Fern Gulch timber sale.

Recent impacts in the Soquel Creek watershed have occurred that have not been considered in past watershed assessments. These include the 2008 Summit Fire, which burned approximately 4,270 acres in portions of the Soquel Creek, Corralitos Creeks, Brown's Creek, and Uvas Creek watersheds (SEAT, 2008). Soquel Creek suffered the greatest amount of high burn severity, with 382 acres. In total, 1130 acres burned in the Soquel Creek watershed (34% high burn intensity, 43% moderate, 20% low, and 3% unchanged.)

Additionally, a large landslide event delivered an extensive amount of fine sediment into the East Branch of Soquel Creek in 2011. Highland Way was closed by a re-activated landslide on approximately March 26, 2011. The slide contributed a substantial amount of soil, rock, and organic debris into the East Branch of Soquel Creek that has had short and long term impacts.

CONCLUSIONS

In summary, it can be stated that the East Branch of Soquel Creek watershed is a highly sensitive basin. This is due to its inherent natural hillslope instability related to seismic forces, steep slopes, weak bedrock, and frequent high intensity rainfall. Impacts from past management activities, prior to implementation of the modern California Forest Practice Rules in 1975, have contributed greatly to degraded conditions in the basin, as has residential development. In spite of these problems, the East Branch below Ashbury Gulch has not been overwhelmed with sediment, and it is clear from abundant observations of steelhead redds (gravel beds where female fish lay eggs) and young fish that spawning and rearing habitat remains.

The East Branch system is stressed by fine sediment moving downstream from tributaries, partially due to its close proximity to the San Andreas Fault Zone. This material is filling pools required for rearing habitat for listed anadromous salmonids. Lack of sufficient volumes of large wood and overdrafting of water in low flow summer months compounds this problem. As a result, the aquatic environment is sensitive to further degradation and timber operations must be carried out with extra caution.

Due to the sensitivity of the hillslopes and current channel conditions, special considerations are needed when planning forest management activities in the East Branch. Appropriate mitigations must continue to be utilized and remedial improvements implemented to repair existing problem areas, such as those suggested in the PWA (2003) report. If these considerations are employed, future timber sales can occur without significant adverse impacts to the beneficial uses of the basin.

MONITORING AND ENHANCEMENT

Ongoing management of SDSF will involve maintaining proper drainage along roads and trails by repairing culverts, water bars, and other drainage structures to reduce or prevent soil erosion and stream sedimentation. *SDSF is required to monitor all timber operations (including all harvesting areas and new roads, skid trails, and landings) annually for 5-7 years following completion of operations. Increased monitoring occurs the first winter after operations above what is required by regulations.* An active watershed remediation program will continue to be used that includes monitoring watershed conditions and implementing enhancement projects. Monitoring has included a forestwide inventory of stored sediments and active landslides, and mapping mass wasting hazards and surface erosion potential. Sediment risk-reduction projects have been rated for cost-effectiveness (PWA, 2003) and will be implemented in conjunction with timber operations according to their priority as available funding permits.

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THE FOLLOWING PUBLIC COMMENTS WERE RECEIVED DURING REVIEW OF THE 1998 GENERAL FOREST MANAGEMENT PLAN

Public comments regarding the East Branch watershed have focused on its distinction and sensitivity. Individuals are concerned that forest management activities will result in general

watershed degradation, including sedimentation of streams and excessive hillslope erosion. This is particularly important to them in regard to steelhead numbers and habitat, and possible impacts upon their land during high intensity rainfall. As stated in this and other chapters, careful pre-project evaluation and measures to ensure the maintenance of watershed integrity are a priority for SDSF. The CWE assessment work discussed above and other studies assist the Forest staff to understand and manage for the sensitive nature of the basin.

MANAGEMENT GUIDELINES

1. Design streamside management zones that properly address the inherently unstable nature of the East Branch watershed in SDSF. This includes extending zone widths beyond the standards set by the California Forest Practice Rules, for Class I fish-bearing watercourses, as is appropriate in sensitive areas. These zones must provide for the long-term recruitment of large wood, protection of the stream channels and banks, stream shading, sediment filtration, nutrient input, microclimate control, floodplain function, and prevention of significant ground disturbance.

2. Place heavy emphasis on road design and maintenance, since roads generally produce the largest percentage of management-related sediment in forested watersheds. New seasonal and temporary roads should be outsloped to avoid concentrating water that could trigger landslides or transport sediment directly into flowing streams. Of foremost concern for new road construction is the avoidance of localized unstable areas. For mainline roads, road drainage structures and watercourse crossings must be adequately sized to ensure that the risk of failure is minimized. Roads no longer needed must be properly abandoned. Wet weather use for roads impacting flowing streams should not occur and an active winter maintenance program is needed to ensure that drainage structures are adequately functioning. (Refer to the Roads and Other Improvements chapter for more information.)

3. No tractor operations will be permitted on slopes which average more than 35 percent without site-specific evaluations of slope stability and erosion potential. This will depend on the ability to mitigate such operations to levels of insignificance.

PLANNED ACTIONS

1. Continue to record data on all timber harvesting operations done in the Forest that could influence soil and water resources. Link THP road mitigation sites, information on road construction and harvesting, and monitoring results through our GIS database.

2. Continue to implement the treatment priorities for high and moderate risk inventoried sediment sources in the Soquel Demonstration State Forest watershed assessment area developed by PWA (2003).

3. Evaluate the performance of each previously-implemented remediation project to

determine the success in reducing the risk of large-scale sedimentation. Redesign and modify any project not meeting its intended objective. (Refer to Appendix C, Monitoring Plan.)

CHAPTER EIGHT: DEMONSTRATION AND EDUCATION

INTRODUCTION

As stated in the Timber Management chapter, a goal of SDSF is to demonstrate sustained-yield timber production with innovative forest management practices within the context of local community protection, and subject to the limitation of commercial timber harvesting provided in the legislation (PRC 4660-4664). The intent of this goal is to encourage conscientious forestry practices on private lands and demonstrate these practices to the surrounding urban populations. This can lead to improved attitudes toward our natural resources and forestry in general, enhancing responsible stewardship of our forest lands.

Another goal is to show ~~f~~ Forest visitors that timber management, forestry education, public recreation, and environmental protection are interrelated and compatible. This will be accomplished through combinations of these programs whenever possible. SDSF's location is well suited for the development of forestry education programs because it is close to schools in both the Monterey Bay and south San Francisco Bay areas. This proximity is ideal for groups to learn the importance of forest ecology and management. Similarly, it offers local landowners and the general public an opportunity to view the protection, management, and utilization of renewable natural resources. Field trips ~~would~~ involve public motor vehicle use.

The Demonstration and Education Programs of SDSF ~~will~~ relies ~~y~~ on interpretation, volunteer participation, and the future creation of an educational center. Each of these elements, as well as the Demonstration and Education Programs themselves, are outlined in the following paragraphs, and further described in the Education Study (Blazet, 1997).

DEMONSTRATION PROGRAM

OVERVIEW

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The Demonstration Program is a major focus of SDSF for a number of reasons. Most importantly, it provides an opportunity for the general public and educational groups to observe an active working forest. Forestry demonstration can assist the public in understanding forest management and its role in resource conservation and local economics. Additionally, it reminds us of the many wood products we use daily and the importance of keeping forests healthy and productive. Knowledge such as this can help change the negative public image generally associated with forest management practices. Also, the demonstration of various forest activities can potentially benefit small private landowners in the management, protection, and enhancement of their forest lands.

The opportunity for demonstration projects ~~will~~ has increased as SDSF has become~~s~~ better established. The staff ~~will~~ remain aware of the demonstration potential at the onset of new activities. Demonstration projects may be short term, with several topics addressed each year, or long term, extending over many years.

The primary consideration of the Demonstration Program is to enhance the public's understanding and awareness of forest management principles and techniques consistent with environmental protection. Throughout the process of establishing projects, a strong emphasis will be placed on environmental protection. The following are demonstration opportunities at SDSF:

Silvicultural Systems	Erosion Control
Tractor/Cable Harvesting Operations	Hardwood Management
Disease and Insect Management	Growth and Yield
Recreation Management	Riparian Management
Reforestation Methods	Cumulative Watershed Effects
Fisheries Protection/Enhancement	Fuelwood Management
Road Construction/Maintenance	Prescribed Burning
Old-Growth Redwood Protection	Habitat Enhancement(Aquatic & Terrestrial)
Watershed Restoration ~~Protection~~	Fire Protection
Exotic Species Control	Rare Plant Management

Part of the demonstration that is done at SDSF involves public field trips of active timber harvests. Four to five field trips were held each year for the 1995 Longridge harvest, the 1997 Amaya harvest and the 2012 Fern Gulch harvest. The field trips were attended by 30 to 40 people per trip. Each timber harvest has also held a specific field trip for the SDSF Advisory Committee to provide an opportunity to review current operations. During the tours over the years the advisory committee, media, and public have had the opportunity to observe operations including rubber-tired skidding, tree falling, horse skidding, cable yarding, a portable mill demonstration, the Badger Spring's old growth grove, the Olive Springs Quarry operation, log truck loading, erosion control techniques, and watercourse crossing installations. Topics discussed have included the history and goals of SDSF, watershed protection and enhancement, and timber management. Questionnaires were filled out by field trip participants to get feedback about their experience and

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recommendations for future field trips. Almost without exception, the field trip participants enjoyed the opportunity and stated that they would be interested to come back in the future. These field trips will continue to be a part of future harvests at SDSF.

PLANNED ACTIONS

1. Demonstrate forest management practices and ecosystem enhancement techniques. To accomplish this, incorporate an identifiable demonstration feature in timber sale planning and implementation, recreation designs and development, and ~~or~~ other forest management activities, as appropriate.

2. Develop and implement outreach programs to contact the general public, school groups, and private landowners for demonstrational opportunities. Encourage visits and tours by interested public groups, individuals, schools, and professional organizations.

3. Establish ~~a~~ safe and efficient methods of displaying information from demonstration projects ~~or~~ and conducting tours of these areas ~~demonstration projects~~. Displays should be made available and tours held at times that encourage ~~f~~ Forest user group's attendance and participation (e.g., summer weekends, evenings).

FORESTRY EDUCATION

OVERVIEW

~~The results of~~ SDSF'~~s~~ has proven to be a valuable and attractive venue for forestry education, just as the Recreation Study (McNally and Hester, 1993) indicate it would. ~~an encouraging level of interest in the Forest's education potential. In order to intensify this interest,~~ SDSF'~~s Forestry Education Program will be~~ provides informative and fun educational opportunities and~~,~~ ~~providing~~ as many hands-on experiences as possible. The program ~~will be~~ is applied in conjunction with demonstration objectives and occurs in many different forms. Forestry education ~~will~~ introduces various target groups to progressive forest management practices, resource protection, logging history, forest ecology, and research. This ~~will be~~ is accomplished through literature provided, indoor presentations, and outdoor programs.

Instructional organizations can learn about SDSF's resources by sponsoring classroom presentations or bringing groups to the Forest. School programs may represent a theme, such as Arbor Day or Earth Day, and include activities both at school and SDSF. Classroom and outdoor presentations might also be subject oriented, with topics such as watershed management, forest ecology, soil biology, fisheries habitat restoration, or wildlife found in the Forest.

~~An e~~ Educator training programs, ~~similar to~~ like the one at Elkhorn Slough Reserve or the Forestry Institute for Teachers, ~~will~~ provide ~~the~~ a means for teachers and their students to experience forestry education without relying on Forest staff. ~~A program such as this will offer workshops for educators on different aspects of SDSF and forest resources in general~~. After completing training, educators may bring their students to the Forest for non-staffed instructional

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field trips. This removes the time burden from Forest staff members while allowing instructors to absorb new information and reinforce their own training.

SDSF staff has assisted with Forest Conservation Days, the web of life based educational program for fifth graders, since its inception in 1992. SDSF staff is also involved with the California Forestry Challenge, which is a competitive event for high school students in technical forestry and current forestry issues. Since SDSF cannot currently provide a suitable venue for hosting the event on the Forest due to lack of staff, infrastructure and services on site, SDSF staff participates in these programs that occurs locally each year.

Information for the general public, professional organizations and small private landowners ~~will be~~ is disseminated through tours, newsletters, brochures, workshops, ~~and~~ seminars and the CAL FIRE State Forest website. Newsletters and brochures ~~may~~ cover information such as current events, research projects, or compatible rural land uses. Workshops ~~will~~ provide opportunities to learn about forest management techniques and how to solve problems in a group setting. ~~Finally, s~~ Seminars ~~will~~ focus on specific topics as well as the presentation of ideas, research results, and group discussion.

PLANNED ACTIONS

1. ~~Develop~~ Continue to provide educational information and programs related to forest management and ecosystem processes. as described above and in the SDSF Education Studay (Blazej, 1997) ~~Presentations suitable for groups which include people of diverse backgrounds and varying ages as well as group-specific programs will be developed.~~

2. ~~Determine the best~~ Utilize various methods to distribute information about the forest resources of SDSF to different user groups. Methods to present facts about SDSF may include oral presentations, written information, ~~and~~ interpretive facilities, and the internet. ~~The Education Study for the Forest was completed in 1997 (Blazej, 1997)~~

3. Continue to ~~E~~ encourage educational organizations, such as local public schools, to use SDSF for ~~the F~~ forestry ~~E~~ education ~~P~~ programs and field trips. Stimulate participation by offering quality educational experiences that are both informative and enjoyable. ~~SDSF should~~ Maintain old and establish new working relationships with educators and their students.

4. Encourage teachers to attend and provide information about ~~Develop a~~ teacher training programs that will allow educators to lead their own forestry education programs. Offer workshops on topics such as forest ecology, wildlife habitat requirements, and watershed dynamics which apply directly to SDSF. ~~The training procedure should encourage on-going programs which allow students to work with SDSF over a period of time.~~

INTERPRETATION

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OVERVIEW

The public can gather information about SDSF in a variety of ways while visiting the Forest. Interpretive facilities such as self-guided trails, information boards, and hands-on activities offer the Forest visitor an opportunity to learn the many features of SDSF. Since groups who utilize the Forest differ in their use of its many resources, information that applies to and interests many different individuals is essential. Interpretive facilities are a great way for the staff to meet the important goals of public demonstration and education without being relied upon for instruction.

INTERPRETIVE OPPORTUNITIES

Self-guided walking tours incorporate designated stops that are marked and indicated in a guide book. Stops on trails in SDSF might focus on unique sites and vegetation of the Forest or provide activities that facilitate learning. Interpretive trails will work well in SDSF because hiking is a common activity. The Forest provides many possibilities for educational trails, including a number of old logging trails and roads.

Information boards are effective tools that offer educational and operational information. Boards located at parking areas, popular recreation sites, trail heads, and along trails ~~will~~ provide information in the form of displays and brochures. Facts that relate to general ~~f~~ Forest news are best suited to this type of interpretive facility, and will include subjects like riparian protection, current logging practices, and ~~or~~ forest ecology.

Hands-on activities with touchable items and sensory-oriented exercises for adults and children are another form of forestry education. These activities ~~will~~ either stand alone or ~~be~~ are coordinated with self-guided and staff-led tours. For example, a touchable tree round on a self-guided trail may help visitors understand how tree age is determined or how human history compares to that of a tree. Forestry tools such as clinometers or diameter tapes ~~could be~~ are used to show visitors and school groups how trees are measured. Areas containing hands-on activities are ~~should be~~ located near popular recreation sites, picnic areas, and parking areas.

Staff-lead tours will travel over expansive areas not covered by self-guided trails and contain stops that are not visibly marked. Guidebooks and hands-on activities may accompany tours, with staff members offering supplemental information.

On the internet – see http://www.icogitate.com/~tree/SDSF.htm.

PLANNED ACTIONS

1. Coordinate planning of interpretive facilities with all ~~f~~ Forest activities, including recreational use, demonstration projects, resource protection, and timber harvesting. Install interpretive facilities near popular recreation sites, parking locations, and areas receiving silvicultural, enhancement, and ~~or~~ restoration treatments.

~~2. Develop an interpretive plan that addresses the SDSF educational audience, types, numbers, and locations of potential interpretive facilities, and the subject matter to be~~

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~~presented. The plan should also include recommendations for facility development as well as monitoring of facility use~~.

VOLUNTEER PROGRAM AND STEWARDS OF SOQUEL FOREST

OVERVIEW

A volunteer program is ~~will be~~ used to assist the small Forest staff in several ways including efforts to provide a complete and comprehensive forestry interpretive program. The major volunteer group associated with SDSF is the Stewards of Soquel Forest. The Stewards of Soquel Forest is a non-profit group that was established in 2000. The goals of the Stewards of Soquel Forest are to enhance the public's experience on the Forest, foster educational programs and assist with trail maintenance and infrastructure improvements. The Stewards have held education and demonstration events, raised funds for SDSF programs and facilities and have been instrumental in maintaining SDSF recreational trails (additional information is provided in the Recreation Chapter). SDSF's ~~Docents are~~ volunteers ~~who~~ have an interest in both the SDSF and natural resources in general and enjoy sharing their experiences with others.

SDSF's volunteers can ~~docents will~~ be available for public contact and interpretation in both the Forest and educational settings (such as classrooms). In the field, ~~docents will~~ they benefit the Forest by providing visitors with information on current events, facilities, vegetation and wildlife, cultural history, and rules and regulations. Ideally, volunteers will have training in first aid and be able to radio for help during emergencies.

Volunteers ~~will~~ also assist in research and monitoring programs, and maintenance and construction projects. The individual skills and talents of SDSF's volunteers, such as knowledge of local flora and fauna, leadership and interpretive skills, and experience working with people, ~~will be~~ are utilized to support the Forest. Through their work, volunteers ~~will both~~ benefit the operation of SDSF and acquire a better appreciation of state forests and natural resources in general.

PLANNED ACTIONS

1. Continue to ~~D~~ develop ~~a~~ volunteer programs which includes docent recruitment. Volunteers will lead tours, patrol the Forest, and assist with education, research, and monitoring programs.

4. Continue to ~~P~~ provide training to familiarize volunteers with the history of the state forest system, SDSF's history and objectives, rules and regulations, patrol procedures, and interpretive skills. General training will also include more specific information relating to SDSF's access routes, vegetation, wildlife, and research and monitoring objectives.

FORESTRY EDUCATION CENTER

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OVERVIEW

If created, the Forestry Education Center (FEC) will be the focal point of SDSF. It could house the ~~f~~ Forest headquarters, staff offices, an interpretive center for forest visitors, and a meeting place for demonstration and educational tours. The FEC may also house a resource library, research laboratory, overnight accommodations, and an auditorium. The auditorium, useful for both administrative and educational purposes, could serve as a location for meetings, classes and workshops, seminars, informational slide shows, and videos.

The FEC would ~~will~~ be used to present a range of information about SDSF's resources including maps, self-guided tour booklets, announcements of current events and manag~~4~~ement activities, sign ups for demonstration tours, and fire prevention information. Examples of interpretive exhibits and displays that could be made available through the FEC include:

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Logging History/Equipment	Herbarium
Silvicultural Systems	Tree Physiology
Wood Products	Wildlife
Watershed Protection ~~use~~	Habitat Resoration ~~Soil Information~~
Fire Safe ~~p~~ Programs	Fisheries

Plans have been approved for a replacement facility at the current SDSF office site in conjunction with the replacement of the CAL FIRE Soquel Fire Station. The new SDSF office would replace the 23 – year - old trailer and would include offices and a classroom. The project has not been funded and there is no estimate of when CAL FIRE might eventually fund implementation.

PLANNED ACTIONS

1. Develop the selection criteria for the FEC based on expected use, cost, building size, and exhibit development. Select and acquire, if possible, an appropriate location for the FEC based on the above criteria as well as proximity to the State Forest and accessibility by the general public. For a detailed analysis of these topics, see the Forestry Education Center Study, Soquel Demonstration State Forest Proposed Program (Butler and Hester, 2011) and companion reports, Forestry Education Center Study, Soquel Demonstration State Forest Listening Report (Butler et al, 2001) and Forestry Education Enter Study, Soquel Demonstration state Forest, An Analysis of California Environmental Education Centers (Butler et al, 2001).

2. Determine specifically how the FEC will be used. Conduct subsequent environmental documentation under CEQA. Design and build the facility, including outside grounds, so that expected use can be accommodated. Expansion and improvement of the ~~c~~ Center in the future should also be taken into consideration during initial planning.

3. Plan and develop public education exhibits that meet forestry demonstration and educational objectives yet remain interesting and fun for all age groups. Encourage

rotating presentations from local schools or special interest groups as well as permanent displays.

4. Seek alternative funding sources as contributions toward development and operation of the FEC. Supplemental funding from grants and private donations may be used for interpretive presentations, display development, and facility improvements.

THE FOLLOWING PUBLIC COMMENTS WERE RECEIVED DURING REVIEW OF THE 1998 GENERAL FOREST MANAGEMENT PLAN

Public comments and concerns relating to forestry demonstration and education have conveyed much enthusiasm. Respondents to the recreation study (see the Recreation chapter) indicated excitement about the potential opportunities to view and learn about the workings of a forest such as SDSF. Additionally, comments about the FEC and demonstration goals express an interest in the facilities and methods through which demonstration and education will take place.

Forest neighbors and users have indicated curiosity in the future of the FEC; specifically its location and proximity to the Forest. Since the actual development of the FEC has yet to be determined, its location and accessibility remain undecided. Time and finances permitting, SDSF plans to carefully select and acquire a piece of property well-suited to everyone's needs.

CHAPTER NINE: TIMBER MANAGEMENT

INTRODUCTION

The main purpose of SDSF's timber management and harvest program is to conduct demonstrations, education, and research in forest management. ~~, including s~~ Sustained-yield management ~~will be demonstrated, with examples~~ is being demonstrated, through the use of timber harvesting, that ensures proper land stewardship, improved forest health, and protects and preserves SDSF as an intensively managed, multifaceted research forest. This is consistent with the legislative goals of PRC Sections 4660-4664.

As stated above, a major purpose of the SDSF timber management program is to demonstrate sustained-yield management with examples of timber harvesting. In simple terms, sustained-yield is the yield of commercial wood that an ownership can produce continuously at a given intensity of management consistent with required environmental protection and which is professionally planned to achieve, over time, a balance between growth and harvest. For SDSF, this plan provides for harvest levels well below the level of growth. SDSF is to be used to demonstrate examples of timber harvesting under sustained yield management while also sustaining or improving air, fish and wildlife, water resources, watersheds, aesthetic values, and recreation. Silvicultural methods and harvest techniques that can be applied under the California Forest Practice Act and Rules for the southern sub-district of the Coast Forest District ~~will~~ are and will continue to be researched and utilized to demonstrate sustained-yield management with an uneven-aged forest structure.

The harvesting of timber will comply with the discussion found in the Funding and Taxes section of the Administration Chapter. A secondary goal of harvesting timber is to generate revenue to cover maintenance, operation, and other costs of SDSF. This includes funds needed for research, inventory, monitoring, and rehabilitation projects of the various resources in SDSF. ~~It is not likely that r~~ Revenues ~~will~~ did not meet expenditures, even at the current minimum levels ~~of expenditures~~, during the initial nor the second ten-year period of this plan. It is anticipated that revenues and expenditures will converge in approximately the fifth decade of operations. Specific revenue projections are not made because of the inherent uncertainty of timber values and markets. Annual harvest levels may need to be adjusted from time to time to reflect physical conditions in the SDSF, such as catastrophic events. If a significant drop in timber prices occurs, timber harvesting will not exceed the limits discussed in the Harvest Plan section of this chapter. The Department will attempt to maintain basic operation and maintenance services from the FRIF fund in line with other State Forests.

HARVEST HISTORY

The first timber harvesting in SDSF occurred during the late 1800's when the Forest was part of land owned by F. A. Hihn (see the Property Description chapter for a more detailed account of the history of ownership). Hihn logged old-growth redwood along portions of Amaya Creek and

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his private ~~Sulphur Springs R~~ road, which is now called Hihn's Mill Road. Upon his death in 1913, Hihn's heirs assumed ownership of his lands and continued limited old-growth redwood and tanoak removal.

In 1924, the property was sold to the Monterey Bay Redwood Company (MBRC). The MBRC harvested approximately 100 million board feet of old-growth redwood from 1926 to 1942. Between 1926 and 1934, logs were yarded to roads using ground lead cable systems powered by steam donkeys. Logs were taken to the millpond, located south of Olive Springs, on trailers towed by tractors. From 1934 to 1942, logs were yarded by tractor and transferred to the mill by log trucks.

The MBRC sold their property to Glenco Forest Products, later known as the CHY Company, in 1961. During their ownership of the SDSF property, CHY performed a small amount of selective timber harvesting between the Sulphur Springs area and the eastern boundary.

In 1979, the Pelican Timber Company purchased a portion of CHY's land, including what is now SDSF, and prepared extensive harvest plans. Pelicans's Timber Harvesting Plans were strongly opposed and, after court battles, expired before large amounts of timber were removed. Pelican did ~~actually~~ harvest a small amount, ~~though~~ however, prior to state acquisition of the property. Approximately 15 acres of hardwoods in the Sulphur Springs area and 230 acres of second-growth redwood and hardwoods along the western boundary were selectively harvested under timber harvesting plans I-80-328 SCR, I-81-25 SCR, and I-83-56 SCR, operated on between 1979 and 1984 (see Figure 11).

Since the dedication of SDSF in 1990, four timber harvesting plans have been ~~approved~~ completed. The first, Long Ridge timber harvesting plan (THP)~~,~~ (I-94-307 SCR) ~~logged~~ harvested in 1995, was a 64 acre single tree selection harvest and yielded ~~500~~ 56,000 board feet. The Amaya Creek THP~~,~~ (I-98-027 SCR) harvested in 1998, was also a selection harvest, but included some small (1/4-1/2 acre) harvest groups. This THP harvested 138 acres and yielded 1.6 ~~5~~ million board feet. Operations on the Rim THP (1-09-107 SCR) ~~are active in 2011~~ occurred over two years and were completed in 2012. The Rim THP was 258 acres and yielded 1.595 million board feet. The fourth plan, the Fern Gulch THP~~,~~ (1-09-096 SCR) was also completed in 2012 and yielded 2.2 million board feet on 201 acres. ~~has been approved but not yet harvested~~. All four harvests combined represent about six million board feet over a period of 22 years, roughly equal to the forest-wide growth in two and one-half years.

CONIFER VOLUME INVENTORY

There have been four~~three~~ known timber inventories completed for the SDSF property since the turn of the 20th century. The first inventory was completed in 1916 preceding significant harvest of the area. Timber cruisers from San Francisco were hired to cruise the Valencia-Hihn ownership comprising 7,071 acres including the SDSF acreage. The purpose of the cruise was to estimate the standing timber volume and establish the value prior to selling the land. 4,488 acres were estimated to contain 172 million board feet of redwood and Douglas-fir when it was sold to

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the Monterey Redwood Company (Powell, n.d.). This yields an average per acre volume for this land, which includes SDSF property, as well as portions of adjacent

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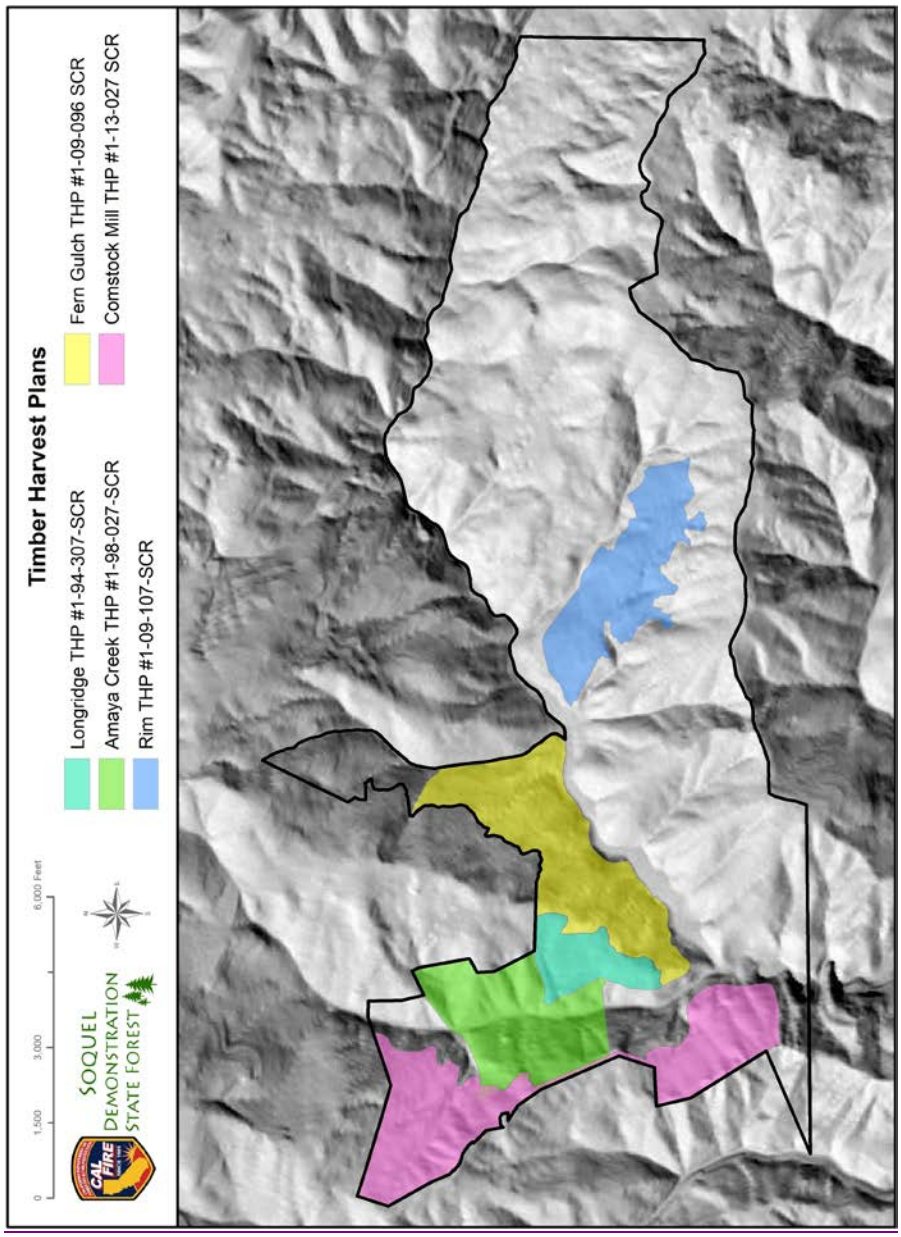

Figure 11: Harvest History for SDSF

watersheds, 38,300 board feet per acre. prior to logging to determine where to locate mills and the best method of transporting logs to those mills. They also judged how much lumber they could harvest from a particular area. The timber cruisers estimated an average volume of 37,300 board feet per acre for the property that is now SDSF, the majority of which was old-growth redwood. However, evidence from other similar tracts and logging history in the area suggest that this figure likely underestimates the amount of timber volume present in the redwood stands at that time.

The second inventory was completed in 1978 for Harwood Products, a potential buyer of the property, to ascertain timber growth and volume. Average stand age was approximated to be anywhere from 30 to 90 years old. The average volume per acre for the SDSF portion of the property was estimated at 13,600 board feet, 90 percent of which was redwood. The third inventory was conducted by SDSF staff in the summer of 1991. The goals of this variable-radius inventory were to establish current volume and basal area by species and to acquire information on species distribution. Table 3 contains the results for volume and basal area of commercial conifers. Based on harvest history, the average age of most f Forest stands was estimated to be 65 years old.

A new, more detailed inventory is needed for harvest scheduling and Wildlife Habitat Relationships (WHR) classification analysis. Resources permitting, the inventory will be designed for use by the year 2000. Data collected will focus on different forest types rather than the Forest as a whole. The sampling design may include both permanent and temporary data collection points as well as variable and fixed radius plots.The average volume for SDSF was estimated to be 28,850 board feet per acre, with a forest-wide total conifer volume of approximately 77.3 million board feet.

Table 3. 1991 SDSF conifer basal area and volume estimates.*

SPECIES	PER ACRE BASAL AREA (sq. ft.)	PER ACRE VOLUME (board feet)	FOREST WIDE TOTAL VOLUME (board feet)
Redwood	138	22,033	59,070,473
Douglas-fir	35	6,817	18,276,377
Both Species	173	28,850	77,346,850

The most recent inventory was completed in the spring of 2006. This was a variable-radius plot

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inventory with plots placed every five acres on a systematic grid. Data measured for all live trees included ~~tree characteristics, snags,~~ species, size and ~~characteristics for all live trees, and~~ unique features such as goose pens, fire scars, and broken tops with potential wildlife habitat value. Table 5 ~~3~~ contains the results for trees per acre, volume, and basal area of commercial conifers and hardwoods. The average age of most forest stands was estimated to be 80 years old~~,~~ based on harvest history. The average conifer volume for SDSF was 42,441 board feet per acre with a forest-wide total conifer volume of approximately 117.4 million board feet. This represents a 52 percent increase in ~~f~~ Forest-wide volume in 15 years.

~~GROWTH~~

~~A conifer growth study was conducted at SDSF in 1993. This growth study produced per acre values for redwood and Douglas-fir on a forest wide basis. The 1993 survey consisted of visits to 30 of the plots installed in the 1991 inventory to assess growth. Volume growth was estimated based on measurements of tree height and five- and ten-year radial increment growth. The results of this study indicated that forest wide annual conifer growth averaged 972 board feet per acre with a standard error of 7.2 percent.~~

Table 5~~3~~. SDSF 2006 Timber Inventory Summary

	Redwood	Douglas-fir	Total Conifer	Hardwood	Total
Trees per acre	180	33~~.0~~	213	315	529
Basal Area* per acre	178	35	212	116	328
Volume* per acre (Board feet for Conifers) (Cubic Feet for HW >=7.0")	34,445	7,996	42,441	2,648	NA
Forest Wide Total Volume	95,261,398	22,114,678	117,376,076	7,323,309	NA

* Basal area, is -the total~~horizontal~~ cross sectional area of trees measured at four-and-one-half feet above ground, and expressed as per unit area of land (typically square feet per acre). It is a measure of forest stocking or density. ~~V~~ Conifer volume is measured in board feet; a board foot is a unit of measure one foot by one foot by one inch.

GROWTH

A conifer growth study was conducted at SDSF in 1993. This growth study produced per acre values for redwood and Douglas-fir on a forest wide basis. The 1993 survey consisted of visits

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Growth based on the 2006 inventory data was estimated using the Forest and Stand Evaluation Environment (FORSEE) growth and yield model. Growth varied by vegetation type and stand density. The percent growth ranged from up to three percent in the lower density oak woodland stands to one percent in the highest density redwood stands. The average overall conifer growth for the forest was estimated to be 975 board feet per acre per year, which represents 2.1 percent forest-wide growth per year. The growth across the Forest is estimated to be 2,615,360 board feet per year.

In the future a continuous forest inventory (CFI) will be utilized at SDSF, by establishing permanent plots systematically located across the Forest. Through this method, sample inventories can be completed periodically to monitor changes in forest structure and growth rates over time.

~~The 1991 and 2006 inventories are independent of each other and therefore not directly comparable. An informal comparison of the 1991 inventory and the 2006 inventory however, suggests that current annual growth on the Forest is on the order of 900 to 1,000 board feet per acre per year. This equals approximately 2.6 million board feet of forest-wide conifer growth per year.~~

VEGETATION TYPE

A new vegetation type map for SDSF was developed by staff foresters based on their on-the-ground experience. ~~. Supporting data used to develop the vegetation map included~~ historical vegetation type maps, a remotely sensed imagery vegetation classification project (Clinton 2009), and the 2006 inventory plot data. The vegetation map uses a standard California Wildlife Habitat Relationships classification system (Mayer and Laudenslayer, 1988), that includes tree species, structure, and density. Figure 5 ~~4~~ (see Chapter 5) shows the ~~V~~ vegetation ~~T~~ type map ~~of~~ for the ~~f~~ Forest.

TIMBER SITE CLASS ~~QUALITY~~

A timber site class ~~quality~~ map for SDSF was ~~recently~~ developed by staff foresters to update the timber type map for the Forest that was created in 1979 by Hammon, Jensen, Wallen, and Associates. ~~.~~The site polygon boundaries were based on their experience and knowledge of the productive potential of different areas on the Forest, guided by site tree data gathered in the 2006 inventory. Additional site tree data was also gathered to fill in any gaps in the site tree coverage. A total of 186 site trees were measured. Figure 12 ~~5~~ shows the timber site class map for the Forest. The most prevalent site class is III (1473 acres), followed by site II (1172 acres), and site IV (36 acres). There is no site I timberland in the Forest.

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SILVICULTURE

MANAGEMENT GOALS

The overarching management goal for SDSF is to maintain the Forest as a mid-successional managed working demonstration forest typical of managed forests in the area with a dynamic range of successional stages across the Forest. Early to late successional forest stages are managed across the landscape over time to meet research and demonstration mandates in the context of a changing climate, continually changing societal preferences and research needs.

FOREST DESCRIPTION

~~Areas in~~ SDSF is well suited ~~eligible~~ for timber harvesting, with adequate stocking composed of ~~include~~ coast redwood and ~~mixed evergreen~~ (Douglas-fir ~~and hardwood) forest communities~~. Hardwoods, especially tanoak, are a large component Forest-wide but have been declining due to Sudden Oak Death ~~of both communities~~. The normal process in forest succession is for conifers to overtop and suppress hardwoods, as is ~~presently~~ occurring in SDSF. This process ~~event~~ will ultimately move parts of the Forest through its current mid-successional stage into a late-successional condition. The 80~~65~~-year-old conifer forest is reasonably healthy though overly dense ~~overcrowded~~ in some areas (i.e., too many trees in any one location). SDSF will research and demonstrate ways to improve forest structure and vigor through timber harvesting.
~~A timber type map for the Forest was created in 1979 by Hammon, Jensen, Wallen, and Associates, a private forestry consulting firm. This map shows homogenous areas based on species, structure (e.g., old growth vs young growth), and density of forest cover. Though the map is functional, the creation of a more inclusive representation of the Forest is necessary. This can be accomplished by a new forest map that includes tree species, structure, and density and WHR classifications.~~

~~CONIFER GROWTH AND YIELD~~

~~A conifer growth study based on the 1991 inventory was done in the first quarter of 1993. A sample of merchantable (greater than 12 inches DBH [DBH represents tree diameter 4.5 feet off the ground on the uphill side]) and submerchantable (less than 12 inches DBH) trees was used to predict growth over a ten-year period. Submerchantable trees are expected to become merchantable during this ten-year growing period. The results indicate the Forest is growing an average of three percent per year. Table 4 illustrates projected annual growth on a per acre basis and forest wide totals for redwood and Douglas-fir.~~

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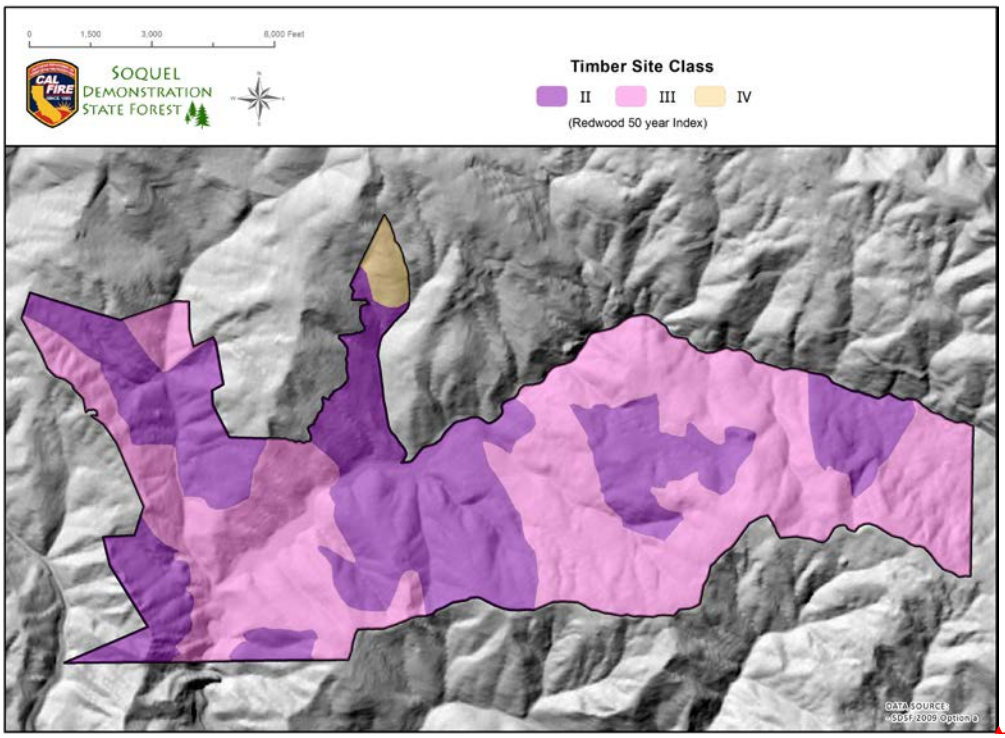

Figure 12: Timber Site Class Map for SDSF

~~Table 4. Annual growth estimates for SDSF's redwood and Douglas-fir.~~

~~SPECIES~~	~~PER ACRE GROWTH (board feet)~~	~~FOREST-WIDE TOTAL GROWTH (board feet)~~
~~Redwood~~	~~713~~	~~1,910,481~~
~~Douglas-fir~~	~~260~~	~~696,256~~
~~Both Species~~	~~973~~	~~2,606,737~~

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SITE QUALITY

Timber site quality information for the Forest comes from the Soil Survey of Santa Cruz County (SCS, 1980). Figure 4 depicts the percentage of acres from each site class in the Forest. Site classifications range from I to V, site I being the best for timber production. As the graph displays, the most prevalent site class is III (1233 acres), followed by site IV (833 acres), and site II (445 acres). Included in the graph are areas which were not classified as timber production land (170 acres); most of these areas correspond to creekbeds and grasslands. There are no areas containing site classes I or V in the Forest.

The diameter distribution (tree diameter class plotted against the number of trees per acre) of SDSF resembles a traditional uneven-aged forest even though the forest is really a young, even-aged stand (Figure 13 5). Uneven-aged forests contain many diameter classes and at least three age classes. These forests are typically managed on a size and structure basis. Even-aged forests contain one to two age classes of trees and are managed according to age.

The diameter class distribution of a truly uneven-aged forest forms an inverse J-shaped curve, indicating decreasing numbers of trees as diameter increases. Smaller diameter classes commonly represent younger trees; the number of those smaller trees which mature into larger and, theoretically, older trees then decreases through time, as the curve shape implies. Having a greater number of trees in smaller diameter classes is preferable in order to ensure that an adequate amount of regeneration is present and can keep the forest viable through periods of natural mortality.

Redwood trees are shade tolerant and many will persist in the understory as small trees over many years. By harvesting competing trees and providing more growing space, the remaining smaller trees in the understory will respond by increasing growth. Redwood trees have a tremendous ability to be released through removal of competition, which is a unique characteristic of the species. Harvesting also stimulates sprouting which introduces yet another age class to the Forest, but adequate sprout growth requires relatively high levels of light (O'Hara and Berrill, 2010).

As Figure 56 indicates, there are concentrations and deficits of specific diameter classes in the distribution. This is typical of a forest, such as SDSF, that has traditionally been managed on an even-aged basis. Most of the concentrations result from overcrowding, which suppresses growth (e.g., 1620-inch diameter class). Those classes with deficits (e.g., 6 4-inch diameter class) contain low numbers because the overcrowded areas take up valuable space and nutrients that other size classes could use. Both the overcrowding and deficiency involved with these particular diameter classes can be remedied through a transition to uneven-aged conditions. Through harvesting, the spacing of trees is improved which redistributes the growth potential on the remaining trees as well as the new generation of trees from sprouting and planting.

Figure 13 6. Diameter class distribution for SDSF.

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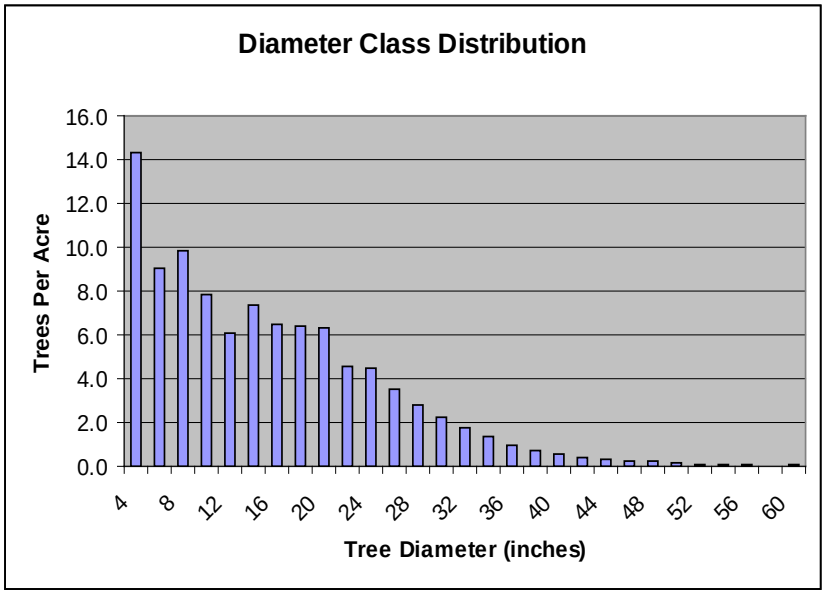

SILVICULTURAL TREATMENTS

Silvicultural treatments involve management decisions and actions which direct forest growth, harvest, and regeneration. Between the late 1920's and early 1940's, SDSF was managed on an even-aged basis with clearcutting and natural regeneration. Currently, forests in Santa Cruz County, including SDSF, are managed on an uneven-aged basis as required by the Coast Forest District's ~~s~~ Southern ~~s~~ Sub-district rules specified by the California ~~of the State's~~ Forest Practice Rules. Two ways to establish and maintain uneven-aged conditions are through single tree or small group selection harvest; both of these methods will continue to be demonstrated by SDSF. Although timber harvesting ~~would~~ focuses on the removal of conifers, some hardwoods will also be removed to prevent hardwoods from dominating the residual stands.

The silvicultural objective is to achieve maximum sustained production, a broad range of diameter classes, multi-aged stands, promotion of growth, and encouragement of natural regeneration. Selective harvesting can improve stagnant forest condtions and enhance overall health. For example, removal of some trees from overcrowded stands will enable remaining trees to grow faster because of reduced competition for light, water, and nutrients. Sprouts and seedlings can also become established easier for the same reasons, thereby increasing both size and age diversity.

~~To create an uneven-aged forest structure, a desired diameter class distribution will be determined and applied to create the favored structure. Silvicultural treatments will focus on harvesting diameter classes that have excess representation. A transition period in which the~~

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~~desired forest size and age structure is obtained will conclude with the forest exhibiting a diameter distribution indicative of a truly uneven-aged forest (Figure 6). As illustrated, the idealized diameter class distribution forms the preferred inverse J-shaped curve of a traditional uneven-aged forest. Once established, the uneven-aged forest will be maintained through selective harvest in all of the merchantable diameter and age classes and through natural regeneration. Growing space must be provided for young/small, middle-aged/medium, and mature/large trees. The preferred level of tree spacing will require a balance between achieving adequate regeneration and providing vigorous growth. Old-growth trees will not be included in uneven-aged management as they will be considered separately from the rest of the Forest (see the following Old-Growth and Late-Successional Management section).~~

All silvicultural methods permitted under the California Forest Practice Rules may be used to varying degrees for research, demonstration, and creation of a wide range of seral stages and a diverse forest structure. This protects the Forest's ability to adapt and change as silvicultural paradigms continue to change. Selection of a silvicultural prescription and cutting cycle for any given stand will depend on the specific conditions present, including vegetation types, site classes, historic management and the coordination required for resource protection, recreation and neighborhood concerns.

For most trees species the literature suggests that ~~A~~ as trees mature, growth rates level off and slowly decline until natural mortality occurs. However, recent work on large, unsuppressed coast redwood trees in Humboldt County provides information pertinent to SDSF stands. This research suggests that as these trees age ground-level measurements of annual growth, including height, ring width, and basal area increment, exhibited decreasing growth (or no change in growth) with age. Wood production of the entire main trunk and whole crown, however, increased with size and age up to and including the largest and oldest trees measured (Sillett et al., 2010). Trees similar to those that were measured in the study would be comparable to the protected old-growth trees at SDSF. Old-growth trees will not be included in uneven-aged management as they will be considered separately from the rest of the Forest (see the following Old-Growth and Late-Successional Management section.)

~~Reduction of growth at any age, however, can be amplified by conditions such as overcrowding. Selective harvesting can improve stagnant forest conditions and enhance overall health. For example, removal of some trees from overcrowded stands will enable remaining trees to grow faster because of reduced competition for light, water, and nutrients. Sprouts and seedlings can also become established easier for the same reasons, thereby increasing both size and age diversity.~~

In most cases, forest regeneration will ~~be allowed to~~ occur naturally after harvesting. This is the best means for SDSF since the dominant tree species, coast redwood, sprouts quickly and vigorously from remaining stumps given sufficient light. Research will be undertaken to study harvest levels required for successful regeneration and sprout growth. In areas that do not regenerate sufficiently (e.g., areas of Douglas-fir, ~~or with~~ heavy competition, or group openings), supplemental tree planting will take place. Tree planting will also take place for research and demonstration purposes, experimenting with alternative means of forest regeneration. Redwood

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or Douglas-fir nursery stock will be favored over hardwood seedlings except in areas where hardwood regeneration is insufficient.

SILVICULTURAL PRESCRIPTIONS AND LANDSCAPES

Silvicultural activities such as harvest and regeneration require planning which is typically outlined in silvicultural prescriptions. Silvicultural prescriptions for SDSF will encourage attention to landscape perspectives and patterns that benefit vegetation, wildlife, and other values, as the Forest is managed for a dynamic range of successional stages across the landscape over time.

Management from a landscape perspective focuses on landscape patterns and the responses of biotic (e.g., plants, animals) and abiotic (e.g., soil and water) factors to changes in those patterns. A large part of this type of management involves the response of biota to both natural and unnatural disturbances (such as ~~unnatural openings or~~ burned areas or opening stands through logging) in the landscape, also known as edge effect. Edge effect, considered to be both beneficial and detrimental, can have impacts on species that are adapted to interior forested habitats. The use of selection methods for harvest, however, can help minimize negative impacts by eliminating sharp contrasts between areas of harvest and adjacent forested areas.

As part of demonstration and research objectives, SDSF will experiment with different sizes of group selection openings as well as feathering the edges of openings. The main purpose of experiments is to determine the extent of edge effect on biota associated with different harvest levels and sizes of group selection openings. Results of demonstration and research projects will be used in the development of future silvicultural prescriptions and activities.

CUTTING CYCLE

Designated forest stands will be available for selective~~ly~~ harvest~~ed~~ ~~once~~~~approximately~~ every ~~ten~~10 ~~20~~ years and successive entries may be upt to 20 years or more in some stands. ~~or more~~. ~~The interval between these harvests is known as the cutting cycle.~~ The length of cutting cycles for individual stands will depend on tree densities, diameter distributions, growth rates, stand objectives and other parameters. ~~Once these items have been analyzed, definitive cutting cycles can be specified. The Option A document prepared for the Forest (CAL FIRE, 2009) Preliminary results indicates that cutting cycles will average would vary from approximately 20 years, in the short term (i.e., over the next decade) to 10-15 years in the long term (i.e., after five decades)~~.

Traditionally, harvesting ~~at the end of a cutting cycle~~ removes the amount of growth that has occurred since the previous harvest. ~~This may be true for some stands, h~~ However, over the next decade ~~for~~ in most stands within SDSF not all of the growth between cutting cycles will be removed (see the Harvest Planning section). By not removing all of the growth, the amount of volume remaining following each stand entry will increase over time. This reflects SDSF's mandate of remaining a demonstration of a financially viable working forest while at the same time enhancing public trust resources.

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SILVICULTURAL TREATMENTS AND NON-TIMBER RESOURCES

One of SDSF's demonstration goals is to display that silvicultural treatments are compatible with aesthetic, biological, and recreation values. Ways to display this compatibility may include harvest methods which are aesthetically acceptable both from a distance and close-up, marking treatment boundaries so that they have minimal visual impact from roads or trails, and providing for habitat improvement through silvicultural prescriptions. These and other examples may be elements of demonstration programs directly related to timber harvest.

OLD-GROWTH AND LATE-SUCCESSION MANAGEMENT

OLD GROWTH

Existing old-growth redwood trees ~~areas~~ in the Forest have been excluded from all future timber harvesting, as mandated by SDSF's authorizing legislation AB 1965. Figure 14 ~~7~~ shows that the only stand of old growth trees is located in the Badger Spring area. There is also a small group of old-growth trees located near Sulphur Springs. ~~s are quite limited (approximately 25 acres) and broken into two to ten acre blocks. (A buffer zone surrounds each block and is included in the total acreage.)~~ Individual old-growth conifer trees are ~~will be~~ identified and marked for preservation and protection during timber harvest preparations and entered into the Forest-wide old growth tree database. ~~; i~~I Individual tree characteristics, listed in Table ~~5~~4 6, helps foresters ~~will be used~~ to identify these old-growth trees in the Forest. (Table ~~5~~ ~~4~~ 6 compares tree characteristics for old growth against those of young growth.) No individual characteristic, including age, is ~~will be~~ used to make a classification. Instead, combinations of these characteristics are ~~will be~~ used to determine if trees are classified as old growth or young growth.

LATE SUCCESSION

Late-succession management areas will be administered to promote the development of functional old-growth habitat characteristics through infrequent, low-intensity timber management activities. These characteristics include multi-level canopy structure which provides vertical and horizontal diversity, stand-age diversity, and large trees, snags, down logs, and other woody debris. Recruitment and retention of these characteristics, which provide important habitat elements for fish and wildlife species, will be attained through silvicultural prescriptions. For example, trees with crowns that extend over ~~the~~ stream channels will not be harvested unless a qualified hydrologist or wildlife biologist recommends removal of such trees to enhance riparian habitat or hydrologic function. These trees may also be removed when recommended by a certified engineering geologist to help stabilize active slides. WHR classifications will be used to assess and maintain the specific wildlife habitat characteristics of these areas in SDSF.

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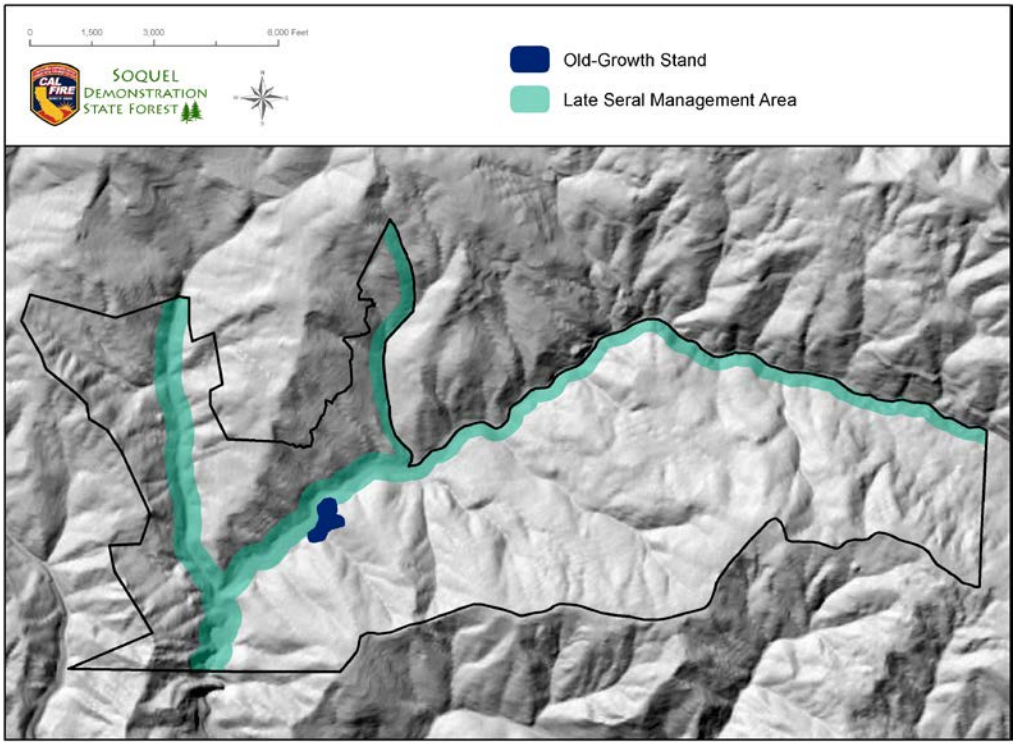

Figure 14: Old-growth Stands and Late Succession Management Areas

Like areas of old growth, sections in the Forest designated for late-succession management have been identified and mapped (Figure 14 ~~7~~). These areas make up 15 percent of the overall ~~f~~Forest, and correspond to a width of 300 feet on each side of the East Branch of Soquel Creek, Amaya Creek, and Fern Gulch ~~Creeks~~ within SDSF boundaries (all Class I watercourses). Timber harvesting in these areas ~~would~~ conforms to the following guidelines, as well as the Anadromous Salmonid Protection (ASP) Rules approved by the ~~State~~ California Board of Forestry and Fire Protection in 2009:

* At least 75% total ~~shade~~ canopy in multiple layers ~~would be~~ retained with 80% post - harvest overstory canopy from 30 to 100 feet from the watercourse transition line(WTL)~~.~~

* At least 25% ~~shade~~ canopy in trees at least 24 inches DBH ~~would be~~ retained.

* All woody riparian (i.e., hydrophytic) vegetation ~~would be~~ retained except where riparian function would be enhanced by removing such vegetation.

* Large snags (i.e., standing dead trees at least 20 inches DBH and 15 feet tall) or

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live wildlife trees (i.e., trees that support bird nests or have cavities or large limbs

Table 6 ~~2~~. Individual redwood and Douglas-fir tree characteristics

YOUNG GROWTH	OLD GROWTH
Abundant branches or knots in the lower 1/3 of the bole (tree trunk).	Lower third of the bole is relatively free of branches or knot indicators.
Branches are small, 3 inches or less in diameter.	Large branches, many larger than 4 inches in diameter.
The tops of the crown are usually pointed and the branches are usually upturned.	Tops of crown are rounded or flat. Branches may be downturned.
Bark is typical of younger trees as described in dendrology books (shallow bark furrows).	Bark is typical of older mature trees as described in dendrology books (deep bark furrows, bark between furrows often plate-like).
Growth is generally fast, as indicated by large annual rings - usually less than 10 annual rings per inch.	Slow current growth as indicated by a long period of narrow annual rings - usually 15 or more annual rings per inch.
Excessive taper in open grown trees.	Very little taper, even in open grown trees.
~~Diameter at breast height (DBH) generally less than 48 inches.~~ Few fire scars or superficial fire scars and burned bark.	~~Diameter at breast height (DBH) generally greater than 40 inches.~~ Large old fire scars, burned bark, and goose pens common.
Tree age less than 175 years.	Tree age 175 years or greater.

Source: CAL FIRE~~CDF~~

that make them valuable for nesting birds) will ~~ould~~ be recruited (created from existing healthy trees) or retained at an average density of at least five per acre.

* At selected locations where conifers are lacking and would not compete with riparian vegetation, Douglas-fir~~s~~ and redwood~~s~~ ~~would~~ may be planted to promote long-term recruitment of large woody debris in streams.

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* Downed logs at least 24 inches in diameter and 30 feet long will ould be retained with the goal of reaching or recruited by felling trees at an average density of at least two per acre, and total coarse, woody debris will ould be retained at an average density of at least 10 tons per acre.

* No harvest within the Core Zone or first 30 feet from the watercourse transition line (WTL),

* Retain 80% post harvest overstory canopy for the Inner Zone, or area from 30 to 100 feet from the WTL.

- A post - harvest stand that retains the 13 largest conifer trees (live or dead) on each acre that encompasses the Core and Inner Zones.
- Large trees retained are to be those most conducive to recruitment to the watercourse channel.
- Additionally, harvesting is prohibited in channel migration zones and additional protection measures are mandated where there are flood prone areas (see 14 CCR 916.9 (f) in the California Forest Practice Rules).

These guidelines will be updated in the future as needed to reflect rule changes for the protection of anadromous salmonid species.

Site disturbance during harvesting operations in late-succession management areas will be kept to a minimum by restricting tractor use and cable-yarding corridors to predesignated trails. Furthermore, all trees to be harvested and all wildlife trees and downed logs to be retained will be marked. A registered g Professional Geologist and a qualified hydrologist will also be utilized to review operations during timber harvest planning.

Areas along the creeks were chosen as late successional areas for a number of reasons, including protection of sensitive riparian zones, fisheries resources, and existing Watercourse and Lake Protection Zones (WLPZ) rule requirements. Furthermore, these areas provide habitat corridors and buffers between creeks stream channels and nearby harvested areas. Corridors are important for wildlife movement and survival, providing a valuable element to the landscape pattern.

HARVEST SYSTEMS

The terrain where logging activities are to occur will be the key factor in determining whether ground skidding, cable logging, or aerial harvest systems are used. The erosion hazard, slope angle, slope stability, and distance to drainages will also be carefully evaluated in the selection of harvest systems. Additional factors include access, public safety, aesthetics, timing, noise, environmental mitigation, economic conditions, research, and demonstration aspects. The appropriate harvest system for each timber sale will be identified and utilized based on the above

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considerations. Refinements on the harvest systems used will be made as necessary to accomplish harvesting in an economical, efficient, and environmentally sound manner.

SYSTEMS FOR USE IN SDSF

Ground skidding logging systems, methods which pull ~~tow~~ logs on the ground to landings (loading areas), consist of tractor, rubber tire skidder, and horse logging. Horse logging, limited to gentle slopes and modest sized trees, can be used to minimize soil disturbance, damage to residual trees in dense stands, or for demonstrative purposes. Tractors and rubber tire skidders are generally used where slopes average less than 35 percent, though steeper slopes will be considered on a site-specific basis. (This ~~would~~ only occurs ~~i~~ on SDSF after evaluations of slope stability and erosion hazard potential and the ability to mitigate any problems to negligible proportions.)

In SDSF, ground skidding equipment will be restricted to the minimum size capable of moving the harvested timber. Skid trail systems (temporary trails used by ground skidding equipment) will be designed so that existing skid trails are utilized where appropriate. All new and rehabilitated trails will be predesignated ~~and placed at a minimum distance of 100 feet apart~~. A ~~c~~Certified ~~e~~Engineering ~~g~~Geologist (CEG) will participate in the preparation of all timber harvest plans. CEGs will ~~to~~ ~~certify~~ review the locations of all proposed roads, skid trails, and landings on unstable soils, ~~slide~~ unstable areas, and areas where the California Forest Practice Rules require that skid trails be designated before the start of timber operations.

~~Ground lead, high lead, and s~~ Skyline logging, commonly referred to as cable logging, use cables to fully or partially suspend logs off the ground while transporting them to designated landings. The cables are attached to a machine, called a yarder, which is equipped with multiple winches and a tower for pulling the cables. A wide range of cable systems are available for logging both large and small timber. In SDSF, cable yarding will generally be used on steep slopes, near drainages, or where road construction is difficult.

Aerial harvest systems incorporate the use helicopters ~~and balloons~~ to move logs from one area to another. These systems are beneficial when the erosion hazard or slope instability are high or when access to an area is limited. In SDSF, aerial systems will be considered primarily for demonstrative purposes and where cable yarding is not possible. Helicopter timber drop-off and landing areas will be located at least 0.5 mile from the nearest occupied dwellings.

A preliminary logging plan for SDSF designated proposed tractor and cable yarding areas, existing and planned roads, and old growth areas (~~Figure 8~~). Based on this plan, approximately 1,700 acres are suitable for yarding by tractors and 900 acres are suitable for yarding by cable yarders or helicopters.

HARVEST SYSTEMS AND COMPATIBILITY

Harvesting operations will be planned and implemented to minimize conflicts with neighbors and visitors where possible. To accomplish this, road and skid trail construction will be designed

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with potential users in mind. For example, specific logging trails can be designed to serve as future recreation trails where appropriate. Certain logging trails may be closed, however, following harvesting activities where public access is inappropriate (e.g., research or sensitive areas, or where trespass across private property would occur). New roads and skid trails will be carefully located to minimize visual impacts. Additionally, the size and duration of area closures and traffic diversions will be evaluated for each timber sale.

HARVEST PLANNING

HARVEST LEVEL

Short Term

SDSF's annual harvest level for the planning period from 2010 to 2020 ~~next ten years~~ will average ~~be~~ between ~~5~~ 800,000 and 900,000 board feet (approximately ~~2~~30 to 35 percent of ~~f~~ Forest-wide growth) equal to 8.6 million board feet. This harvest level is consistent with AB 1965 in that it provides for timber management demonstrations and promises an intensively managed research forest. ~~In 1995, SDSF's first timber harvest removed 550,000 board feet. A second harvest that was planned for 1998 and that was expected to harvest over 1.0 million board feet, never occurred. In the mid-1990s future harvests were expected to yield 1.5 million board feet every other year, equivalent to 750,000 board feet per year or 30 percent of forest-wide conifer growth.~~ So far during planning period 1, up to year 2013, 3.8 million board feet have been harvested on SDSF. This harvest rate is substantially lower than SDSF's current conifer growth rate of 2.6 million board feet per year ~~and is approximately one percent of the standing conifer inventory~~. ~~The maximum harvest level allowed regardless of the market price of timber or revenue needs shall be no more than 35 percent of growth or an average of 900,000 board feet per year.~~ It is expected that a timber harvest of 1.5 to 2 million board feet will occur every other year starting in 2014.

Long Term

The harvest level is projected to gradually increase as the Forest inventory and growth increases. It is anticipated that the funds needed for the maintenance and operations expenses of SDSF, reasonable capital costs and other expenses incurred in fulfilling the objectives of PRC sections 4660–4664 on SDSF will only be fulfilled once long term harvest levels are achieved.

Forest stocking and growth will be reevaluated in the second decade (2020 to 2030) when a new Forest inventory is conducted and updated data are used to project future conditions once again. ~~from approximately 866750,000 board feet per year in the first decade to~~ The harvest level on SDSF will be consistent with the Management Goal in Chapter 2 to "Demonstrate sustained-yield timber harvest practices through harvest operations that balance harvest rates with growth over time and are compatible with rural land use in Santa Cruz County, while promoting recreation opportunities, forest health, watershed protection, wildlife, and fisheries values as well as aesthetic enjoyment."
~~approximately 1.55 million board feet per year in the fourifth and subsequent decades. This gradual increase in harvest levels over the first fiveour decades to the equivalent of 50-60 percent~~

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~~of forest-wide growth shall be the maximum percentage of growth harvested in the fifth and subsequent decades regardless of revenue needs. It is anticipated that the funds needed for the maintenance and operation expenses of SDSF, reasonable capital costs, and other expenses incurred in fulfilling the objectives of PRC Sections 4660-4664 on SDSF will only be fulfilled once this harvest level is achieved. An analysis of sustained yield production was completed according to the California Forest Practice Rules (CCR 913.11) to determine the effects of this harvest level over time on average stocking level (i.e., timber volume per acre) and corresponding stand growth rates. This analysis concluded that the proposed harvesting schedule is sustainable over the long term (Jones and Stokes Associates, Inc., 1996).~~

Sustained yield production is achieved by balancing growth and harvest over time, maintaining a timber inventory capable of ~~sustain~~ producing the long-term sustained yield (LTSY) (i.e., the harvest level projected to be sustainable after 100 years), and having the projected annual harvest level for all future rolling ten-year periods not exceed the LTSY. These results were ~~demonstrat~~ established by projecting stocking conditions, growth, and harvest levels for the planning area over a 100-year period based on the best available information and accepted principles of forest management and statistics.During the development of the 1998 General Forest Management Plan for SDSF, a compromise was made to limit harvest levels at SDSF to no more than 50-60 percent of forest-wide growth regardless of LTSY or revenue needs. There was a fear that SDSF would be used to generate much needed funds for California and that the revenue from timber harvesting would not be used consistent with fulfilling the objectives of PRC Sections 4660-4664. Since SDSF was established, the total harvested volume has been 5,825,000 board feet over a period of 23 years. This amount of volume growth at SDSF is accumulated in just over two years.

To evaluate timber production capabilities ~~T~~ the land area within SDSF was grouped according to its availability for timber harvesting: unavailable (e.g., ~~grasslands, brushlands, streams, ponds, trails, landings,~~ inoperable areas, old-growth ~~management~~ protection areas, ~~roads,~~ and ~~unconvertible~~ pure hardwood areas); limited availability (e.g., late succession management areas, recreation sites, and unstable areas); and fully available. As a result, 60 percent of SDSF (1,609 acres) is fully available for timber production, 30 percent (804 acres) has limited availability, and 10 percent (268 acres) is unavailable (Table 7). All long-term sustained yield values are based on the ~~F~~ full and ~~L~~ limited ~~A~~ availability acres only. Unavailable acres are not included in the analysis. Figures 15 and 16 illustrate the inventory, growth and harvest rates projected over ten planning periods generated from this analyisis based on the 2006 timber inventory data and current constraints on the harvest level.

Table 7 ~~3.~~ ~~Soquel~~ SDSF forest land availability

Timber Capable	Condition Class	Acres	Percent of Ownership
	Full Availability	1,609	60
	Limited Availability	804	30
	Unavailable	268	9.9
	Subtotal	**2,677**	99.9
Non-Timber Capable	Non-timber	4	0.1

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	Ownership Total	**2,681**	100

The calculations of standing inventory, growth and sustainable harvest levels are based on the 2009 Option A plan for SDSF. The Option A plan, submitted with each timber harvesting plan, is subject to revision at any time as new information becomes available (such as a new timber inventory). This analysis showed that the inventory of SDSF on the full and limited availability acreage is 112 million board feet or an average of 46,200 board feet per acre. The analysis also showed that the growth is 2.25 million board feet per year. In this projection the harvest level was constrained to gradually increase over each planning period to a maximum of less than 50 percent of growth. This may not be sustainable in the future as an inventory of over 100,000 board feet per acre is not a realistic condition for a manageable stand. Therefore, future inventories, analysis and management plan updates will be conducted which will revise these projections.

Table 7 ~~4.~~ Projected ~~SDSF~~ Forest - wide (full and limited availability) Average Annual Inventory, Harvest and Growth ~~Decadal harvest, growth, and inventory summary of available acres~~ by ~~p~~ Planning ~~p~~ Period

Period	Year	Inventory, MMBF(1)	Inventory per Acre MBF(2)	Harvest, MMBF(1)	Growth per year, MMBF(1)
1	2010-2020	112 ~~1,517~~	46.2	.866~~,656~~	2.25~~,493~~
2	2020-2030	125~~,356~~	51.9	1.03~~,315~~	2.37~~38~~
3	2030-2040	139~~8,771~~	57.5	1.1~~,824~~	2.65~~,479~~
4	2040-2050	153~~,426~~	63.6	1.45~~,485~~	2.91~~,057~~
5	2050-2060	168~~7,998~~	69.6	1.4~~,890~~	3.0~~,007~~
6	2060-2070	183~~,114~~	75.9	1.50~~4,960~~	3.10~~,803~~
7	2070-2080	199~~8,956~~	82.5	1.55~~,458~~	3.15~~,454~~
8	2080-2090	215~~4,952~~	89.0	1.5~~,711~~	3.2~~,348~~
9	2090-2100	232~~1,580~~	96.0	1.6~~,039~~	3.28~~,797~~
10	2100-2110	248~~,338~~	102.9	1.60~~5,992~~	3.34~~,357~~
11	2110-2120	~~265,703~~		~~16,629~~	~~33,658~~

Table 8 Projected SDSF Forest - wide (full and limited availability) Average Annual Inventory, Harvest and Growth by Planning Period

Period	Year	Inventory MMBF (1)	Inventory per Acre MBF(2)	Harvest per Year MMBF(1)	Growth per Year MMBF(1)
1	2010-2020	112	46.2	0.866	2.25
2	2020-2030	125	51.9	1.03	2.37
3	2030-2040	139	57.5	1.18	2.65
4	2040-2050	153	63.6	1.45	2.91
5	2050-2060	168	69.6	1.49	3.00
6	2060-2070	183	75.9	1.50	3.10
7	2070-2080	199	82.5	1.55	3.15

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8	2080-2090	215	89.0	1.57	3.23
9	2090-2100	232	96.0	1.60	3.28
10	2100-2110	248	102.9	1.60	3.34

1)MMBF = million board feet 2) MBF = thousand board feet

~~As a result, 55 percent of SDSF (1,475 acres) is fully available for timber production, 30 percent (805 acres) has limited availability, and 15 percent (400 acres) is unavailable.~~

~~Sustained yield production was analyzed based on the following highly conservative simplifying assumptions:~~

- ~~stand age averages 60 years;~~
- ~~all SDSF timberlands support mixed-species, mixed-age stands of redwood, Douglas-fir, and hardwood trees with an average stocking level of 30,000 board feet per acre;~~
- ~~all SDSF timberlands are currently growing at an average rate of 1,000 board feet per acre per year, and will maintain this average growth rate over a wide range of stocking levels and average stand ages;~~
- ~~harvesting will remove an average of 10,000 board feet per acre from fully-available lands and 3,500 board feet per acre from lands with limited availability each decade; and~~
- ~~the forestwide harvesting level will gradually increase from 750,000 board feet per year in the first decade to 1.5 million board feet per year in the fifth and subsequent decades.~~

~~The projected distribution of SDSF timberlands by average stocking level over the next ten decades is shown in Table 6. Based on the above assumptions, fully-available timberlands account for 86 percent of the total first-decade harvest, and lands with limited availability account for the remaining 14 percent.~~
~~In the first decade, a total of 645804 acres of fFully a Available land and 402300 acres of less Limited Availablity e land are harvested. The remaining Fully and Limited Availability land will be harvested in the second decade. This pattern is repeated in subsequent decades, resulting in a 20-year average cutting cycle. total area harvested each decade then increases through the fifth decade, when the entire 1,475 acres of fully-available land and 214 acres of less available land are harvested. From the fifth through the tenth decades, all fully-available lands are harvested (at the relatively light intensity of 10,000 board feet per acre) approximately once per decade (Jones and Stokes Associates, Inc., 1996).~~

~~As shown in Table 6 and Figure 9, the average stocking level on fully-available landsacres is projected to increases from 3046,000 board feet per acre to an weighted average of 46110,000~~

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~~board feet per acre after ten decades. The average stocking level on lands with limited availability gradually increases over this period to 110,000 board feet per acre. Based on the stocking conditions projected for the tenth decade, the LTSY for SDSF is at least 13.37 million board feet per year; this estimate is very conservative. The LTSY could be increased if more harvesting occurred in the less-available land class. This analysis shows that the proposed harvesting schedule balances harvest and growth, maintains an inventory capable of producing the LTSY, and does not exceed the LTSY in any future period (Jones and Stokes Associates, Inc., 1996)~~.

Figure 15 ~~9~~. ~~Decadal harvest, decadal growth and~~ SDSF inventory ~~of available acres~~ by planning period.

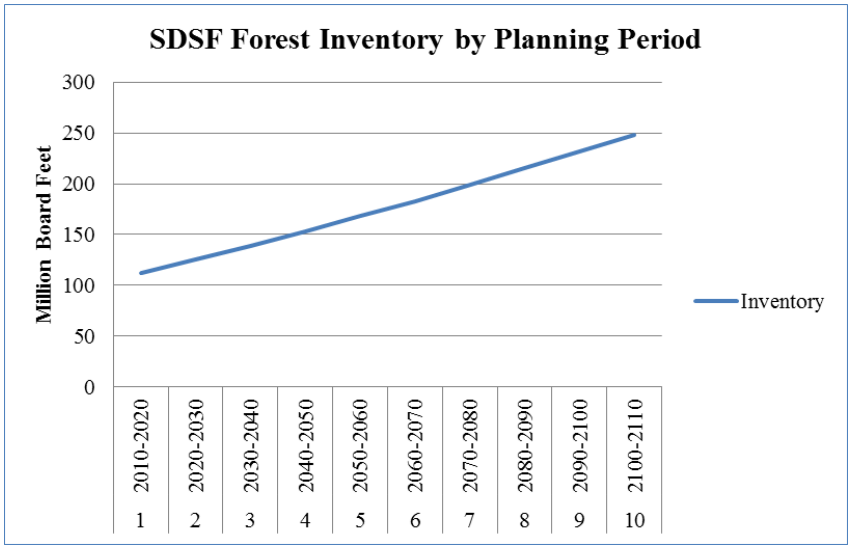

Figure 16 SDSF Projected Annual Growth and Harvest

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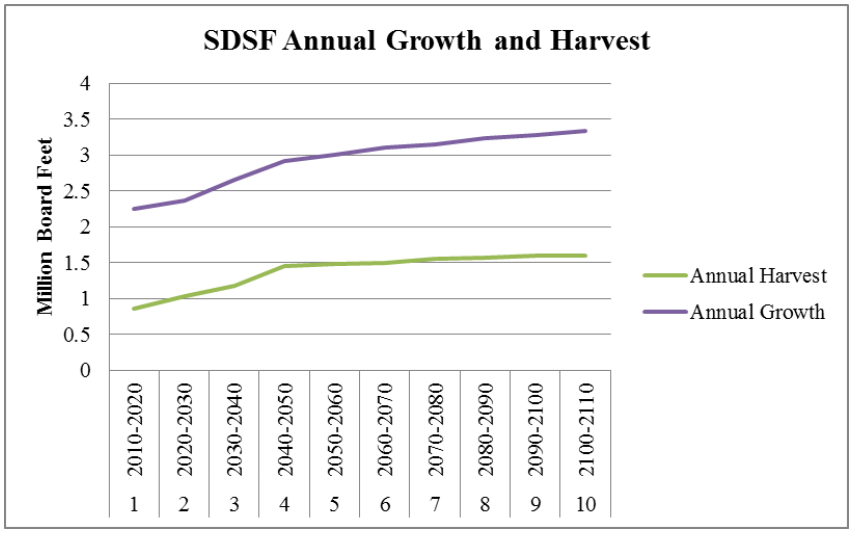

In future analysis and planning efforts ~~As part of the analysis for each succeeding decade~~, the short and long term harvest levels will be reevaluated based on the best available information at that time. The level of timber harvesting shall not exceed LTSY and on a cumulative basis shall be limited to the level of timber harvesting necessary to provide the funds needed for the maintenance and operation expenses of SDSF, reasonable capital costs, and other expenses incurred in fulfilling the objectives of PRC Sections 4660-4664 on SDSF.

HARVEST PROCESS

An important demonstration for SDSF is to support a viable local forest products industry. A local forest products industry is essential to maintain managed, working forests in the region. Financially viable managed forests in turn are an important tool to maintain large contiguous areas of wildlands in the Santa Cruz Mountains and avoid land conversion and development pressures.

~~It is anticipated that A~~~~approximately every two years,~~ SDSF staff will implement ~~plan~~ a timber sale every year or every other year. ~~, in accordance with environmental laws, which fulfills the harvest objective.~~ The scarcity of sawmills in the region reflects the tenuous and sometimes unpredictable nature of timber supply in the Santa Cruz Mountains. A predictable and consistent supply of raw materials from SDSF is important in order to contribute to the viability of these sawmills and ensure their continued existence.

Each plan will specify, at a minimum, the area and volume to be harvested, logging and silvicultural methods to be used, and restoration and ~~mitigation~~ protection measures necessary to address environmental concerns. All potential harvests will be evaluated by ~~CDF~~ CAL FIRE Forest Practice staff and will be available for public review.

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Once a timber sale has been approved by the ~~CDF~~ CAL FIRE Director, a minimum bid will be established for the sale. The timber designated for harvest will then be sold to the highest bidder. The timber purchaser will enter into a contract with the State which specifies all requirements in detail, including the operation and payment schedule, adherence to applicable laws, and any additional improvements or demonstrations. SDSF staff will administer the sale, assuring that the contractor abides by the contract. Furthermore, ~~CDF~~ CAL FIRE Forest Practice Inspectors ~~Officers~~ from the San Mateo-Santa Cruz Unit and resource professionals from the other Review Team agencies will conduct a Pre-Harvest Inspection and periodically inspect the operation during and after logging. Additionally, a Waiver from a Waste Discharge Requirement will be obtained from the Central Coast Regional Water Quality Control Board prior to the commencement of ~~ing~~ timber operations.

The harvest process will be administered through the ~~CDF~~ CAL FIRE Class III permit system for major timber sales. Periodically, small timber sales (less than 100,000 board feet) may be offered for demonstration or research purposes. These harvests would require a Class I minor timber sale permit. Any conifers removed in minor sales or lost through catastrophe (earthquake, wind, fire, flood, or pest infestation) must also be applied to the designated harvest level. In the event of a major catastrophe, salvage logging would occur and the annual harvest level would be recalculated.

It is generally accepted that winter timber harvesting will not occur at SDSF. This means that no heavy equipment operations or log trucking will occur during the winter period, beginning October 15th and ending May 1st. Certain activities will require a winter operations plan to be included in a THP. The activities that may occur in the winter period are lopping of slash, falling of timber outside of the stream protection zones during dry periods, tree planting, erosion control maintenance, and firewood cutting and splitting.

TIMBER OPERATIONS MONITORING

To avoid adverse impacts on water quality and fisheries resulting from the discharge of sediment to watercourses attributable to timber operations, SDSF staff will monitor all timber operations (including all harvesting areas and new roads, skid trails, and landings) annually for five to seven ~~5-7~~ years following completion of the operations. Occurrences of substantial surface erosion (~~i.e.~~e.g., gullies) or mass wasting (~~i.e~~ e.g., landslides or slumps) resulting from the operations will be identified and described by a ~~r~~Registered ~~p~~Professional ~~f~~Forester. Each substantial gully or landslide will be evaluated to determine its cause and identify stabilization measures that will be most feasible, effective, and cost effective. Such measures will be implemented within 90 days from the date when the subject site is identified, unless due cause for delay is explained and a reasonable alternative schedule for implementation is proposed by the ~~f~~Forest ~~m~~Manager. Appropriate mitigation measures to be incorporated into future timber operations will be described and specified in future timber harvesting plans to avoid a recurrence of the observed erosion or mass wasting events (i.e. adaptive management).

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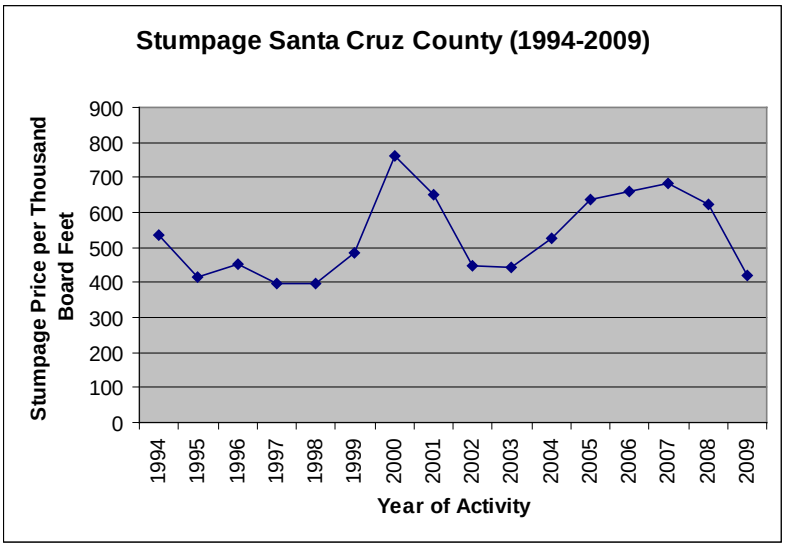
TIMBER MARKETS

The local timber market is largely influenced by the proximity of sawmills and economic conditions. The closest large sawmill to SDSF is the Big Creek Lumber Company mill, located 17 miles north of Santa Cruz near Davenport. The next closest sawmill is ~~are~~ ~~operated by~~ Redwood Empire Sawmills ~~and Preston Lumber~~ in Cloverdale, 165 miles north of Santa Cruz on Highway 101, ~~and~~ ~~The Harwood Products mill in Branscomb, 250 miles north of Santa Cruz and west of Highway 101, handles mostly fir logs. T~~the Sequoia Forest Products ~~Industries mill, located in Dinuba, is 150 miles southeast of the Forest~~.

The timber market has historically undergone fluctuations as a consequence of economic conditions. Figure 16 ~~9~~ ~~12~~ indicates dramatic changes in redwood stumpage prices during the last ~~20~~15 years (State Board of Equalization, 2010).

Figure 16 ~~0~~. ~~Timber market s~~ Santa Cruz County Redwood Stumpage Values ~~prices~~.



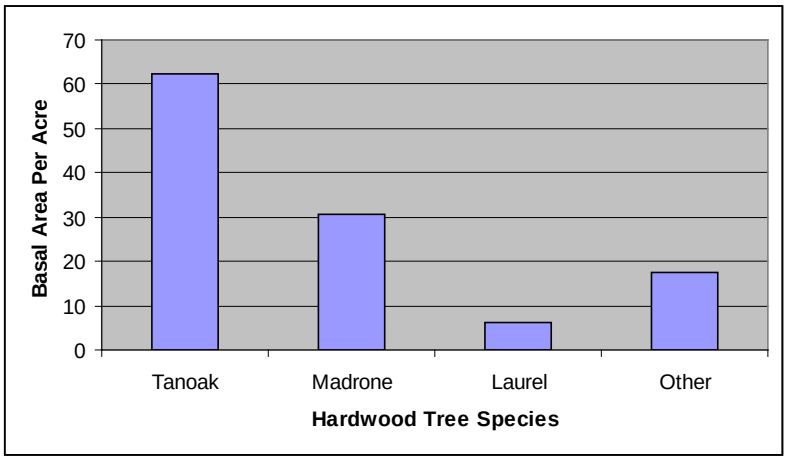
Stumpage prices reflect the value of logs delivered to the mill less the costs of logging, hauling, and cleanup. In the 1990s, stumpage prices ~~have been~~ ~~were~~ increased significantly and have widely fluctuated since then~~ing, but they declined considerably in the last few years~~. Factors contributing to the~~is~~ rise in the 1990s included a decline in federal timber sales, reduction of available timber elsewhere, increased forest regulations, and protection of threatened and endangered species. ~~Furthermore, t~~~~T~~ Starting in 2008, the demand for forest products declined ~~recently~~ with the economic recession and decreased markets for lumber related to the housing market. ~~remains strong, keeping prices high.~~ These factors, along with the cyclical nature of the timber market, are expected to continue and influence market activity.

Timber values for SDSF are not expected to be equal to general redwood/Douglas-fir prices. Bidding competition for SDSF sales will generally be lower because of the scarcity of sawmills in the region. Harvesting operations will usually be more expensive because of the amount of rehabilitation and restoration work planned. For example, existing undersized road culverts will be replaced, existing roads will be reshaped and surfaced to reduce erosion and additional fire hazard reduction work will be performed. These revenue reducing activities will be added to the cost of harvesting.

HARDWOOD MANAGEMENT

The 2006~~1999~~ timber inventory estimated hardwood basal area to be 116 square feet per acre. Figure ~~12~~ 17 ~~3~~ represents the hardwood basal area by the three most common species and a grouping of lesser occurring species (live oak, willow, alder, and bigleaf maple). As the graph indicates, tanoak is the most common hardwood species present. Hardwoods are a significant component of SDSF and, on average, comprise 40 percent of the basal area. Since the 2006 inventory however, dramatic visual indications of a shift in this composition is evident. Many areas where madrone and tanoak occurred in greater abundance than bay-laurel have seen significant mortality in the tankoak and madrone from several pathogens that affect these species and not the bay-laurel. Various experiments and demonstrations will focus on improving the health of these stands and reestablishing a diversity of species.

Figure 18 ~~1~~. Estimated ~~b~~ Basal ~~a~~ Area for SDSF's ~~h~~ Hardwood ~~t~~ Tree ~~s~~ Species.



Hardwood stands will be evaluated during wildlife and timber management planning. The ~~f~~ Forest type map discussed in the Conifer Volume Inventory section ~~will~~ classif~~y~~ies hardwoods as well as conifers in SDSF. Areas that have always been hardwood will remain so and will be

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examined for wildlife habitat enhancement and research opportunities. Approximately 100 acres of SDSF timberlands that naturally support conifers but, as a result of past logging and other management, currently support pure or predominantly hardwood stands ~~(primarily tanoaks and madrones)~~ will gradually be harvested and reforested where appropriate by planting redwood and Douglas-fir seedlings. These stands are widely distributed throughout the Forest in units one-quarter to one acre in size. An ~~site specific~~ analysis of potential biotic and wildlife habitat impacts will occur prior to all hardwood conversion. Any individual openings will not exceed 0.5 acres. These areas will be treated by planting group openings or by selectively removing a portion of the canopy and interplanting with conifer. Focusing on areas along the edges of conifer stands has proven the most successful in other areas of the Santa Cruz Mountains. Experimentation with differing levels of canopy reduction as well as prescribed burning in these areas may be pursued as a demonstration.

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Another aspect of hardwood management ~~will be~~ is to examine and experiment with alternative uses for hardwoods. The goal is to efficiently utilize more raw material, targeting portable sawmill owners, timber operators, and private property owners in the process. Some items that can be made from hardwood lumber include furniture, paneling, flooring, and decking. Hardwoods can also be utilized as fuelwood and chips. SDSF will research and demonstrate the management and use of hardwoods as a timber resource.

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DEMONSTRATION AND RESEARCH PROGRAMS

SDSF's demonstration and research programs will integrate all facets of timber management consistent with PRC Sections 4660-4664 and subject to the limitations of this management plan. Each timber sale will serve as a demonstration but also may contain a research component. Research projects will evaluate the applicability, practicality, and effectiveness of various strategies of forest and watershed management. Timber management demonstrations will include planning and operational projects as well as tours showing the risks and benefits of timber harvesting. Additional information on projects can be found in the Demonstration and Education and Research chapters.

Findings of research and demonstration projects will be available to the general public, small private landowners, researchers, and the forest products industry. Information will be distributed through research publications, direct mailing, ~~and~~ libraries, and posting on the internet (see http://www.fire.ca.gov/resource_mgt_stateforests_publications.php).

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SDSF can best serve the general public by providing information and experiences which enhance understanding of forest management principles and good land stewardship. The best way to provide learning opportunities is through exposure to forest management activities. Demonstration subjects might include the complexities of land management, trade-offs involved with timber harvesting, and the extent of wood products utilized by consumers. With this information, the public can make their own informed decisions regarding the effects of forest management on the environment.

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Small private landowners can gather useful information and learn to plan more efficiently by viewing land management alternatives. Visiting project sites and observing results is an effective way to understand management techniques and how they might apply to private land. Of most benefit will be practical, directed projects that clearly demonstrate timber management, natural resource enhancement techniques, and solutions to specific problems.

Timber operators and industrial land managers will have the opportunity to view various harvesting and environmental protection techniques. Demonstration and research project ideas will be solicited from this group. Possible projects may include evaluating methods to enhance forest health and regeneration, testing new harvest and management techniques, and solving operational problems.

MINOR FOREST PRODUCTS

The primary minor forest product that will be sold from the Forest is fuelwood. Fuelwood, primarily from hardwood tree species, will be available on an intermittent basis, usually as the result of other management activities. These activities may include road work, fuel break construction or maintenance, by-products of timber sales, and wildlife habitat improvement projects.

Additional forest products may be sold as they become available. These include salvage sawlogs, redwood split salvage, cull logs, roots and stumps, posts, boughs and other greens. As with the hardwood management program, the use of these products promotes utilization of raw materials that might otherwise accumulate and present safety or fire hazards.

~~PUBLIC COMMENTS AND CONCERNS~~ *THE FOLLOWING PUBLIC COMMENTS WERE RECEIVED DURING REVIEW OF THE 1998 GENERAL FOREST MANAGEMENT PLAN*

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Comments and concerns regarding SDSF's timber management program have been very detailed and encompass a variety of subjects. Since it is impossible to address every comment directly, five broad topics of concern which cover most comments have been identified.

The first and probably most important concern to neighbors and other users of SDSF involves disturbance caused by logging activities. Logging truck traffic on mountain roads, reduced access to the Forest, alteration of the forest viewshed, and noise are sources of apprehension for many individuals. As stated in the management guidelines below, SDSF will strive to reduce possible impacts to forest neighbors and users during all forest management activities.

Another concern that has generated many comments deals with the possibility of negative impacts on Forest wildlife. Comments generally focus on the effects of timber harvesting on wildlife habitat, including concern for streams and adjacent riparian areas. SDSF plans to evaluate and monitor the response of various plant and animal species to forest management activities. Results of studies may include strategies to improve adverse conditions, enhance mediocre areas, or maintain exceptional situations.

The third area of attention deals with revenue from State Forest harvests. Interested individuals have expressed an opinion that SDSF should only harvest enough to cover basic expenses and that revenue should only be used for these expenses~~ only~~. CAL FIRE~~CDF~~ recognizes that PRC Sections 4660-4664 limits the level of harvests on a cumulative basis to that necessary to provide the funds needed for the maintenance and operation expenses of SDSF, reasonable capital costs, and other expenses incurred in fulfilling the objectives of PRC Sections 4660-4664 on SDSF. ~~CDF~~ CAL FIRE must also comply with California Forest Practice Act and Rules and Board of Forestry and Fire Protection policy. The Department will not attempt to accurately estimate revenues over any specific time period. As revenues increase over time, the Department will request expenditure augmentations through the normal budget process. Final state forest allocations ultimately rest with the Legislature.

Concern for the natural instability of the Soquel Creek watershed and excessive soil loss is also prevalent. Logging activities in the ~~f~~Forest will adhere to California Forest Practice Rules which limit road and skid trail construction. These regulations require site-specific mitigation as necessary to reduce erosion to minimum levels. Additionally, adherence to the Anadromous Salmonid Protection Rules, environmentally sound logging practices, input from Professional Geologists for all timber sales, and experimental research will be used to minimize damage to this sensitive area.

Finally, neighbors of SDSF would like to see local loggers, trucking companies, and mills perform the felling, hauling, and milling of products from the Forest's timber sales. While this may be ideal, the bid process cannot be limited to local businesses. In some cases, the highest bidder will likely be local, keeping the work and revenue in ~~the~~ Santa Cruz County ~~area~~.

MANAGEMENT GUIDELINES

1. Create and maintain a dynamic mosaic of a wide range of seral stages across the Forest that change over time. Optimize the Forest's attraction as a working forest and research destination to best meet the multiple use mandate.

2. Maintain and enhance a healthy forest ecosystem. This includes the monitoring of basic resources and requiring management activities that ensure forest vigor. The Forest will be periodically surveyed on an informal basis for general health, with emphasis on disease and insect activity, tree growth and vigor, and soil stability. Other monitoring activities, such as those developed for fisheries and wildlife, will contribute additional information on the health of individual resources within the ecosystem.

3. Protect and monitor the watershed, soil, fisheries, and wildlife resources during all timber harvesting activity. The fundamental goal is to minimize impacts to these resources through planning and mitigation developed on a site specific basis. Harvesting operations will be planned to occur in an orderly fashion across the plan area and will be completed

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from the back to the front to minimize the need to re-open landings, skid trails and roads one year to the next. Protection measures may include selecting low impact harvest methods, avoiding sensitive areas, monitoring for the introduction of invasive exotic plants and conserving or improving resource integrity. Timber harvesting will not occur during the period of winter operations (October 15 through May 1 ~~April 15~~), the period prescribed -in the ASP Forest Practice Rules, except as noted in the Harvest process section.

~~3~~4. Design timber management activities based on landscape perspectives. Components to consider will include horizontal and vertical forest structure, vegetation density, edge effect, corridor size, and biological diversity.

~~4~~5. Timber sales will have demonstrational value and include experimental and educational aspects whenever possible. This may include pre-harvest and post-harvest activities as well as actual harvest procedures.

~~5~~6. Consider neighbor and visitor concerns during all timber harvesting activities. SDSF will strive to reduce excessive noise, visual impacts, and transport activity. Logging methods and haul routes that facilitate reduced disturbance will be evaluated on a site-specific bas~~e~~is and used as appropriate.

~~6~~7. Demonstrate timber management compatibility and integration with recreation. Whenever possible, design timber sales to minimize conflicts with recreational use and improve recreation facilities such as roads and trails. Additionally, safe recreational behavior during logging activities will be encouraged through signs, direction from SDSF staff, and alternative routes.

~~7~~8. Monitor all timber operations annually for ~~5-7~~ five to seven years following completion of the logging operations. Any substantial surface erosion or mass wasting found will be identified and described by a ~~r~~Registered ~~p~~Professional ~~f~~Forester and evaluated to determine its cause. Stabilization measures that will be most feasible and cost effective will be identified and implemented within 90 days. (Refer to Appendix C, Monitoring Plan.) Each timber harvesting operation will include sediment source remediation. High-priority remediation sites will be considered when selecting areas for upcoming harvests. In some cases, remediation at locations other than timber harvest areas could constitute offsite mitigation for the watershed impacts of harvesting.

PLANNED ACTIONS

1. Harvest between ~~5~~800,000 and 900,000 board feet per year for the period from 2010 to 2020 ~~next ten years~~. This is estimated to be approximately ~~20~~ 30-35 percent of ~~f~~ Forest-wide growth.

2. ~~2.~~ Protect all old-growth redwood and Douglas-fir trees in the Forest. Maintain and update the old-growth tree data base.

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3. Promote the development of functional old-growth habitat characteristics in late-succession management areas within 300 feet of the East Branch of Soquel Creek, Amaya Creek, and Fern Gulch. –Follow the Anadromous Salmonid Protection Rules for protection of Class I, II, and III watercourses to enhance riparian functions and help recover state and federally listed fish species.

4. Identify aniticpated planned harvest areas for the planning period up to 2020 five ten-year period 19982012 to 200717 and develop a Management Unit Map. Evaluate all possible harvesting and silvicultural methods, new road construction needs, and compatibility with other forest uses for each area under consideration. Planning for future harvests will include consideration of potential impacts to smaller watersheds and their future management to allow for well-designed monitoring of potential impacts on water quality.

54. DevelopRefine a forest type map which includes tree species, WHR classifications, forest structure, and vegetation density. As resources permit, create a develop and maintain a the Geographic Information System (GIS) database for the Forest which contains this forest type map. The database will eventually include information on soil characteristics, streams, topography, research, sites, inventories and roads, trails, facilities, and other improvements.

65. Reinventory of the Forest on a regular schedule, using either a temporary plot system or installing a continuous forest inventory system of permanently monumented monitoring plots, to be remeasured at regular intervals. The next inventory will occur between 2016 and 2021. bywas completed in 2006. This the year 2000. The new inventory will collected information by forest type including timber volume, tree age, growth, mortality, stand structure, and WHR characteristics. The remeasurement interval and sampling scheme will be specified in the inventory design.

6. Monitor all timber operations annually for 5-7 years following completion of the logging operations. Any substantial surface erosion or mass wasting found will be identified and described by a registered professional forester and evaluated to determine its cause. Identify and implement sStabilization measures that will be most feasible and cost effective will be identified and implemented within 90 days. (Refer to Appendix C, Monitoring Plan.)

7. Convert approximately 16 acres of hardwoods back to conifers over the next ten years. Individual openings will not exceed 0.5 acres. Within each new project area, whether it be a THP or other experiment or demonstration, hardwood stands will be considered for management. Some areas of hardwood will be managed by single tree selection harvesting or group selections. These areas will be planted with conifers as appropriate. Hardwood trees with particular wildlife value will be retained. Experimental treatments will also be demonstrated (i.e., reduction of bay laurel in stands with extreme oak and madrone mortality).

8.Monitor timber operations areas for infestations of invasive, exotic species. Eradicate new populations prior to them becoming established and producing a seed bank.

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CHAPTER TEN: RESEARCH

INTRODUCTION

It is the State Board of Forestry and Fire Protection's policy for all ~~s~~State ~~f~~Forests to conduct innovative research in forest management. The purpose of such research is to provide resource management information to the general public, small forest landowners, and the forest products industry. Research opportunities in SDSF are numerous, offering small or large, general or specific, and experimental subjects. Individuals conducting research may represent private organizations, including consulting firms and environmental protection groups, or public agencies, such as institutions of learning or resource-based departments.

A plan to identify specific subjects of concern and research priorities for SDSF needs to be formulated so that continuous and long-range studies can commence. Forest staff will investigate possibilities and rely heavily on what the public, ~~CDF~~CAL FIRE officials, and resource professionals would like to see analyzed.

COMPLETED PROJECTS

Several research projects and surveys, summarized below, have ~~already~~ been completed for resources within SDSF. Procedures and results of each study are outlined in their respective chapters with the exception of the Geologic Survey (Manson and Sowma-Bawcom, 1992), which is covered in the Property Description chapter.

ARCHAEOLOGICAL STUDIES ~~Y~~

A complete surface field survey for archaeological and historical sites was conducted in 1991 by Dr. Brian Dillon. Dr. Dillon is a consulting archaeologist affiliated with ~~the~~ California State University at Northridge. Sites found during this study will be protected for cultural, research, and educational purposes. Additional surveys for acheological and historical sites have been completed for timber harvest plans, road and trail construction sites, and other projects. Several historic artifacts and archaeological sites have been recorded by CAL FIRE staff and protected.

A cultural resources study of the six-acre Badger Spring Picnic Area was completed in 2011 by Patricia Paramoure, a Master's student at Sonoma State University.

These confidential archaeological reports are filed with the Office of Planning and Research- State Clearinghouse.

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BIOLOGICAL ASSESSMENT

An inventory and assessment of SDSF's biota was completed by biologists from California Polytechnic State University, San Luis Obispo, in 1993. The survey resulted in lists of all plants and animals seen, heard, or tracked in the Forest (refer to Appendix B for species lists). The study, which concentrated on special status species, was under the direction of Professors V.L. Holland and Mike Hanson (Holland et al., 1992).

Several bird surveys were conducted by wildlife biologist David Suddjian, including raptor surveys for the Fern Gulch THP in 2001, 2005 and 2006, and a Marbled Murrelet survey in 2003 and 2004. After ten snags were created in Douglas-fir trees as part of the Long Ridge THP in 1995, Mr. Suddjian published the "Tale of Ten Snags: A Forest Management Success Story" article in the September/October 2001 issue of the Santa Cruz Bird Club Newsletter. After monitoring the post-harvest bird occupancy in these snags, he found that increased bird populations, new tree cavities, active nests and foraging evidence suggested that the snag management program was successful.

Raptor surveys of the Fern Gulch and Rim THP areas were completed by RPF Matt Greene in 2011 and 2012 (Greene, 20011; Greene, 2012). Two new species were observed; they have been added to the end of the Birds list under "Fauna of SDSF" in Appendix B.

A botanical survey of the Fern Gulch area was completed in 2002 by Tim Hyland (Hyland, 2002)and updated in 2010 by Tim Hyland and Dylan Neubauer (Hyland and Neubauer, 2010). Ms. Neubauer completed a botanical survey of the Comstock Mill THP area in 2013 (Neubauer, 2013). Lists of the species they observed have been added to the end of the "Flora of SDSF" list in Appendix B.

A study of blood-borne disease in SDSF was started in 2009 under Professor Janet Foley at the University of California Davis School of Veterinary Medicine, and continues currently. The study investigates blood-borne diseases including Lyme disease and anaplasmosis by surveying their hosts, which include ticks and small mammals (Foley, 2011).

A herpetological survey, started in 2010, continues currently with the help of volunteers under the North American Field Herping Association (NAFHA). The purpose of the survey is to verify and photo voucher all varieties of reptiles and amphibians existing in SDSF (Erickson, 2011, 2014). The list of amphibians and reptiles that have been observed are in "Fauna of SDSF" in Appendix B.

Researchers from the Santa Cruz Mountain Puma Project through the University of California at Santa Cruz have been studying mountain lions in SDSF since 2009 using telemetry collars to collect continuous movement and location data. This study, led by ecologist Dr. Chris Wilmers and Paul Houghtaling, seeks to determine the success rate, effort and community-level consequences of predation, to understand cougar habitat

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requirements, and to provide guidance on movement corridors for lions within and between the mountain ranges on the central California coast. No formal reports have been provided to SDSF staff, but more information may be found at http://people.ucsc.edu/~cwilmers/.

GEOLOGIC SURVEYS

An extensive geologic survey of SDSF involved detailed mapping of geologic features and areas damaged during the Loma Prieta earthquake. This analysis was conducted in 1992 by Michael Manson and Julie Sowma-Bawcom (Manson and Sowma-Bawcom, 1992)of the California Division of Mines and Geology (renamed California Geological Survey). Mapped information includes geologic characteristics, landslides, stream orders, and areas where mitigation work can be done. Additional geologic surveys have been completed for timber harvest plans, road and trail construction sites, and other projects.

RECREATION STUDY AND PLAN

A recreation survey to determine ~~f~~ Forest recreational users' views and use patterns was sent to the neighbors of the Forest and the local mountain community in 1992 (Hester et al., 1992). Copies of the survey were also distributed in the State Forest and in The Forest of Nisene Marks State Park. Results of the study have been a primary source of public input into the forest management planning process. The principal investigators for the study were Marcia McNally and Rand~~y~~olph Hester from the University of California, Berkeley. The Recreation Study Final Report by McNally and Hester was completed in 1993 (Hester et al, 1993). The Draft Education and Recreation Master Plan was completed in 1996 (University of California, 1996).

EDUCATION

Researchers from University of California at Berkeley, led by Dr. Nova Blazej, completed an Education Study in 1997 (Blazej, 1997). In 2001, an analysis and report were completed for a proposed Forestry Education Center at SDSF.

TIMBER AND GROWTH INVENTORY

A ~~f~~Forest-wide timber inventory and supplemental growth analysis were conducted to determine the current conditions of forest volume and vigor. The timber inventory, completed in 1991 by SDSF staff, surveyed both conifers and hardwoods on a ten percent sample of the Forest (Lee, 1991). The growth study used a portion of the plots established by the timber inventory but assessed the current growth rates of conifers only.

A new timber inventory was completed in 2006. A Forest-wide forest resources inventory and sustainable harvest analysis were conducted to determine the current conditions of the forest and harvest levels that are sustainable in perpetuity without degrading the

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productivity of soils and the ecosystem. The forest inventory surveyed all tree species, conifers and hardwoods on a two percent sample of the Forest. –The 2006 forest resources inventory forms the basis for the "Option A " plan, which is– a document that demonstrates the sustained yield that is achievable for a property. In the Option A plan, the inventory data was used as input to the FORSEE growth model, which along with harvest scheduling software projected the growth and development of the f Forest over a 100-years planning interval. This analysis formed the basis for determining sustainable harvest levels in the next 5 five to 10 ten years that are also achievable in the long term.

In 2010 the Option A plan for long-term growth and yield forest management was completed.

In 2011 Mike Papa, a Forestry Science master's student from California Polytechnic State University at San Luis Obispo, completed his thesis titled "Effects of Silviculture Maanagement on Coast Redwood Forest Composition, Density, and Structure in Santa Cruz and San Mateo Counties". Papa used data from the Amaya and Longridge THPsat SDSF to examine forest restoration management (Papa, 2011).

WATERSHED ASSESSMENT

Dr. Brook Kraeger, a consultinghydrologist and neighbor, has recorded rainfall and stream flow data from gauages in a 159-acre tributary to Soquel Creek in the Forest for many years using rain and stream gauges. The intent of the long-term monitoring is to evaluate hydrologic modeling and examine the impact of timber harvesting on the hydrologic process. Kraeger provides raw data to SDSF that is used in annual reports, the Steelhead Trout Population Survey Reports and the Instream Temperature Monitoring reports (see Figure 6, page 47). This work is also supported by a Campbell Scientific CR1000 weather station that was established at the lower helipad in 2013.

A comprehensive cumulative watershed effects analysis for the East Branch of Soquel Creek watershed was completed by CDF CAL FIRE forest hydrologist Pete Cafferata (Cafferata and Poole, 1993). Chris Poole, a student intern from the University of California, Santa Cruz, and Forest staff assisted with data collection. Subsequent Soquel Creek Watershed studies and surveys have been done by the California Department of Fish and Game, the Resource Conservation District of Santa Cruz County, the National Marine Fisheries Service, Natural Resources Conservation Service, and others.

A study on the movement of large woody debris in Soquel Creek was published in 2003 (Lassettre and Kondolf, 2003). Information obtained from these assessments guides should allow future management activities to maintain or enhance watershed and soil integrity. Steve Reynolds, California Geological Survey, completed the 2013 Soquel Creek Large Woody Debris As-Built Report for Site 1 of the LWD project (Reynolds, 2013). Reynolds also provided a report after completion of the four sites in 2012 and 2013, and offers a comparison of large wood loading rates in enhanced stream reaches to those in other minimally disturbed watersheds (Reynolds, 2013). Based on the work done

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in 2012 and 2013, this report contains findings and recommendations for future restoration work.

FISHERIES ASSESSMENTS

One formal and comprehensive aquatic habitat survey was conducted on SDSF in 1994. A draft fisheries management plan was developed by Forestry Aide Bronwen Berlekamp and former Forest Manager Thomas Sutfin in 1995 (Berlekamp and Sutfin, 1995).

A macroinvertebrate sampling study performed by SDSF staff was conducted in October of 1995. The California Department of Fish and Game analyzed the collected samples and produced a report of their findings in May 1996 (CDFG, 1996).

Annual fish population surveys were conducted on SDSF in cooperation with the Department of Fish and Game from 1993 to 2001 at four separate sites. From 2002 until the present, SDSF has continued these annual surveys in cooperation with the NOAA Southwest Fisheries Science Center (Sogard et al., 2009). NOAA Fisheries added a fifth permanent station, increased the monitoring frequency, and incorporated additional research components. These Steelhead Trout Population Survey Reports have been completed every year to the present, with the exception of the year 2000 (CAL FIRE, 1993-1999, 2001-2012).

~~Habitat typing for the Forest's five electrofishing stations has been conducted periodically since 1997.~~

In-~~S~~ stream ~~T~~ temperature ~~M~~ monitoring has been conducted ~~annually~~ most years since 1997 using HOBO data loggers at seven sites in the forest (CAL FIRE, 1997-1999, 2001-2003, 2005-2012). Results of this monitoring have been compiled including seven-day moving averages which can provide significant information about the chances for fish success because these calculations reflect the duration of high water temperatures.

~~Steelhead Trout Population Surveys have been conducted annually since 1993.~~

~~A study on the movement of large woody debris in Soquel Creek was published in 2003 (Lassettre and Kondolf, 2003).~~

FOREST HEALTH

~~UC Berkeley staff have completed several studies and monitored the status of Sudden Oak Death on the forest since 2001.~~ Since the beginning of the Sudden Oak Death (*Phytophthora ramorum*) outbreak in the Santa Cruz Mountains in the late 1990s, SDSF

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staff has worked closely with U.C. Cooperative Extension specialists and researchers from the U.C. Berkeley Forest Pathology and Mycology Laboratory, led by Dr. Matteo Garbelotto (Garbelotto, 2013). Several Sudden Oak Death (SOD) studies have been completed over the years on SDSF including early work on various treatment options using direct chemical control with phosphonates and evaluations of the role of bay-laurel as a SOD vector (Hayden et al., 2011). In 2001, a transect/plot system was established for long-term monitoring of the occurrence and spread of SOD over time (McPherson, no date).

A biological control study of California bay laurel resprouts was begun in 2013 by Dr. Marianne Elliott from Washington State University to test new strategies for managing the spread of Sudden Oak Death (Elliott et al., 2012). The aim of the study is to develop and evaluate the effectiveness of treatment and eradication strategies to suppress bay laurel resprouts which can harbor SOD (Elliott, 2013).

A graduate student from the University of North Texas, Alicia Gray, completed a Master's thesis on Sudden Oak Death host species in SDSF in May 2014 (Gray, 2014).

ATMOSPHERIC STUDY

Researchers from the University of North Texas, Department of Geography, led by Dr. Alexandra Ponette-Gonzalez, began a study in 2012 to estimate atmospheric deposition into the Santa Cruz mountains using through-fall measurements and air-borne LiDAR. Rainwater was collected in a rain gauge and throughfall was collected in open funnel collectors in grasslands and forest stands of Douglas-fir to measure variation of chemical levels for future deposition modeling. Results from this study were provided in a Master's thesis by Kereen Griffith (Griffith, 2014).

RESEARCH PRIORITIES

Subjects for research ~~will~~ include all ecosystems in the Forest but are likely to focus on elements in riparian and coast redwood forest habitats. Studies will concentrate on all components of resource management, including protection, management, and public use. ~~Initial~~ Current research priorities are listed below; as forest management techniques evolve, precedence will adjust accordingly.

WATERSHED MANAGEMENT

* Monitor the effects of forest management activities on the resources of the East Branch of Soquel Creek watershed within SDSF.
* Investigate stream enhancement and rehabilitation techniques.
* Investigate and document effective techniques to minimize ~~Control~~ erosion and

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stream sedimentation caused by logging, road building, and recreational use.

* Monitor stream discharge and precipitation in small headwater basins.

TIMBER MANAGEMENT AND FOREST HEALTH

* Investigate optimal spacing requirements for growth and regeneration.
* Study hardwood management and Sudden Oak Death.
* Study old-growth redwood forest communities and ways to achieve late-succession stand characteristics over time.
* Investigate logging techniques which minimize visual, auditory, and environmental impacts.

FISHERIES AND WILDLIFE

* Assess the current condition of the fisheries resources within SDSF and document long-tem trends..
* Study methods to improve steelhead and coho rearing habitat conditions.
* Investigate methods to improve wildlife habitat and provide for healthy biodiversity.

RECREATIONAL USE

* Monitor environmental impacts of visitors to the Forest.
* Study the reactions and responses of recreational users and neighbors to all forest management activities.

~~PUBLIC COMMENTS AND CONCERNS~~ *THE FOLLOWING PUBLIC COMMENTS WERE RECEIVED DURING REVIEW OF THE 1998 GENERAL FOREST MANAGEMENT PLAN*

The general public's wishes regarding research include desire to be kept informed of SDSF's research plans and actions, both presently and in the future. Specifically, curiosity relating to research subjects, objectives, and investigators (and their affiliation) has been prevalent. To satisfy this concern, SDSF plans to announce current research projects through publications such as the Mountain Network News and other local newspapers. Additionally, newsletters containing information on present activities will be posted on signboards throughout the Forest.

Other public comments have suggested that information derived from research studies should be used to formulate forest management policy and actions. Gaining information which will aid in the management of SDSF is essentially the purpose of research projects; the Forest staff intends to put to use relevant information obtained through research.

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A final category of public interest involves the availability of study results. Individuals have expressed that research findings be made available as conclusions that may be applicable to their own lands. As stated in the management guidelines below, results will be available through public libraries, natural resource journals, ~~CDF~~ CAL FIRE publications, the CAL FIRE web site, and direct mailing.

MANAGEMENT GUIDELINES

1. Actively design and carry out continuing scientific studies which refine and improve upon existing state of the art forest land management techniques.

2. Coordinate research projects with other ~~s~~State ~~f~~Forests and local, state, and federal public agencies. Additionally, research opportunities have been and will continue to ~~may~~ be provided for universities, industry professionals, and private interest groups. Research may be formal or informal, depending on the party conducting the study and available funding.

3. Assure dissemination of research results in a timely and professional manner. Information gained from studies will be made available to local, state, and federal public agencies as well as resource professionals, forest neighbors, and other interested individuals. Reports may be made available through direct mailing, newsletter articles, public libraries, ~~or~~ professional natural resource journals, and the CAL FIRE web site.

PLANNED ACTIONS

1. ~~Develop a comprehensive~~ Create a list of priority research needs ~~plan~~ that ~~evaluates research subjects and priorities,~~ identify ~~ies~~ proper audiences, and defines techniques to distribute information effectively and in a timely manner. ~~The plan will e~~ Encourage innovative research in forest management, resource protection, and recreation. ~~An i~~ Investigate ~~ion to develop the plan will examine~~ previous research to determine the extent of what has already been completed in the area as well as topics lacking in information.

2. Serve as an outdoor laboratory for ~~CDF~~CAL FIRE research projects and encourage investigations by other agencies and educational institutions. Use study results to improve forest practices both in the Forest and statewide.

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CHAPTER 11: RECREATION

INTRODUCTION

The legislation creating ~~s~~State ~~f~~Forests (Public Resources Code 4631-4664) and Board of Forestry and Fire Protection policy both state that recreation is to be an integral part of the Demonstration State Forest Program. In addition, SDSF's enabling legislation, AB 1965, states that public enjoyment and open access are to be provided. SDSF's recreational management goal is to provide for uses that are compatible and integrated with resource protection, public education, and forest management while following the guidelines of AB 1965 and Board ~~of Forestry~~ policy.

Prior to state acquisition of SDSF in 1988, the property was privately owned and used primarily by the owners, their guests, neighbors bordering the property, and frequent trespassers. Users consisted of equestrians, motorcycle riders, four-wheel drive enthusiasts, hunters, target shooters, and a limited number of hikers, mountain bikers, and campers.

Since the establishment of SDSF, recreational use of the Forest has changed. ~~Current~~ The primary user groups who utilize the forest are (in order of use) mountain bikers, hikers and walkers, and equestrians. ~~The increase in mountain bikers has resulted from an overflow of riders from The Forest of Nisene Marks State Park (TFNMSP) and community awareness of a new riding place~~. The majority of recreational users at SDSF come for the mountain biking. SDSF offers a unique experience with several miles of single track trails and a lengthy downhill decent from the ridge to Hihn's Mill Road. Other recreational users include picnickers, ~~occasional~~ mushroom gatherers ~~ing groups~~, bird watchers, trail runners, dog walkers, environmental organization members, ~~a~~ dog search and rescue training personnel ~~organization~~, geo-caching individuals, and people coming to enjoy the forest environment. ~~Nonmotorized p~~

RULES, REGULATIONS AND POLICIES

Public access is allowed during daylight hours. ~~Camping, c~~Campfires, fishing, hunting, ~~organized races~~, commercial events, and the use of firearms and motor vehicles are generally not allowed. ~~permitted~~. ~~at the present time~~.

~~The recreation plan, which will be completed following the approval of this general plan, may call for development of one rustic group campground for occasional use by groups using SDSF for education, nature study, and recreation. Although the exact location of the proposed campground has not been determined, it may be located at one of four sites (Figure 13).~~

Current forest regulations prohibit all recreational motor vehicle use. The primary grounds for this regulation are ~~poor road alignment~~ lack of infrastructure (parking areas, barricades to prohibit vehicles driving onto sensitive areas), lack of SDSF personnel to provide patrol and

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security and maintenance costs associated with increased traffic on unimproved roads. Other reasons include resource protection, safety, and fire prevention.

ILLEGAL ACTIVITIES

The enforcement of regulations has decreased the number of motorcyclists to a few violators, and four-wheel drive ~~enthusiast~~ devotees' use is now almost non-existent.

In the past illegal shooting at Rattlesnake Gulch, private property across Highland Way from the Forest was a detriment to Forest visitors. Gunfire could be heard throughout the Forest and many users found this unnerving. Additionally, the noise and danger of gunfire reduced the quality of users' forest experiences. Since then, this problem has been solved and is no longer an issue to forest users.

Vehicles parked along Highland Way and occasionally in the parking lot have been burglarized. Recreation users are warned to not leave valuable in their vehicle and especially not in plain sight. Users are encouraged to use the 911 system to report illegal activities and activate emergency response as needed.

Illegal parties at the Highland Way parking lot have been an ongoing problem. CAL FIRE law enforcement, Santa Cruz County Sheriffs and State Parks Rangers have worked together to respond to these parties when it can be coordinated in the early stages. Additional security measures have been employed and are coordinated through law enforcement officers. Neighbors are encouraged to use the 911 system to report this activity and to activate law enforcement response.

Other illegal activities that have been ongoing involve illegal harvesting of trees (particularly along property boundaries), illegal trail building and dumping of trash on the forest. All these activities are investigated and responded to by SDSF staff in coordination with law enforcement.

THE RECREATION STUDY AND PLAN

To gain a better idea of current and future recreational users, their views, and related issues, SDSF implemented a recreation study which obtained information from the community and current users. The study, titled Soquel Demonstration State Forest Recreation Study Final Report (McNally and Hester, 1993), was intended to be the primary source of citizen involvement in the recreational planning process~~, was~~ and designed to develop recreational and forest management strategies for SDSF. The results are ~~were~~ to provide baseline information about existing and potential recreational users that will be utilized as more detailed recreation planning occurs.

The recreation study involved mailing questionnaires to all individuals who share a boundary with the Forest or live nearby. Additionally, different user groups who frequent the Forest were asked to fill out surveys while visiting SDSF. Information about the Recreation Study and the questionnaire were also published in the Mountain Network News, the Summit community's

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local newspaper. Of the 6,600 individual questionnaires distributed, 800 were returned. Several common themes or issues of concern were determined through this process and are discussed in this chapter.

The draft Education and Recreation Master Plan was completed in 1996. It calls for development of one site "to be used exclusively for education oriented group camping"(University of California, 1996). Consistent with this plan several actions have been completed. AThis campground has been developed and is used on a limited basis by researchers and personnel working on projects in the Forest (Figure 14). Interpretive sign boards have been placed in project areas, new trails have been developed, trail maintenance occurs on a regular basis, a portable toilet has been made available, picnic tables have been added and additional signage has been placed.

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The study and plan that were prepared in the 1990s were predicated on securing new and better access on the west end of the Forest. Both plans describe the lack of adequate public access as the biggest challenge to overcome in managing recreation and education programs. As new access continues to be evaluated and negotiated, several new issues related to recreation have developed. In the 20 years since the Recreation Study was completed, new partnerships have developed, recreational activities have changed considerably, and best management practices have evolved. For example advancements in battery technology has led to the development of electric-assist mountain bikes which look and perform similarly to non-motorized mountain bikes, blurring the line in what is defined as a motorcycle. Also the development of high-powered LED light systems has brought night-time recreational use to many nearby trail systems. Management strategies should be reviewed in light of these changes.

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PARTNERSHIPS

SDSF staff has fostered the development of groups to support recreation and education goals and conduct trail patrols. Three groups have partnered with CALFIRE in this way and dedicated volunteers donate hundreds of hours of labor annually.

The Stewards of Soquel Forest is a non-profit organization founded in 2000 that assists with the recreation and education goals of SDSF. The Stewards coordinate volunteers for trail maintenance work and lead trail work days every year. They also assist with other projects such as steelhead trout monitoring, and public demonstration and education events.

A local chapter of the International Mountain Bicycling Association (IMBA), Silicon Valley Mountain Bikers (formerly named Responsible Organized Mountain Pedalers), has sponsored educational events and organized volunteers to do trail patrol at SDSF through the National Mountain Bike Patrol program.

Another local IMBA chapter, Mountain Bikers of Santa Cruz, has taken a leadership role in developing a plan for a new trail on the forest. They have partnered with the Stewards of Soquel Forest and developed a trail crew leader training program to build a cadre of volunteer crew

leaders to help build the new trail. They are leading a fundraising effort and donating their staff time to train, plan and implement the trail building effort.

The relationships with these organizations have been valuable to SDSF, allowing growth and improvements in the trail system and facilitating recreational use while minimizing CALFIRE staff time and reducing costs of managing the trail system. Through improved communication and by working together, trail issues and recreational user issues are continually being resolved.

REGIONAL CONTEXT

SDSF's location is centered between the population centers of the Silicon Valley and the greater Santa Cruz metropolitan area, which provides for day use by many outdoor enthusiasts. SDSF is also a key link in a contiguous greenbelt between Los Gatos and Soquel which has been identified as an important region within the Land Trust of Santa Cruz County's Conservation Blueprint Initiative.

SDSF's recreational opportunities exist alongside and are connected with those provided by other nearby public land managers as well as private property owners, some of which are described below.

THE FOREST OF NISENE MARKS STATE PARK (TFNMSP)

~~* **Findings:**~~ Sharing a common boundary with TFNMSP is positive and offers prime recreational opportunities for both facilities. Recreationists, particularly mountain bikers and hikers regularly~~, are starting to~~ use both facilities in one outing. Reaching the summit of Santa Rosalia Mountain and the entrance to SDSF by way of Aptos Creek Fire Road is a significant athletic feat requiring over 2500 feet of elevation climbing

Some people think the Forest is part of TFNMSP. Management staff of both facilities have a good working relationship with one another; they meet regularly to share information and solve common problems, strengthening their relationship. As a result of this alliance, the new State Park map has been updated to include SDSF and reflect the connections of the Ridge Trail in SDSF with the Aptos Creek Fire Road located on TFNMSP.

SIERRA AZUL & UVAS OPEN SPACE PRESERVES

The Midpeninsula Regional Open Space District is planning public access to the Rattlesnake Gulch parcel of the Sierra Azul Open Space Preserve, potentially with a hike-in campground on a knoll overlooking SDSF. The Open Space Master Plan is still being developed and revised with ongoing public comment.

The Santa Clara County Open Space Authority (OSA) has acquired land to the east of Rattlesnake Gulch which connects to Santa Clara County's Uvas Canyon County Park. Additional acquisitions are being pursued by the OSA in this region.

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BAY AREA RIDGE TRAIL

Through the development of additional public access in Sierra Azul potential exists for a link from SDSF to the Bay Area Ridge Trail, which is the longest recreational trail in the region. When completed, the Ridge Trail will connect Sierra Azul Open Space Preserve to Mt. Madonna County Park. A potential trail connection from SDSF to the Ridge Trail would likely bring additional visitors to the Forest, who may make use of the Hihn's Mill Road parking area or roadside parking along Highland Way.

BAY TO BAY TRAIL

Public support for a long distance regional trail connecting the San Francisco Bay to the Monterey Bay began to develop in 2001. This trail concept is a route from the Bay Trail in Alviso, up along the Guadalupe River Trail in San Jose, through Sierra Azul OSP, crossing the Bay Area Ridge Trail near its highest point, then down into SDSF to TFNMSP, and ending at New Brighton State Beach.

CAMP LOMA

Camp Loma is a recreational facility operated by Santa Cruz County Youth Activities. Facilities include a large covered dining area, commercial-style kitchen, lawns, pool, showers, campsites and other amenities. It is available for rental and several groups have made use of the facilities to support events on SDSF.

ADAMS RANCH CONSERVATION EASEMENT

The Land Trust of Santa Cruz County owns a conservation easement over a parcel between Longridge Road and Adams Road, which includes an existing trail and language which provides for its eventual connection to the Fern Gulch area of SDSF. Other landowners in this neighborhood have expressed interest in providing easements to improve connectivity to SDSF.

PEDESTRIAN & CYCLING ROUTES

A roadside pathway along Summit Road between Highway 17 and Soquel-San Jose Road provides a separated environment for pedestrians and cyclists of the surrounding community. Soquel-San Jose Road has recently been designated as a cycling route by Santa Cruz County. "Sharrows" have been painted on the roadway and signs installed to encourage safe sharing of the road. Both of these facilities have the potential to bring recreational users to SDSF in an auto-free manner should trail connections to the Forest be completed.

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NEIGHBORING COMMUNITIES

Neighbors of the Forest have a range of opinions and concerns regarding recreational use. Some neighbors who live nearby want to assure they can continue to access, or to gain access

to the forest directly from their neighborhood without encouraging general public use of narrow local roads. Alternative access points would require careful planning and management to address concerns.

* **Recommendations:** The relationship between TFNMSP and the Forest has much potential. Thinking of the common boundary as one when problem solving could lead to beneficial solutions for both facilities, extending the State's resources that much further.

* **Actions To Date:** Managers of both facilities meet regularly to share information and solve common problems, strengthening their relationship. As a result of this alliance, the new State Forest map has been updated to reflect the connections of the Ridge Trail in SDSF with the Aptos Creek Fire Trail of located on TFNMSP.

Some neighbors are concerned that recreation and timber harvesting will disrupt their quality of life in the mountain community. They are worried that too many people will come from the larger metropolitan areas and impact their roads, increase fire danger, and vandalize property. Some individuals have expressed concern regarding excessive noise and their views being destroyed by timber harvesting.

Some trespassing through private property to enter and leave the Forest has been reported. Forest patrols continue and citations to trespassers have been issued. Publishers of trail guides have been contacted to correct errors and promote an accurate depiction of public access routes. SDSF maps provided to the public do not show private roads adjacent to the Forest.

* **Findings:** * **Recommendations:** Every effort is should be made to consider the impact of proposed management activities on surrounding neighbors. SDSF W works with the community to aid in their understanding of SDSF as public land with certain legislated mandates that include education, public use, and timber management. A demonstration that includes visual impact analysis for preparation of timber harvests could be considered.

* **Actions To Date:** Several p Public meetings and tours are have been conducted to discuss SDSF mandates and hear public concerns. Access issues are being investigated and detailed recreation and timber management planning have been completed. are proposed. Motor vehicle use within the Forest is restricted, limiting the types and levels of recreational use.

PUBLIC ACCESS AND STAGING AREAS

* **Findings:** Public access into the Forest is currently continues to be a significant challenge. Many Some users trespass through private property to enter and leave the Forest. At this time, only one remote, legal access point that provides a staging area with parking exists. This entry, the main entrance to SDSF, consists of an easement across private property and is subject to winter closures. Furthermore, those who do not use trails (e.g., physically challenged

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individuals) are limited to using the edge of the Forest only because there is no public access by motor vehicles into the internal areas of SDSF.

* **Recommendations:** Providing alternative access requires a complete analysis of access needs and an assessment of land available for easement or acquisition. Accommodating non-trail users should be a consideration in future recreation and education planning. Developing an Access Plan to address this issue is a high priority.

EXISTING FACILITIES

Signs and Maps

* **Findings:** A number of survey respondents felt that the Forest needs more d Directional signs with mileage have been installed at all trail intersections and the entrance to the Forest. Large signs at each entrance have also been placed listing the forest rules and regulations that are enforced. Sign boards are located at three locations on SDSF: the Highland Way entrance, Badger Springs and the Ridge Trail entrance from the State Park. The sign boards are updated periodically with educational materials, announcements, a large Forest map, and public notices regarding rules and closures. Also at each sign board there are brochure maps provided to users for free.and a better map for orientation purposes.

MULTI-USE ROAD AND TRAIL SYSTEM

The trail system of SDSF consists mostly of old logging roads that have been reopened , along with some singletrack trail segments (Figure 19 3). Currently, many of the trails are not completely contained within the State Forest where they meander along the Forest boundary. Some trails lead from the State Forest to the State Park and others end at private land.

Loop trails are necessary to the trail system as they keep visitors inside the Forest and direct them back through the State Park or to Highland Way, instead of onto private property. Most visitors use the interconnected trail system on the south side of the creek, typically descending the Ridge Trail and climbing Hihn's Mill Road and connecting between the two using the singletrack trails to loop between them. This natural circulation pattern results in many trails being used in a de-facto one-way direction.

Trails are shared by all recreational users, except for one half-mile of Ridge Trail between Corral Trail and TFNMSP. Horses are not allowed on this upper section to keep them from entering the Park, as they are not permitted due to deed restrictions.

* **Findings:** Currently, SDSF does not suffer the problems and conflicts experienced on other public lands that allow hiking, horseback riding, and mountain biking on the same trails. The remoteness of the entrance road, the length of Hihn's Mill Road that must be traversed before reaching the first trail junction and the steep and rough conditions of the singletrack trails seem to filter out casual trail users who seek short and easy trail experiences. Consequently most

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of the forest users are more experienced and adventurous than typical park visitors. The main trails along the southern portion of the forest are used extensively by mountain bikers while the trails on the north and western side of Soquel Creek are used much less, mainly by neighbors to SDSF.

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Forest staff has worked to effectively manage the trail system and to monitor the satisfaction of all user groups. Forest trails are open to all user groups and trail etiquette is stressed to Forest visitors. A Trail Use And Safety Guide has been developed to foster cooperative use and reduce trespass problems.

ROAD AND TRAIL DESCRIPTIONS

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Hihn's Mill Road – 5.6 miles

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Hihn's Mill Road is the main road through the Forest, being used by nearly all recreational visitors as well as SDSF staff, emergency vehicles, timber operators, researchers and others. This rocked, all-season road traverses the length of the Forest. From Highland Way it crosses Soquel Creek at a bridge, passes through the main parking lot and staging area, traverses private property for a half mile before entering SDSF at the eastern boundary. It descends over 1000 feet in elevation for 4 miles, passing the bottom of each of the singletrack trails before crossing Soquel Creek again. From the lower bridge it then climbs up past the intersection of Amaya Creek Road, and continues to the gate at Olive Springs Quarry. Public use is restricted by an administrative closure past Amaya Creek Road to limit trespass into the hazardous mining area.

Ridge Trail - 3.3 miles

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Ridge trail leads from TFNMSP at the southeast corner of the State Forest and follows Santa Rosalia Ridge to Sawpit Trail. It meanders along the common boundary between the State Forest and TFNMSP. This trail is the only other authorized public access route to the Forest aside from the main entrance at Highland Way.

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Corral Road/Trail - 1.7 miles

Corral trail starts at Sulphur Springs Trail and connects with Ridge Trail toward the southeast end of the Forest. It is named for an old corral, less than half way up the trail, that was used by the Sulphur Springs Resort to house their livestock. The top 0.3 miles consists of a singletrack trail.

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Sulphur Springs Trail - 1.5 miles

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This trail is a road that starts on Hihn's Mill Road and goes up to Ridge Trail. It was constructed in the 1870's to access the Sulphur Springs Resort. The trail passes remnant cold springs, but all of the old resort buildings have been destroyed or removed. This route also serves as an emergency vehicular access to the lower helipad near Hihn's Mill Road and the upper helipad on Santa Rosalia Ridge.

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Braille Trail – 1.5 miles

This is the most recently developed trail in the Forest. Connecting Hihn's Mill road with Ridge Trail, Braille Trail is a good example of the extraordinary relationship that has grown between SDSF staff and the public. This trail began as an unsanctioned trail in the late 1990's.. It was originally constructed by mountain bikers at night where they found their way "by Braille". Its route and construction methods were found to cause adverse impacts to water quality and unnecessary risks to public safety. Public support for correcting the inappropriate trail features led to an alliance between SDSF and recreational trail advocates and began formation of the Stewards of Soquel Forest. A compromise solution led to the challenging but environmentally sustainable trail alignment in place today that is now a sanctioned trail. Many of the volunteers involved in realigning Braille Trail have continued their association with SDSF to construct and maintain highly desirable and environmentally considerate trails.

Tractor Road/Trail - 1.5 miles

This trail was constructed in 1934 when logging methods changed from steam donkey to crawler tractor. It was the first logging road developed to access the slopes of Santa Rosalia Ridge. It starts at Hihn's Mill Road and ends at Ridge Trail.

Flow Trail (planned) - 4.5 miles

In 2013 a planning effort began to develop a new type of trail called a flow trail at SDSF, following the reopening of Tractor Trail for a logging road used during the Rim THP. This effort is sponsored by the Mountain Bikers of Santa Cruz. They have provided funding and expertise for planning and implementation. The flow trail is a trail that is designed to be used by any skill level bicyclist and emphasizes a low gradient with grade reversals that utilize the rider's momentum to minimize pedaling and braking. Since all the single track trails at SDSF are appropriate for highly skilled, experienced bicyclists, the new flow trail will allow for a more diverse recreational experience. This trail will be appropriate for families with children and beginner mountain bikers.

Sawpit Trail - 1.2 miles

This recently developed trail ~~is the most recently developed trail in the Forest. It~~ starts at Hihn's Mill Road and connects with Ridge Trail. It is located one-half mile east of the picnic area at Badger Springs. There is a sawpit along the trail that was used before the turn of the century for cutting logs into lumber.

Long Ridge Trail - 1.5 miles

This trail starts on Hihn's Mill Road and travels to Long Ridge Road. The last 0.1 mile is on private property. This trail is primarily used by neighboring equestrians.

Amaya Basin Road – 0.7 miles

This trail is a road that begins midway along Longridge Road and extends along the eastern side of Amaya Creek. It ends at a landing last used for the Longridge THP.

Fern Gulch Spur – 0.2 miles

This trail is a logging road constructed in 2011 for the Fern Gulch THP and ends at a

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landing used for those harvest operations.

Amaya Creek Road – 2.0 miles

This road starts on Hihn's Mill Road, about ½ mile west of the bridge over Soquel Creek. It climbs up to the ridge separating Amaya Creek from Hester Creek and intersects with Comstock Mill Road near the Forest boundary.

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Amaya Pond Trail – 0.5 miles

This trail is a road that starts about half way along Amaya Creek Road. It passes near Amaya Pond, and then descends down in a sinuous manner towards Amaya Creek, ending at a landing.

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Amaya Bridge Trail (planned)

In 2003 planning began for this trail that would connect Amaya Pond Trail with Longridge Spur Trail, providing a loop on the north side of the Forest. Complex issues arose in designing the bridge needed to cross Amaya Creek and planning was put on hold until more resources could be provided.

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Comstock Mill Road 0.7 miles

Public use of Comstock Mill Road is currently restricted to prevent trespass onto private property.

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High Bridge Spur Trail (inactive) - 0.3 miles

This trail is the original route of Hihn's Mill Road into the Forest. The bridge was lost to fire in the 1970's but the road prism remains and was re-established as a logging road with temporary bridges for the neighboring CHY Olive Springs THP. This route is in the area closed administratively to prevent trespass at Olive Springs Quarry.

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OTHER FACILITIES

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Picnic Areas

The Badger Springs picnic site was the first such area in the Forest and was established long before the State assumed -management. This area is very scenic and, consequently, is a common destination for Forest visitors. Badger Springs is located along Hihn's Mill Road in the alluvial flats of the East Branch of Soquel Creek. The site has several picnic tables~~,~~ and a few ~~log benches, and 13~~ hitching posts for horses. On the opposite side of the road is the Forest's ~~two~~ ten-acre old-growth redwood grove.

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Other picnic area locations are the Forest entrance, Sulphur Springs, and on Ridge Trail between Sulphur Springs Trail and Tractor Trail.

Portable Toilets ~~Outhouses~~

There is one ~~were two~~ portable toilet ~~outhouses~~ in the Forest, provided and maintained by a generous donation from a mountain bike manufactorer. It is located by the eastern property gate on Hihn's Mill Road. ~~that have been removed due to budget cuts. They~~

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may be brought back if funding becomes available. Alternatively, permanent structures may be constructed if designated by future recreation planning.

Parking Area

There is one parking area located just outside the Highland Gate entrance. This area is not in SDSF, but the State has a public-use easement with the owners, Roger and Michelle Burch. The parking area has been rocked, and is generally accessible to the public year round. is closed in the winter as it does not have an all-weather surface and is susceptible to damage by motorcycle and four-wheel drive vehicle use. Currently, winter visitors park at turnouts along Highland Way. Work done in or around the parking lot to maintain erosion control, reduce fire hazard, post new signage or change access through the common gates is coordinated with Burch family representatives. Recent upgrades include additional rocking, installation of new signage, redecking of the bridge over Soquel Creek and the installation of a steel gate on the bridge that replaces the old chain gate. SDSF staff will continue to coordinate with the Burch's to determine the need to close the parking lot due to any range of issues from saturated soil, to illegal parties, high fire danger or timber operations.

Campground

There is one campground that is used by special permit on a limited basis by educational groups, researchers and personnel working on projects on the Forest.

RECREATION PROGRAMS

ORGANIZED EVENTS

Organized events are allowed through a fee based Special Use Permit. Special use permits may allow uses which are restricted such as use of motor vehicles and camping. These events are limited to the number that can be managed by the SDSF staff and are evaluated on a case by case basis.

Forestry Education

* **Findings:** There is an encouraging level of interest in the Forest's educational potential. Local teachers are interested in bringing classes out to the Forest and local residents like the idea of educating the general public about the environment. * **Recommendations:** Additional Forestry Education programs and interpretive information should be provided for R recreational users. should be included in the Forestry Education. Rest stops for different user groups will need to be located so that interpretive materials can be distributed to all recreationists. * **Actions To Date:** Outreach programs have been initiated with local schools and natural history organizations. Interpretive signs have been installed on the forest. SDSF Forest staff members offer verbal educational information to the public, both in the office and out in the field Forest. Draft plans for integrating recreation and education have been completed.

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FUTURE RECREATION

Additional opportunities are available to provide a more diverse recreational experience at SDSF. This includes the potential development of new facilities such as a forestry education center and new uses such as an ADA accessible trail, an interpretive trail, or possibly a disc golf course. Members of the public have expressed a desire for these types of opportunities at SDSF, as well as a larger and more interconnected trail system. Each of these possiblities needs further investigation and planning in order to evaluate the feasibily and compatability with the goals and mandates of SDSF.

As progress is made toward securing new access for a forestry education center and new facilities, a recreation and trails plan should be developed. The new recreation and trails plan will require careful consideration of how changes in access and use patters will affect the other areas of SDSF's mission, such as education, research, watershed protection and demonstration of sustainable forestry.

SDSF is one of the few publicly owned lands in Santa Cruz County that has the ability to provide a public hunting opportunity and may elect to do so in the future in conjunction with CDFW. Given existing constraints of access to the Forest, limited availability of CDFW and CAL FIRE staff time, the Santa Cruz County 'no shoot' zone, and multiple uses occurring on the Forest, a pilot program may initially be implemented to determine long-term feasibility of a hunting program. Game species may include, but not be limited to, deer, wild pig, band-tailed pigeon, California quail, and/or wild turkey. SDSF staff will work with local CDFW wildlife biologists and statewide program staff as necessary to determine appropriate levels of harvest in order to maintain population viability and to schedule special hunt events. Any hunting program which may be established for a particular species will be consistent with the appropriate statewide Environmental Impact Report or equivalent Strategic Plan developed by CDFW and will comply with all State and Federal laws pertaining to sport hunting.

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~~The plan also encouraged development of groups to support recreation and education goals and do trail patrols. The Stewards of Soquel Forest and the SDSF Trail Patrollers have since been formed. These dedicated volunteers donate hundreds of hours of labor annually on a range of activities, including trail maintenance and patrol.~~

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~~RESULTS~~

~~Included here is a partial summary of the findings and recommendations from the study, and what the staff has done to address these issues. For complete details see the Soquel Demonstration State Forest Recreation Study Final Report (McNally and Hester, 1993). Additional recreation planning beyond the scope of this General Forest Management Plan was completed in 1996 . The Education and Recreation Plan was developed based on the results of the Recreation Study. The new plan offers solutions to existing conflicts, including access and user circulation patterns. Additionally, alternatives for recreational use such as a rustic group~~

campground were considered and safety concerns and hazard mitigation examined. Recreational development levels that allow the maintenance of SDSF's rustic qualities were determined through the Education and Recreation Plan.

* **Actions To Date:**Forest patrols have been increased and citations to trespassers have been issued. Publishers of trail guides have been contacted to correct errors and promote an accurate depiction of public access routes. Additionally, loop trails have been developed to reduce trespass. Alternative access routes are being evaluated. ; a comprehensive analysis within the context of a detailed recreation plan is needed.

* **Recommendations:** A map that correctly depicts Forest trails, roads, and access points is a high priority. More clearly visible signs should be placed throughout the Forest, including the entrance at Highland Way.

* **Actions To Date:** All high-use loop trails as well as the entrance and main road have been signed and the SDSF brochure and map have been redesigned to correct previous shortcomings.

Shooting and Hunting

* **Findings:** Illegal shooting at Rattlesnake Gulch, private property across Highland Way from the Forest, iwas a detriment to Forest visitors. Gunfire couldan be heard throughout the Forest and many users foundind this unnerving. Additionally, the noise and danger of gunfire reducesd the quality of users' forest experiences. Actions have been taken to address the problems of illegal shooting.

* **Recommendations:** No recommendations were made to resolve the shooting problem at Rattlesnake because the area iwas not within state control.

* **Actions To Date:** The Forest staff has worked extensively with the landowner, County Board of Supervisors, Planning and Public Works Departments, and sheriff's office to solve this problem. The area has now been gated and fenced, reducing resolving the problem significantly. The property was acquired by the Mid-Peninsula Open Space District. A trail head linking this area to the Bay Area Ridge Trail is planned for future construction.Observed target shooters at Rattlesnake Gulch were asked to leave and informed of local shooting ranges.

Neighbors' Concerns

Multi-Use Trails

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~~EXISTING FACILITIES~~

~~Trail Descriptions~~

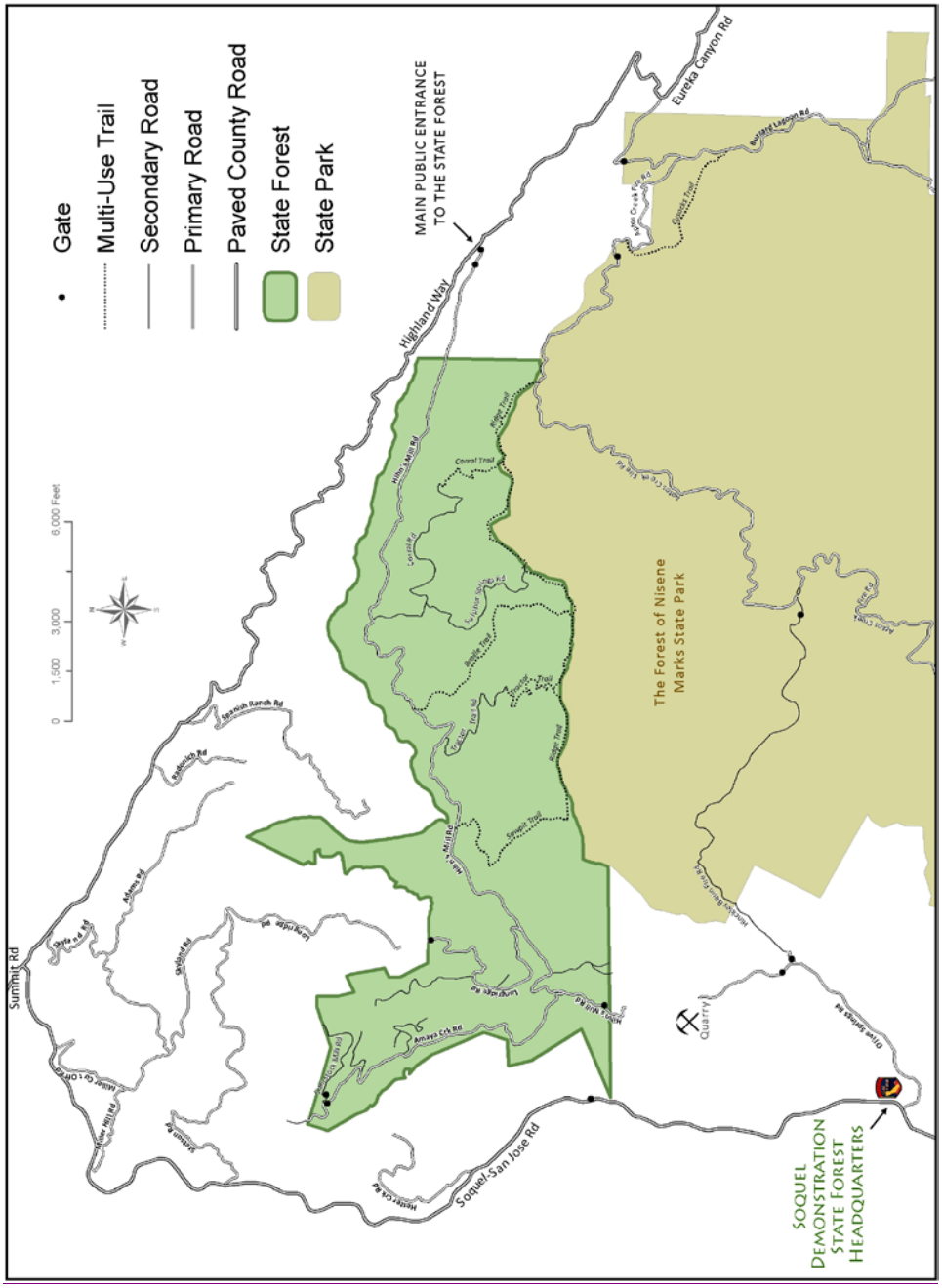

Figure 19: Transportation System of SDSF

~~Sign Boards~~

~~There are three information boards in the Forest that provide brochures, maps, and public information for visitors. The boards are located just inside the Highland Gate entrance, at the Badger Springs picnic area, and on Ridge Trail at the southeast edge of the Forest. The Ridge Trail sign board also provides TFNMSP information as it lies on the boundary between the Park and the Forest.~~

~~PUBLIC COMMENTS AND CONCERNS~~ *THE FOLLOWING PUBLIC COMMENTS WERE RECEIVED DURING REVIEW OF THE 1998 GENERAL FOREST MANAGEMENT PLAN*

Many comments and opinions were gathered during the Recreation Study. Appendix A of the study's final report contains all of the results of the questionnaire as well as comments and concerns of users and neighbors. The major public concerns, such as access, are addressed in the Results portion of this chapter's Recreation Study section as well as in the study itself. For detailed comments, refer to Soquel Demonstration State Forest Recreation Study Final Report (McNally and Hester, 1993).

MANAGEMENT GUIDELINES

1. ~~1.~~ Public safety and protection of the natural resources of the Forest will be emphasized in all patrol and management planning activities. Violators of Forest regulations will be cited.

~~1.~~2.

2. Certain ~~Prohibited~~ activities may be prohibited, and certain areas administratively closed by order of the Forest Manager. Such restrictions will be posted at all entrances and sign boards on the Forest. Special use permits may be granted at the discretion of the Forest Manager to allow otherwise unauthorized uses on a case-by-case basis. Restricted activities include use of recreational motor vehicles ~~within SDSF~~, camping, ~~or~~ fires ~~without a permit~~, entering closed areas, gathering mushrooms without a permit, use after sunset and before sunrise, large public gatherings (raves), organized races, commercial events, shooting, hunting and fishing (per Department of Fish and Game Regulations). ~~The Forest is also administratively closed to shooting, and hunting, organized races, and commercial events.~~

3. In accordance with Board of Forestry and Fire Protection policy, recreational facilities will be maintained with minimal development, preserving the rustic and informal characteristics of the Forest. Periodic assessments will be made to ensure that facilities meet users' needs while remaining as natural as possible.

~~3.~~4. Regular maintenance will be provided to ensure the upkeep and safe conditions of all existing facilities, including picnic tables, signboards, parking areas, and trails. Periodic

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inspection and maintenance of recreational facilities will be performed by Forest staff, Ben Lomond Conservation Camp crews, and ~~supplemented by~~ volunteers~~, including the Stewards of Soquel Forest and the SDSF Trail Patrollers, communication with visitors regarding the condition of these facilities.~~

~~4~~5. Recreation will be coordinated to achieve integration and compatibility with timber management, resource protection, demonstration and education, and the neighboring community. Demonstrations will show how recreation and timber harvesting, two seemingly conflicting management objectives, can be integrated. Forestry education will be an integral part of the recreation experience. Interpretive resources will explain the basics of forest management, current research on the forest, and the need to protect sensitive resources. In addition, visitors will be directed away from private property through circulation patterns (loop trails), use of proper signage ~~ing~~ (directional, regulation, no trespassing), and keeping ~~f~~ Forest attractions away from private property boundaries.

~~5~~6. SDSF will be managed to provide positive experiences for all recreational users. ~~Forestry education will be an integral part of the recreation experience.~~ Proper trail etiquette between mountain bikers, equestrians, and hikers will be encouraged through signs, educational information, and patrol by staff and volunteers.

~~6~~7. Management will strive to minimize ~~reduce~~ recreational development and recreational use impacts in ecologically sensitive areas such as ~~SDSF's~~ riparian zones ~~areas~~. ~~The majority of riparian areas in the Forest are not suited for recreational use and will not be developed. Remaining areas, however, will not be foreclosed to recreational use or forestry education options.~~ Any recreational improvements in riparian areas will be based on careful site-specific evaluations.

PLANNED ACTIONS

1. ~~Additional recreation planning beyond the scope of this General Forest Management Plan was completed in 1996 is needed. A detailed and comprehensive~~ The Education and ~~Recreation Plan was shall be developed based on the results of the Recreation Study. The new plan will offers solutions to existing conflicts, including access and user circulation patterns. Additionally, alternatives for recreational use such as hunting and a rustic group campground were will be considered and safety concerns and hazard mitigation examined.~~ Record and compile descriptions of all reported violations or nuisances caused by public users at SDSF or on adjacent ownerships including, but not limited to, trespass, vandalism, littering, and noise. Implement restrictions on public use if needed. (Refer to Appendix C, Monitoring Plan.)

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~~2. Recreational development levels that allow the maintenance of SDSF's rustic qualities were will be determined through the proposed Education and Recreation Plan. Public input into development levels shall be encouraged.~~

2. Conduct ongoing patrols of riparian areas including those with existing facilities to enforce prohibitions on vandalism and other damage to riparian habitat related to public use. Implement additional restrictions on public use as needed. (Refer to Appendix C, Monitoring Plan.)

3. Evaluate and grant requests for recreational Special Use Permits on a case-by-case basis.

~~5. Record and compile descriptions of all reported nuisances caused by public users at SDSF or on adjacent ownerships including, but not limited to, trespass, vandalism, littering, and noise. Implement additional restrictions on public use as needed. (Refer to Appendix C, Monitoring Plan.)~~

4~~6~~. Compile annual estimates of public use of SDSF in user days using ~~camping records,~~ patroller reports, surveys, trail counters, and other information. (Refer to Appendix C, Monitoring Plan.)

4. Continue to support, and work to expand volunteer programs to enhance recreation, interpretation and patrol.

5. Provide input to neighboring land managers to facilitate interconnected trail systems and regional trail development.

6. Develop an Access Plan, and acquire land or easements necessary to provide better public access to the Forest via Soquel-San Jose Road.

7. Evaluate the need for a new Recreation and Trails Master Plan for SDSF to improve the trail network and recreation opportunities in the Forest.

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CHAPTER 12: RESOURCE PROTECTION

FIRE PROTECTION

The CAL FIRE San Mateo-Santa Cruz ~~Ranger~~ Unit Chief is responsible for fire protection in the State Forest. The Forest Manager, the Unit's Operations ~~Officer South~~ Division Chief for Santa Cruz County, and the local CAL FIRE~~CDF~~ Battalion Chief will work together to ensure an adequate fire protection program is in place for SDSF. In addition, the Forest staff will work with other agencies as needed to provide fire protection for the Forest.

FIRE HISTORY

In the era before fire suppression, the fire return interval for the area that is now SDSF was roughly ten to twenty years. These fires were caused by lightning or set by Native Americans to manage vegetation.

A fire that occurred in 1903 spread from the east to Santa Rosalia Ridge down to the Sulphur Springs area (Powell, n.d. pg. 161). Another fire started in 1922 in Hinckley Creek and spread to Soquel Creek, burning a total of 7,000 acres.

A 50-year fire history (1929-1979) of the Santa Cruz Mountains was compiled by Jason Greenlee in 1981. The area which is now SDSF was included in the study, and the following fires occurred during that 50-year period:

1933 - 240 acres burned in the Amaya Creek ~~D~~drainage.

1936 - 54 acres burned along Santa Rosalia Ridge between Tractor Trail and Sawpit Trail.

1936 - 118 acres burned in the Hinkley Creek ~~B~~basin, with approximately 25 acres in the Forest, along the ridgeline at the top of Sulphur Springs Trail.

1938 - 87 acres burned along the upper portion of Sulphur Springs Trail.

1957 - 168 acres burned from Highland Way to Hihn's Mill Road, just east of Ashbury Gulch. Approximately 50 acres were in the Forest.

~~In addition, an earlier fire in 1922 started in Hinckley Creek and spread to Soquel Creek, burning a total of 7,000 acres.~~

The exact causes of these fires are not known, but it is believed that logging practices of the past, coupled with high risk machinery and equipment, caused most of them. Phil Mason, a long-time

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local resident, remembers that the 1933 fire was caused by a steam donkey engine that caught fire, burning the Amaya Creek ~~D~~drainage.

Modern logging methods and equipment are much safer from a fire perspective, and the risk of fire has been greatly reduced. This is evident from the lack of fires in the Forest during the last 30 years. The only known recent fire occurred in 1970 when the High Bridge, at the southwest edge of the Forest, was set on fire~~ by an arsonist~~.

R~~The most r~~ecent large fires in the area ~~was~~include the Lexington Fire in July, ~~of~~ 1985; the Summit Fire in May, 2008; and the Loma Fire in October, 2009.~~.~~ Though not in the State Forest, the Lexington fire's impact to the Summit mountain community was severe enough to mention here. An arsonist started the fire which burned 13,800 acres in the Los Gatos Creek Drainage (600 acres were in Santa Cruz County). Forty-five hundred people were evacuated from their homes, including residents of the Summit area. In the end, 44 structures were destroyed, including houses and outbuildings.

The Summit Fire burned 4,270 acres in the upper portion of the Soquel and Corralitos Creek watersheds on May 22 – 27 ~~3~~, 2008. In total, 1,130 acres burned in the Soquel Creek watershed (34 percent high burn severity, 43 percent moderate, 20 percent low, and three percent unchanged). Thirty-five residences and 64 outbuildings were destroyed. ~~Portions of the area burned suffered significant damage and mortality to the understory herbaceous and shrub layers, including ground-level vegetation in riparian areas. The majority of the overstory canopy survived intact. Isoloated pockets of mature trees, including hardwoods, redwood, and Douglas-firs, were damaged or killed. Knobcone pine and chaparral in the upper portion of the watershed burned with high intensity, and suffered significant mortality (State Emergency Assessment Team, 2008).~~

The Loma Fire burned 485 acres within the Soquel Creek watershed between October 25 and November 2, 2009. One trailor and two outbuildings were destroyed. The fire started on Loma Prieta Ridge and was pushed southwest by strong northeast winds. The fire slowed when it entered the 2008 Summit Fire boundary. Activity also slowed in unburned forested areas, due to higher humidity and higher fuel moisture. Existing roads provided access and control lines to aid the fire-fighting effort. The Summit Fire and the Loma Fire had very similar affects where ~~P~~portions of ~~the~~ each area burned suffered significant damage and mortality to the understory herbaceous and shrub layers, particularly at higher elevations. The majority of the overstory canopy survived intact. Isolated pockets of mature trees, including hardwoods, redwoods, and Douglas-firs, were damaged or killed. Knobcone pine and chaparral in the upper portion of the watershed burned with high intensity, and suffered significant mortality. ~~The~~ Both fires burned through a number of swales and watercourses but higher humidities and fuel moisture levels in these areas kept the intensity of the burn relatively low.

The largest recent fire in the Santa Cruz Mountains was the 2009 Lockheed Fire, which burned 7,819 acres, mainly in the Scotts Creek watershed (CAL FIRE, 2009). While located approximately 12 miles to the west of SDSF, this fire exhibited a similar pattern to the Summit Fire, burning in the chapparal and knobcone pine-covered portions of the burn area near ridges

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with considerably higher intensity than in the redwood stands located lower on slope near watercourses. Loganbill (2013) reported that the first winter after the fire did not produce increased stormflow sediment and event sediments loads, likely due to the fact that near-stream sediment contribution was minimal, and the majority of hillslope-derived sources were not hydrologically connected.

PRE-SUPPRESSION

Pre-suppression is defined as fire protection activities performed before fire occurrence to ensure reduced fire intensity and effective fire suppression. Pre-suppression plans discuss site-specific ways to minimize loss and reduce hazard and risk. The current pre-suppression plan for SDSF will be updated by the local ~~CDF~~CAL FIRE Battalion Chief with assistance from the Forest Manager. The more comprehensive plan will include the definition and assessment of high risk and hazard areas within the watershed boundaries, maps of fire defense improvements, prevention techniques, and an evaluation of available resources. State Forest staff ~~is currently~~ continue to work~~ing~~ on ~~some of~~ these activities.

Fire Defense Improvements

Fire defense improvements will be strategically located to protect forest land and neighboring properties. Improvements in the State Forest ~~will~~ include ~~one or more two~~ three water tanks ~~(e.g., 10,000 gallons),~~ ~~water sources along the East Branch of Soquel Creek,~~ shaded fuel breaks, and two helipad locations (Figure 19 ~~4~~). ~~The water sources and tank will be positioned so that water will be available throughout SDSF during a fire emergency~~. In addition, appropriate signing, fire hazard reduction, and adequate access to roads and trails will be added or maintained. Fire hazard and prevention information as well as Forest regulations will be posted on all information boards. The parking area, information boards, and picnic areas will be treated to reduce fire hazards for safety and demonstration purposes. The major roads and trails in the Forest are maintained ~~are in the process of being have been opened~~ to provide access for fire protection purposes.

Shaded fuelbreaks protect high value areas such as forest land, historical sites, and neighboring property. Typically, they are areas 100 to 300 feet wide where vegetation and other forest fuels have been decreased in order to reduce the rate of spread of an advancing fire. Less wide shaded fuel breaks are also beneficial. Within SDSF all main roads and prominent ridgelines will be treated as shaded fuelbreaks. Within these shaded fuelbreaks, ~~All~~ dead trees and ladder fuels (shrubs and lower tree limbs) are removed and the overstory canopy is thinned to a level where shade will still retard the growth of new ground fuels. The understory is modified so that a low-growing ground cover is retained within the fuelbreak to provide fuels to start a backfire. Whenever possible, fuelbreaks should visually merge with the surrounding landscape, conforming to the natural features of the area. Periodic maintenance is ~~will be~~ needed to maintain fuelbreak specifications.

Shaded fuelbreaks in SDSF ~~will~~ are being constructed, with the help of crews from Ben Lomond ~~Youth~~ Conservation Camp, along ridges and high use roads and trails. This is to provide safe locations for fire control lines and backfiring; ridgelines are commonly used as control points. ~~In~~

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~~addition, bl~~ shaded fuelbreaks ~~or the modification of fuels around homes will be considered on a site specific basis, as subsequent planning occurs.~~ Shaded fuelbreaks and roads also aid in the compartmentalization of the property in order to contain a wildfire to its smallest size possible given existing infrastructure. This will minimize the need to install additional fuelbreaks with bulldozers in the event of a wildfire.

Regulations

Restrictions are in effect for hunting and shooting, smoking, and fires within the Forest. Smoking and fires are not permitted anywhere in the Forest, including parking areas. A possible exception to these regulations would be campfires in a proposed permit-only group campground (to be addressed in the Recreation Plan for SDSF). Hunting and shooting are administratively prohibited in the Forest.

The periods of extreme fire danger for SDSF usually occur from July through October though these periods may be extended by severe weather. During these periods, SDSF will follow the ~~Ranger~~ Unit's Red Flag Alert Plan. This is consistent with the plan The Forest of Nisene Marks State Park follows during extreme fire danger conditions. The Forest Manager will coordinate with the Unit Operations ~~Officer South~~ Division Chief to determine necessary actions to be employed. The steps include increasing patrols of the Forest, posting red flag alert signs, providing more fire prevention information and awareness of current conditions to Forest visitors, and reducing the number of visitors in the Forest by posting the area as closed.

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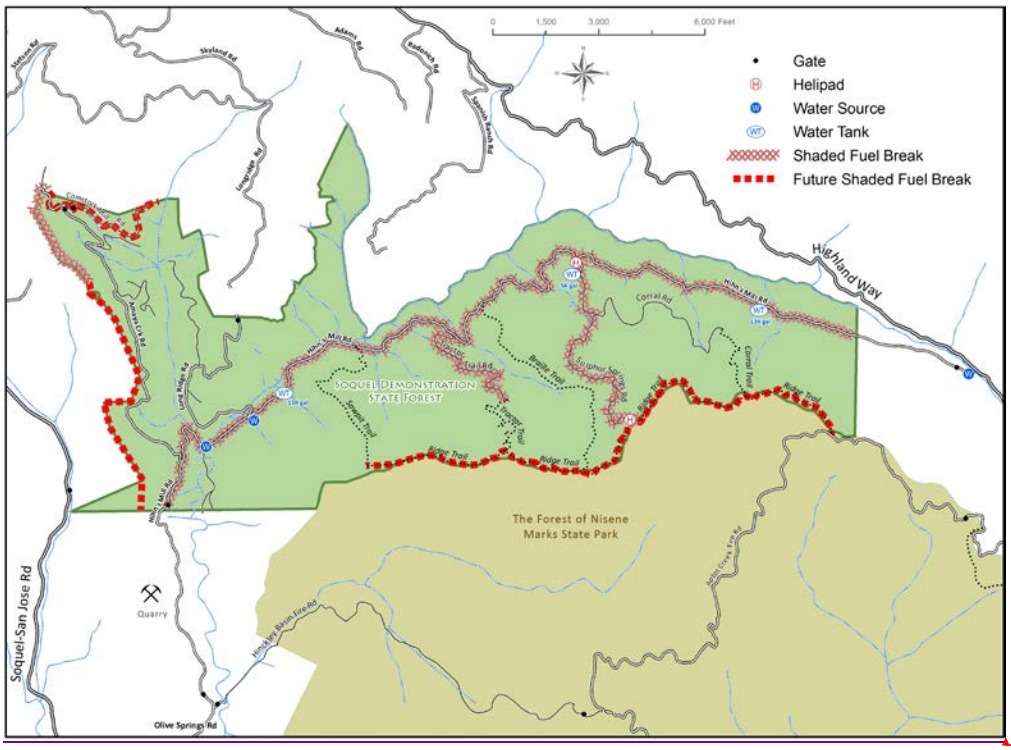

Figure 20: Fire Defense Improvements

Education

SDSF staff will coordinate with the Unit Fire Prevention staff for educational purposes. Educational information will be used to reduce the number of human-caused fires within the State Forest. Target groups will include neighbors, visitors, school groups, and local organizations. In general, neighboring property owners pose a risk of human-caused wildland fires in the Forest. They will be encouraged to meet with Burrell and Soquel Forest Fire Station personnel for information on CAL FIRE~~CDF~~'s Fire ~~Safe~~ Prevention Program in order to minimize the risk of wildfire.

Signs will be posted on all information boards alerting Forest visitors to the dangers of fire and ways they can minimize these dangers. Dangerous Fire Area signs will be posted when appropriate. During regular patrols, visitors will be informed of fire hazards and prevention methods.

School groups and local organizations will be referred to ~~the~~ Fire Prevention staff or local ~~forest~~ fire stations for fire safety information and presentations. Groups visiting the Forest for education programs will be informed of fire safety, hazards, and prevention techniques. Education programs will also cover the ecological role of fire in the environment and the

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importance of fire in maintaining biodiversity.

Enforcement

Forest patrol is an important part of fire protection and prevention. SDSF staff will coordinate with the Unit Fire Prevention staff for patrol purposes. Patrols will include public contact, fire detection, and patrol of roads and trails during the fire season. ~~CDF~~ CAL FIRE personnel will be utilized for weekend patrols and major holidays, especially during periods of high fire danger. CAL FIRE~~CDF~~ peace officers will either provide direct supervision or lead these activities. Additional patrols may be conducted by volunteers as deemed appropriate and safe by CAL FIRE~~CDF~~. SDSF staff foresters will also enforce fire-related California Forest Practice Rules at active logging sites on the Forest.

Fire suppression cost recovery will be pursued for damages resulting from deliberate and negligent acts of Forest users. Active investigations will be used to locate responsible parties and recover maximum legal damages.

SUPPRESSION

Suppression tactics are based on information from and implementation of the pre-suppression plan. SDSF staff can support initial attack fire control personnel by providing local expertise regarding current road conditions, fuelbreaks to be utilized for compartmentalization of the fire, vegetation conditions, and cultural resources. The staff may also evacuate visitors, close the fire area, perform law enforcement tasks, and assist with media information as appropriate.

Detection

Detection strategies include daily patrols, searching for evidence of fires, and CAL FIRE~~CDF~~ air flights during extreme fire danger periods or after lightning storms. Also, the ~~Ranger~~ Unit's Emergency Command Center will check the Automatic Lightning Detection System (ALDS) for possible strikes in the Forest.

Communication

As part of communication, SDSF will maintain an adequate radio system and stay in close contact with local ~~forest~~ CAL FIRE fire stations (Burrell, Soquel, and Corralitos). Local CAL FIRE~~CDF~~ fire control personnel will become familiar with the Forest, its road and trail systems, water sources, and landmarks (for use as reference points) and be advised of any changes that occur.

CAL FIRE~~CDF~~'s resource tracking system, Computer Aided Dispatch (CAD), will be used to dispatch the appropriate personnel and equipment to any fires on SDSF. The State Forest is a defined response area within CAD. The staff will inform the Emergency Command Center of any changes or updates to the CAD database, including information on roads, access points, and fire defense improvements.

POST-SUPPRESSION

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Post-suppression activities include the evaluation of pre-suppression information, suppression actions, and ~~rehabilitation needs~~ fire line suppression repair. Fire suppression repair involves ~~erosion control~~ actions needed to repair damage caused ~~rehabilitate areas directly impacted~~ by suppression activities ~~(e.g. firelines, roads, helipads, etc.)~~. Common suppression repair activities include fireline erosion control, watercourse crossing repair, slash treatment, road repair and drainage improvements, gate and fence repair, waterline repair, mapping of hazardours trees, etc. Rehabilitation involves erosion control and other restoration activities not directly caused by fire suppression activities. ~~Ranger~~ Unit personnel will evaluate post-suppression activities on an individual fire basis.

To minimize increases in wildfire risks resulting from increased public use of ~~in~~ the Forest, the staff will record and compile descriptions and locations of all wildfires occurring at SDSF. This information will be evaluated annually. If an increase in wildfire frequency occurs, appropriate measures will be implemented as needed to reduce wildfire risk.

PRESCRIBED FIRE

Prescribed fire is the controlled use of fire under specific weather and fuel moisture conditions within a predetermined area. Fire, under these conditions, produces the intensity of heat and rate of spread required to accomplish specific management objectives. These objectives could include fire hazard reduction, silvicultural research, and ecosystem enhancement.

A prescribed fire program that involves these objectives will be evaluated for SDSF. A risk and benefit assessment will be the first step in the evaluation. The greatest risk is the loss of fire control and resulting damage that may occur. Benefits include a reduction in fuel load, removal of exotic plant species, and improvements to vegetation and wildlife habitats. A prescribed fire program must consider the mountain community's concerns and address them effectively. An established prescribed fire program provides research opportunities for both resource management and fire behavior purposes.

If a prescribed fire program is established in SDSF, a weather station will be established and monitored, fuel loads and types will be sampled and mapped, and burning prescriptions will be developed for the different vegetation types found in the Forest.

~~PUBLIC COMMENTS AND CONCERNS~~ *THE FOLLOWING PUBLIC COMMENTS WERE RECEIVED DURING REVIEW OF THE 1998 GENERAL FOREST MANAGEMENT PLAN*

On April 29, 1993, SDSF held a workshop designed to gather information, comments, and concerns from the public. Based on the comments received, there are four major issues concerning fire protection and SDSF.

The first issue involves concern ~~uneasiness~~ about logging equipment and its potential to cause fires. As stated earlier in this chapter, modern logging methods and equipment are much safer and less likely to generate fires than historic logging practices. Additionally, logging contractors are required by law to develop a fire protection plan for each THP and to follow the state's Forest

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Practice Rules regarding fire protection. During harvest activities in SDSF, periodic inspections will be performed by both CAL FIRE Forest Practice Officers and Forest staff.

The risk of fire as a result of recreational use is also a concern. Individuals commented on issues such as limiting the number of people allowed in the Forest during periods of high fire danger and the prohibition of fires and camping at all times. Forest policy is to inform users of fire danger and to discourage activities that may result in increased fire risk. Similarly, camping, hunting and shooting, and publically owned motor vehicles are prohibited in SDSF though they may be allowed in the future (to be addressed in SDSF's proposed Recreation Plan).

The third issue raised at the workshop concerns the use of prescribed fire in SDSF. Comments about the consequences of both using and refraining from prescribed burning were received. As mentioned above, a risk and benefit analysis will be completed and analyzed before any decisions are made in this area. Lastly, comments regarding fire defense improvements vary from concern about how improvements may change the character of SDSF to suggestions for road accessibility. Currently, roads in the Forest are kept clear of combustible vegetation by Ben Lomond ~~Youth~~ Conservation Camp crews and Forest staff. Likewise, the condition of roadbeds are examined periodically and maintained as needed. Though fire defense improvements may change the appearance of some areas, their presence is needed in order to allow timely and effective response should a fire occur.

PLANNED ACTIONS

1. Coordinate with the Unit Battalion Chief and other fire control personnel to develop a comprehensive pre-suppression plan for SDSF.

2. Determine fire defense improvement locations and initiate their construction. Include the Unit Operations Chief ~~Officer South~~ in all decisions.

3. Provide patrols to enforce fire prevention policies, coordinating with the Fire Prevention staff as needed. Forest staff and volunteers will patrol SDSF on weekends and holidays, especially during periods of high fire danger. The Forest will be closed to public use when fire risks become excessive.

4. Conduct fire prevention education for neighbors and Forest visitors utilizing SDSF and fire prevention staff members.

5. Work with the Department of Parks and Recreation personnel from The Forest of Nisene Marks State Park to ensure effective fire protection along Santa Rosalia Ridge.

6. Record and compile descriptions/locations of all wildfires occurring at SDSF including ambient weather and fire hazard conditions, ignition source, area and vegetation types burned, and estimated damage. Implement appropriate measures as needed to reduce wildfire risks. (Refer to Appendix C, Monitoring Plan.)

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7. Evaluate the needs and feasibility of a prescribed burn program.

FOREST PEST MANAGEMENT

Forest pests, such as insects, diseases, and vertebrates, have long been established in California's native timberlands. Populations of pests are dynamic and fluctuate in response to climatic and environmental changes such as drought, forest overstocking and windthrow, fire, and other site disturbances. The actual or potential effects of pests may reduce or threaten to reduce anticipated tree growth, species composition, or forest stocking. At the same time, other forest resources, such as wildlife habitat, may be impacted. Integrated forest pest management ~~is~~provides a ~~way~~means to address ~~all of~~ these issues.
~~and make any possible multiple resource impacts related to pest management as insignificant as possible.~~

The intent of integrated pest management (IPM) is to prevent or restrain forest pest problems using~~by both pest~~ population suppression and the minimization of factors ~~which~~that predispose trees to infestation. IPM ~~may~~ makes use of the benefits of cultural, mechanical, chemical, semiochemical (i.e., synthetic pheromone), and biological pest management alternatives.
~~, reducing pest populations and promoting forest health. For pest problems in SDSF, management options that successfully merge with short and long term forest uses will be selected.~~

~~P~~Pests known to have caused ~~whole or partial~~ tree mortality within ~~and~~or adjacent to SDSF are listed in Table 9 ~~7~~.

~~Other pests of tree species that occur within the Forest may be present but have never been reported or detected. Still, other pests known to these tree species in other locations could be translocated to SDSF.~~
There may be other pests of local tree species that are seldom detected or reported, or are of minor significance. State Forest staff will continue to monitor the Forest for early signs of forest pests or conditions that may lead to infestation.

~~Tree mortality rarely occurs as a result of a single type of pest infestation. Typically, a single pest invades and weakens a tree, making it vulnerable to attack by some other agent. Beetles, for example, favor trees that have been weakened by other agents such as fungal infections, windthrow, or fire. Conversely, beetles can transmit spores from fungi-infected trees to healthy ones, ultimately leading to tree mortality.~~

Monitoring is an essential part of detecting early signs of forest pests or scenarios that may lead to infestation. Part of pest monitoring in SDSF will involve forest health surveys to detect pest damage or infestations in standing trees, slash, windthrow, down woody debris, or stumps. SDSF will also assist the pest monitoring program of the California Department of Food and Agriculture by deploying and inspecting gypsy moth traps in high use areas of the Forest. Other

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efforts to reduce pest damage or predisposition will include:

Table ~~5~~9. Forest pests of the Soquel Creek watershed

PEST	HOST
Fungal Diseases	
~~b~~Black stain root disease	Douglas-fir
Armillaria root disease	Douglas-fir, oaks, tanoak ~~(*Quercus*)~~
M~~m~~adrone canker	Madrone
Sudden Oak Death	Primary hosts on SDSF are California bay laurel and tanoak
Insects	
F~~f~~latheaded fir borer	Douglas-fir
Douglas-fir beetle	Douglas-fir
R~~r~~edwood bark beetle	~~R~~Coast redwood
Western oak bark beetle	O~~o~~aks ~~(*Quercus*)~~, tanoak
California oakmoth	Oaks, ~~(*Quercus*)~~tanoak
Mammals	
Tree s~~S~~quirrels	Coast r~~R~~edwood

* The minimization of injuries to residual trees during forest management activities.

* Reuse of old tractor roads or recreational~~skid~~ trails where available to ~~avoid further~~reduce soil compaction.

* Retention of a diverse species composition in or adjacent to stands following forest management activities and ~~in any~~within or near~~by~~ future ~~plantings~~regeneration units.

* Avoidance of non-native tree species which may be predisposed to pests ~~and~~with few~~er~~ local pest predators and parasites.

* Use of ~~CDF~~ CAL FIRE or other forest pest management specialists to train ~~employees~~SDSF staff in forest pest recognition and management.

SUDDEN OAK DEATH (SOD):

~~California Code of Regulations - The Oak Mortality Regulation, as Applied to State Lands~~.

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Sudden oak death is a disease effecting several species of plants. It is caused by a water mold, *Pytophthora ramorum*, and is related to other *Phytophthora* species that cause potato blight and Port Orford cedar root disease. Sudden Oak Death kills some species and individual plants rapidly. Other species may die back slowly, develop spots on the leaves and stems, or show almost no effects. Susceptible plants include members of the "red" oak group - coast and canyon live, black and Shreve oaks; as well as tanbark oak, California bay, rhododendron, and many other native and non-native species.

The disease was first found around Mt. Tamalpais in Marin county in 1995. It may have been imported to California from Europe on nursery shipments of rhododendrons. Rapid expansion of the number of dead and diseased trees and the geographical area affected occurred after wet winters and springs in the late '90's and again in 2004 through 2006. The disease is now confirmed to occur in California throughout the San Francisco Bay Area, and in coastal counties from Monterey to Humboldt. For more information on SOD, please see http://www.suddenoakdeath.org/.

The disease is well-established at SDSF and in surrounding areas, and effects tanoaks, coast live oaks, and other susceptible species throughout the Forest. The death of trees in SOD disease centers has created openings in areas formerly dominated by tanoaks. Research conducted as SDSF and elsewhere indicates that over time tanoaks will no longer be a dominant species in the overstory in these locations. Douglas-fir and bay trees are likely to become the dominant overstory species in these areas in the future.

SDSF is within the declared SOD Zone of Infestation (ZOI) established by the California State Board of Forestry and Fire Protection and is within the "Regulated Area" for SOD as designated by the California Department of Food and Agriculture. The ZOI and Regulated Area are identical and cover all portions of the 14 ~~fourteen~~ infested counties identified in the California Department of Food and Agriculture (CDFA) Section 3700: Oak Mortality Disease Control.

Federal regulations from the USDA-APHIS, and state regulations from CDFA address SOD concerns. CDFA regulations limiting the movement of host materials apply to forest management activities on SDSF including timber harvest, timber stand improvement activities, and harvest of minor forest products. Under the state regulation, host material cannot be transported from the Regulated Area unless accompanied by a compliance agreement. ~~The Forest Practice Rules (FPRs) do not specifically address SOD. However, w~~ Wherever a Zone of Infestation applies, the FPRs [14 CCR 917.9(a)] also requires that mitigations be included in Timber Harvesting Plans (THPs) to prevent the spread of the infestation. ~~The following section includes a discussion of the applicable regulations, descriptions of host material, the "free-from" protocol, what constitutes a "compliance agreement," and mitigation measures to prevent the spread of SOD.~~

A federal quarantine for *P. ramorum* was issued as an interim rule by USDA –APHIS, with the most recent rule dated February, 2007. For more information on the Federal rule see http://nature.berkeley.edu/comtf/pdf/APHIS-2005-0102-0001.pdf.

~~Host Material, The Oak Mortality Regulation~~

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~~This is a California state law (Section 3700 in Title 3 of the Code of Regulations). The law defines the regulated articles (plants or plant parts) and commodities (unprocessed wood, wood products, and any other product, article, or conveyance presenting a risk of spreading the pathogen). On CDFA's regulatory web page, with a link to APHIS' updated February 2010 host list, 46 proven hosts and 81 associated plants (nursery stock) are now regulated as either entire plants or specific plant parts thereof. To review this list and keep abreast of updates, consult CDFA's web site at http://pi.CDFA.ca.gov/pqm/manual/htm/455.htm.~~

~~Based upon currently available information, CDFA, the County Agricultural Commissioners, USDA Forest Service, and CAL FIRE have ranked the regulated articles according to their potential for transport of *P. ramorum* and believe that the highest risk for infected vegetation transport is from nursery stock of host species, followed by green waste, then firewood and logs. Lumber and manufactured wood products are not considered a risk for transport of *P. ramorum*. Soil is not included in California's regulations, but is in the federal regulations. Infested watercourses are not enforced in either. The enforcement rules are strictest for the highest risk regulated articles. Green waste is considered higher risk than firewood because the pathogen sporulates readily on leaves from tanoak, rhododendron, bay, and some other hosts. However, sporulation is rare on wood.~~

SOD is known to occur at ~~On~~ SDSF, and host material that is likely to be transported may consist of logs from host species produced as part of a harvest plan and ~~. In addition, there is the potential for minor forest products such as salvage sawlogs, firewood, and greenery to be moved from the regulated area.~~ minor forest products such as salvage sawlogs, firewood, and greenery.

~~Although SOD is present on the Forest, trained SDSF personnel will submit samples of symptomatic hosts and non-hosts to CDFA for confirmation of pathogen in new areas or on new hosts. As new hosts are confirmed by CDFA, the entire plant or specific portions thereof are amended to the rules as regulated articles. CDFA currently recognizes only RPFs, government agency personnel, and others that have been approved or attended specific CA Oak Mortality Task Force (COMTF) certified training as "official samplers." The COMTF training session attendance roster may act as a list of official samplers. Only an official sampler can complete a free-from survey as discussed below. The completed free-from survey, if part of an approved THP, will allow the plan to serve as a compliance agreement for a period of one year.~~

~~Regulated Area.~~

~~As of May 1, 2010, regulated counties are Alameda, Contra Costa, Humboldt, Lake, Marin, Mendocino, Monterey, Napa, San Mateo, San Francisco, Santa Clara, Santa Cruz, Solano, and Sonoma.~~

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Distribution of SOD

Check the following website for known infested areas: http://www.cnr.berkeley.edu/comtf/. Information on local distribution may also be obtained from the County Agricultural Commissioner's office or CAL FIRE.

State Regulation.

SOD can spread via host material. Therefore, plants, plant parts, unprocessed wood and wood products, and other products of the above mentioned hosts cannot be moved from counties infested with SOD without authorization by the County Agricultural Commissioner or CAL FIRE's and USDA Forest Service's harvest document approval process. The term "harvest document" refers to any document filed with the California Department of Forestry and Fire Protection that authorizes the removal of forest products for commercial purposes. See http://pi.CDFA.ca.gov/pqm/manual/htm/455.htm for California Department of Food and Agriculture's (CDFA) regulations regarding commodities covered and restrictions of their movement.

Compliance Agreement.

A compliance agreement is required to move regulated articles of host material from the regulated area. A compliance agreement may be obtained through the County Agricultural Commissioner's office. An inspector will complete an inspection and make a determination that all the regulations are understood, that compliance with the regulations will be achieved and that all provisions of the compliance agreement will be carried out. Once a landowner and USDA-APHIS sign a compliance agreement, the regulated host material may be moved interstate as stipulated in the compliance agreement.
A compliance agreement consisting of a free-from certification is only valid in California, as APHIS does not have allowance for free-from surveys in its regulations. A THP or other "harvest document" approved by CAL FIRE may also serve as a compliance agreement. An approved harvest plan without a free-from survey, but with approved SOD mitigation covering known hosts, will allow transport of host material from the regulated area. Approved plans with an incorporated free-from survey may act as a compliance agreement for a one-year period from the date of a documented negative result survey, or one year from the date of a negative reply from CAL FIREA to samples of symptomatic hosts.

Free-from Protocol

A *P. ramorum* "free-from" survey is a survey of land with host trees or shrubs that is done to determine if *P. ramorum* is present in the area in which a commercial operation will be conducted. All survey results are good for one year, unless symptomatic hosts are observed during that year. Transects would be run designed to cover representative areas of known SOD hosts. Transect width is variable to allow for adequate inspection. The official sampler must look for symptoms on all hosts along transects (also as approaching site, etc.). Samples will be sent to CDFA's Sacramento lab to confirm presence of *P. ramorum*. Since the survey is to determine

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presence or absence, if many symptomatic trees/shrubs are found, the survey may be stopped to wait for lab results. However, if *P. ramorum* is not found, the survey will need to be completed for the entire area.

Firewood sales on State Forest lands

Firewood sales for host material will not be permitted in areas with confirmed cases of sudden oak death (*P. ramorum*). Personnel setting up firewood sales must know how to recognize symptoms of *P. ramorum*. They should use the "free-from" protocol to determine if *P. ramorum* is present in the proposed firewood area. If *P. ramorum* is not detected in the "free-from" survey, the
operation is set up as usual with no further regulation for a period of one year. For firewood permits, a provision will be added to the permit explaining the current regulations, and that compliance is required.
On State Forest lands, where the public is required to have a permit to collect firewood, CAL FIRE shall uses this public contact to educate the person(s) about sudden oak death by providing a Pest Alert or other
information on sudden oak death along with the firewood permit. A provision is be added to the permit explaining the current regulations, and that compliance is required.

For Timber Harvesting Plans

If host material is to be moved intrastate from the regulated area, one of three procedures shall be followed:
1. A survey to determine the area is "free-from" *P. ramorum* is completed by Registered Professional Foresters (RPFs) or other official sampler. Symptoms of P. *ramorum* will be surveyed for during the timber cruise or pre-sale layout done to develop the Timber Harvesting Plan. If no *P. ramorum* is detected, the survey design and results may be incorporated into the plan. If the one-year free-from period expires prior to or during timber operations, a new free-from survey must be conducted and amended to the plan. Or,
2. If a free-from survey results in positive SOD finds, mitigation measures shall be written into the plan. At a minimum, mitigations shall include current regulations. In support of 14 CCR 917.9, the RPF is encouraged to add additional measures or Best Management Practices to limit the spread or build-up. Best Management Practices for forestry may be found on COMTF's web site at: http://nature.berkeley.edu/comtf/pdf/ForestryGuidelines.pdf. Or,
3. In lieu of a free-from survey, the RPF may assume that all known SOD hosts found on the plan area are infected, and appropriate mitigation measures shall be incorporated.

Forest Practice Rules Compliance

Pursuant to 14 CCR 917.9(a) for commercial harvest subject to the California Forest Practice Rules, and within the declared Zone of Infestation, the plans must identify feasible measures to mitigate adverse infestation or infection impacts during timber operations (PRC 4527).

Federal (APHIS) Enforcement Rules to Prevent Spread of SOD

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~~Regulated articles may be transported interstate from the regulated area only if accompanied by a certificate/compliance agreement which verifies the regulated articles have been treated according to measures in the federal register.~~

~~Acceptable treatments are:~~
~~1. Wood products such as firewood, logs, or lumber must be free of bark.~~
~~2. Soil (nursery industry) that has not been in contact with SOD-infected hosts and is free of duff, or soil which has been heat-treated at 180F for 30 minutes.~~
~~3. Wreaths, garlands, and greenery dipped for one hour in water held at 160F. Bay leaves used in wreaths also may be vacuum/heat treated.~~
~~4. Green waste may move to energy generation facilities under limited permits issued by the local Agricultural Commissioner.~~

Hazard Reduction for SOD

Severely diseased or dying oaks and tanoaks with stem infections are often attacked by bark beetles (western oak bark beetle and ambrosia beetles) and infected with decay fungi such as *Hypoxylon* spp. Trees with these secondary insect attacks and decay fungi may be structurally weakened and should be removed if adjacent to ~~high-use~~ roads~~, and~~ trails, or other high-use areas.

In addition, trees killed by SOD may lead to increased surface and crown fuels, thus potentially influencing fire behavior. In addition to addressing ~~Rather than just a~~ public safety issues, removal of dead and dying trees should also lessen fire intensity and reduce the risk of ~~surface and~~ crown fires in disease centers.

Further SOD Education

SDSF should make interested public parties aware that the COMTF keeps track of the latest information and links on sudden oak death at their web site, www.suddenoakdeath.org.

PITCH CANKER

SDSF staff will incorporate the most current best management practices as identified by the California Pitch Canker Task Force for controlling the distribution and spread of Pitch Canker. Very few pine trees exist at SDSF. ~~The following are management practices to be applied should pitch canker be identified on SDSF:~~

~~a. The timely removal and disposal of trees dying from pitch canker may help prevent the buildup of destructive beetles which can attack other trees, and can carry the pitch canker pathogen to uninfected trees. The disposal of pitch canker diseased material should be done on-site so as not to spread the disease to uninfested areas. Limbs and small pieces of wood may be left on-site or they may be chipped or burned. Logs cut from pitch canker diseased trees may be split for firewood for local use, but infected logs shall first have the stem cankered sections bucked from~~

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them. The remaining wood should be seasoned beneath a tightly sealed, clear plastic tarp to prevent the buildup of destructive insects. California Department of Forestry and Fire Protection Tree Note #3, Controlling Bark Beetles in Wood Residue and Firewood, provides specific guidelines for placing tarps over and around firewood. Do not stack pine firewood next to living pine trees or transport it to uninfested areas.

b. The distribution of the disease is discontinuous; thus, there are infested as well as uninfested areas within the ZOI. CAL FIRE pest management specialists continue to monitor for the disease. SDSF staff should report any symptomatic knobcone pines their CAL FIRE pest management specialist for determination of presence of pitch canker.

c. Directions for Registered Professional Foresters and Licensed Timber Operators:
° Know when you are working within an infested area.
° The California Department of Forestry and Fire Protection (CAL FIRE) has the authority to impose conditions on the commercial harvest of trees from timberland within the ZOI. Such actions are to be carried out on a case-by-case basis and depend upon the harvest operation's potential to contribute to disease spread. For all timber operations regulated by the Department, the Department must be informed if pitch canker is present within the operating area.
° Do not transport infected or contaminated material to areas that are free of the disease.
° When cutting or pruning a diseased tree, clean tools with a disinfectant before using them in uninfested areas. Lysol® is an effective sterilizer. Make sure that clients and co-workers are aware of these guidelines.

d. Directions for Firewood Cutters:
° SDSF personnel should be kept informed whether pitch canker is determined to be present on the Forest. Any suspect areas shall be avoided for firewood harvest until an official determination is made as to presence or not of the disease. At time of firewood permit issuance, SDSF personnel shall direct firewood cutters to disease free areas of the Forest. Information on pitch canker disease recognition and regulations shall be provided with the collection permit in the event pitch canker becomes present on the Forest.
° Tools and machinery that are used to cut trees with pitch canker disease WILL BECOME CONTAMINATED with the pitch canker fungus. There is little chance of spreading pitch canker if contaminated tools are only used on dead trees or on trees that are not pines. However, if contaminated tools or machinery will be used on living pines, the tools should be cleaned and sterilized before use on uninfected trees or in uninfested areas. Lysol® is a suitable sterilizer for this purpose. A logical alternative to repeated cleaning of equipment is to reserve one set of equipment for use only in infested areas, and another set for use only in uninfested areas.
° Do not transport pine firewood out of infested counties (Santa Cruz County is an infested county). Sell pine firewood locally using local use guidelines.

e. Directions for Other Forest Product Harvesters:
° SDSF personnel, at time of collecting permit issuance shall direct collectors to disease-free areas of the Forest. Information on pitch canker disease recognition and regulations shall be provided with the collection permit.
° Collectors shall not be permitted to remove pine products from trees infested with pitch canker

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~~disease.~~

~~f. Directions for Reforestation in Areas Affected by Pitch Canker:~~
~~° Material for replanting should be as local in origin as possible to retain the genetic integrity of the local population.~~
~~° Option 1. The preferred strategy for reestablishing knobcone pine would be to allow natural regeneration to occur. Site improvement to encourage regeneration may be required where a dense overstory precludes the development of a seedling stand. Where natural regeneration does occur, it can be expected that pitch canker will eventually infect some or most of the young trees. However, the trees will vary in their susceptibility and some may sustain little or no damage. This is the least intrusive approach to reforestation, with the possibility that a level of pitch canker resistance will be attained that eventually provides the desired density of mature trees.~~
~~° Option 2. If option one is acceptable in principle but there is insufficient seed to produce a stand, locally collected seed could be introduced. By collecting seed from asymptomatic trees, there is more likelihood that some are resistant, and a certain percentage of the progeny will carry this trait as well. It is thought that a small percentage of resistant individuals may be sufficient to establish a stand. To diversify the seed source, it is recommended that seed be gathered from: (1) multiple trees, at least 100 meters apart where possible, (2) trees of differing ages, and (3) different heights within the same tree. Trees that have been planted should be avoided, as they may be non-local in origin. In addition, trees with evidence of disease, especially western gall rust, should not be used as a seed source.~~
~~° Option 3. The least desirable measure for maintaining knobcone pine presence is to transplant known resistant seedlings from a reputable source. The potential loss of genetic integrity could result in a nonnative stand. However, there is currently no program identifying genetically resistant knobcone pines.~~

TREE SQUIRRELS

Tree squirrels may damage sapling redwoods by stripping the bark from upper stems. This causes partial or complete girdling, leading to either top kill or sapwood decay. As damage from squirrels is associated with dense second growth redwood stands, thinning is the only recommended management action. Where trees are more widely spaced, squirrel damage will generally be reduced.

PLANNED ACTIONS

1. Continually monitor the Forest for signs of pests and notify the CAL FIRE ~~CDF~~ Forest Pest Management Specialist of any findings. Take action as needed to minimize or eliminate any problems.

2. Thin dense stands of trees where necessary to maintain healthy growing conditions.

3. Provide applied forest pest research opportunities to interested agencies, institutions, or organizations.

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4. Coordinate with Santa Cruz County in the detection of and protection against gypsy moths or other introduced pests.

5. Continue to remove dying and dead trees adjacent to high-use roads, trails and other facilities.

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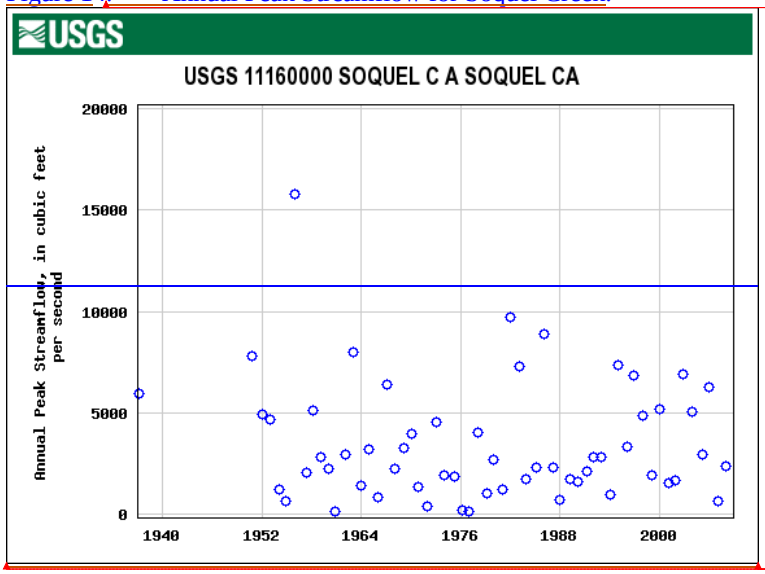
WATERSHED ASSESSMENT

PHYSIOGRAPHY OF THE WATERSHED

SDSF is located almost entirely within the drainage of the East Branch of Soquel Creek, its landbase covering approximately 21 percent of the basin. For the most part, the Forest is underlain by fine grained sedimentary rocks that are highly weathered and easily eroded. The headwater channel of the East Branch follows the San Andreas Fault Rift Zone and is heavily disturbed from landslides triggered by earthquake activity. Hillslopes throughout the Forest are commonly steep and prone to large, deep-seated landslides. Even greater instability occurs in active inner gorge zones near stream channels. When compared to mass erosion events (e.g., large landslides), surface erosion of the loamy soils is of minor significance.

As stated in the Property Description chapter, the Soquel Creek watershed has a Mediterranean climate with cool, wet winters and warm, dry summers. Mean annual precipitation in the East Branch watershed varies from 30 to 46 inches and takes place primarily between November and April. Discharge records from the USGS stream gauging station located immediately upstream from the bridge in the town of Soquel show that the average discharge is 1.05 cubic feet per second per square mile. High intensity, long duration winter storms, however, produce extreme levels of runoff. ThisMajor floods occurred during December, 1955 andthe January, 1982 runoff event, producing log jams and flooding in the town of Soquel (Lassettre and Kondolf, 2003; see Figure 16). Singer and Swanson (1983) state that the villageSoquel has a chance of being flooded once every seven to ten years.

Figure 14. Annual Peak Streamflow for Soquel Creek.



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BENEFICIAL USES

The two main beneficial uses of the East Branch of Soquel Creek are cold water fisheries and water supplies for various purposes. The East Branch supports spawning and summer rearing habitat for coho salmon and steelhead trout, but the number of returning fish has declined significantly in the past 2540 years (refer to the Fisheries chapter). For example, in 1982 steelhead populations were only one-third to one-quarter of what they were thought to have been 30 years agoin the 1960s (Singer and Swanson, 1983). Coho salmon were thought to be extirpated from the Soquel Creek basin since 1968 (SCCRCD 2003, NMFS 2010), but 170 young-of-the-year fish were documented during surveys conducted in a stream reach below SDSF in August 2008. The major factors limiting anadromous fish populations are believed to be low summer flows, and limited rearing habitat due to siltation of pools and removal of woody debris. Large wood loading, floodplain connectivity, and estuary function were listed as poor for the Soquel Creek watershed in the draft Central California Coast (CCC) coho salmon recovery plan (NMFS 2010). The East Branch of Soquel Creek is considered to be the southern most extent of coho salmon in California.

The other primary beneficial use in the main stem of Soquel Creek is water supply. There are eight dams in the Soquel Creek watershed that impede or block anadromous salmonid migration (NMFS 2010). Additionally, n Numerous small diversions exist that provide water for domestic, agricultural, and industrial purposes. Two permitted domestic water supply systems exist in the main Soquel Creek watershed that utilize surface flow, but apparently there are no permitted systems utilizing surface water in the East Branch basin. The East Branch Soquel Creek watershed assessment conducted in 1993 reported that there were six surface water diversions in the East Branch basin (Cafferata and Poole 1993). The largest diversion in the East Branch is operated by the Olive Springs Quarry.

Diversions and overdrafting of groundwater in low discharge summer months have dewatered portions of the East Branch [p.22] stream channel during drought years. This is likely to be a critical limiting factor for the fisheries resource in the lower part of the basin. The largest diversion in the East Branch is operated by the Olive Springs Quarry. After complaints by the city of Capitola in 1988, the State Water Resources Control Board concluded that a watermaster was needed to effectively regulate water use under low flow conditions, particularly during drought years, due to the complicated interrelationships of the water rights on Soquel Creek (Cafferata and Poole, 1993). To date, however, no watermaster has been appointed (Alley and Associates, 2004).

LAND USE HISTORY

The major types of land use in the East Branch watershed are timber management, recreation on public land, ranching, and residential development. The East Branch watershed's long history of timber harvesting began with clearcutting in the 1870's and continued into the 1940's. Timber was originally removed by oxen (1870-1895), then by steam donkey (1895-1930), and finally by crawler tractor. Following World War II, selective harvesting replaced clearcutting, continuing

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to the present day. Currently, nearly all of the old-growth timber has been harvested except for minor reserved groves and widely scattered suppressed trees. Second-growth harvesting has taken place on approximately 881790 acres over the past 10 years. In recent years, cable yarding has been used along with tractor logging to selectively harvest timber in the basin. Approximately 20 percent of the basin is dominated by chaparral and has never been harvested.

Recreation in the form of hiking and mountain biking takes place primarily in The Forest of Nisene Marks State Park and SDSF (SDSF also allows horseback riding). Additionally, adjacent property owners often allow friends and neighbors to utilize their lands as an access route to the park or SDSF. The Olive Springs Quarry, located near the East Branch channel, has produced sand and gravel from granitic rock exposed along the Zayante Fault for over 3045 years. Residential development has occurred in the chaparral communities and has steadily expanded over the past 2540 years. Over the whole Soquel Creek watershed, housing development is rated as moderate to high, with approximately 7,000 housing units present in the basin. Residential and commercial development is considered a very high threat to coho salmon (NMFS 2010).

Approximately 20 percent of the basin is dominated by chaparral and has never been harvested.

CUMULATIVE WATERSHED EFFECTS ASSESSMENT

Cumulative watershed effects (CWE) can be defined as the combined impacts on the beneficial uses of water physical and biological impacts that result from multiple land use disturbances over space and time. These impacts occur within and away from the locations of actual land use and are transmitted through the fluvial system. When considering CWE, it is appropriate to estimate how current and future projects, when combined with impacts from past activities, will influence beneficial uses present in the basin under review. Techniques to determine whether CWE are significantly adversely impacting beneficial uses have been developed, but are generally considered to be inadequate for varying reasons. Existing CWE assessment approaches mostly range from checklists or indices that are subjective but inexpensive and simple, to complex physically based models that have large data needs and are difficult to apply (Litschert 2009).

Watershed analyses and assessments are often used to evaluate cumulative watershed effects. For example, Berg et al. (1996) found that watershed analysis was the most suitable approach for assessing cumulative watershed effects in the Sierra Nevada. While a formal watershed analysis has yet to be completed for the Soquel Creek watershed, several watershed assessments and studies have been completed over the past 30 years that contribute a considerable amount of information regarding cumulative watershed effects. These studies include: Singer and Swanson (1983), Cafferata and Poole (1993), Santa Cruz County Resource Conservation District (2003), Alley and Associates (2003, 2004), Balance Hydrologics (2003), Greening Associates (2003), Pacific Watershed Associates (2003), and Lassettre and Kondolf (2003).
resource professionals acknowledge that no fully adequate method yet exists. The methods utilized here are based on the best current knowledge available to address the problem.

SDSF's Cafferata and Poole's rapid landscape-level watershed assessment for the East Branch of Soquel Creek CWE assessment was conducted in 1992 and 1993 by CDF Hydrologist Pete

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Cafferata, UC Santa Cruz student Chris Poole, and Forest staff. It is described below in considerable detail. Since specific harvest units had not been defined, the entire Forest served as the project area for this assessment. CWE assessment guidelines suggest that a. The assessment areas was the East Branch itself, which encompasses areas outside of the Forest. (Assessment areas must be large enough to detect past impacts and small enough to determine what the impacts of the proposed projects will be on the area.) The CWEThis assessment completed for the East Branch watershed evaluated the current condition of stream channels in the basin and determined how they would likely be altered with future timber operations.

The CWE analysiswatershed assessment for SDSF was broken down into two main tasks: a stream channel inventory and a hillslope erosion/sedimentation evaluation. The stream channel inventory was completed in 1992 and illustratesd the current condition of the channel network within the assessment area. Channel stability was rated with the U.S. Forest Service's Pfankuch Method, while channel condition was evaluated with CDF's Guidelines for Assessment of Cumulative Impacts (Poole, 1992CDF, 1994). Due to limited personnel and time constraints, stream channels within SDSF were analyzed in greater detail than channels located in other areas of the basin (Poole, 1992.

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The hillslope component of the CWE evaluation was completed in the summer of 1993. Quantitative estimates of erosion risk and erosion volumes associated with anticipated activities (e.g., timber harvesting and road building) were made based on the results of the Critical Sites Erosion Study (CSES; Lewis and Rice, 1989; Rice and Lewis, 1991). A selected number of random sample locations were installed on existing, planned, and abandoned roads, as well as past harvest areas. The resulting data was input into equations to estimate the risk of generating critical, or large, erosion sites (i.e., a large erosion event producing more than 100 cubic yards per acre). These equations are based on measurements made for slope, amount of hillslope or road curvature, soil color, and rock hardness.

On-site measurements were made to assess other sources of erosion not addressed by the CSES. Estimates were then made of the amount of sediment that could result from the approximated erosion. The significance of the estimated sedimentation was studied by comparing it with expectations of sediment yield for Soquel Creek. Since long-term sediment data from the Soquel Creek basin was not available, information from the San Lorenzo River, a similar, neighboring basin, was used. The methodology utilized for the hillslope erosion and sedimentation analysis was designed by Rice (1993) and hwas been used in several parts of the state in the 1990's.. Results of the CWE study are reported in Cafferata and Poole's Watershed Assessment for the East Branch of Soquel Creek (1993).

FINDINGS

Locations in the East Branch assessment area that were found to have poor stability and channel conditions were Amaya Creek, Hinckley Creek, and the East Branch between Ashbury Gulch and the upper SDSF boundary. The reaches with the best ratings for stability (high-fair) and channel conditions were the upper part of the East Branch above SDSF and the main stem of Soquel Creek below the junction with the West Branch. Intermediate in stability and channel conditions

~~were tThe reaches of the East Branch between Ashbury Gulch and the junction with the West Branch were reported as having intermediate stability and channel conditions.~~

~~Summarizing the results for the 10 miles of the East Branch surveyed, fair channel stability was the generalmost frequent finding (10% good, 67% fair, and 23% poor). (This compares reasonably well to the fair/poor relative overall rating for sediment and log contribution assigned to the East Branch by Singer and Swanson [(1983]). The exception was the highly impacted reach along the San Andreas Rift Zone. Additionally, the major tributaries were severely degraded by heavy landsliding activity. Very large quantities of sediment are stored in these headwater tributaries, as well as in wide, vegetated terraces along the lower reaches of the East Branch.~~

~~Observation of the East Branch channel revealed that riffle stretches generally had cobble and gravel sized particles protecting the stream bottom surface. Inspection of stable pools below Ashbury Gulch, however, showed that this habitat type contained significant percentages of fine sediment.~~

~~Large woody debris was not found to be blocking anadromous fish passage in the East Branch, but was limiting habitat use in the major tributaries. Large wood was generally lacking along most of the East Branch of Soquel Creek below Ashbury Falls, except where it had accumulated in a few fairly stable locations . Wood has accumulated in a few fairly stable locations but is lacking in the remainder of the channel. Large woody debris is valuable because of the pool habitat for young steelhead salmonids, that forms around it in gravel dominated stream systems.~~

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~~Results of the hillslope evaluation indicate that the risk of generating critical erosion sites is not significantly different from the average for the rain-dominated portions of the northern Coast Ranges in California (Cafferata and Poole, 1993). Very large amounts of existing erosion were measured on a few of the plots, however, and existing erosion was found to be considerably higher than the amount estimated from the critical site equations. For example, one of the road plots had a culvert that had carved an exceptionally large gully below its outlet, while another had large amounts of cut and fill slope erosion 50 feet from a Class II stream. Therefore, the potential for producing large erosion events is clearly evident in this terrain, even though the critical site equations did not generate exceptionally large estimates.~~

~~The terrain slope and distance to a Class II stream were used as an index of the proportion of erosion which would become sediment. The average sediment delivery was found to be much higher than is commonly assumed in forested watersheds. This is due to very high delivery from relatively few plots with extensive amounts of existing erosion. Long-term sediment data does not exist for Soquel Creek at the USGS gaging station; the nearest station with long-term discharge records and a reasonable sediment record is found on the San Lorenzo River at Big Trees State Park. A s Statistical analyseis have inindicated that peak storm discharges on Soquel Creek wereare significantly related to those of the San Lorenzo River. The peak storm discharge/annual sediment yield relationship generated for the San Lorenzo River was then used to estimate the annual sediment yield at Soquel Creek.~~

Extreme natural variability in sediment yield for Soquel Creek was found for 1952 to 1990, with the range spanning several orders of magnitude. The estimate of mean annual sediment yield based on the stream discharge record for Soquel Creek (~1,500 yd3/mi2/yr) was somewhat higher than that calculated based on hillslope erosion plot measurements (documenting the impacts of roading and past harvesting). Due to the assumptions involved in making these estimates, however, it is unlikely that these estimated sediment yields are significantly different. Both estimates of sediment discharge for Soquel Creek are high for forested areas and illustrate the erosive nature of the basin. Cafferata and Poole (1993) concluded that it was It is unlikely, however, that the limited timber harvesting and rebuilding of abandoned roads planned for SDSF willwould significantly elevate the erosion rate and have a significant adverse impact on the aquatic system. The anticipated sediment production from SDSF's timber production iswas found to be small compared to the range of variability in sediment flux observed in this basin.

More recent watershed assessment work in the Soquel Creek watershed can be compared to the results of the Cafferata and Poole (1993) rapid assessment. For example, Lassettre and Kondolf's (2003) much more detailed large wood study included the lower part of East Branch of Soquel Creek. They reported an average large wood loading for this reach of 0.005 m3/m2, which they stated lies at the low end of the range of observed values for North American streams (e.g., approximately 36 times lower than for old growth coast redwood forests in Humboldt County). Similarly, Alley and Associates (2003) reported that large wood was extremely scarce in Soquel Creek compared to other coastal streams recently surveyed.

Large wood loading in the East Branch of Soquel Creek is low due to extensive log removal efforts by Santa Cruz County from the 1950's to the 1990's. The Santa Cruz County RCD watershed assessment (SCCRCD 2003) concluded that the scarcity of large wood limits juvenile salmonid production throughout the Soquel Creek watershed. Similar to other studies, their assessment states that large wood is scarce in the middle part of the East Branch and recruitment is low for this channel reach.

Balance Hydrologics (2003) reported that Soquel Creek has experienced prolonged periods (up to 25 to 30 years) of disturbed watershed conditions over the past 150 years. These conditions, they found, were caused by both natural processes and anthropogenic activities with the later likely resulting in an increase in the natural, base rate of sediment production in the watershed, although small relative to natural rates.

The Santa Cruz County Resource Conservation District (2003) watershed assessment project concluded that overall lateral channel stability of Soquel Creek was relatively high during the past 54 years with minor adjustment at several points of meander along the East Branch and mainstem. Major sediment production from natural sources was found to occur in both the East and West Branches and is most pronounced following earthquakes, large magnitude floods or forest fires, and is usually related to landsliding.

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The SCCRCD (2003) assessment states that several factors appear to limit distribution and abundance of steelhead. These factors include passage impediments, poor spawning habitat quality (high proportion of fine sediment, number of constricting, steep riffles below spawning glides), low spring and summer baseflows, limited amount of escape cover (provided by instream wood, undercut banks, unembedded boulders, water depth itself), elevated water temperature, and limited water depth. Throughout the watershed, low baseflows and sedimentation limit the amount and quality of rearing habitat.

PWA (2003) inventoried the SDSF road network (18.2 miles) and found 82 sites with significant sediment delivery potential. Fifty seven of these sites were at stream crossings. Three crossing sites were identified as having a high treatment immediacy, with a potential sediment delivery of approximately 1,631 yds3.

CONCLUSIONS

In summary, it can be stated that the East Branch of Soquel Creek watershed is a highly sensitive basin. This is due to its inherent natural hillslope instability related to seismic forces, steep slopes, weak bedrock, and frequent high intensity rainfall. Impacts from past management activities, prior to modern California Forest Practice Rules, have contributed to degraded conditions in the basin, as has residential development.
The East Branch system is stressed by fine sediment moving downstream from tributaries, partially due to its close proximity to, and the San Andreas Fault Zone. This material is filling pools, required for rearing habitat for listed anadromous salmonids. Lack of sufficient volumes of large wood and overdrafting of water in low flow summer months compounds theis problem. As a result, the aquatic environment is sensitive to further degradation and timber operations must be carried out with extra caution.

Due to the sensitivity of the hillslopes and current channel conditions, special considerations will beare needed when planning forest management activities in the East Branch. Appropriate mitigations must continue to be utilized and remedial improvements implemented to repair existing problem areas, such as those suggested in the PWA (2003) report. If these considerations are employed, future timber sales can occur without significant adverse impactsfurther degradation to the beneficial uses of the basin.

MONITORING AND ENHANCEMENT

Ongoing management of SDSF will involve maintaining proper drainage along roads and trails by repairing culverts, water bars, and other drainage structures to reduce or prevent soil erosion and stream sedimentation. An active watershed remediation program will continue to be developedused that includes monitoring watershed conditions and implementing enhancement projects. Monitoring has includesd a forestwide inventory of stored sediments and active landslides, and mapping mass wasting hazards and surface erosion potential in Amaya Basin. Landscape Sediment risk reduction projects will behave been rated for cost-effectiveness (PWA, 2003) and will be implemented in conjunction with future timber operations according to their

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priority as available funding permits.

PUBLIC COMMENTS AND CONCERNS

Public comments regarding the East Branch watershed have focused on its distinction and sensitivity. Individuals are concerned that forest management activities will result in general watershed degradation, including siltationsedimentation of streams and excessive hillslope erosion. This is particularly important to them in regards to steelhead numbers and habitat, and possible impacts upon their land during high intensity rainfall. As stated in this and other chapters, careful pre-project evaluation and measures to ensure the maintenance of watershed integrity are a priority for SDSF. The CWE assessment work discussed above and other studies assistwill help the Forest staff to understand and manage for the sensitive nature of the basin.

MANAGEMENT GUIDELINES

1. Design streamside management zones that properly address the inherently unstable nature of the East Branch watershed in SDSF. This may includes extending zone widths beyond the standards set by the California Forest Practice Rules, for Class I fish-bearing watercourses, as is appropriate in sensitive areas. These zones must provide for the long-term recruitment of large woody debris, protection of the stream channels and banks, stream shading, sediment filtration, nutrient input, microclimate control, floodplain function, and prevention of significant ground disturbance.

2. Place heavy emphasis on road design and maintenance, since roads generally produce the largest percentage of, most management-related sediment in the forested environmentwatersheds. New seasonal and temporary roads should be outsloped to avoid concentrating water that could trigger landslides or transport sediment directly into flowing streams. Of foremost concern for new road construction is the avoidance of localized unstable areas. For mainline roads, road drainage structures and watercourse crossings must be adequately sized to ensure that the risk chance of failure is minimized. Roads no longer needed must be properly abandoned. Wet weather use for roads impacting flowing streams should not occur and an active winter maintenance program is needed to ensure that drainage structures are adequately functioning. (Refer to the Roads And Other Improvements chapter for more information.)

3. No tractor operations will be permitted on slopes which average more than 35 percent without site-specific evaluations of slope stability and erosion potential. This will depend on the ability to mitigate such operations to levels of insignificance.

PLANNED ACTIONS

1. DevelopContinue to utilize a document that will records data on all timber operations activities done in the Forest that could influence soil and water resources. This

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~~document, titled Timber Operations History, is will become part of an ongoing watershed workassessment. For example, information on road construction and harvesting dates as well as the harvesting systems and site preparation techniques utilized would beare recorded and mapped.~~

~~2. Develop a simple long-term in-channel monitoring program to document changes in the critical component of pool space for anadromous fisheries. Pool space can be used to evaluate and monitor channel conditions and detect and evaluate sediment sources. Sedimentation levels will be monitored at a minimum of four pools. The same pools will be monitored annually through 1999 and periodically thereafter. (Refer to Appendix C, Monitoring Plan.)~~

~~Implement the treatment priorities for high and moderate risk inventoried sediment sources in the Soquel Demonstration State Forest watershed assessment area developed by PWA (2003).~~

~~3. Inventory, delineate, describe, and risk-rate active landslides and substantial unconsolidated concentrations of sediment and debris in the Forest by June 30, 1999. Also, identify, design, and prioritize feasible projects to reduce the risk of failure of high- or extreme-risk landslides and sediment-debris stores, and estimate the cost-effectiveness of each such project by June 30, 1999. A certified engineering geologist will be consulted for these projects. (Refer to Appendix C, Monitoring Plan.)~~

~~. Evaluate the performance of each previously implemented remediation project to determine the success in reducing the risk of large-scale sedimentation. Redesign and modify any project not meeting its intended objective. (Refer to Appendix C, Monitoring Plan.)~~

~~Prepare a map of Amaya Basin depicting risk of mass movement by December 31, 1998. The map will delineate risk classes for deep- and shallow-seated mass movements and for surface erosion. A certified engineering geologist will be consulted for this project. (Refer to Appendix C, Monitoring Plan.)~~

CHAPTER 13: ARCHAEOLOGY

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INTRODUCTION

An archaeological and historical field survey of SDSF was conducted during the summer of 1991. The chief investigator was Dr. Brian Dillon, a consulting archaeologist associated with the California State University at Northridge. In March of 1992, an archaeological and historical report was generated from the survey. In addition to study results, this report also includes information from an archival records research and an extensive oral history interview process. During the survey, Dr. Dillon and his crew discovered six archaeological sites within the State Forest boundaries: two prehistoric and three historic sites as well as one site with both prehistoric and historic features. For a detailed account of the archaeology and history of SDSF, refer to Archaeological and Historical Survey of Soquel Demonstration State Forest, Santa Cruz County, California (Dillon, 1992). Additional studies covering SDSF history and archaeology are listed in the References section of this management plan.

The significance of each site was determined by its archaeological and historical value, as outlined in state and federal guidelines. Significance, as defined by these guidelines, is based on uniqueness and preservation, with both considered in the determination of a site's value. Unique refers to how many other similar features exist (on other sites), while preservation refers to the condition of the features remaining on the site. A site is not considered significant if it, although unique, has been completely destroyed as there is nothing left to protect or study.

A confidentiality policy exists which limits public disclosure of sensitive archaeological and historical resources. Consequently, site locations in SDSF with moderate to high levels of significance will not be revealed to the general public. The confidentiality policy protects the resources from artifact collection, site excavation, and vandalism. The policy was approved by the State Historical Resources Commission under authority of Public Resources Code Section 5020.4 (c).

~~For a detailed account of the archaeology and history of SDSF, refer to Dillon's Archaeological and Historical Survey of Soquel Demonstration State Forest, Santa Cruz County, California (1992). The following is a brief description of the six archaeological sites found in SDSF and a discussion of their significance, as determined by Dillon.~~

Since 1991, at least five additional archaeological surveys have been conducted on SDSF. Citations of these surveys—most of which were carried out for the preparation of timber harvesting plans (THPs) and included limited portions of the Forest—are included in the References section of this document. As a result of these surveys and the initial one conducted by Dr. Dillon, most of the Forest has been examined at least once for archaeological resources. Surveys conducted since 1991 have resulted in the identification and recording of additional archaeological features at two of the sites first identified during the 1991 survey, two additional

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prehistoric archaeological sites and nine historic-era sites. The following is a brief description of the sites recorded to date within SDSF.

PREHISTORIC SITES

The prehistoric era is believed to have begun on the central coast about 4,000 years ago. The most active times were during the Late Prehistoric Period, 1000 - 1600 AD, when hundreds of sites were established. The prehistoric sites found in SDSF are from this Late Prehistoric Period.

SITE DESCRIPTIONS

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P-44-000328 (CA-SCR-296)

This site contains bedrock mortars and rock art. It may also contain subsurface deposits. The ~~rock art~~presence of petroglyphs - consist~~s~~ing of multiple cupules on a ~~bedrock~~sandstone boulder – prompted Brian Dillon to declare this ~~, and is~~ the ~~only~~first cupule site to be~~one~~ recorded on the Pacific Coast between Monterey and Marin Counties. The site was probably a temporary camp set up during the summer and fall months to collect acorns and to fish for steelhead. The uniqueness and preservation of this site are both high, and it has the highest level of significance of all the sites found within SDSF.

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P-44-000329 (CA-SCR-297/H)

This site has both prehistoric and historic features. The prehistoric feature is a ~~bedrock~~sandstone boulder with multiple mortars. ~~It is well preserved but not unique, and therefore has a low level of significance. Combined with t~~The historic features is, according to Dillon, "…a split-redwood corral dating to the depression era of the 1930s."~~the site has a moderate level of significance.~~

CA-SCR-298

This site contains a ~~bedrock~~sandstone boulder with a single mortar hole. ~~It is well preserved, but not unique to the county or the state. The site has a significance value of low.~~

P-44-000544(CA-SCR-346)

This site consists of a concentration of mortars and cupules observed on the surfaces of several sandstone outcrops and a sandstone boulder located on a midslope bench.

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P-44-000 (CA-SCR-) [Numbers not yet assigned]

This site consists of several mortars on the surface of a sandstone boulder. Although the site has

been recorded, a Primary Number and Trinomial have not yet been assigned.

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HISTORIC SITES

The Historic Period began along the central coast in 1769 and continues to the present day. The historic sites found in SDSF span from the Mexican Period, 1822 - 1848, to the Anglo-American Period, 1848 to present. The most recent site in the Forest, however, dates back to World War II.

SITE DESCRIPTIONS

~~CA-SCR-297/H~~

~~As previously mentioned, this site contains both prehistoric and historic features. The historic feature is, according to Dillon, "a split-redwood corral dating to the depression era of the 1930's." It is interesting to note that this corral is now located in a dense stand of second-growth redwoods, whereas 60 years ago it must have been an open site. The corral is fairly well preserved and considered unique regarding forest recovery. Historically, the significance value is high, but overall, including the low prehistoric significance value, the site has a moderate level of significance.~~

CA-SCR-299H

This site contains the remains of a sawmill that was in use until the mid-1940's. The buildings surrounding the mill were bulldozed in the 1960's. ~~The site is neither unique nor well preserved and has a low significance value.~~

CA-SCR-300H

This site contains a sawpit that was likely used approximately 165~~150~~ years ago to saw large logs into smaller sizes. ~~The sawpit is fairly well preserved and somewhat unique. The significance level for this site is moderate.~~

CA-SCR-301H

This site contains the remains of a ~~sulphur baths and~~ resort and sulphur baths that were very popular from the late 1870's to the early 1920's. ~~Unfortunately, it has not been well preserved, though it is somewhat unique. The significance level for the site has been determined to be moderate.~~

P-44-000545 (CA-SCR-347H)

This linear site consists of a 5,650-foot long segment of old dirt road that corresponds in location to a road labeled “Old Spanish Ranch Road” on the “Official Map of the County of Santa Cruz” (Punnett Brothers, 1906). The road prism was probably built before 1898 and possibly as early as 1856. Historic features identified at various points along it include portions

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of split redwood post and barbed wire fence and remnants of an old fruit orchard located on an adjacent parcel of privately-owned land.

~~PUBLIC COMMENTS AND CONCERNS~~ *THE FOLLOWING PUBLIC COMMENTS WERE RECEIVED DURING REVIEW OF THE 1998 GENERAL FOREST MANAGEMENT PLAN*

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Following completion of the archeological study in SDSF, members of the public expressed a desire to learn about Dr. Dillon's discoveries and their significance. Individuals were interested in research or other studies that might result from the findings as well as seeing the archeological sites. Eventually, all sites of moderate and high significance will be more thoroughly evaluated and, depending on the results, may be available for public viewing.

MANAGEMENT GUIDELINES

1. ~~Archaeological and historical sites~~Heritage resources on SDSF will be protected, especially during planning and management activities including timber harvesting, recreation, and forestry education.

2. Sites with moderate to high significance value will be preserved and kept confidential, as per the State Historical Resources Commission and Public Resources Code. If, after thorough and careful study, it is determined that certain sites can endure limited public use, they may be made accessible to the community.

3. Educational opportunities, including the display of resilient historic features, will be incorporated into SDSF's Demonstration and Forestry Education programs.

PLANNED ACTIONS

1. Provide the opportunity for scientific study and research of all archaeological and historical resources. Researchers working with sites of moderate or high significance will be expected to uphold all confidentiality policies.

2. After extended study of all archeological sites, create interpretive material for those sites determined to be safe from public harm. Information may be made available through signs, brochures, and staff or docent-led tours of historical areas.

3. Research additional historic information including maps, photographs, written documents, and interviews.

CHAPTER 14: ROADS AND OTHER IMPROVEMENTS

SDSF FACILITIES

The first development of roads within SDSF can be traced back to the mid-nineteenth century. According to local historian Ron Powell (Rancho de Palo de Yesca: the Soquel Augmentation Rancho, n.d.), the Santa Cruz Gap Turnpike (an arterial between Santa Cruz and the Santa Clara valley) was completed in May of 1856. This road included parts of what are now Hihn's Mill Road, Long Ridge Road, and Spanish Ranch Road. Further development of roads occurred when Frederick A. Hihn acquired the SDSF property in 1864.

In the 1870's, Hihn built Sulphur Springs Road to reach his Sulphur Springs Resort as well as a private road for logging and mill access. These roads, along with segments of the Santa Cruz Gap Turnpike, created what is now known as Hihn's Mill Road. This route extends from the Olive Springs Quarry to the parking area off Highland Way and originally included most of what is now Sulphur Springs Road. Additionally, logging by Jared and Seth Comstock in 1878 led to the construction of Comstock Mill Road and portions of Robinwood Lane.

The remainder of the roads in SDSF were constructed by the three timber companies that owned the property after Hihn. This later road construction started with the Monterey Bay Redwood Company in 1924, continued through the CHY Company ownership in the 1960's and 1970's, and ended with the Pelican Timber Company in the 1980's. Figure 19 ~~5~~ shows the locations of all existing forest and access roads.

The only portion of SDSF that does not contain roads is the area south of Badger Springs to Santa Rosalia Ridge. This area is bordered by Sawpit Trail (see the Recreation chapter for information on trails) on the east, the East Branch of Soquel Creek on the northwest, and the Forest boundary on the south. Steam Donkeys were used to log this section prior to the introduction of crawler tractors, so no major roads or trails were built. Scars on the slopes above Badger Springs are still evident from this type of logging.

The only bridges associated with SDSF cross~~es~~ the East Branch at the Highland Way entrance and a short distance upstream from the entrance of Amaya Creek on Hihn's Mill Road . The Highland Way bridge ~~. It~~ is a narrow nine-foot wide railroad car bridge supported by earthen abutments. Future plans call for replacing this bridge with a wider structure. This bridge and the nearby parking area are located on the Burch property. The second bridge, Hihn's Bridge, is a 90-foot-long rail flatcar bridge installed by CAL FIRE in ~~?~~1999. Hihn's Bridge was built as part of the contract with the timber purchaser for the Amaya THP #1-98-027 SCR. Plans for the Hihn's Bridge are part of the THP and additional reports and plans are stored at the SDSF office. The load rating for this bridge as determined by the California Department of Transportation is MS-18 or HS-20. The point load capacity is 200,000 to 240,000 pounds. At the time the bridge was built it cost about $120,000.

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LEGAL ACCESS

When the State acquired the major portion of the Pelican Timber Company's holdings along the East Branch in 1988 (refer to the Administration chapter for details), the property was inaccessible from county roads. The Forest is surrounded by private property on three sides and The Forest of Nisene Marks State Park (largely undeveloped) to the south. To ensure access, two deeded right-of-ways through private property were granted at the time of acquisition, providing for both administrative and public access.

The first right-of-way is through the Burch property to the east of SDSF. This route includes 0.7 miles of Hihn's Mill Road out to Highland Way, and provides the only public vehicular access to SDSF. (Vehicles are not allowed in the Forest but can drive to and park in a designated area just off of Highland Way.) The second right-of-way is through the CHY Company property to the southwest of SDSF and includes ~~1~~ one mile of Hihn's Mill Road from the Forest boundary to the Olive Springs Quarry. Olive Springs Road, which connects with the major arterial of Soquel-San Jose Road, can then be accessed through the quarry for administrative purposes only.

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DRIVABLE ROADS

All drivable roads in SDSF have been evaluated for safety and stability and are open to varying degrees of seasonal vehicular use. A number of old logging roads and constructed skid trails in the Forest, however, still need to be accurately mapped and have their suitability for reuse determined. Table ~~8~~ 10 is a summary of the drivable roads in SDSF with information on the road name, length, and location.

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PUBLIC ACCESS ROADS

County roads leading to SDSF access points include Olive Springs Road, Highland Way, and Eureka Canyon Road. Olive Springs Road provides reliable year-round administrative access through the Olive Springs Quarry. As mentioned above, this road connects with Hihn's Mill Road at the southwestern edge of the Forest. This route from the quarry has a rock surface and is generally open.

Highland Way, which is east of Soquel-San Jose Road, leads to the eastern portion of SDSF and, as previously mentioned, provides the only public vehicular access. Highland Way has been unreliable during recent winters, however, due to landslide closures. Eureka Canyon Road, which winds through the mountains from Corralitos, provides a longer alternate route to the Highland Way entrance. Eureka Canyon Road is typically used when closures block Highland Way but is also subject to slides. The Aptos Creek Fire Road, located within The Forest of Nisene Marks State Park, provides administrative access as well as a public entrance (by foot or bicycle) at the east end of Ridge Trail.

ROAD BUILDING AND MAINTENANCE

Road building and maintenance are critical elements of forest management. Forest roads are usually the largest ~~potential~~ source of management-related sediment erosion and they provide the means to recreate, harvest timber, access emergency situations, maintain facilities, and patrol the Forest. Therefore, they should be in the best possible condition at all times. Culverts,-bridges, ford crossings, water bars, rolling dips, and drainage ditches~~,~~ (structures which divert water away from or off of roads), need to be

Table ~~8~~ 10. Drivable road segments of SDSF

ROAD NAME	LENGTH	LOCATION
Hihn's Mill Road	7.0 miles	Highland Way to Olive Springs Road
Amaya Creek Road	2.0 miles	Hihn's Mill Road to Comstock Mill Road
Comstock Mill Road	0.7 miles	Robinwood Lane to private property
Sulphur Springs Road~~Trail~~	1.5 miles	Hihn's Mill Road to Ridge Trail
Corral Trail	1.2 miles	Sulphur Springs Trail to the end of roaded portion of Corral Trail
Tractor Trail	1.3 miles	Hihn's Mill Road to end of roaded portion of Tractor Trail
Longridge Road	1.5 miles	Hihn's Mill Road to private property
Amaya Basin Road	0.7 miles	
Amaya Pond Road	0.5 miles	
Amaya Spillway Road	0.1 miles	
Lower Helipad Road	0.1 miles	
Shortridge Road	0.1 miles	

regularly inspected and repaired as necessary. Winter inspection is crucial as the majority of water and ~~top~~soil movement occurs during the ~~is~~ rainy season. New roads or skid trails will not be constructed or old roads or skid trails rehabilitated without thorough evaluations of topography, intended use, soil stability, drainage capabilities, and construction costs.

There are approximately 19 miles of existing or abandoned roads within SDSF ~~(Refer to Figure 8 Timber Management chapter)~~. According to analysis done for the EIR ~~A~~about 22 miles of new roads are needed to complete the Forest road network~~;~~ and ~~approximately seven miles of roads would be constructed, and one to two miles of old road would be abandoned during the next ten years. In addition,~~ approximately 15 miles of road ~~proposed for construction will~~ will eventually

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be abandoned~~ eventually~~. The existing road density is ? miles per square mile.

California Forest Practice Rules specific to road building and maintenance will be applied during all forest management activities. This will be particularly emphasized during timber harvesting operations. These regulations, along with other site-specific strategies, will help minimize erosion and sediment delivery to watercourses, visual disturbance, and road construction/maintenance needs. Generally, all construction or rehabilitation of roads will include outsloping of road surfaces, rolling dips, and ~~a minimum~~ limited use of inside ditches to minimize hydrologic connectivity to stream channels. A road management plan will be developed which includes information from the 2003 PWA road inventory, which identified 82 sites with significant sediment delivery potential to watercourse channels. ~~an inventory and risk rating of constructed skid trails and roads, and designs mitigation projects from problem areas~~.

~~PUBLIC COMMENTS AND CONCERNS~~ *THE FOLLOWING PUBLIC COMMENTS WERE RECEIVED DURING REVIEW OF THE 1998 GENERAL FOREST MANAGEMENT PLAN*

Since the roads of SDSF will not be available for motorized use by the public, comments regarding them have been minimal. The issue of Forest access, however, is another matter. While most of the access concerns described in the Administration chapter relate to the lack of public entrances, the inadequacy of existing public entrances is a problem as well. Individuals have expressed that the entrances are not only remote, but also difficult to maneuver in some cases. This is particularly true of equestrians who trailer their horses to the Highland Way parking area. As detailed in the Administration chapter and Management Guideline Number 1 below, SDSF is actively seeking new legal access points. New entrance areas will be designed so that multiple uses can be accommodated.

Another concern is that excessive road building will take place in the Forest. Though SDSF does not have a detailed road construction plan, California Forest Practice Rules place restrictions on the amount and types of roads that can be built in forested areas. It is the intent of the Forest to adhere to these regulations in addition to the examination of all projects and possible impacts on a site-specific basis.

MANAGEMENT GUIDELINES

1. Work with neighboring ownerships to maintain and improve access to the Forest. Continue working with the Olive Springs Quarry and the County of Santa Cruz to ensure that both ends of Hihn's Mill Road remain open.

2. All roads and other improvements shall be monitored and maintained in good condition. This will provide for safety and help prevent surface and mass erosion. Ben Lomond ~~Youth~~ Conservation Camp and California Conservation Corps crews, ~~CDF~~CAL FIRE heavy fire equipment operators, and volunteers will help with road maintenance and repair, as appropriate.

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3. New roads and other improvements will be developed as needed for access, resource protection, and forest management activities. High standards and compliance with California Forest Practice Rules for new logging road construction and existing road rehabilitation to minimize soil damage will be emphasized. Roads located within or near unstable areas will be designed with the assistance of CEG staff from the California Geological Survey. New construction and maintenance methods will be researched and incorporated to demonstrate their effectiveness.

4. Roads that are not needed to provide access, are high risk for sediment production, and are difficult to maintain and monitor will be abandoned.

5. Design watercourse crossings to reduce sediment inputs from vehicle use, bicyclists and equestrians on roads and install foot bridges at stream crossings on trials.

6. Close the Highland Way parking lot and Forest roads during periods of heavy precipitation and soil saturation when sediment delivery to a watercourse is a risk.

PLANNED ACTIONS

1. Determine the best approach for a road management plan and ~~D~~ develop a ~~road management~~ plan for SDSF. ~~Complete a~~An inventory, assessment, and risk-rating of ~~all existing~~ forest roads ~~by December 31, 1998~~was completed as part of the Santa Cruz County Resource Conservation District's Soquel Creek watershed assessment (Pacific Watershed Associates, 2003). ~~.~~ An assessment of constructed skid trails will be completed ~~by June 30, 1999~~when funds become available. ~~Design mitigation projects for each high- and extreme-risk road segment and estimate the cost-effectiveness of each project by June 30, 1999.~~ (Refer to Appendix C, Monitoring Plan.)

2. Road conditions will be continually assessed to determine which segments are no longer suitable for use. ~~Approximately one to two miles of old road beds will be abandoned over the next 10 years.~~

3. Investigate and, if possible, acquire additional administrative and public access to SDSF. Alternative funding sources will be examined for these acquisitions as well as for construction and maintenance. (Refer to the Administration chapter for more information on access issues.)

4. Continue to ~~U~~ upgrade Hihn's Mill Road and the Highland Way entrance parking area for all-season use. This includes road rocking and replacing culverts at risk of failure with larger culverts. ~~Revise the right-of-way agreement with~~ Coordinate work at the Highland Way parking lot and along the Burch right of way with the landowner representatives.~~to clarify maintenance authority and responsibility~~ ~~i~~ Improve forest access. Upgrade Longridge, Amaya Creek, and Sulphur Springs Roads for improved emergency access.

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~~6.~~5. Widen and provide permanent abutments to the Highland Way entrance bridge in cooperation with Burch/Redwood Empire. ~~Develop a permanent structure for crossing the East Branch via Hihn's Mill Road below the confluence with Amaya Creek.~~ ~~Install~~ Maintain trash racks above the inflow to ~~each~~ culverts in the Forest ~~by December 31, 1997~~. Inventory, assessment, ~~and~~ risk-rate ~~each~~ing, and cost-effectiveness of repair of culverts was completed as part of the Santa Cruz County Resource Conservation District's Soquel Creek watershed assessment (Pacific Watershed Associates, 2003). Continue to upgrade and remediate watercourse crossings identified in the PWA report. ~~by December 31, 1998. Design projects to reduce the risk of failure of high- or extreme-risk culverts, and estimate the cost-effectiveness of each project by December 31, 1998. (Refer to Appendix C, Monitoring Plan.)~~

~~7~~ 6. Initiate a mile-post system for roads and trails to facilitate management and emergency response as well as a gate identification system. Create GIS layers and maps of roads and gates to be utilized in computer - aided dispatching for emergencies.

~~7~~

~~8~~7. ~~Certify~~ Review the location of all roads, landings, and skid trails on unstable areas by a C~~c~~ertified ~~e~~Engineering ~~g~~Geologist.

8. Implement the Streambank Failure/Hihn's Mill Road repair project along the portion of Hihn's Mill Road east of Hihn's Bridge using a fish friendly design.

9. Install a permanent year around crossing of Soquel Creek at Longridge Road.

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PERSONAL COMMUNICATION

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APPENDICES

APPENDIX A: TEXT OF ASSEMBLY BILL 1965

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ASSEMBLY BILL NO. 1965

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CHAPTER 1338

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An act to add Article 4 (commencing with Section 4660) to Chapter 9 of Division 4 of the Public Resources Code, relating to state forests.

(Approved by Governor September 29, 1987.
Filed with Secretary of State September 29, 1987.)

LEGISLATIVE COUNSEL'S DIGEST

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AB 1965, Farr. Soquel Demonstration State Forest.

Under existing law, the Department of Forestry and Fire Protection is authorized to engage in the management, protection, and restoration of state forests in accordance with plans approved by the State Board of Forestry and Fire Protection.

This bill would declare it the policy of the state to establish the Soquel Demonstration State Forest in Santa Cruz County. The department would be responsible for the development and establishment of the state forest and for maintenance and operations. The bill would authorize the department to permit a limited amount of commercial timber operations within the forest in order to provide funds for its maintenance and operation. The bill would require the department, in conjunction with a specified advisory committee, to adopt a general plan for the park by January 1, 1989, and would require the general plan to be approved by the advisory committee prior to adoption by the department.

The department's duties and authority under the bill would only arise if the state acquires the property comprising the demonstration forest.

The people of the State of California do enact as follows:

SECTION 1. Article 4 (commencing with Section 4660) is added to Chapter 9 of Division 4 of the Public Resources Code, to read:

ARTICLE 4. SOQUEL DEMONSTRATION STATE FOREST

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4660. It is hereby declared to be the policy of the state to establish and preserve an intensively managed, multifaceted research forest which is representative of forest activities as a living forest in Santa Cruz County within northern California's coastal redwood belt. The coast redwoods, as the dominant tree species in this area, are a valuable natural resource and are unique

in North America for their beauty, abundance, diversity, and public accessibility, and their extreme beauty and economic value requires special measures for their protection for the use, enjoyment, and education of the public.

It is the intent of the Legislature, in establishing the Soquel Demonstration State Forest, to provide an environment that will do all of the following:

(a) Provide watershed protection for local communities and base-line monitoring and studies of the hazards, risks, and benefits of forest operations and watersheds to urban areas.

(b) Provide public education and examples illustrating compatible rural land uses, including sustained yield timber production, as well as the historic development of timbering and forestry machinery, within the context of local community protection and nearby pressures.

(c) Provide a resource for the public, environmental groups, elected officials, environmental planners, the educational community, and the media as an open environment for the inspection and study of environmental education, forestry practices, and effects thereof.

(d) Protect old growth redwood trees.

4661. The department may permit a limited amount of commercial timber operations on the property within the Soquel Demonstration State Forest in order to provide funds for the maintenance and operation of the state forest and to allow fulfillment of the objectives of Section 4660. Income from the state forest property shall sustain all costs of operation and provide income for research and educational purposes.

4662. The department is responsible for the development and establishing of the Soquel Demonstration State Forest and for ongoing maintenance and operations. The director shall appoint an advisory committee to assist the department in planning future management of the forest. The advisory committee shall include representatives of the Santa Cruz County Board of Supervisors, the Department of Parks and Recreation, the Board of Forestry and Fire Protection, the Forest of Nisene Marks Advisory Committee, and the Department of Fish and Game.

4663. The department, in coordination with the advisory committee, shall adopt by January 1, 1989, a general plan for the state forest which reflects the long-range development and management plans to provide for the optimum use and enjoyment of the living forest, as provided in Section 4660, as well as the protection of its quality and the watershed within the Santa Cruz area. The general plan shall be approved by the advisory committee prior to adoption by the department.

4664. The duties and authority of the department pursuant to this article shall only arise if the state acquires the property comprising the Soquel Demonstration State Forest.

APPENDIX B: SPECIES LISTS FOR SDSF

FAUNA OF SDSF

From Preliminary Biological Assessment of Soquel Demonstration State Forest, Santa Cruz County, California (Holland et al., 1992) and David Suddjian, Biological Consultant.

SCIENTIFIC NAME	COMMON NAME
FISH	
Lampetra tridentata	Pacific lamprey
Oncorhynchus mykiss iridius	steelhead trout
Oncorhynchus ~~gairdnerii~~mykiss	rainbow trout
Gasterosteus aculeatus	northern threespine stickleback
Cottus sp.	sculpin
AMPHIBIANS	
Lawrence Erickson, herpetologist and CAL FIRE Fire Captain, updated the nomenclature for amphibian and reptile species previously observed. He has also conducted on-going surveys, resulting in observations of some new species on the Forest.	
Taricha torosa torosa	California N~~n~~ewt, Coast Range Newt
Taricha ~~granulosa~~granulosa granulosa	R~~r~~ough-skinned N~~n~~ewt
Dicamptodon ensatus	Pacific ~~g~~Giant S~~s~~alamander, California Giant Salamander
Batrachoseps attenuatus	California S~~s~~lender ~~s~~Salamander
Ensatina eschscholtzii xanthoptica	Yellow-eyed E~~e~~nsatina
Aneides flavipunctatus niger	Santa Cruz B~~b~~lack S~~s~~alamander
Aneides lugubris	~~a~~Arboreal S~~s~~alamander
Bufo boreas halophilus	California Toad, W~~w~~estern T~~t~~oad
Pseudacris sierra~~Hyla regilla~~	Sierran Tree Frog, Pacific ~~c~~Chorus ~~f~~Frog
Rana boylii	F~~f~~oothill Y~~y~~ellow-legged ~~f~~Frog
Rana ~~aurora~~ draytonii	California ~~r~~Red-legged F~~f~~rog
REPTILES	
~~Clem~~Actinomys marmorata pallida	~~w~~Western ~~p~~Pond ~~t~~Turtle, Southern Pacific Pond Turtle
Sceloporus occidentalis boucurtii	~~w~~Western ~~f~~Fence ~~l~~Lizard, Coast Range Fence Lizard
Plestiodon~~Eumeces~~ skiltonianus skiltonianus	Skilton's Skink, W~~w~~estern S~~s~~kink

Elgaria~~Gerrhonotus~~ ~~multicarinatus~~coerulea coerulea	~~sou~~Northern ~~a~~Alligator ~~l~~Lizard, San Francisco Alligator Lizard
Elgaria multicaranata multicaranata ~~Gerrhonotus coeruleus~~	~~n~~S~~o~~r~~u~~thern A~~a~~lligator ~~l~~Lizard, California Alligator Lizard
Charina bottae	Northern R~~r~~ubber B~~b~~oa
Diadophis punctatus amabilis	Pacific R~~r~~ing-necked ~~s~~Snake
Contia tenuis	~~s~~Sharp-tailed ~~s~~Snake
Pituophis catenifer catenifer ~~melanoleucus~~	Pacific G~~g~~opher S~~s~~nake
Lampropeltis getula~~us~~ californiae	~~common k~~California Kingsnake
Lampropeltis zonata multifasciata	California ~~m~~Mountain ~~k~~Kingsnake, Coast Mountain Kingsnake
Thamnophis sirtalis infernalis	~~common~~California Red-sided ~~g~~Garter S~~s~~nake, Red-spotted Garter Snake
Thamnophis elegans terrestris	~~w~~Western ~~t~~Terrestrial G~~g~~arter ~~s~~Snake, Coast Garter Snake
Thamnophis ~~couchii ssp.~~ atratus atratus	Santa Cruz G~~g~~arter S~~s~~nake
Coluber constrictus flaviventris	Western Yellow-bellied Racer, Western Racer
Crotalus oreganus oreganus	Northern Pacific Rattlesnake, Western Rattlesnake

BIRDS

Ardea herodias	great blue heron
Butorides ~~striatus~~virescens	green~~-backed~~ heron
Aix sponsa	wood duck
Mergus merganser	common merganser
Anas platyrhynchos	mallard
Cathartes aura	turkey vulture
Pandion haliaetus	osprey
Accipiter striatus	sharp-shinned hawk
Accipiter cooperii	Cooper's hawk
Buteo jamaicensis	red-tailed hawk
Buteo lineatus	red-shouldered hawk
Aquila chrysaetos	golden eagle
Falco columbarius	merlin
Callipepla californica	California quail
Actitis macularia	spotted sandpiper
Patagioenas ~~Columba~~ fasciata	band-tailed pigeon
Zenaida macroura	mourning dove
~~Otus~~ Megascops kennicottii	western screech owl
Bubo virginianus	great horned owl
Glaucidium gnoma	northern pygmy-owl
Asio otus	long-eared owl
Aegolius acadicus	northern saw-whet owl

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Calypte anna	Anna's hummingbird
Selasphorus rufus	rufous hummingbird
Selasphorus sasin	Allen's hummingbird
Megad~~C~~eryle alcyon	belted kingfisher
Melanerpes formicivorus	acorn woodpecker
Sphyrapicus ruber ~~nuchalis~~	red-breasted ~~naped~~ sapsucker
Picoides pubescens	downy woodpecker
Picoides villosus	hairy woodpecker
Colaptes auratus	northern flicker
Empidonax difficilis	Pacific-slope flycatcher
Sayornis nigricans	black phoebe
Myiarchus cinerascens	ash-throated flycatcher
Contopus cooperi ~~borealis~~	olive-sided flycatcher
Contopus sordidulus	western wood-peewee
Cypseloides niger	black swift
Chaetura vauxi	Vaux's swift
Tachycineta thalssina	violet-green swallow
Stelgidopteryx serripennis	northern rough-winged swallow
Hirundo pyrrhonota	cliff swallow
Corvus corax	common raven
Cyanocitta stelleri	Steller's jay
Aphelocoma californica ~~coerulescens~~	western scrub - jay
~~Parus~~ Poceile rufescens	chestnut-backed chickadee
~~Parus~~ Baeolofus inornatus	~~plain~~ oak titmouse
Psaltriparus minimus	bushtit
Certhia americana	brown creeper
Sitta pygmaea	pygmy nuthatch
Troglodytespacificus ~~troglodytes~~	Pacific ~~winter~~ wren
Thryomanes bewickii	Bewick's wren
Chamaea fasciata	wrentit
Cinclus mexicanus	American dipper
Regulus calendula	ruby-crowned kinglet
Regulus satrapa	golden-crowned kinglet
Polioptila caerulea	blue-gray gnatcatcher
Toxostoma redivivum	California thrasher
Catharus ustulatus	Swainson's thrush
Catharus guttatus	hermit thrush
Turdus migratorius	American robin
Ixoreus naevius	varied thrush
Bombycilla cedrorum	cedar waxwing
Sturnus vulgaris	European starling
Vireo cassinii ~~solitarius~~	Cassin's ~~solitary~~ vireo
Vireo huttoni	Hutton's vireo
Vireo gilvus	warbling vireo
Setophaga ~~Dendroica~~ coronata	yellow-rumped warbler

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Setophaga ~~Dendroica~~ townsendi	Townsend's warbler
Dendroica occidentalis	hermit warbler
Setophaga ~~Dendroica~~ nigrescens	black-throated gray warbler
Setophaga ~~Dendroica~~ petechia	yellow warbler
Oreothlypis~~Vermivora~~ celata	orange-crowned warbler
Oreothlypis~~Vermivora~~ ruficapilla	Nashville warbler
Geothlypis ~~Oporornis~~ tolmiei	MacGillivray's warbler
Cardellina ~~Wilsonia~~ pusilla	Wilson's warbler
Piranga ludoviciana	western tanager
Passerella iliaca	fox sparrow
Melospiza melodia	song sparrow
Melospiza lincolnii	Lincoln's sparrow
Zonotrichia atricapilla	golden-crowned sparrow
Zonotrichia leucophrys	white-crowned sparrow
Pipilo maculatus ~~erythrophthalmus~~	spotted ~~rufous-sided~~ towhee
Melozone ~~Pipilo~~ crissalis	California towhee
Junco hyemalis	dark-eyed junco
Pheucticus melanocephalus	black-headed grosbeak
Loxia curvirostra	red crossbill
Haemorhous ~~Carpodacus~~ purpureus	purple finch
Coccothraustes vespertinus	evening grosbeak
Spinus ~~Carduelis~~ tristis	American goldfinch
Spinus ~~Carduelis~~ psaltria	lesser goldfinch
Spinus ~~Carduelis~~ pinus	pine siskin

The following additional bird observations were reported by Matt Greene in his 2012 reports on "Raptor Surveys for Fern Gulch THP" and "Rim THP Raptor Survey". These reports also confirmed sightings of many of the species observed previously,

SCIENTIFIC NAME	COMMON NAME
Meleagris gallopavo	wild turkey
Dryocopus pileatus	pileated woodpecker

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MAMMALS

Didelphis virginiana ~~marsupialis~~	opossum
Sorex trowbridg~~ie~~i	Trowbridge's shrew
Neurotrichus gibbsii	shrew-mole
Scapanus latimanus	broad-footed mole
Myotis lucifugus	little brown myotis
Myotis evotis	long-eared myotis
Myotis volans	long-legged myotis
Myotis californicus	California myotis
Lasionycteris noctivagans	silver-haired bat
Lasiurus cinereus	hoary bat
Pipistrellus hesperus	western pipistrelle
Eptesicus fuscus	big brown bat
Sylvilagus bachmani	brush rabbit
~~Eu~~ Neotamias merriami	Merriam's chipmunk
Sciurus griseus	western gray squirrel
Thomomys bottae	Botta's pocket gopher
~~Prognathus~~ Chaetodipus californicus	California pocket mouse
Reithrodontomys megalotis	western harvest mouse
Peromyscus truei	pinyon mouse
Peromyscus californicus	California mouse
Peromyscus maniculatus	deer mouse
Neotoma fuscipes	dusky-footed woodrat
Urocyon cinereoargenteus	gray fox
Procyon lotor	raccoon
Mustela frenata	long-tailed weasel
Mephitis mephitis	striped skunk
Canis latrans	coyote
~~Felis~~ Puma concolor	mountain lion
Lynx rufus	bobcat
Sus scrofa	feral pig
Odocoileus hemionus	black-tailed deer

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From Preliminary Biological Assessment of Soquel Demonstration State Forest, Santa Cruz County, California (Holland et al., 1992) and Randy Morgan; the report for the "botanical survey for the Fern Gulch THP", submitted by Tim Hyland on May 2, 2010; and the report for the botanical survey for the Comstock Mill THP, submitted by Dylan Neubauer on May 14, 2013

Acer macrophyllum	bigleaf maple
Acer negundo	California boxelder
Achillea millefolium	yarrow
Acmispon americanus	Spanish clover
Acmispon americanus var. *a.*	Spanish trefoil
Acmispon glaber var. *g.*	deerweed
Acmispon heermannii var. *orbicularis*	Heermann's trefoil
Acmispon parviflorus ~~Lotus micranthus~~	small---flowered trefoil
Adenocaulon bicolor	trail plant
Adenostema fasiculatum	chamise
Adenostoma fasiculatum var. *f.*	chamise
Adiantum aleuticum	five-finger fern
Adiantum jordanii	California maidenhair
~~*Adiantum pedatum*~~	~~five-finger fern~~
Aesculus californica	California buckeye
** *Ageratina adenophora*	eupatorium
Agoseris grandiflora	large-flowered Agoseris
Agrostis ~~*exarata var. pacifica*~~ *avenacea*	Pacific bentgrass
Agrostis hallii	Hall's bentgrass
Agrostis stolonifera	western bentgrass
Agrostis pallens	leafy bentgrass
**Aira caryophyllea*	silvery hairgrass
Allium unifolium	one-leaved onion
Allophyllum divaricatum	straggling gilia
Alnus rhombifolia	white alder
Alnus rubra	red alder
Amsinckia intermedia	common fiddleneck
**Anagallis arvensis*	scarlet pimpernel
Anaphalus margaritacea	pearly everlasting
Anisocarpus madioides	woodland Madia
**Anthemis cotula*	mayweed
Anthriscus caucalis	Knotted hedge parsley
Anthoxanthum occidentale	vanilla grass
Aquilegia formosa	northwest crimson columbine
Aralia californica	California spikenard
Arbutus menziesii	madrone
Arctostaphylos andersonii	Santa Cruz mountain manzanita
Arctostaphylos crustacea	brittle-leaved manzanita

* non-native

** most invasive

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Arctostaphylos crustacea subsp. *crinita*	crinite manzanita
Arctostaphylos sp.	manzanita
Arctostaphylos tomentosa ssp. *crinita*	brittle-leaved manzanita
Artemisia douglasiana	mugwort
~~(Scientific names preceded by * are non native.)~~	
Asarum caudatum	wild ginger
Asyneuma prenanthoides	bellflower
Athyrium filix-femina var. cyclosorum	lady fern
**Avena fatua*	common wild oats
Baccharis ~~douglasii~~ glutinosa	marsh baccharis
Baccharis pilularis ~~var. c~~ *ssp. Consanguinea*	coyote brush
Barbarea sp.	wintercress
Boisduvalia densiflora	dense-flowered Boisduvalia
Boykinia ~~elata~~ occidentalis	coast Boykinia
**Brassica nigra*	black mustard
**Briza maxima*	rattlesnake grass
Briza minor	little quaking grass
Brodiaea elegans	harvest brodiaea
Bromus carinatus	California brome
Bromus carinatus var. *c.*	California brome
**Bromus diandrus*	ripgut brome
**Bromus hordeaceus*	soft chess brome
Bromus laevipes	woodland brome
~~**Bromus mollis*~~	~~soft chess brome~~
**Bromus ~~rubens~~ madritensis*	red brome
Bromus vulgaris	woodland brome
Calamagrostis rubescens	wild morning glory
Calandrinia breweri (CRPR 4.3)	Brewer's redmaids
Callitriche marginata	California water starwort
Calochortus albus	fairy lantern
Calystegia occidentalis	pine grass
**Calystegia occidentalis*	coast morning glory
Calystegia purpurata subsp. *p.*	western morning glory
Cardamine californica	milkmaids
Cardamine oligosperma	few-seeded bittercress
** *Carduus pycnocephalus* subsp. *p.*	Italian thistle
~~*Calystegia occidentalis*~~	~~pine grass~~
~~*Campanula prenanthoides*~~	~~bellflower~~
**Carduus pycnocephalus*	Italian thistle
**Carduus tenuiflorus*	slender-flowered thistle
Carex barbarae	Santa Barbara sedge
Carex bolanderi	Bolander's sedge
Carex globosa	round-fruited sedge
Carex harfordii	Harford's sedge
Carex tumulicola	foothill sedge
Ceanothus cuneatus	buck brush
Ceanothus papillosus	warty-leaved ceanothus

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Ceanothus thyrsiflorus	blue brush
Ceanothus thyrsiflorus var. *t.*	blue---blossom
* *Cedrus deodara*	Deodar cedar
Centaurea melitensis	tocalote
Centaurea solstitialis	yellow star thistle
Cerastium glomeratum	mouse-eared chickweed
Chlorogalum pomeridianum	soap plant
Chlorogalum pomeridianum var. *p.*	soap plant
Cirsium brevistylum	Indian thistle
Cirsium vulgare	bull thistle
Clarkia purpurea ssp. *viminea*	large godetia
Claytonia parviflora subsp. *p.*	small---flowered claytonia
Claytonia ~~Montia~~ perfoliata	miners' lettuce
Clinopodium ~~Satureja~~ douglasii	yerba buena
Clintonia andrewsiana	red clintonia
Collomia heterophylla	varied-leaved Collomia
Conium maculatum	poison hemlock
Convolvulus arvensis	bindweed
Corallorhiza maculate var. *occidentalis*	unspotted spotted coralroot
* *Cordyline* sp.	cordyline
Cornus sericia ssp. californica	western red or creek dogwood
Cornus sericia ssp. *sericia*	red osier dogwood
Cortaderia jubata	pampas grass
Corylus cornuta	California hazel
Corylus cornuta var.*californica*	California hazel
* *Cotoneaster pannosus*	silverleaf cotoneaster
Cryptantha micromeres	minute-floweredcryptantha
Cynoglossum grande	hound's---tongue
Cynosurus echinatus	dog's-tail grass
Cyperus eragrostis	tall cyperus
* *Cytisus scoparius*	Scotch broom
Dactylis glomerata	orchard grass
Danthonia californica	California oat grass
~~*Dentaria californica*~~	~~milkmaids~~
Deschampsia elongata	slender hairgrass
Dichelostemma pulchellum	blue dicks
* *Dichondra micrantha*	Asian pony's foot
Drymocallis ~~Potentilla~~ glandulosa	cinquefoil
Dryopteris arguta	coastal wood fern
Ehrharta erecta	panic veldt grass
Elymus glaucus	western ryegrass
Elymus glaucus subsp. *g.*	blue wildrye
Epilobium brachycarpum	annual willowherb
Epilobium ciliatum ssp.*ciliatum*	

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~~*californicum*~~	California willow herb
Epilobium ciliatum subsp.*watsonii*	Watson's willow herb
Epipactis helleborine	eastern orchid
Equisetum hiemale	scouring rush
Equisetum hyemale ssp.*affine*	common scouring rush
Equisetum talmateia ssp. *Braunii*	giant horse tail
Equisetum telmatiea	horsetail
Ericameria arborescens	golden fleece
Erigeron ~~*Conyza*~~ *canadensis*	horseweed
**Erigeron sumatrensis*	wide---leave horseweed
Eriodictyon californicum	California mountain balm
Eriophyllum confertiflorum var. *c.*	golden yarrow
** Euphorbia peplus*	petty spurge
Eurybia radulina	broad---leaved wood aster
Festuca arundinacea	tall fescue
Festuca bromoides ~~*Vulpia*~~	six-weeks fescue
Festuca californica	California fescue
Festuca ~~*Vulpia*~~ *myuros*	rattail fescue
Festuca occidentalis	western fescue
Festuca perennis ~~*Lolium multiflorum*~~	annual rye grass
Festuca rubra	red fescue
Festuca subuliflora	crinkle-awned fescue
** Filago gallica*	daggerleaf cottonrose
Fragaria ~~*californica*~~ *vesca*	California strawberry
Frangula ~~*Rhamnus*~~ *californica*	California coffeeberry
Frangula californica subsp. *c.*	California coffeeberry
Fritillaria ~~*lanceolata*~~ *affinis var.affinis*	checker lily
**Galium aparine*	goosegrass
Galium californicum	California bedstraw
Galium californicum subsp. *c.*	California bedstraw
** Galium murale*	tiny bedstraw
** Galium parisiense*	Parisian bedstraw
Galium porrigens	climbing bedstraw
Galium triflorum	trifid bedstraw
Gamochaeta ustulata ~~*Gnaphalium californicum*~~	California everlasting
**Gastridium phleoides* ~~*ventricosum*~~	nitgrass
**Genista monspessulana*	French broom
Geranium dissectum	cut-leaved geranium
Geranium molle	dove's-foot geranium
Gnaphalium luteo-album	weedy cudweed
Gnaphalium purpureum	purple cudweed
Gnaphalium ramossisimum	pink everlasting
**Hedera helix*	English ivy
Helenium puberulum	sneezeweed
Heracleum maximum	cow parsnip
Heteromeles arbutifolia	toyon

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Heuchera micrantha	small-flowered heuchera
Hieracium albiflorum	white-flowered hawkweed
Hierochloe occidentalis	vanilla grass
**Hirschfeldia incana* ~~*Brassica geniculata*~~	perennial mustard
**Holcus lanatus*	velvet grass
Holodiscus discolor	cream bush
Holta ~~*Psoralea*~~ *macrostachya*	leather root
Hordeum brachyantherum subsp. *b.*	California barley
**Hordeum* murinum ssp.*leporinum*	foxtail barley
**Hypericum calycinum*	St. John's wort
** Hypochaeris glabra*	smooth cat's---ear
**Hypochoeris radicata*	hairy cat's ear
Iris ferneldii	Santa Cruz Mountain iris
Iris macrosiphon	ground iris
Juglans sp.	walnut
Juncus bufonius	toad rush
Juncus effusus var. *brunneus*	bog rush
Juncus effusus var. *pacificus*	Pacific rush
Juncus patens	common rush
Juncus xiphioides	iris-leaved rush
** Lathyrus latifolius*	perennial sweet pea
Lathyrus vestitus	common Pacific pea
Lathyrus vestitus var.*vestitus*	wood-pea
**Lepidium strictum*	wayside pepper grass
**Linum bienne*	small-flowered flax
Logfia filaginoides ~~*Filago californica*~~	California Filago
Lonicera hispidula	hairy honeysuckle
Lotus eriophorus	wooly trefoil
~~*Lotus purshianus*~~	~~Spanish clover~~
Lotus scoparius	deerweed
Lupinus albifrons	bush lupine
Lupinus latifolius	broad-leaved lupine
Lupinus latifolius var. l.	broad---leaved lupine
Lupinus nanus	sky lupine
Luzula comosa var. *c.*	common wood rush
Luzula multiflora	wood rush
Madia elegans	common Madia
Madia gracilis	slender tarweed
~~*Madia madioides*~~	~~woodland Madia~~
**Madia sativa*	coast tarweed
Maiantemum ~~*Smilacina*~~ *racemosum* ~~*a*~~	western Solomon's seal
Maianthemum ~~*Smilacina*~~ *stellatum* ~~*a*~~	slender Solomon's seal
**Marah fabaceus*	wild cucumber
** Matricaria discoidea*	pineapple weed
**Medicago polymorpha*	bur clover
Melica imperfecta	small-flowered melic grass
Melica subulata	Alaska onion grass
Melica torreyana	Torrey's melic grass
**Melilotus albus* ~~*a*~~	white sweetclover

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*Melilotus indicus ~~a~~	yellow sweetclover
*Melissa officinalis	lemon balm
Mimulus ~~Diplicus~~ aurantiacus	sticky monkeyflower
Mimulus aurantiacus var. a.	sticky monkeyflower
Mimulus cardinalis	scarlet monkeyflower
Mimulus guttatus	common monkeyflower
Morella ~~Myrica~~ californica	wax myrtle
*Myosotis latifolia	forget-me-not
*~~Rorippa n~~ Nasturtium ~~-~~officinale	watercress
Navarretia squarrosa	skunkweed
Nemophila parviflora	small-flowered Nemophila
Nemophila parviflora var. p.	small-flowered nemophila
Nemophila pedunculata	meadow nemophila
~~L~~ Notholithocarpus densiflora	tanoak
Oemeria cerasiformis	oso berry
Osmorhiza berteroi ~~chilensis~~	sweet cicely
Oxalis albicans	hairy wood sorrel
Oxalis oregana	redwood sorrel
Oxalis pes-caprae	sour grass
Oxalis pilosa	hairy wood sorrel
Pellaea andromedifolia	coffee fern
Pentagramma ~~Pityrogramma~~ triangularis ssp.triangularis	goldenback fern
Persicaria ~~Polygonum~~ ~~punctat~~punctate ~~um~~	smartweed
Petasites frigidus var. palmatus	coltsfoot
Phalaris californica	California canary grass
Pinus attenuta	knobcone pine
* Pinus coulteri	Coulter pine
* Pinus pinea	Italian stone pine
* Pinus radiata	Monterey pine
Piperia elongata	rein orchid
Pityrogramma traingularis ssp triangularis	gold-backed fern
*Plantago lanceolata	English plantain
Plantanus racemosa	California sycamore
Poa howellii	Howell's bluegrass
Polygala californica	California milkwort
Polypodium californicum	California polypody
Polypodium calirhiza	polypody
*Polypogon interruptus	beard grass
*Polypogon monspeliensis	rabbitsfoot grass
Polypogon viridis	water beard grass
Polystichum dudleyi	Dudley's shield fern
Polystichum munitum	western sword fern
Populus trichocarpa	black cottonwood
Potentilla glandulosa	sticky potentilla
Prosartes ~~Disporum~~ hookeri	Hooker's fairy bells
~~G~~ Pseudognaphalium californicum	California everlasting
~~G~~ Psudeognaphalium luteo~~-~~album	weedy cudweed
~~G~~ Pseudognaphalium sp.	everlasting
~~G~~ Pseudognaphalium ramossisimum	pink everlasting
~~G~~ Pseudognaphalium stramineum	cotton-batting plant

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Pseudotsuga menziesii	Douglas-fir
Psilocarphus tenellus	slender woolly marbles
Pteridium aquilinum	bracken fern
Pteridium aquilinum var.pubescens	bracken fern
Quercus agrifolia	coast live oak
Quercus agrifolia var. *a.*	coast live oak
Quercus agrifolia x kelloggii	hybrid oak
Quercus kelloggii	black oak
Quercus parvula var. *shrevei*	Shreve oak
Quercus parvula var.*shrevei* x *kelloggii*	hybrid oak
Quercus wislizenii	interior live oak
Ranunculus muricatus	prickle-fruited ranunculus
Ribes menziesii	canyon gooseberry
Ribes menziesii var.senile	Santa Cruz gooseberry
Ribes sanguineum var. glutinosum	flowering current
Rorippa palustris	yellow cress
Rosa californica	Caifornia wild rose
Rosa gymnocarpa	wood rose
Rosa gymnocarpa var. *g.*	wood rose
Rosa spithamea	ground rose
Rubus leucodermis	western raspberry
Rubus parviflorus	thimble berry
Rubus ursinus	California blackberry
*Rumex acetosella	sour dock or sheep sorrel
*Rumex conglomeratus	clustered dock
Rumex salicifolius	willow dock
Rupertia physodes	Rupert's scurf-pea
Sagina apetala	sticky pearlwort
Salix lasiandra	yellow willow
Salix lasiolepis	sandbar willow
Salix sitchensis	velvet willow
Sambucus nigra ssp.caerulea ~~mexicana~~	elderberry
Sanicula crassicaulis	Pacific sanicle
Scirpus microcarpus	panicled bulrush
Scoliopus bigelovii	California fetid adder's tongue
Scrophularia californica	California figwort
**Senecio ~~Erechtites~~ glomeratus ~~a~~*	fireweed
Senecio minimus	toothed firewe
Sequoia sempervirens	coast redwood
Silene gallica	windmill pink
**Silybum marianum*	milk thistle
Sisyrinchium bellum	blue-eyed grass
Solanum umbelliferum	blue witch
Soliva sessilis	common soliva

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*Sonchus asper	prickly sow thistle
Sonchus asper subsp. a.	prickly sow thistle
*Sonchus oleraceus	common sow thistle
*Spergularia sp.	sand spurry
Stachys ajugoides var. rigida	rigid hedge nettle
Stachys bullata	hedge nettle
Stachys chammisonis	swamp hedge-netle
Stachys rigida	hedge nettle
Stachys rigida var. quercetorum	rigid hedge nettle
*Stellaria media	common chickweed
Stipa pulchra	purple needlegrass
Symphoricarpos albus	tall snowberry
Symphoricarpos albus var.laevigatus	snowberry
Symphoricarpos mollis	snowberry
Symphotrichum ~~Aster~~ chilense ~~is~~	common California sister
*Torilis arvensis	hedge parsley
*Torilis nodosa	knotted hedge parsley
Toxocodendron diversilobum	poison oak
Toxicoscordion fremontii	Fremont's star lily
Trientalis latifolia	Pacific starflower
*Trifolium angustifolium	narrow-leaved clover
Trifolium bididum var.decipiens	pinole clover
Trifolium dubium	shamrock
Trifolium gracilentum	pin-point clover
*Trifolium hirtum	rose clover
Trifolium microcephalum	small-headed clover
Trifolium obtusiflorum	creek clover
Trifolium repens	white clover
Trifolium variegatum var. v.	white-tipped clover
Trifolium wildenovii ~~tridentatum~~	tomcat clover
Trillium ovatum	coast trillium
Triodanis biflora	Venus's looking glass
Trisetum canescens	tall trisetum
Trisetum sp.	trisetum
Triteleia ~~Brodiaea~~ laxa	Ithuriel's spear
Typha latifolia	broad-leaved cattail
Umbellularia californica	California bay
Urtica dioica ssp.holosericea	stinging nettle
Urtica urens	dwarf nettle
Vaccinium ovatum	huckleberry
Vancouveria planipetala	inside-out flower
Verbena lasiostachys	western verbena
Verbena lasiostachys var.lasiostachys	verbena
Veronica americana	American speedwell
Veronica arvensis	common speedwell
Veronica peregrina	purslane speedwell
Veronica persica	Persian speedwell
Vicia disperma	two-seeded vetch

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**Vicia sativa*	common vetch
Vicia sativa subsp. nigra	narrow-leaved vetch
Vicia sp.	Wild cucumber
**Vinca major*	periwinkle
Viola ocellata	two-eyed violet
Viola pedunculata	Johnny jump-up
Viola sempervirens	redwood violet
Whipplea modesta	yerba de selva
Woodwardia fimbriata	western chain fern

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SCIENTIFIC NAME	COMMON NAME
Agricus hondensis	felt-ringed Agricus
Amanita gemata	gemmed Amanita
Amanita pantherina	panther Amanita
Amanita phalloides	death cap
Amanita vaginata	grisette
Armillaria mellea	honey mushroom
Auriscalpium vulgare	
Boletus edulis	king bolete
Calodera viscosa	yellow tuning fork
Camarophyllus borealis	snowy waxy cap
Camarophyllus russocoriaceus	cedar waxy cap
Cantherellus californicus	chanterelle
Cantharellus cibarius	
Caulorhiza umbonata	redwood rooter
Clitocybe deceptiva	anise mushroom
Clitocybe nebularis	cloudy Clitocybe
Coprinus micaceus	mica cap
Cortinarius sp.	Cortinarius
Cortinarius varius	Cortinarius
Craterellus cornucopioides	horn of plenty
Crucibulum acul	white-egg bird's nest
Entoloma sp.	
Fistulina hepatica	beefsteak polypore
Fomitopsis cajanderi	
Fomitopsis pinicola	red-belted conk
Galerina sp.	
Gomphidius subrosea	rosy Gomphidius
Gymnopilus sapineus	common Gymnopilus
Gyromitra infula	hooded false morel
Hebeloma crustuliniforme	poison pie
Helvella compressa	
Helvella aculate	fluted black elfin saddle
Helvella aculate	
Hemimycena sp.	
Heterotextus alpinus	
Hygrocybe acutoconica	a cute conic waxy cap
Hygrocybe coccinea	righteous red waxy cap
Hygrocybe conica	witch's hat
Hygrocybe flavescens	golden waxy cap
Hygrocybe punicea	scarlet waxy cap
Inocybe citrifolia	
Inocybe fastigiata	corn silk Inocybe
Lactarius argillaceifolius	vulgar milk cap
~~*Lactarius chrysorheus*~~	~~yellow-staining milk cap~~
~~*Lactarius fragilis*~~	~~candy cap~~
~~*Lactarius rubrilacteus*~~	~~bleeding milk cap~~
~~*Lenzites betulina*~~	~~gilled polypore~~
~~*Leptonia parva*~~	~~blue-black Leptonia~~
~~*Naematoloma fasciculare*~~	~~sulfur tuft~~

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Lactarius chrysorheus	yellow-staining milk cap
Lactarius fragilis	candy cap
Lactarius rubrilacteus	bleeding milk cap
Lenzites betulina	gilled polypore
Leotia lubrica	
Leptonia parva	blue-black Leptonia
Naematoloma fasciculare	sulfur tuft
Paxillus involutus	poison pax
Phylloporus rhodoxanthus	gilled bolete
Pleurocybella porrigens	angel wings
Pleurotus ostreatus	oyster mushroom
Pluteus cervinus	deer mushroom
Psathyrella longipes	
Pseudohydrum geltinosum	jelly tooth
Ramaria sp.	Ramaria
Ramaria gelatinosa	jellied-base coral
Ramaria stricta	straight-branched coral
R ussula brevipes	short-stemmed Russula
Russula cremoricolor	creamy Russula
Russula silvicola	emetic Russula
Stereum hirsutum	hairy Stereum
Trametes versicolor	turkey tail
Verpa conica	thimble morel

From personal communication with Nathan Wilson of the Fungus Federation of Santa Cruz

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APPENDIX C: SOQUEL DEMONSTRATION STATE FOREST MONITORING PLAN

Identified monitoring projects will be implemented as staffing and budget limitations allow. To finance construction, these projects are generally incorporated as part of the timber harvest planning process.

WATERSHED MONITORING

TIMBER OPERATIONS

To avoid adverse impacts on water quality and fisheries resulting from the discharge of sediment to watercourses attributable to timber operations, Soquel Demonstration State Forest (SDSF) staff will monitor all timber operations (including all harvesting areas and new roads, skid trails, and landings) annually for ~~5-7~~ five to seven years following completion of the operations. Occurrences of substantial surface erosion (i.e.,gullies) or mass wasting (i.e., landslides or slumps) resulting from the operations will be identified and described by a registered professional forester (RPF).

Each substantial gully or landslide will be evaluated to determine its cause and identify stabilization measures that would be most feasible, effective, and cost effective. Such measures will be implemented within 90 days from the date when the subject site is identified, unless due cause for delay is explained and a reasonable alternative schedule for implementation is proposed by the SDSF forest manager. If, based on the judgement of a certified engineering geologist (CEG), no stabilization measures are feasible or reasonable to apply to the subject site, feasible offsite watershed remediation measures will be implemented as recommended by the CEG in conjunction with the next timber operation conducted at SDSF.

The SDSF forest manager will describe appropriate mitigation measures to be incorporated into future timber operations and specified in future timber harvesting plans (THPs) to avoid a recurrence of the observed erosion or mass wasting events.

ROADS

An ~~By December 31, 1998, the California Department of Forestry and Fire Protection (CDF) will~~ inventory~~,~~ that delineated, described, and risk-rated ~~each segment of~~ forest roads at SDSF was completed as part of the Santa Cruz County Resource Conservation District's Soquel Creek watershed assessment (Pacific Watershed Associates, 2003). This assessment included identification, , prioritization and design of feasible projects to remediate sediment-discharge risks associated with each high-and extreme-risk road segment and estimated the cost-effectiveness (in dollars per cubic yard of sediment) of each such project. Such projects include recontouring of roads and/or installation of improved drainage structures.

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SDSF staff conduct forensic monitoring of roads during and/or following most large storms. Any repair~~s~~ needs are addressed as quickly as possible within the constrainsts of funding and legal and regulatory requirements.

~~A SIMILAR INVENTORY OF CONSTRUCTED SKID TRAILS WILL BE COMPLETED BY JUNE 30, 1999. THIS INFORMATION WILL BE COMPILED INTO A DATABASE TO BE MAINTAINED ON AN ONGOING BASIS. THE DESCRIPTION AND RISK-RATING OF SEGMENTS WILL FOCUS ON CONDITIONS AFFECTING THE RISK THAT RUNOFF WILL CAUSE EROSION RESULTING IN SUBSTANTIAL SEDIMENT DISCHARGE TO A WATERCOURSE. SUCH CONDITIONS WILL INCLUDE, BUT ARE NOT LIMITED TO:~~

~~* PRESENCE OF INSIDE DITCHES,~~
~~* STABILITY OF FILL DEPOSITS,~~
~~* ADEQUACY AND RELIABILITY OF DRAINAGE STRUCTURES,~~
~~* GRADE,~~
~~* POTENTIAL FOR A DIVERTED WATERCOURSE TO BE TRANSPORTED DOWN THE ROADWAY,~~
~~* PROXIMITY TO A WATERCOURSE, AND~~
~~* EXISTING SUBSTANTIAL GULLIES.~~

~~BY JUNE 30, 1999, CDF WILL IDENTIFY AND DESIGN FEASIBLE PROJECTS TO REMEDIATE SEDIMENT DISCHARGE RISKS ASSOCIATED WITH EACH HIGH AND EXTREME-RISK ROAD SEGMENT AND ESTIMATE THE COST- EFFECTIVENESS (IN DOLLARS PER CUBIC YARD OF SEDIMENT) OF EACH SUCH PROJECT. SUCH PROJECTS COULD INCLUDE ABANDONMENT OR RECONTOURING OF ROADS, OR INSTALLATION OF IMPROVED DRAINAGE STRUCTURES.~~

CULVERTS

~~Soquel~~ SDSF staff evaluated the culverts along all Forest roads to determine where trash racks were necessary and appropriate. Steel T-posts were installed above each culvert where a need was determined. This work was completed prior to~~By~~ December 31, 199~~7~~8. Each culvert is inspected annually and after large storm events, and cleaned as needed.~~, trash racks will be installed above the inflow to each culvert at SDSF. Any culverts for which trash rack installation is not needed (based on low risk of culvert failure) will be identified and explained by a RPF. The trash racks will be maintained on at least an annual basis, or more frequently if required based on the occurrence of storm events.~~

~~By December 31, 1998, CDF will~~An inventory~~,~~ to delineate, describe, and risk-rate ~~each~~ culverts at -SDSF was completed as part of the Santa Cruz County Resource Conservation District's Soquel Creek watershed assessment (Pacific Watershed Associates, 2003). ~~.~~ This information was ~~ill be~~ compiled into a database to be maintained on an ongoing basis. ~~The description and risk-rating of each culvert will focus on the potential for culvert failure to result in diversion of flows and consequent erosion and discharge of sediment to a watercourse.~~ The risk rating ~~will~~

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~~be~~was based on standard engineering criteria for adequate culvert sizing, including effective culvert diameter, extent of watershed ~~tributary~~ area, and estimated discharge ~~intensity~~ of a storm with a ~~50~~100-year recurrence interval ~~period~~.

The inventory included i~~By December 31, 1998, CDF will i~~dentif~~y~~ication, prioritization and design of feasible projects to reduce the risk of failure of high-or extreme-risk culverts, and estimated the cost-effectiveness(in dollars per cubic yard of sediment) of each such project. ~~Such p~~Potential projects ~~could~~ include replacement of existing culverts with more reliable drainage structures (e.g., rocked dips) or larger culverts.

SDSF staff conduct forensic monitoring of drainage structures during and/or following most large storms. Any repairs needs are addressed as quickly as possible within the constrainsts of funding and legal and regulatory requirements.

ACTIVE LANDSLIDES AND SEDIMENT STORES

~~By June 30, 1999,~~ CAL FIRE~~CDF~~, in conjunction with a CEG, will continue to inventory, delineate, describe and risk-rate active landslides and substantial unconsolidated concentrations of sediment and debris at SDSF. This information will be compiled into a database to be maintained on an ongoing basis with new landslides added as they occur. Unconsolidated concentrations of sediment and debris and active landslides identified by Manson and Sowma-Bawcom (1992) will be included in the database. The description and risk-rating of segments will focus on conditions affecting the likelihood that runoff or seismic activity will cause mass movement resulting in sediment discharge to a watercourse.

~~By June 30, 1999,~~ CAL FIRE~~CDF~~ ~~will~~, in conjunction with a CEG, will continue to identify and design feasible projects to reduce the risk of failure of high-or extreme-risk landslides and sediment-debris accumulations ~~stores~~, and estimate the cost-effectiveness (in dollars per cubic yard of sediment) of each such project. Landslide risk-reduction projects could include installation of drainage structures on roads above landslides to reduce the discharge of concentrated runoff onto the landslide, or armoring or buttressing of landslide toes. Sediment-debris accumulation ~~store~~ risk-reduction projects could include recontouring or removal of material to reestablish original watercourses, bucking of logs in debris piles and using the logs to armor eroding bank faces, or revegetation.

AMAYA BASIN

The California Geological Survey compiled a map on landslides triggered by the 1989 Loma Prieta earthquake for Soquel Demonstration State Forest (Bedrossian, 1989). This map was focused on earthquake-triggered landslides and does not identify other unstable areas. Additional reconnaissance-level slope stability mapping, which includes descriptions of the geology and geomorphologic features related to slope stability was prepared by Manson and Sowma-Bawcom (1992), including all of the Amaya Creek and Fern Gulch watersheds. This mapping was based upon aerial photographic interpretations with little field work and is recognized as being useful

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only for preliminary review of regional slope stability ~~only~~.

In 2004, the California Geological Survey submitted an Engineering Geologic Report for the portion of Fern Gulch that was ~~to be~~ included in the Fern Gulch ~~a proposed State Forest~~ timber sale. This report includes a detailed landslide map that ~~designed to~~ assisted with ~~in~~ timber sale development.

At the request of the Soquel Demonstration State Forest manager, the California Geological Survey began preliminary work for more detailed mapping of the Amaya Creek watershed in 2001, but this work was not funded and the mapping has yet to be completed.

~~To minimize the risk of adverse effects on water quality and fisheries resulting from timber operations in Amaya Basin, by December 31, 1998, CDF will, in conjunction with a CEG, prepare a map of Amaya Basin depicting risk of mass movement. The map will delineate risk classes for deep and shallow seated mass movements and for surface erosion.~~

REMEDIATION PROJECTS

~~By June 30, 1999,~~ CAL FIRE~~CDF~~ will prioritized all sediment-discharge projects identified and designed to remediate high- or extreme-risk conditions, as described above. Such projects will be implemented in conjunction with future timber operations according to their priority as available funding permits, to ensure, to the extent practicable, that no significant increase in sedimentation results from the timber operations proposed in each THP.

SDSF staff monitor roads and drainage structures following most large storm events. When possible, inspections are conducted during storm events. Any repair needs are quickly addressed. To avoid adverse impacts of implementing remediation projects on water quality and fish habitat, CAL FIRE ~~CDF~~ will evaluate the performance of each previously-implemented remediation project to determine whether the project was successful in reducing risk of large-scale sedimentation. ~~Performance monitoring will be conducted following each storm event estimated to have a recurrence period of at least 2 years and continue for at least 4 years.~~ If CAL FIRE~~CDF~~ determines that any project is not meeting its intended objective, CAL FIRE~~CDF~~ will redesign and modify the project as needed.

AQUATIC RESOURCE MONITORING

FISHERIES MANAGEMENT PLAN

~~By December 31, 1998, CDF will adopt a~~A Fisheries Management Plan for SDSF was completed in August, 1995.~~specifying in detail all aquatic resource monitoring activities to be implemented on an ongoing basis, including monitoring frequency and intensity.~~ The aquatic-resource monitoring program ~~will~~ includes the ~~first four~~ items described below.

FISH POPULATIONS

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In cooperation with the California Department of Fish and Game (CDFG), f~~F~~ish population surveys ~~will be~~were conducted at four separate sites on ~~Soquel~~ SDSF from 1993 to 2001. ~~annually through 1997 and periodically thereafter. Sampling will occur at a minimum of four permanent stations, including stations on the East Branch and Amaya Creek.~~
From 2002 until the present, ~~Soquel~~ SDSF has continued these annual surveys in cooperation with the National Oceanic and Atmoshperic Administration's National Marine Fisheries Service (NOAA Fisheries). NOAA Fisheries added a fifth permanent station, increased the monitoring frequency, and incorporated additional research components.

HABITAT

One formal and comprehensive a~~A~~quatic habitat survey~~s~~ was ~~will be~~ conducted on ~~Soquel~~ SDSF in 1994. Several additional surveys have been conducted by various fisheries biologists in conjunction with other research studies. ~~at least once every 10 years and, to the extent possible, will use methodologies recommended by the California Department of Fish and Game (DFG).~~

POOL SEDIMENTATION AND STREAM TEMPERATURE

The Aquatic Resources Monitoring Plan includes a pool s~~S~~edimentation component to assess and monitor pool substrate embeddedness. At that time, the V* methodology was a popular assessment procedure to quantitatively measure sediment impairment. Fisheries biologists and hyrologists later advised SDSF staff that measuring sediment in a small number of pools, particularly using the V* method, would not be as useful as measuring other parameters, such as water temperature. To date, no formal survey has been conducted to assess pool sedimentation on watercourses within the Forest. The 1994 Fish Habitat Survey Report and other limited-scope investigations provide descriptions of the channel substrate composition.

On the advice of fisheries biologists, ~~Soquel~~ SDSF staff initiated a long-term program to monitor stream temperature at various sites on the Forest. Temperature data has been recorded from 1997 to the present ~~through 2009~~.~~levels will be monitored at a minimum of four pools. The same pools will be monitored annually through 1999 and periodically thereafter.~~

AQUATIC INVERTEBRATES

A macroinvertebrate sampling study was performed by ~~Soquel~~ SDSF staff in October, 1995. ~~Ecological condition of aquatic habitats will be monitored by sampling of invertebrates using the protocol developed by the U.S. Environmental Protection Agency in cooperation with DFG. Sampling will occur at three stations, including at least two stations where fish population surveys take place, at least annually through 1999 and periodically thereafter.~~
The California Department of Fish and Wildlife ~~Game~~ analyzed the samples and produced a report of their findings in May, 1996. Since then, NOAA Fisheries has conducted additional assessments in conjunction with other research projects.

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HABITAT ENHANCEMENT STRUCTURES

Fish habitat enhancement structures will be reviewed and approved by CDFW ~~G~~ and an inter-agency team ~~a qualified hydrologist~~ before installation.

To avoid adverse impacts of habitat-enhancement structures on fish habitat, CAL FIRE~~CDF~~, in conjunction with CDFW ~~G~~, will evaluate structures annually for three years following installation to determine whether they are performing as intended and whether they are causing any unintended adverse impacts on fish habitat. If CAL FIRE~~CDF~~ and CDFW ~~G~~ determine that any structure is functioning improperly or is adversely affecting aquatic habitat, ~~CDF~~CAL FIRE will redesign, repair, or remove the structure, as needed.

FISH POACHING AND HARASSMENT

To avoid adverse impacts of public use on fish, ~~CDF~~ CAL FIRE and CDFW ~~G~~ will conduct ongoing patrols in SDSF to enforce prohibitions on fishing and fish harassment. Incidents of fishing or harassment will be recorded and compiled. CAL FIRE~~CDF~~ and CDFW ~~G~~ will evaluate such information annually in conjunction with fish population estimates to determine whether poaching or harassment have had a significant adverse effect on SDSF fisheries. If so, ~~CDF~~ CAL FIRE will respond by closing streamside trails and intensifying law enforcement (e.g., increased patrols of streamside roads) as needed to ensure rapid fishery recovery and avoid additional adverse fishery effects.

RIPARIAN RESOURCE MONITORING

To avoid adverse impacts of public use on riparian habitat, CAL FIRE~~CDF~~ will conduct ongoing patrols in SDSF to enforce prohibitions on vandalism and other damage to riparian habitat related to public use. Incidents of damage will be recorded and compiled. A qualified wildlife biologist will evaluate such information annually to determine whether the damage constitutes a significant adverse effect on wildlife. If so, CAL FIRE~~CDF~~ will implement additional restrictions on public use (e.g., prohibiting camping or weekday recreation use or cordoning off of sensitive areas) as needed to ensure rapid habitat recovery and avoid additional adverse wildlife effects.

WILDFIRE MONITORING

To minimize increases in wildfire risks resulting from increased public use at SDSF, CAL FIRE~~CDF~~ will record and compile descriptions of all wildfires occurring at SDSF including ambient weather and fire hazard conditions, ignition source, area and vegetation types burned, and estimated damage. Such information will be evaluated annually to determine whether wildfire incidents have increased substantially in frequency or intensity relative to 1990-1995 conditions. If so, ~~CDF~~ CAL FIRE will implement appropriate measures (e.g., prohibiting all fires or weekday recreation use, or allocating additional fire-suppression resources for SDSF) as needed to reduce wildfire risks.

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EMERGENCY SERVICES MONITORING

To minimize adverse effects on emergency response performance for residents of Santa Cruz County resulting from increased demands for such services at SDSF, CAL FIRE~~CDF~~ will record and compile all requests for emergency responses, including requests for police, fire medical, or search and rescue services. Descriptions of emergency responses will include response times. Such information will be evaluated annually to determine whether the demand for emergency services or average emergency response time has increased substantially relative to 1990-1995 conditions. If so, CAL FIRE~~CDF~~ will enhance its emergency response capability by upgrading roads; developing additional helispots along remote trails; and, either directly or through a management agreement with another qualified entity, providing additional human and equipment resources for emergency response at SDSF.

This data has not been complied into a comprehensive report, but the data is examined by staff to evaluate any trends. All incident reports must be reviewed prior to public release to insure that legally confidential information (such as ongoing law enforcement actions, and the identities of juveniles or injured Forest visitors) is not disclosed. ~~Soquel~~ SDSF staff do not have adequate resource to produce such a report.

NUISANCE MONITORING

To minimize nuisance impacts on SDSF neighbors, CAL FIRE~~CDF~~ will record and compile descriptions of all reported nuisances caused by SDSF users at SDSF or on adjacent ownerships including, but not limited to, trespass, vandalism, littering, and noise. This information has not been compiled into a comprehensive report, but the data is examined by staff to evaluate any trends.

~~Soquel~~ SDSF staff work closely with individuals and groups of volunteers ~~CDF will organize and supervise a volunteer patrol force~~ to assist in this effort. The Stewards of Soquel Forest and a local National Mountain Bike Patrol group have both contributed information to the nuisance monitoring database. ~~Soquel~~ SDSF staff have developed good relationships with neighbors to prevent incidents that constitute a nuisance.
~~Nuisance reports will be evaluated annually to determine whether nuisance incidents had increased substantially in frequency or intensity relative to 1990-1995 conditions, and whether such a trend constitutes a significant adverse impact on neighbors. If so, CDF will implement additional restrictions on public use (e.g., prohibiting weekday recreation use) and intensified law enforcement (e.g., increased patrols) to ensure that nuisances caused by SDSF users are minimized.~~

PUBLIC-USE MONITORING

~~CDF~~CAL FIRE will use camping records, surveys and other information to compile annual estimates of public use of SDSF in user days. Use will be estimated for specific activities including, but not limited to, mountain biking, camping, equestrian use, and educational activities.

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CULTURAL RESOURCE MONITORING

CAL FIRE will monitor and periodically inspect heritage resources on SDSF to ensure that existing policies are affording effective protection. The identification and protection of cultural resources are important components of forestry in California today. Registered Professional Foresters are required to attend archeological training classes to acquire the ability to recorgnize cultural materials, and to be able to develop effective protection measures. In its role as a demonstration forest, SDSf can serve as a proving ground for the development and implementation of effective heritage resource management strategies.

CITATIONS

Manson, M.W., and J.A. Sowma-Bawcom. 1992. Geology, slope stability, and earthquake damage in Soquel Demonstration State Forest. California Department of Conservation, Division of Mines and Geology. Sacramento, CA.

Pacific Watershed Associates, 2003. Erosion Prevention Planning Project for County Roads and Roads in the Soquel Demonstration State Forest, in the Soquel Creek Watershed, Santa Cruz County, California. Summary Report prepared for the Santa Cruz County Resource Conservation District and the California Department of Fish and Game. Arcata, CA. 31 p. plus appendices

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~~Figure 1. Location map for SDSF~~
~~Figure 2. SDSF and adjacent ownerships~~
~~Figure 3. Locations of soil series in SDSF~~
~~Figure 4. Vegetation Type Map for SDSF~~
~~Figure 5. Site Class Map for SDSF~~
~~Figure 12. Recreational trails of SDSF and potential camp~~
~~Figure 13. Proposed fire defense improvements.~~
~~Figure 15. Drivable Roads of SDSF and Surrounding Area~~

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